Organic Farming: The Present and Future

Prof. S. Pasupalak
Vice Chancellor,
Orissa University of Agriculture & Technology, Bhubaneswar

Organic agriculture is a unique production management system, which promotes agro-ecosystem health including biodiversity. Organic farming primarily aims at cultivating the land and raising crops in a way to keep the soil alive and in good health by use of organic materials and beneficial microbes. It is performed with an intention for maintaining diversity of crops, keeping soil healthy for future years, producing high quality products and recycling nutrients. Compared to conventional methods, organic methods consume less fossil energy and cause less soil erosion, but have mixed effects on soil nutrient status and grain protein content (William et al., 1981).

Organic crop production system is not a new concept to the farmers of the country. Organic agriculture is as old as Indian agriculture. Indian farmers were all organic farmers before advent of synthetic fertilizers and pesticides. No standards were existing except the traditions set by our ancestors. Increase in population and per capita income are obviously pushing up the food demand, which needs to be met through enhanced productivity per unit area by application of modern tools of technology. In this context, suitable technology needs to be devised to maintain qualitative and higher production level by use of organic inputs.

Numerous reports have emphasized the need for major changes in the global food system i.e. agriculture must meet the twin challenge of feeding a growing population and minimizing its global environmental impacts (Godfray et al., 2010). Organic farming, a system aimed at producing food with minimal harm to ecosystems, animals or humans is often proposed as a solution.

During the past few years, organic agriculture has become popular in many parts of the world. However, despite this growth only a small share of total agricultural land is under organic agriculture. The small market shares in industrialized countries may be attributed to the premium price at which organic food is marketed. The question what is the future for organic agriculture. Some argue that it could become the conventional production system of the future, while others do not agree with.

Organic farming practices are different basing on location, time and farmers involved. However, the concept of organic farming is based on following principles:

- Nature is the best role model for farming, since it does not use any external input.
- The entire system is based on understanding of nature’s ways of replenishment as the system does not degrade the soil.
- The soil in this system is considered as a living entity due to abundant presence of micro-organisms.
- The living population of microbes and other organisms in soil are significant contributors to its fertility on a sustained basis.

Popularization of organic agriculture depends on its economically competitiveness with conventional agriculture. This depends on productivity of organic agriculture, demand for its products and the extent of consumer prices. Feeding the world with organic agriculture may require more land than with conventional agriculture. As global food security has become a primary concern, the productivity of organic agriculture for feeding the world is an important factor. Some practices in conventional agriculture (viz. shifting cultivation) cause environmental damage and that the scarcity of natural resources will also increasingly become a limitation in conventional systems. Paul et al. (2002) found that crop
yields are reduced by 20\% in the organic systems, although input of fertilizer and energy was reduced by 34 to 53\% and pesticide input by 97\%. Enhanced soil fertility and higher biodiversity found in organic plots may render these systems less dependent on external inputs.

Among the benefits of organic technologies are higher soil organic matter and nitrogen, lower fossil energy inputs, yields similar to those of conventional systems and conservation of soil moisture and water resources (especially advantageous under drought conditions). Conventional agriculture can be made more sustainable and ecologically sound by adopting some traditional organic farming technologies (David et al., 2005). The specific Advantages of organic farming are:

- Organic matter supplies all the essential macro and micro plant nutrients.
- It improves physico-chemical and biological properties of soil.
- Organic matter recycling is renewable and thus energy resources can be made available for organic production.
- Organic farming improves agro eco-system and helps stopping environmentally degradation.
- Organically grown crops are preferred most by people as it is believed to be more nutritious compared to the conventional ones.
- Organic produce fetches more prices in the national and international market.
- In the long term, organic farms save energy and protect the environment.
- Organic food has no harmful chemicals such as insecticides, fungicides and herbicides.

In the present day context, organic farming is gaining importance in the era of conservation agriculture for sustainable crop production. Huge sources of organic matters e.g. agricultural waste, debris of forest, animal body parts, rural and urban residues go waste. With consistent effort, these can be appropriately utilized to provide plant nutrient by maintaining soil health. Market demand for organic food is growing day by day, both inside the country and abroad.

Due to abundant availability of biomass, agricultural wastes and natural resources; there is vast scope for expanding organic agriculture in our country. Several plants present in the forest eco-system, can be effectively used for production of bio-pesticides to be utilized for management of insects, diseases etc. Several technologies have been developed to manage pests and diseases without use of harmful chemicals. Use of botanicals, pheromone trap, light trap, clean cultivation, line sowing, proper water management techniques, summer ploughing, advocating tolerant crop varieties and use of biological agents are prominent among non-chemical plant protection measures.

Harnessing the nutrient from farm renewable resources include crop residues and farm wastes, which are valuable sources of plant nutrients. In tropical and subtropical soils, there is a general deficiency of organic carbon and plant nutrients due to rapid loss of these components by bio-degradation. To make up for these losses, extensive utilization of organic residues in agriculture is essential.

Some critics argue that organic agriculture may have lower yields and would therefore need more land to produce the same amount of food as conventional farms, resulting in widespread deforestation and biodiversity loss and thus undermining the environmental benefits of organic practices (Trewavas, 2001). In a study by Verena et al. (2012), it was observed that organic yields are typically lower than conventional yields. But, these yield differences are highly contextual depending on system and site characteristics and range from 5 to 34\% lower yields as compared to conventional practices.

However, under certain conditions with good management practices for particular crop types and growing conditions, organic systems can nearly match conventional yields.

No process can be perfect and has its own pros and cons. Organic farming has its own benefits that are far bigger than
the related disadvantages of organic farming. Thus, it is very much essential to create awareness among the people about the benefits of this process so that it can be adopted on a large scale. It can minimize the present issues linked to organic farming due to bulk production. The factors limiting organic yields need to be carefully understood with assessment of social, environmental and economic benefits of organic farming systems to establish organic agriculture as an important tool in sustainable food production.

References


Organic Farming for Sustainable Agriculture

L. M. Garnayak

Dean, College of Agriculture, Orissa University of Agriculture and Technology, Bhubaneswar

Agriculture sector witnessed unparalleled growth worldwide due to increased use of improved seeds, fertilizers, irrigation, pesticides and farm machinery. Food production scenario in the country like India has changed from ship-to-mouth to self-sufficient status and even surplus for export. But with time, extensive dependence on chemical farming has resulted in erosion of biodiversity, a primary resource for sustainability of a system; declining factor productivity; fatigue in yields; declining or rising water table; increasing deficiency of secondary and micro nutrients and enhanced emission of green house gases (GHGs). Dr M S Swaminathan, the scientific leader of the green revolution movement in India, in his address way back 1968, the era of inception of green revolution in India, has cautioned that “The initiation of exploitative agriculture without a proper understanding of the various consequences of every one of the changes introduced into traditional agriculture, and without first building up a proper scientific and training base to sustain it, may only lead us, in the long run, into an era of agricultural disaster rather than one of agricultural prosperity.” Today the agricultural soils in many developing countries are associated with extensive degradation, declined productivity, deteriorating environmental quality, reduced profitability and threats to human and animal health, making the system an unsustainable one. Advanced technologies such as GM crops coupled with complex fertilizers duly supplemented by potent molecules for pest management will further deteriorate the situation beyond human imagination. Consequently, need has been felt to adopt an alternative practice that would impart sustainability to agriculture besides ensuring better animal and human health. Further, stringent standards for food in foreign markets leading to rejection of many Indian food consignments in the recent past, increasing demand of high quality food without any serious ecological impact and harmful residues has paved the way for organic farming. Organic farming will bring sustainability to the agricultural production system, create opportunity of organic food availability at premium prices and serve the dual purpose of healthy food with conservation of resources.

In agricultural production system, sustainability is a question, and will remain so, rather than an answer. With input intensive agriculture, a threat to basic natural resources required for agricultural production system, was realized; and many definitions started pouring in with regards to sustainability. The World Commission on Environment and Development (1987) has given the most common and universal definition: “Sustainable development is a development that meets the needs of the present without compromising the ability of future generation to meet their own needs”. Sustainable agriculture includes the global perspective in terms of environment, economy and full human needs. European Environment Agency (EEA) in 2008 defined that “Sustainable agriculture entails the management of natural resources in a way, which ensures that the benefits are also available in future. A broader understanding of sustainability extends to the protection of landscapes, habitats and biodiversity and to overall objectives such as quality of drinking water and air.” The Technical Advisory Committee, Consultative Group of International Agricultural Research (CGIAR, 1988) states “Sustainable agriculture should involve the successful management of resources to satisfy changing human needs while maintaining or enhancing the quality of the environment and conserving natural resources”. Sustainable agriculture employs ecological principles and use of environmentally friendly and renewable strategies in agriculture to protect biodiversity. Dr M S Swaminathan has identified 14 dimensions of sustainable agriculture as technological appropriability, economic feasibility, economic viability, environmental soundness, temporal stability, resource use efficiency, local adaptability, social acceptability and social sustainability, political willingness, administrative manageability, cultural desirability, renewability, equity, and productivity. The elements of sustainable agriculture are conservation agriculture, soil and water conservation, crop diversity, organic farming, integrated farming systems, integrated nutrient management, integrated pest management, water quality and water conservation, agroforestry and marketing.

Organic farming is a system which avoids or largely excludes the use of synthetic and to the maximum extent feasible
rely upon crop rotations, crop residues, animal manures, off-farm organic waste, mineral grade rock additives and biological system of nutrient mobilization and plant protection. It is a method of farming system which primarily aimed at cultivating the land and raising crops in such a way, as to keep the soil alive and in good health by use of organic wastes and other biological materials along with beneficial microbes to release nutrients to crops for increased sustainable production in an eco-friendly pollution free environment. The practice emphasises on the use of organic matter for enhancing soil properties, minimize food chain associated health hazards and helps in attaining closed nutrient cycles, the key factors for sustainable agriculture. The objectives of environmental, social and economic sustainability are the basics of organic farming. The key characteristics include protecting the long-term fertility of soils by maintaining organic matter levels, fostering soil biological activity, careful mechanical intervention, nitrogen self-sufficiency through the use of legumes and biological nitrogen fixation, effective recycling of organic materials including crop residues and livestock wastes and weed, and diseases and pest control relying primarily on crop rotations, natural predators, diversity, organic manuring and resistant varieties. Organic farming may be defined comprehensively as environment friendly ecological production system that promotes and enhances biodiversity, biological cycles and biological activities. It is based on minimum use of off-farm inputs and management practices that restore, maintain and enhances ecological harmony. The variants of organic farming are: Eco-farming, Biological Farming, Bio-dynamic Farming, Regenerative Agriculture, Macrobiotic Agriculture, Natural Farming, Nature's Agriculture, Permaculture, Natueco Farming, Panchagavya Krishi, Rishi Krishi, Jaivik Krishi, Homa Farming, Homa Jaivik Krishi, etc.

The principal aims of organic farming as embodied in the IFOAM (International Federation of Organic Agriculture Movements) are:

- to produce food of high nutritional quality in sufficient quantity,
- to interact in a constructive and life-enhancing way with natural systems and cycles,
- to consider the wider social and ecological impact of the organic production and processing systems,
- to encourage and enhance biological cycles within the farming system, involving micro-organisms, soil flora and fauna, plants and animals,
- to maintain and increase the long term fertility of soils,
- to maintain the genetic diversity of the production system and its surrounding, including the protection of wildlife habitats,
- to promote the healthy use and proper care of water, water resources and all life therein,
- to use, as far as possible, renewable resources in locally organised production systems,
- to give all livestock, conditions of life that allow them to perform all aspects of their innate behaviour,
- to minimise all forms of pollution that may result from agricultural practices, and
- to progress towards an entire production, processing and distribution chain which is both socially justifiable and ecologically responsible.

At present, most optimistic estimates show that about 25-30 percent of nutrient needs of Indian agriculture can be met by various organic sources. Supplementation of entire N through FYM sustains crop productivity at more than use of conventional N fertilizers. Combined use of chemical fertilizers along with various organic sources is capable of sustaining higher crop productivity, improving soil quality and productivity on long-term basis. The organic sources besides supplying N, P and K also make unavailable sources of elemental nitrogen, bound phosphates, micronutrients and decomposed plant residues into an available form to facilitate the plants to absorb the nutrients. Application of organic sources encouraged the growth and activity of mycorrhizae and other beneficial organisms in the soil and is also helpful in alleviating the increasing incidence or deficiency of secondary and micronutrients and is capable of
sustaining high crop productivity and soil health. Addition of organic amendments and casting of earthworms to soil also proved effective in controlling diseases of crops. Organically managed field has higher earthworm activity than inorganic agriculture and in the biodegradation process both earthworms and microbes work together and produce vermicompost, which is the worm fecal matter with worm casts. Organic fertility amendments enhanced beneficial soil microorganisms, reduced pathogen population, total carbon and cation exchange capacity and lowered down bulk densities, thus improved soil quality. The farmers can in turn, get good remuneration from organically produced crops and if included in high value crop rotations.

Organic farming is the most widely recognized alternative farming system for sustainable production without many detrimental effects in the environment and ecology. Consumer demand for organic products is steadily increasing across the globe but production has not kept pace with the demand. Area under organic agriculture has been expanding rapidly and is being practiced in more than 120 countries worldwide. Globally, 37.5 Mha of agricultural lands (roughly 0.6% of the agricultural land) are currently managed organically by 1.9 million producers. The continent with most organic area is Australia (12.2 Mha), Europe (11.2 Mha), Latin America (6.8 Mha), Asia (3.2 Mha), North America (3.0 Mha) and Africa (1.1 Mha). India ranks 10th in terms of cultivable land under organic certification with organic production of around 1.34 Mt. The country exported around 135 organic products annually (0.16 Mt) valued 374 million US $.

Though organic farming has emerged as an alternative to chemical farming with some positive impact, the real players i.e., policy makers, scientists and in large the farming community have many apprehensions as:

- Can yield level be maintained in organic farming?
- Are there enough organic wastes available for recycling to convert entire area in the country?
- Are organic techniques effective for everywhere and all crops?
- Are organic commodities better in quality, nutrition with higher therapeutic values?
- Can insect-pests, diseases, and weeds be managed organically?
- Are organic techniques eco-friendly and cost effective?
- Are there enough market for organic product?, etc.

India blessed with rich natural heritage of soil, climate and biodiversity has a vast potential for organic farming, particularly in following avenues:

- In rainfed areas where there is little or no scope for use of fertilizers and other agro-chemicals
- The north-eastern region of India provides considerable scope and opportunity for organic farming due to least utilization of chemical inputs.
- Tribal dominated areas
- Export oriented basmati rice, tea, coffee, ginger, turmeric, black pepper, coconut, areca nut, cashew, sugar, wheat used far bakery, mango, banana
- Organic potato in hill and mountain ecosystem
- Organic off-season vegetables
- Sorghum, cotton, soybean, groundnut, millets, pulses grown in Semi Arid Tropics
- Agroforestry system
- Crops in cold desert under traditional farming
• Medicinal and aromatic plants
• Organic based farming systems

Organic farming is beneficial to both developed nations with respect to environmental protection, biodiversity enhancement, and reduced energy use and CO$_2$ emissions and also to developing countries for sustainable resources use, increased crop yield without over reliance on costly inputs, and environmental and biodiversity protection. But the practice has different perspective between developed and developing countries. Organic farming may be the best answer for the developed countries endowed with surplus resources, but limited population with high purchasing power and requiring food of the highest quality. But for resource poor, highly populous country like India, with ever growing demand for food out of shrinking natural resources, site and crop specific organic farming may be promoted without compromising the food grain production to feed the ever increasing population. Rather than promoting organic farming enmass and universally, it would be desirable to carefully delineate areas for organic agriculture, which provides better profitability and boost to the export.

“Organic farming—the real green revolution- A solution to non sustainability, hunger and poverty”

References:
International Organic Farming: Special Reference to South East Asia and Europe

Ashutosh Mohanty, PhD

Director, Mongolia International University, Ulaanbaatar

Introduction

Organic Farming is a global phenomenon since the last decades and it is presumed globally that there is a huge market for potential Organic Agriculture products in the USA, Middle East, and Europe. Europe countries like Netherlands, Germany, Italy produce a large variety of food crops including cereals, pulses, and oilseeds and large number of seasonal fruits. In the name of increased productivity, indiscriminate application of enormous quantity of chemical fertilizers is being followed keeping the health factor at bay. Hence an alternative method of farming is of urgent need which could satisfy the needs of increased food production as well as providing a security against any potential health problem. Organic farming has been proved as a solution to both of these problems. Also since the need for the prerequisites for organic farming is less as compared to chemical farming, therefore, in a country like India where the agriculture is highly influenced by the vagaries of various biotic and abiotic factors, organic farming is capable enough to provide economic security to the mediocre farmers as well. Last year, the international organic export and domestic market grew by 30 and 40 per cent respectively, and will sustain primarily due to an increasing number of affluent and health conscious consumers. As the industry continues to grow, it faces unique challenges. Due to relatively small volumes, the costs of organic food products are relatively high. The cost of cultivation increases as it takes more time and energy to produce than its chemical-intensive counterpart. High demand and low supply has further created an inflationary pressure on organic food products. This supply-demand mismatch can be eased fundamentally by making organic production mainstream with location-specific hybrid production strategies. Specialised farmer training costs, higher processing and inventory holding costs, and increased packaging, logistics and distribution costs add to the price of end products. Nevertheless, investments in achieving operations excellence by companies will facilitate lowering the cost of organic food products. However, with the policies implemented by the EU and ASSEAN to encourage organic farming regarding the commencement, implementation and the marketing of organic food products as well as the increasing demand of the organic products in the domestic and international market, there is ample scope for organic food industries to expand and generate revenue for strengthening the Indian economy. Being an international Researcher and academician, we presume that if we promote Organic Agriculture in South Asia and India could be a global leader in Organic Agribusiness and farmers could sustain their livelihood.

Organic Farming in Thailand

Thailand is predominantly an agriculture-based country. A large proportion of population derives their livelihood and income from agriculture sector. With a favourable climate and well-developed agricultural processing facilities, Thailand is among the top ten agricultural exporters in the world. Her main exporting commodities include rice, pineapple, baby corn, shrimp and chicken account for a large part of the world trade supplies. Organic agriculture has become a major policy theme for agricultural development in Thailand since the Taksin administration took power 3 years ago. Organic farming was enlisted as an important national agenda, to promote safe food and national export. Many government authorities have initiated projects and activities centered around organic farming promotion. But very few concrete projects have been implemented. However, organic farming is not a recent phenomenon in Thailand. Local farmers have practiced traditional farming for hundred of years. Such practices have been developed and enriched through farmers’ knowledge of local agro-ecology and environmentally sustainable ways of farming. The introduction of ‘green revolution’ in the 1970s, has not replaced all traditional farms and many have resisted this unsustainable technology.
Around early 1980s, many farmers and local non-government organizations (NGOs) came together to establish the Alternative Agriculture Network (AAN) to foster sustainable agriculture activism in Thailand. The AAN provides a discussion forum of experience sharing and policy advocacy for sustainable agriculture, including organic farming. The AAN at present constitute the core of the organic and sustainable agriculture movement in Thailand.

The early pioneers in organic project are the non-governmental organizations. Aiming at promoting sustainable farming practices, NGOs under AAN umbrella organized organic conversion programme and developed organic farming technologies. Some NGOs also initiated fairtrade programme for domestic and/or export market for the produces. They main targets are small-scale producers and marginalized farmers. The AAN saw the importance of organic certification and forged cooperation with consumer and environmental movements to establish a national organic certification body in mid 1990s. The organic cum fairtrade projects constitute a large part of the present organic movement until today.

The mainstream business sector, also saw the business opportunities in organic trade, has also initiated several organic project. Many of them convert part of their production to organic farming and lunched organic trade initiatives. Their projects are often large scale and exclusive for contracted trading partners. In the last few year, several new business organic projects was launched and they have become an important actor in the Thai organic movement presently.

**Organic Production**

Thai organic agriculture is at the beginning of the take-off stage. The development so far is largely in the hand of farmers and private sector while government supports are developing but still lacking behind. Its development has capitalized on the country’s strengths by focusing on organic rice and vegetable production. The majority of organic producers are family farms organized under grower group programme or organic projects. The predominant organic agriculture in Thailand is crops, especially rice, vegetables and fruits. A couple of wild products like honey exist. There is growing number of certified aquaculture productions and a few organic livestocks. Several producer groups produce organic rice, most of which is the jasmine rice. Most of the rice is exported (mainly to European markets) and small quantity is sold domestically. Vegetables are the second most important organic crops. They are fresh vegetables and baby corn. Majority of fresh vegetables is sold in Thailand while baby corns are all exported. An estimate of 30,755 hectares of farmland is presently now under certified organic management. This represented around 0.15% of the total farmlands.

**Domestic Certification and Regulation**

Since gaining the IFOAM-accreditation at the end of 2002, the Organic Agriculture Certification Thailand (ACT) is the first and the only Thai organic certification body that can offer internationally-recognized organic certification services. Established in 1995, ACT is an independent private certification body. ACT’s standards include crop, wild product harvest, aquaculture, processing and handling. In 2007, ACT helped to organize a regional collaborative platform of organic certification bodies in Asia, Certification Alliance to provide one-stop inspection services to organic operators in the region.

Several local certification bodies also exist offering services for specific regions or at national level but for limited scope. The Northern Organic Standards Organization (private organization) certifies organic crops in the Northern Thailand, the Organic Crop Institute (Department of Agriculture) offers certification of crops (except rice), Department of Rice offer certification for organic rice, Organic Aquaculture Farm and Product Certification Center (Department of Fisheries) offers certification for aquaculture and Department of Livestocks offer certification for livestocks. There are also several foreign certification body operating in Thailand, mainly from the European Union.

In 2002, the National Office of Agricultural Commodity and Food Standards (ACFS) completed a national production and processing guidelines of organic crops, livestock, and shrimp production. The guideline is supposed to used for national organic accreditation. At the moment, only ACT is accredited by the ACFS.

**Organic Markets**

Reliable sources of data on organic produce are hard to find. The situation is confused by the various standards or systems of certification for organically produce and other safe produce (with no organic certification). This made it impossible to categorically differentiate between the two markets. Despite such limitation, Green Net and Earth Net Foundation estimates the total market for certified organic produces in 2009 at US$ 135.44 million, around half of which is sold domestically and the another half is exported. Currently, there are 3 channels where such products are sold, i.e. supermarket chain, specialized shops, and direct marketing (either farmer market or membership). In supermarkets, organic and/or “health” products are sold in the same way as conventional products, e.g. on the same product shelves. Only when there is product promotion or on special occasion, then organic and health products are displayed separately. Main products sold through supermarket...
channel are fresh fruits and vegetables and rice. None of these supermarkets makes explicit advertisement campaign on the availability of the organic and health products. In specialized shops, organic and health foods are the main feature of the shops. Due to limited assortment of organic products, these shops have to carry many conventional health food items. Even organic products are still much more predominant but there lacks a clear identification or labeling to separate the different product quality. Consumers shopping in these shops often assume that all products there are “green and/or healthy”. Direct marketing through farmer markets gain popularity in recent years and a few sell through membership scheme. The direct markets normally focus only on fresh produces. [from “Overview of organic agriculture in Thailand”, Green Net’s website]

Organic Farming in Mongolia: Brief Overview

With about three million inhabitants living on a surface area four and a half times larger than Germany, Mongolia has one of the lowest population densities in the world. Despite the high economic growth over the last few years, even today one third of the population lives in poverty. A productive agriculture and thus adequate supply is only restrictedly possible due to the poor soil with the exception of the fertile grounds of the village of Khuder Soum in the province of Selenge, in the North of Mongolia, which is one of the biggest farming regions of the country. Due to the breakup of state-owned farms in 1991, most of the 400 families living in the village lost their jobs. Many of them started to cultivate small areas of land and grow vegetables in small spaces. This pilot project was intended to provide poor families with money to buy seeds and tools for vegetable gardening and with knowledge on sustainable farming methods and the long-term use of it.

The project was coordinated by the GNF in cooperation with the Mongolian nature association United Movement of Mongolian Rivers and Lakes (UMMRL), responsible for the implementation in the project area. UMMRL is a union of six associations and NGOs aiming at the protection of lakes and rivers in the Eastern, Western, South-Western and central regions of Mongolia. The NGO Khuder River is involved in this project.

Project activities

According to article 29.2 of the Mongolian Land Law, land not exceeding 0.1 hectare may be given for possession for 15 to 60 years free of charge to citizens for cultivating vegetables, fruits, berries and fodder plants. Based on this land possession licence 10 families (45 family members including 23 children) were given one hectare land to grow vegetables.

A. Vegetable growing and harvest

At the beginning of the project, staff of the NGO Khuder River distributed in total 1.2 tons of potatoes and 5 kg vegetable seeds to the 10 families. In late June potatoes were planted, carrots, cabbage, cucumber and onions sown. The cucumbers were sown in the greenhouse, which was built by jobless people within the scope of the project. The installation of an irrigation system with an integrated water pump to ensure optimal growth of the vegetables was part of the project as well.

B. Building of a storage facility

In the following weeks the workmen starting building a 60 ton storage facility. This is particularly important with regard to the project sustainability. The new storage room not only allows storing vegetables to offset poor harvests, but also to sell them at local markets when the vegetable prices are high due to low supply.
C. Training of the families

There was a big interest in vegetable cultivation, growing and storage of vegetables, and some more families than the 10 selected families attended the workshop, which was organised by the NGO Khuder River. The families were instructed how to correctly utilize the soil richness and to allow the soil to regenerate in order to practice sustainable and productive farming. Appropriate irrigation and fertilisation as well as prevention of insecticides and effective use of natural resources were workshop issues. The workshop director gave hints about how to achieve high vegetable market prices and informed about vegetable products. The families were enthusiastic about the offer of the local environmental organisation and in the course of the workshop they discussed other possibilities to fight poverty in the village and increase the income of the inhabitants.

D. Harvest

The first harvest was quite successful. From 1.2 tons of seeds over 14 tons of vegetables were harvested, particularly potatoes, onions, cabbage and cucumbers. Additionally to storing vegetables, many families produced pickled vegetables and some families started selling vegetables at regional markets.
Outlook

The local people were very satisfied with the project progression. They are allowed to continue growing vegetables on the land rented over the next years, and are convinced that both their standard of life and the quality of cultivated vegetables have improved. On the one hand the cultivated products contributed to a balanced nutrition of the families involved, on the other hand they were able to generate additional income. Not only the families directly concerned benefited from wholesome food, also the other village dwellers.

Organic Farming in Netherlands:

Organic arable production in the Netherlands Until the late 1970s and early 1980s, organic arable production in the Netherlands was small, and was concentrated on a few specialized arable farms, some large mixed farms and many small vegetable farms. Fertilization levels appeared to be low, although exceptions have been mentioned in horticulture (Anon., 1977). In the late 1980s and early 1990s, a number of conventional arable farmers, being concerned about environmental issues and global fairness (‘critical farmers’), converted to organic arable production. These farmers introduced a high level of professionalism and technical skills into organic crop production. The products were sold through several small wholesalers, among them one co-operative in Lelystad (Nautilus), supplying specialized organic stores mainly. A growing supply and consumer demand combined with export opportunities to Germany and Great Britain strengthened the position of the Nautilus co-operative. In 2002 the co-operative had obtained a market share of more than 50% of sales of fresh produce and 80% of the sales to processors. Expected sales were pooled and co-ordinated to spread the marketing risks of individual crops among members for whom it was possible to engage in forward planning where crop rotations were concerned (Wijnands et al., 2005). A second wave of farmers converted to organic arable production in the period 1999-2001, triggered by governmental conversion payments and by a growing market, mainly caused by supermarkets entering the organic market. These farms were better capable of delivering what the market wanted in terms of volume, production per hectare and external quality, but they were no longer willing to engage in the co-operative structure. Organic production grew faster than demand. Overproduction, competition from imports and a weakened bargaining position on the part of the farmers due to the collapse of the co-operative structure...
International Conference on Organic Farming for Sustainable Agriculture (OFSA)

all contributed to a drop in farm-gate prices. Most of the co-operative’s former members now either organize the sales of their produce individually or in small regional groups. Still, a major part of the arable products are being exported (65% of the vegetables), while the position of the supermarket chains seems to stabilize at more than 50% of the organic vegetables and potatoes consumed in the Netherlands (Wijnands et al., 2005). To compensate for lower prices, farmers grew more than 50% of high-value crops in rotation, such as vegetables and potatoes (Wijnands et al., 2005). Closely related to this and the market specifications, average fertilization rates increased. Increasing amounts of other ‘permitted fertilizers’ of conventional origin are also used: for example ‘vinsasse’, a by-product of the sugar beet industry and a fast-releasing N source with high levels of K. Organic animal production in the Netherlands is relatively large and is selling a major part of its manure (see above). Nevertheless, in 2003 only 7% of the total N-input of 198 kg N per hectare on average modern organic arable farms on clay soils originated from organic sources, while ISO kg (or 75%) came from non-organic animal manure. If animal manure and other permitted fertilizers of conventional origin are to be banned, manure application rates on organic arable farms will have to be reduced by more than 50%. Simultaneously, organic livestock farmers, particularly dairy farmers, should double the sale of manure (Prins, 2005). NJAS 54-4, 2007 453 J. De Wit and H. Verhoog Table 1. Average nitrate contents in carrots from randomly chosen farms in different years during the period 1996-2004. Year Number of farms NO3 (mg kg-1) 1996 10 89 1998 11 117 2003 20 23 2 2004 15 Source: Bokhorst & Janmaat (2006). The intensive cropping patterns and the high fertilization rates resulted in large mineral surpluses of approximately 90 kg N (excluding N-fixation), 60 kg P/KO and 175 kg Kz 0 per hectare on the average modern organic arable farms on clay in 2003 (Prins, zoolS). These phosphate surpluses are even higher than on comparable integrated conventional farms, although nitrate leaching is often lower (Spruijt-Verkerke et al., 2004). Moreover, the increasing nitrate levels in carrots (see Table I) mirror the intensified arable production and high fertilization rates. For a long time, carrot was an organic product that was hardly fertilized. But presently, nitrate levels are three times higher than in conventional carrots, with a wide range varying from II to 864 mg nitrate per kg (Hoogenboom et al., 2006). Conclusions on the conventionalization of Dutch organic agriculture On the basis of the information presented above, it cannot be concluded that conventionalization is the dominant phenomenon in OA as a whole. However, in the described sub-sectors of Dutch organic agriculture there clearly is a growing influence of conventional agro-food commodity chains and the utilization of high levels of off-farm inputs. Also, it can be concluded that this form of organic agriculture does not attain high levels of environmental protection and animal welfare. Simultaneously, standards of animal welfare and environment in conventional agriculture are increasing. So one might conclude that organic agriculture is becoming less distinguishable from conventional agriculture (Meeusen et al., 2006). Even though current practices in Dutch OA are compliant with the current EU regulation 992/91 on OA, these developments may have serious consequences for the general image of OA. They will hamper long-term market perspectives as well as support from (inter)national authorities, animal welfare and environmental organizations. One of the reasons they have been supporting organic agriculture is the production of so-called ‘public goods’ such as better animal welfare, a better environment and rural development (Stolz & Stolze, 2006). The smaller the distinction with conventional farming in this respect, the narrower the support will be. It therefore appears necessary to have a debate as to whether a development is required to counteract the trends of conventionalization, and if so, how this development can be achieved. 454 NJAS 54-4, 2007 Organic values and the conventionalization of organic agriculture can be achieved. This debate is complicated because additional rules will increase production costs (Bos & De Wit, 2006). This would contradict current efforts to decrease price differences with conventional products in order to realize stronger market growth, which in turn will lead to larger economies of scale and consequently decreasing price differences. Moreover, additional rules might contradict one of the objectives of the present revision of the ED-regulation, i.e., the simplification of the regulation. On the other hand, some regulation seems required as private initiatives to limit, for example, off-farm inputs have to compete in the market with those that adopt less restrictive practices if this is permitted by the (international) rules. Organic values Whether conventionalization is problematic can also be analysed by weighing its consequences against the values the organic movement holds. However, the different views or perspectives on what ‘organic’ means and which values are important for OA hamper such an analysis. It is argued that sociologically oriented research into the motives shown by different stakeholders lacks a normative judgement about the values of
OA, and thus falls short in providing a normative basis for the question in which direction OA and its regulation should develop. Later in this section it is argued that the OA principles formulated by IFOAM in 2005, may serve as such a normative basis. Organic values as motives of different stakeholders In literature the word ‘value’ is used in different ways. In most sociological research on organic values, the word value is almost identical to the motives of different stakeholders in the organic sector (producers, retailers, processors, consumers) for being active in the organic sector. This type of research is often initiated by the idea that insight into the various values, motives and expectations held by stakeholders may help prioritize research, extension and marketing activities and also help establish stable organic chains. A few examples are described below. Value segmentations in the organic sector The report compiled by Meeusen et al. (2003) forms the basis for later, more detailed research covering the organic food chain in the Netherlands (Meeusen et al., 2005; Wijnands et al., 2005). The authors present the results of interviews with stakeholders in the organic sector. The report further contains an extensive theoretical analysis of the literature on values, value segmentation and the relationship between values and behaviour. On this basis, the authors arrived at a segmentation based on two sets of values: individualist versus collectivist, and materialist versus non-materialist. They show that the proposed value segmentation accounts for differences in behaviour exhibited by the organic actors with respect to expectations concerning organic food (what is ‘organic’), reasons for buying organic food and expectations with respect to other actors (communication and co-operation in the sector). NJAS 54-4, 2007 455 J. De Wit and H. Verhoog Meeusen et al. (2003) describe four ‘world views’, or organic ‘chains’. The combination of individualist and materialist values (‘calculating chain’) centres mostly around financial motives, whereas in the combination collectivist-immaterial (‘responsible chain’) the emphasis is on non-financial motives. The latter type of actors usually opts for fully organic, i.e., no production or retailing of non-organic products. They maintain more informal relationships among each other (based on trust, not on formal contracts), with a greater willingness to give and ask for information on the product and the production methods. Individual interests are less important than collective values (public goods) such as environment, animal welfare or social justice (fair trade). The unique chain (individualist and non-materially oriented) and the traditional chain (collectivist and materially oriented) are somewhere in between the opposites represented by the other two chains. Attitudes expressed by organic pig farmers In a research project about attitudes of Dutch organic pig farmers towards animal welfare issues, Van Huik & Bock (2006) found that different attitudes exist, which may be related to different farmer types in organic agriculture. These farmer types differ as to their original motivation to adopt organic farming. The ‘ideological’ farmer type has become an organic farmer out of ideological (ethical) motives; the ‘pragmatic’ farmer type is mainly motivated by the continuation of the farm and by financial arguments. The latter may have been attracted to convert to organic farming because of financial incentives offered by the government and may be ready to give up organic practices when more financial gain can be obtained through other ways of pig farming. Views on animal welfare also differ. The ideological farmer type focuses on the animals themselves and their ability to show natural behaviour, whereas the pragmatic farmer type also includes performance levels (production efficiency) in his views on animal welfare. In conclusion, the authors believe to have found evidence supporting the view that financial incentives contribute to the conventionalization of organic farming, and thus may lead to a reduction of animal welfare standards in the organic sector as a whole through unfair competition. Different perspectives on organic agriculture On the basis of their extensive knowledge of the organic sector, Alme & Noe (2007) distinguish three perspectives on organic farming within the sector: 1. Organic as a protest movement against modern industrialized agriculture, which uses inorganic fertilizers, chemical pesticides, food additives or genetically modified organisms. 2. Organic as a logo-poietic system or ideology, i.e., a self-organizing principle (‘autopoiesis’) creating meaning (‘logo’). Organic agriculture is seen as a system that creates itself and holds itself together by a common meaning, a shared world view, core principles. 3. Organic as a market niche: as part of the global market system and based on organic standards that define the market niche. The authors argue that each perspective incorporates a certain understanding of organic agriculture, agriculture, featuring certain concepts and values and a particular logic or rationality, and that these perspectives cannot be merged into one.
Conclusion

There is a need to institute a central body which can help farmers overcome the hassles, to spread awareness about organic farming, and to ensure availability of organic inputs, seeds and pesticides. State agencies should support farmers in developing bio-fertilizers by setting up necessary facilities. Recently, burning of farm waste hazed the skies over Punjab and Haryana, if the farmers had been aware that the waste could have been decomposed to developed bio-fertilizers, it would be great success.

In other words, if the Organic Agriculture sector wants to adhere to its core values and cultivate long-term market perspectives as well as public support based on its distinguish ability, a development is required to limit conventionalization or to mitigate its effects. Such effects occur in intensive situations in the Netherlands - and probably also in other parts of north-western Europe. As the use of off-farm inputs (either from conventional sources or organic inputs transported over a long distance) plays an important role both in conventionalization itself and in its negative effects on the core organic values, this development is best focused on a reduced use of off-farm inputs. Given the financial motivation of important stakeholders and the influence of international trade and economic competition, such development will require regulative action at international level. This should be focused on better rules (regulating external inputs being more important than the last tiny possible additive) or even on a regulative system in which operators (are allowed to) take responsibility to translate organic values into practice, possibly coupled to regulative procedures based on participatory guarantee systems.

References:


Sustainable agriculture: between past and future

Parama Karuna Devi
Jagannatha Vallabha Vedic Research Center

The Sanskrit word “dharma” comes from the root “dhr”, which means “to sustain”.

It is therefore clear that sustainable development is dharmic, and non-sustainable development is adharmic.

Sustainable agriculture and sustainable development are precisely what made India great in ancient times.

Only a few centuries ago, Odisha was one of the richest and most biodiverse agricultural and forestry regions in India, supplying abundant resources and especially food not only for its human population but also for a great number of elephants and a wealth of wildlife.

By definition, development is the increase in the production of valuable assets, that manifests the full potential of resources and make it available to people.

It is called “sustainable” when such increase can be maintained in the long term, with a favorable effect on the quality of life of the people as it produces and utilizes energy and goods in such a way to actually improve and increase resources instead of damaging and depleting them.

It is said, yatobhyudaya nisreyas siddhih sa dharmah: “Dharma is that from which you achieve perfect progress in life both materially and spiritually and along an extended period of time.”

Ignorance or neglect of the universal and eternal principles of Dharma inevitably lead to non-sustainable development. In turn, non-sustainable development becomes the cause for disaster and destruction for the individual, for society and for the world in general.

While we must preserve and revive our glorious past, however, we do not need to reject useful and sustainable modernisation, innovations and contributions, even when they come from outside.

This is the key to understanding the true original Vedic approach, affirmed already in Rig Veda: aa no bhadrah kratavo yantu visvatah (1.1.89), “let good things come to us from everywhere”.

To achieve success in this enterprise, we need to increase and strengthen the number of persons who are properly qualified to lead and support society according to the principles of sanatana dharma: krinvanto visva aryam (Rig Veda 9.63.5), “let us make everyone a civilized person”.

Some of the fundamental instruments in implementing sustainable development are the knowledge of permaculture, agroforestry, diversification of crops, re-evaluation of ancient cultivars and products, environmental protection, local self sufficiency and zero km products, role of cows in organic agriculture, coping with climate change, locally based renewable energy production and especially windpumps, village level technology innovations, renovation of ancient technology for handicrafts, direct value increase of agricultural produce by local processing and preservation, development and empowerment of human resources, self-employment training, integrated urbanisation, and many others.
Use of Bioinoculants for Soil Fertility Management in Organic Farming

S. K. Pattanayak, K K Rout & R. D. Behera*

Department of Soil Science and Agricultural Chemistry, OUAT, Bhubaneswar-3
Email: sushanta_1959@yahoo.com, Mobile: 09437446459
* Ph.d Scholar, Dept. of Soil Science & Agricultural Chemistry

The environmental problems due to excessive, injudicious imbalanced application of chemical fertilizers and agro-chemicals have led to a matter of concern with modern farming intensive agricultural practices followed during last five decades without proportionate supplementation have proved detrimental to the natural resource base and the environment. This led to a search for alternate agricultural system.

The organic farming is a “Production system which avoids or excludes the use of synthetic fertilizers, growth regulators, pesticides and livestock feed additives”. This type of farming depends upon (a) crop rotation, (b) use of crop residues, (c) animal manures, (d) cultivation of legumes (e) green manuring, (f) use of off farm organic wastes, (g) biological sources of nutrients and (h) biopesticides for plant protection. The scope of this paper is limited to the biological sources of nutrients for soil fertility management for organic farming; hence emphasis is given on use of bioinoculats in organic farming.

Microbes are incredibly diverse and are responsible for almost 90 per cent of genetic diversity on planet earth. Soil microorganisms provide an essential function in nourishing and protecting the plants. They also play a crucial role in providing soil, air and water services that are critical for human survival. Understanding this linkage allows better nutrient management decisions.

As soluble carbon is released by roots, micro-organisms are stimulated and colonize the soil surrounding the roots. This can result in competition of nutrients because the plants and microbes rely on the same essential nutrients for growth. The microbial conversion of nutrients into a soluble form takes place through numerous mechanisms (Table 1).

Table 1 Microbially mediated soil transformations that influence plant nutrient availability.

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Microbial transformation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>Mineralization, immobilization, nitrification, denitrification, urea hydrolysis, N$_2$ fixation.</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>Mineralization, immobilization, extra cellular phosphatase activity, acidic dissolution of mineral P, facilitated uptake by mycorrhizal fungi.</td>
</tr>
<tr>
<td>Potassium</td>
<td>K release due to silica dissolution of structural minerals</td>
</tr>
<tr>
<td>Sulphur</td>
<td>Mineralization, immobilization, oxidation, reduction, extra cellular sulphatase activity.</td>
</tr>
<tr>
<td>Iron</td>
<td>Change in oxidation state, production of siderophores, and chelation</td>
</tr>
<tr>
<td>Zinc</td>
<td>Facilitated uptake by AM fungi</td>
</tr>
<tr>
<td>Copper</td>
<td>Facilitated uptake by exudates and AM fungi</td>
</tr>
<tr>
<td>Manganese</td>
<td>Change in oxidation state</td>
</tr>
</tbody>
</table>

The extra cellular enzymes and organic compounds can be specifically excreted to solubilize plant available nutrients from soil organic matter, crop residues or manures. Organic acids released by microbes can dissolve precipitated nutrients on soil minerals and expedite mineral weathering, nutrients are made more soluble (e.g., Fe) as microbes derive energy from oxidation and reduction reactions.
Micro-organisms as Biofertilizers

The microbial inoculants of beneficial microorganisms are popularly known as Biofertilizers. These are living or latent cells of efficient strains of micro-organisms capable of fixing atmospheric nitrogen, solubilizing phosphorus, mobilizing nutrients, water and decomposing organic matter.

The seeds are coated, seedlings are dipped in inoculum or applied in the rhizosphere of the target crops so that the population of desired organisms increase in the vicinity of seed or root. These are self-generating microbes, multiplied artificially in specific cultured medium.

Based on mode of action of microbes, different biofertilizers are classified into four groups:

1. **Nutrient fixers**: It is related to N. Nitrogen fixation take place by both symbiotic on nonsymbiotic /free living microbes.

2. **Symbiotic N₂ fixers**:
   These are capable of fixing atmospheric N₂ into NH₃ by living in the roots of leguminous plants/non leguminous plants; which include (i) *Rhizobium*- legume symbiosis, (ii) *Bradi Rhizobium*, (iii) *Frankia*, (iv) Cyanobacterial associations, and (v) Lichens.

   **Rhizobia**: The bacteria belonging to genera, *Rhizobium*, *Bradi rhizobium*, *Sinorhizobium*, *Azorhizobium* and *Mesorhizobium* collectively called as rhizobia. The extent of N₂ fixation varies widely ranging from <50 to >300 kg ha⁻¹ per annum. The extent of fixation depend upon the soil (near neutral reaction)-crop association and climatic conditions, highest being under temperate climate and lowest under tropical/sub-tropical climate. It perform poorly in acidic soils.

   **Azo-rhizobium**: It is a stem nodulating bacteria and fixes N₂ in the stem of symbionts. Also produce large amount of IAA that influence crop growth.

   **Bradi-rhizobium**: It is reported to be a good N₂ fixer. It can tolerate considerable acidity. Its inoculation with mucuna seeds enhances C, N, P and K in soil through enhanced biomass production.

   **Frankia**: It forms nodules in non-legumes i.e., casuarina, alnus and myrica.

   **Lichens**: Symbiotic association between algae and bacteria

3. **Free living N₂ fixers – Diazotrophs**
   These are free living (nonsymbiotic) aerobic chemolithotrophs and anaerobic photoautotrophs. These are non nodulating bacteria. They include number of families.

   **Azotobacteraceae e.g., Azotobacter**: They are aerobic free living non-symbiotic bacteria. This is non-nodulating bacteria fixes N₂ in their own body.

   **Spirillaceae: e.g. Azospirillum and Herbaspirillum**

   These are gram negative, free living, associative symbiont and non-nodulating micro-aerobic bacteria occur in the rhizosphere of dicots and monocot plants. The N₂ fixation under favourable condition range from 20-40 kg ha⁻¹. Under stress condition it keep itself survive by utilizing root exudates of existing plants/crop plants. Though it utilize carbon as food and energy source, but the population do not fluctuate so rigidly as *Azotobacter* (Pattanayak et al., 2008). The *Azospirillum* is the producer of growth promoters like IAA, gibberlins, cytokinins and enhance root growth and influence nutrient uptake by the plants.
Acetobacter diazotrophicus

It is a diazotroph. Occur in roots, stems and leaves of sugarcane and sugar beat crop plants as N₂ fixer and applied through soil application. The extent of N₂ fixation maximum up to 15 kg ha⁻¹ year⁻¹. In addition to this it produces IAA and help nutrients uptake and seed germination.

Cyanobacteria (Blue green algae)

The nostoc, anabaena, oscillatoria, aulosira, lyngbya etc. are prokaryotic organisms and photosynthetic in nature. They play an important role in enriching paddy field soil by fixing both N₂ and CO₂. It also supply vitamin B complex and growth promoting substance. It fixes 20-30 kg N₂ ha⁻¹. Influence crop yield by 10-15 per cent when applied @ 10 kg ha⁻¹.

Azolla – Anabaena symbiosis

It is one significant non-nodule N₂-fixing systems involving cyanobacteria. It is a floating aquatic fern, found on water surface having a cyanobacterial symbiont Anabaena azollae in their lives. It fixed N₂ in paddy field eco system and excrete organic N into water during its growth and also contribute immediately upon incorporation in to the soil. It contribute N, P,K and organic carbon to soil. Azolla is the scavenger of K and heavy metals from soil, hence used as biofertilizers.

Phosphorus solubizing microorganisms (PSM)

The PSM include both bacteria and fungi.

Phosphate solubilizing bacteria

The Pseudomonas fluorescens, Bacillus megatherium var. phosphaticum, Acrobacter acrogens, Nitrobacler spp., Escherichia fecundi, Serratia spp., Pseudomonas striata, Bacilus polymyxa are the bacteria (Phosphobacteria) having P solubilizing ability through release of organic acids which help in slow dissolution of fixed phosphates and simultaneous complexing Fe, Al and Mn in acid soils keeping phosphate free for crop availability. Additionally these microbes also produce growth hormones to influence crop growth. With their use 25-40 per cent saving in recommended dose of phosphorus application

Phosphate solubilizing fungi

Like bacteria some fungi have ability to secrete organic acids and making P more available in soil. These fungi include Aspergillus awamori, Aspirgellus niger and Pencillum digitatum. In addition to dissolution of P, these organisms have the capacity to degrade and decompose soil organic matter and release of plant available nutrients.

Plant growth promoting Rhizobacteria (PGPR)

These are also called microbial pesticides, e.g., Bacillus spp. And Pseudomonas fluorescence, Seratia spp and Ochrobacterium spp. are able to promote growth of plants. The Pseudomonas fluorescence on application to creepers enhance the uptake of nutrients.

Mycorrhizae

The symbiotic beneficial association of fungi and higher plant roots is observed in Mycorrhizae. The mycorrhizal fungi
derive survival advantage from host plants in terms of sugars which constitute 5-30 per cent of its total photosynthate. In turn plants receive many benefits from this symbiosis. First of all rhizospheric volume of the host plant is increased, 5-15 cm away from infected roots. The absorbing power of host plant roots get increased at least by 10 times compared to uninfected one. Mycorrhizae greatly enhance the ability of the plants to take up immobile plant nutrients in soil, like P and Zn. Water uptake by plants is improved. Mycorrhizal infection make the plants more resistant to drought and salinity stress. Further, its infection protect the plant from excessive uptake heavy metals, potential toxins and soil borne disease pathogen and parasitic nematodes. For soil restoration it become useful by forming soil aggregates.

**Endomycorrhizae: Arbuscular mycorrhizae (AM)**

The AM fungi are agriculturally important where soils are low in nutrients especially P. It is very much essential for many legumes and long duration crops. However, cruciferous crops like mustard, cabbage, and rapeseed and crops belonging to **chenopodiaceae** family like beet and spinach do not form mycorrhizal association.

**Soil acidity: its effect on biota**

Different species of soil biota have their own preferences for soil reaction (pH). Some are more acid-or alkaline tolerant while others prefer a neutral soil pH. Once soil reaction changes, the species composition of the soil environment changes. Among microbes bacteria prefer soil to be on the alkaline side to neutral, while fungi prefer more acidic soil pH.

In low pH soils the beneficial elements required for both plant and microbes such as Mo, P, Ca, Mg and S become less available. Other elements such as Fe, Al and Mn become more available sometimes reach toxic level which necessitates amelioration measures.

**Improving potentiality of inoculum**

The potency of solid charcoal based inoculum can be increased several times – *Azotobacter* by 20 times, *Azospirillum* by 15 times and PSB by 22 times of their initial population (lignite base) by inoculating them to pre-limed (5 %) vermicompost/FYM in 1:25 ratio, incubating for 7 days at 30 per cent moisture under shade and has been successfully used in bioinoculation programme (Table 2).

**Table 2 Bioefficacy of inoculated and incubated limed vermicompost/ FYM**

<table>
<thead>
<tr>
<th>Organisms</th>
<th>Lignite base</th>
<th>Population CFU x10^7 g^-1 inoculum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VC</td>
<td>FYM</td>
</tr>
<tr>
<td>Azotobacter</td>
<td>2.7</td>
<td>0.10 0.04</td>
</tr>
<tr>
<td>Azospirillum</td>
<td>6.0</td>
<td>0.12 0.06</td>
</tr>
<tr>
<td>PSB</td>
<td>0.2</td>
<td>0.01 -</td>
</tr>
<tr>
<td>Inoculated</td>
<td>48.0(17)*</td>
<td>41.0(15) 54.0(20) 46.0(17)</td>
</tr>
<tr>
<td>Inoculated to limed (5 %) sources</td>
<td>85.0(14) 78.0(12) 90.0(15) 81.0(14)</td>
<td></td>
</tr>
</tbody>
</table>

*Data in the parenthesis indicate per cent increase over respective lignite base population.

**Combined use of bioinoculants**

Many researchers agree with the application of single inoculation of beneficial (desired) microbe either *Azotobacter*/ *Azospirillum* for different crops. But research conducted at Bhubaneswar (Pattanayak, 2000) on combined or lone inoculation of these microbes on **okra crop** indicated that the performance of combined source of microbes superseded
the performance of lone source, not only with respect to fruit yield (13-37 %) but also in the uptake of major nutrients (Table 3) significantly.

Table 3: Productivity and uptake of nutrients by okra crop under the influence of lone/combined sources of BFs

<table>
<thead>
<tr>
<th>Organics</th>
<th>Fruit yield (t ha⁻¹)</th>
<th>Uptake of Nutrients (kg ha⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>N</td>
</tr>
<tr>
<td>No organism</td>
<td>4.40</td>
<td>39.2</td>
</tr>
<tr>
<td>Azotobacter (Azot.)</td>
<td>4.98</td>
<td>49.9</td>
</tr>
<tr>
<td>Azospirillum (Azs.)</td>
<td>5.57(27)</td>
<td>54.7</td>
</tr>
<tr>
<td>Azot. + Azs</td>
<td>6.03(37)</td>
<td>58.1</td>
</tr>
<tr>
<td>LSD (P = 0.05)</td>
<td>0.37</td>
<td>2.9</td>
</tr>
</tbody>
</table>

Azot. + Azs.: *Azotobacter* and *Azospirillum* (1:1) 4 kg each ha⁻¹,

Soil: Loam, pH: 5.3, OC: 4.5 g kg⁻¹ soil.

Integrated use of bioinoculants under organic farming for improvement of crop productivity.

Local potato of Kandhamal

The tribal farmers of Kandhamal district use leaf litter and small amount of animal manure (FYM @ 2 t ha⁻¹) for production of their local potato having high storability. Integrating diazotrophs and PSB with such locally available sources yielded 18 per cent higher tuber yield compared to local practice yield of 12.2 t ha⁻¹, with a benefit of Rs.22,000 ha⁻¹ (Table 4) (Pattanayak and Rao, 2014).

Table 4: Improvement of yield of local potato with the use of BFs in the district of Kandhamal

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Practices</th>
<th>Tuber yield (t ha⁻¹)</th>
<th>Response (%)</th>
<th>Extra income (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Local practice</td>
<td>12.2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Improved practice</td>
<td>14.4</td>
<td>18</td>
<td>22,000.00</td>
</tr>
</tbody>
</table>

*Sale price of local potato at farmers level Rs.10,000/-

Local practice: FYM 2 t ha⁻¹ + leaf litter @ 2 t ha⁻¹

Improved practice: FYM @ 2 t ha⁻¹ + Neem, oil cake 50 kg ha⁻¹ + Azoto+Azs + PSB @ 4 kg each ha⁻¹.

Potato and okra crops

Both potato (Kufri Jyoti) and Okra- Bindi (cv. BO-2) crops were grown in potato-okra and rice (residual cropping system in mid up land irrigated system in acid Inceptisols of Bhubaneswar. The results revealed that both fresh and
dry matter production of both the vegetable crops were significantly influenced by addition of FYM @ 5 t ha\(^{-1}\) to each crop compared to the yields due to no nutrient addition (control) (Table 5). Bioinoculation of crops (consortia) had at par performance with that of FYM application alone. However, their integrated use had significant influence over their lone use (Pattanayak, 2005).

**Table 5: Fresh and dry matter of potato crop (Kufri Jyoti) and Okra (Bhindi) under the influence of organic packages.**

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Packages</th>
<th>Potato</th>
<th>Okra</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Fresh weight (kg ha(^{-1}))</td>
<td>Dry weight (kg ha(^{-1}))</td>
</tr>
<tr>
<td>1</td>
<td>Control</td>
<td>3430</td>
<td>670</td>
</tr>
<tr>
<td>2</td>
<td>FYM</td>
<td>5720</td>
<td>970</td>
</tr>
<tr>
<td>3</td>
<td>BI</td>
<td>5930</td>
<td>1058</td>
</tr>
<tr>
<td>4</td>
<td>FYM+BI</td>
<td>7070</td>
<td>1259</td>
</tr>
<tr>
<td></td>
<td>LSD (P=0.05)</td>
<td>1070</td>
<td>114</td>
</tr>
</tbody>
</table>

**Table 8. Root characteristics of potato crop (Kufri Jyoti) under the influence of organic packages**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Package of practice</th>
<th>Root length (cm)</th>
<th>Volume (cc)</th>
<th>Weight (g/plant)</th>
<th>CEC cmol (P(^+)) kg(^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Control</td>
<td>21.8</td>
<td>2.0</td>
<td>2.84</td>
<td>2.43</td>
</tr>
<tr>
<td>2</td>
<td>FYM</td>
<td>24.7</td>
<td>2.4</td>
<td>3.37</td>
<td>2.83</td>
</tr>
<tr>
<td>3</td>
<td>BI</td>
<td>24.2</td>
<td>2.4</td>
<td>3.45</td>
<td>2.94</td>
</tr>
<tr>
<td>4</td>
<td>FYM+BI</td>
<td>25.3</td>
<td>2.7</td>
<td>3.91</td>
<td>3.09</td>
</tr>
<tr>
<td></td>
<td>LSD (P=0.05)</td>
<td>3.1</td>
<td>0.9</td>
<td>0.40</td>
<td>0.45</td>
</tr>
</tbody>
</table>

FYM: @ 5 t ha\(^{-1}\), BI: *Azotobacter* + *Azospirillum* + PSB @ 4 kg each ha\(^{-1}\)

**Rhizome yield of turmeric in Kandhamal**

Farmers of Kandhamal district use leaf litter as natural source of manure for organic turmeric cultivation in hill slopes. Integrated use of neem oil cake @ 50 kg ha\(^{-1}\), FYM @ 2 t ha\(^{-1}\) and bioinoculants like *Azotobacter*, *Azospirillum* and PSM @ 4 kg each inoculated to 300 kg FYM in two packages indicated the superiority of the improved practices in increasing rhizome productivity (Table 6), hence the benefits (Pattanayak and Rao, 2014).

**Table 6: Biofertilizers as integral component of organic package for turmeric production**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Package</th>
<th>Rhizome yield (t ha(^{-1}))</th>
<th>Yield advantage (t ha(^{-1}))</th>
<th>Benefit (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FP</td>
<td>19</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Organic-IU</td>
<td>22.8(20)</td>
<td>3.8</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Organic-II</td>
<td>23.9(26)</td>
<td>4.9</td>
<td>17,500</td>
</tr>
<tr>
<td></td>
<td>LSD (P=0.05)</td>
<td>0.81</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
FP: Leaf litter only @ 2 t ha⁻¹
Organic-I: Neem oil cake 50 kg ha⁻¹ + Leaf litter + FYM 2 t ha⁻¹.
Organic-II: Neem oil cake 50 kg + Leaf litter mulch + FYM 2 t ha⁻¹ + BF

Leafy vegetable crops

The bioinoculated leafy vegetable crops like spinach, methi and coriander in Godimala village of Pipili block in Puri district increased the productivity ranging from 7 to 12 per cent, yielding monetary benefit of Rs.12,400 to 14,300 ha⁻¹ against the investment of Rs.2000 on bioinoculation (Table 7) (Pattanayak, 2005).

Table 7: Influence of bioinoculation on leafy vegetable crops

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Crop</th>
<th>Biomass yield (t ha⁻¹)</th>
<th>Response (%)</th>
<th>BI Benefit (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Uninoculated</td>
<td>Bioinoculated (%)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Spinach</td>
<td>2.7</td>
<td>2.89</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>Methi</td>
<td>2.3</td>
<td>2.45</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>Coriander</td>
<td>2.35</td>
<td>2.64</td>
<td>12</td>
</tr>
</tbody>
</table>

Storage quality of potato

The storage experiment conducted for two months under room temperature with potato tubers produced with organic packages indicated that K/Na ratio controls rotting of potato. Decreasing concentration, hence lowering of uptake of K and increasing uptake of Na, increases potato rotting and vice-versa (Table 8) (Pattanayak, 2012).

Table 8: Rotting of potato tuber (kufri Jyoti) open storage produced out of organic treatments

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Organic sources</th>
<th>Rotting (%)</th>
<th>K/Na ratio (Uptake)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Control</td>
<td>44.1</td>
<td>5.2:1</td>
</tr>
<tr>
<td>2</td>
<td>FYM</td>
<td>39.7</td>
<td>5.8:1</td>
</tr>
<tr>
<td>3</td>
<td>BI</td>
<td>38.5</td>
<td>6.0:1</td>
</tr>
<tr>
<td>4</td>
<td>FYM+BI</td>
<td>36.9</td>
<td>7.0:1</td>
</tr>
</tbody>
</table>

Conclusion

Organic farming is no doubt a good proposition which is environmental friendly, but sole dependence on such practice is not at all possible, considering present day population. Definitely it will encourage organics addition in agriculture thereby better utilization of the wastes, efficient utilization of nutrients supplied through the wastes. It will help improving soil health for sustainable production. Specific crops should be brought under organic cultivation like, scented rice, some fruit crops, pine apple, papaya, etc. spices like ginger, turmeric etc. The kitchen garden concept should be prioritized to come under organic cultivation. There is no difference between organically grown crops and crops with balanced inorganic nutrients, rather imbalance nutrition create imbalance in the quality of the crop.

Way forward

- Organic zones are to be declared, so that the production area can be separated.
- Accordingly the crops are to be grown and product are to be certified.
- Price of the product should be fixed accordingly to make the system viable.
- Awareness has to be created for organic farmings where ever possible.
References


The development of indigenous technical knowledge (ITK) systems, including management of natural environment, has been a matter of survival to the people who generated these systems long back (George et al., 2000). Most ITKs were based on the local availability of material and human resources to ensure minimal livelihoods for local people. Such systems are cumulative, representing generations of experience, careful observations and trial and error experiments. However, with the pressing demands for higher yields to support the growing population a shift from the traditional farming system to intensive farming took place where application of synthetic pesticide has become a widely accepted method in pest control. Extensive use of high yielding varieties and agrochemicals like fertilizers and pesticides coupled with the multiple impacts of climate change has brought phenomenal changes in the crop – pest scenario in recent years (Patnaik, 2016).

Presently ETLs as criteria for management decisions increased the risk of economic losses because the sampling plans and decision criteria are not followed precisely for which pesticide applications are not made when they are needed. Therefore, development of new knowledge systems with emphasis on eco-friendly approaches and new IPM strategies are felt essential to prevent new pests or the intensification of the existing ones. It has now been established that the sustainability in crop production and protection can only be achieved by developing technologies that are based on locally available inputs that are easily acceptable and cost effective. The innovative ideas of farmers in solving technical problems by local resource managements are therefore, gaining importance in recent years (Patnaik, et al., 2014). Innovations based on traditional knowledge have also been emphasized by the National Innovation Foundation (NIF) and Department of Science & Technology, Govt. of India. The World Summit on Sustainable Development (WSSD) held at Johannesburg in South Africa during 2002 has strongly advocated the use of local technical knowledge in crop husbandry package (Anonymous, 2002).

The era of traditional approach existed much before we stepped into the era of pesticides and the era of IPM. The ITKs are usually based on three categories viz., (1) Cultural practices, (2) Physical and mechanical methods and (3) Use of botanicals. Since IPM is a knowledge-based, farmer driven management approach, education of farmers on alternatives to pesticides has been considered as a top priority and emphasis is now given to IPM as an important component of crop production systems to improve the profitability and environmental safety. Some traditional and modern knowledge in context with the above categories having relevance for adoption in IPM strategies are discussed below;

1. **Cultural practices:** These are prevention-based pest management systems which are followed to prevent, suppress, or eradicate the pest build-up by disrupting the normal relationship between the pest and the host plant and thus make the pest less likely to survive, grow, or reproduce. The practices like selection of healthy seeds of proper variety, timely planting, crop rotation, planting of trap crops, companion planting, and intercropping are widely experimented and practiced by the farmers. This often requires more effort, information and management attention than pesticide-based systems. But once growers learn the tricks to enhance the population of beneficial, and then the biointensive or ecologically based IPM systems become more cost-effective and reliable than chemical-intensive systems, and prove to be safer to both farmers as well as the surrounding environment. Some of the cultural practices that make crop protection cost effective and eco-friendly are cited below;
(a) Trap Cropping:

Trap cropping - a traditional tool of pest management was a common method of pest control for several cropping systems before the introduction of modern synthetic insecticides (Talekar and Shelton, 1993). However, trap cropping is more knowledge-intensive than many other forms of pest management. As a general guideline for trap cropping about 10% of the total crop area is planted with the trap crop (Hokkanen, 1991).

Examples of trap crops successfully utilized in India are Pigeonpea in cotton, Marigold/sorghum in tomato (Tomato: Marigold ratio 15:1); Castor/Sunflower in groundnut; Mustard in Cauliflower / Cabbage (1: 30 for early duration, 2: 25 for medium duration, 2: 20 for late duration). Crops like sorghum or pearl millet or maize around the main vegetable crop fields act as barrier against the entry of whiteflies and aphids (Iyyappan, 1994). Similarly, groundnut in uplands if intercropped with pigeonpea or cowpea prevents the leaf minor attack.

(b) Enhancing / Conserving natural enemies:

Proper enhancement of habitats ensuring the survival and development of natural enemies can augmentation their population. Growing diverse plant species or a variety of sequentially flowering species within or in nearby fields will provide natural enemies with nectar, pollen, and shelter throughout the growing season which concurrently enhances the natural enemy activity. In order to accomplish diversity it is suggested that in about 20% of the peripheral land can be utilized for trees like *Glyricidia sepium*, *Cassia auriculata*, Drumstick, Karanj, Neem, Jatropha etc. Fallow/unused land can be cropped with niger / sunflower / papaya / spineless mimosa. These crops can sustain the activity of both pollinators and beneficial arthropods. Certain trap crops also help in reducing insect pest populations by enhancing the natural enemies within the field. Examples of such practices that enhance or conserve natural enemies are cited below;

- Sorghum as a trap crop to manage cotton bollworm, *Helicoverpa armigera*, also increases rates of parasitism by *Trichogramma chilonis* (Virk, et al., 2004).
- Using molasses grasses as an intercrop with maize also increases the parasitism of stem borers by *Cotesia* spp (Khan and Pickett, 2004).
- The tribal farmers of north Odisha grow chickpea intercropped with either linseed or coriander and this practice has enabled them to manage *H. armigera* population appreciably. *H. armigera* population can be effectively managed in chickpea if intercropped with either linseed or coriander in 4:2 ratios (Reena, et al., 2009). Coriander in chickpea attracts the parasitoids like *Campoletis chlorideae*.
- Growing crops like sunflower/niger in unutilized fields surrounding the crop fields’ help to conserve natural enemies in situ as these crops provide shelter and food (nectar & pollen) to natural enemies.
- Sorghum / maize crop either surrounding pigeon pea fields or intercropped with pigeon pea encourages the birds to alight especially during the panicle stage of the sorghum. It helps to conserve natural enemies and serve as perches for predatory bird like Drongo, Blue jay, Myna.
- Ground cover and Wind breaks: Prevalence of dry weather conditions for a prolonged period may create dusty winds which can interfere with the activity of natural enemies and this may also cause outbreaks of spider mites. Thus, to reduce dust in the air growing of ground cover crops and windbreaks are also felt essential in recent years while planning the IPM in various crop ecosystems.

(c) Synchronous and Timely sowing or Planting

Timely sowing / planting of healthy and disease free seeds / seedlings / saplings or selecting resistant/tolerant crop varieties are essential practice to suppress the insect pests. This has been amply justified in various crops through field experiments across the country and a few examples are cited below;
Pluses:

- Chickpea, sown between second fortnight of October and 1st fortnight of November not only evades the outbreak of gram pod borer, *Helicoverpa armigera*, but also enhances the yield.
- Pigeon pea sown by mid-June escapes severe pod damage and ratooning of the crop should be avoided in pod fly and eriophyid mite prone areas.

Cereals:

- Completion of rice planting/sowing within two months in rice growing areas restricts yellow stem borer generations.
- Early planting or avoiding planting of old seedlings or use of low nitrogenous fertilizers or avoiding planting in shades of tall trees within the field - are the measures to prevent leaf folder incidence in rice.
- Avoiding late sowing and sowing in low lying rice fields can prevent cut worms, *S. mauritia*. Direct sown rice, mostly in the upland escaped the attack by cutworms.

Oil seeds:

- Early sowing of mustard (during first fortnight of October) of the short duration varieties under non irrigated conditions escapes the attack of aphid and the leaf webber in coastal districts of Odisha.
- Early sowing of *kharif* sesamum ie. during the first fortnight of June helps to escape the leaf webber infestation.

(d) Healthy crop husbandry practices to avoid insect incidence

- Plant material should be thoroughly inspected for insects like scales and mealy bugs, before being introduced.
- Growing azolla prevents the whorl maggot infestation in rice so its widespread adoption in whorl maggot prone area is essential.
- Avoid the severity of insect incidence: In rice fields draining out the standing water for 3 or 4 days, if possible can suppress insects like caseworm and BPH/WBPH.
- Avoid insecticides application during peak activity of the parasitoids.
- Avoiding excess nitrogenous fertilizers and irrigation can reduce the incidence of phloem-feeding pests such as aphids.
- Recognize and conserve spiders in crop ecosystems: Spiders constitute an essential portion of the predatory arthropods in several ecosystems (Chatterjee, *et al.*, 2009). In rice fields spiders constitute over 90% of the natural enemy population and played important role in suppressing the insect pests (Tanwar, *et al.*, 2011). Their predatory potency limits the exponential growth of pest populations in various ecosystems (Ghavami, 2008). Straw bundles are prepared with wheat straw measure about 90 cm in length and 25 cm in diameter. Both the ends of bundle are tied with plastic rope and the entire bundle is covered with a plastic net. The so prepared bundles are then placed in sorghum field for 15 days for charging with spiders before using them in rice. In rice, these bundles were fixed vertically with bamboo sticks after 15 days of rice transplanting @ 20 bundles/ha so that the lower portion of the bundle remained 15 cm above the water level.
(2) Physical or Mechanical control

It involves the mechanical removal of pests. For example, hand-picking the larvae and grubs, removing eggs from the tips of the leaves by pinching off the terminal portion, creating flames with bonfires etc. Certain local practices and traps / baits prepared indigenously using locally available resource are found most suited for suppression of insect pests and rodents. A few examples are cited below;

- **Helicoverpa control in chickpea**: Tribal women in northern Odisha collect tender terminal leaves during early vegetative stage of chickpea crop which they use for culinary purpose and also they get some income by selling them in local market. It has been observed that irrespective of sowing dates and varieties, *Helicoverpa* preferred the 2nd and 3rd leaf for oviposition on chickpea (Patnaik and Senapati, 2002) and the practice of nipping tender leaves as followed by the tribal women help to reduce the *Helicoverpa* menace considerably as most eggs of the pest is removed through nipping in the early stage of the crop.

- **Pod borer control in pigeon pea**: In pigeonpea at pod initiation stage, when 1-2 larvae per plant are noticed, shake the plants gently with a polyethylene sheet below the crop canopy. This gentle shaking can dislodge most of the caterpillars (85-97%) from the plants.

- **Birds control larval stages of insects**: In chickpea, it has been reported that a small flocks of 3 to 13 cattle egrets can consume 4 to 37 larvae per sq.meter (Patnaik, et al., 1995). Since, the birds are potent predators of larval stages of insects, erection of bird perches @ 25/ha facilitate predation of insects. In paddy fields erection of bird perches attracts Black Drongo bird which exclusively feeds on adult moths of yellow stem borer and leaf folder. A wooden log or a branch bifurcated at the top provided with an earthen container filled with water mixed with cooked rice attracts the birds.

In cabbage / cauliflower, removal of leaves with early instar *Spodoptera* larvae can suppress its incidence appreciably as these larvae after hatching from eggs habitually congregate below a leaf surface and feed on chlorophyll content of the leaf before migrating to other plants. A routine check of such infested leaves during early stage of the crop and their removal will be the most cost effective mechanical control of *Spodoptera*.

- **Bait for Rats**: Boil 10 kg of wheat seeds in water with two large pieces of the bark from the *Gliricidia* tree. Then use the boiled wheat seeds in the field or in stores where rat menace exist. *Gliricidia* is a rat killer as it contains coumarin which gets converted to anticoagulant dicoumerol by bacterial fermentation. This reduces the protein Prothrombin to cause death in rats due to internal bleeding.

**Other methods to prevent rat**

- Fruits of *Mucuna pruriens* Back (Fam: Papilionaceae) are kept in the active rat burrows. When the rodent enters into the hole, it collides against the hairy fruits with irritating hairs and leaf the spot with irritation.

- A mixture containing 90% crushed sesame or g.nut or niger with 5% thick sugar crystals and 5% powdered fused electric bulb or tube light is placed in a bowl near rat holes and when rats feed this mixtures they die within a week.

- Inserting 10 – 12 inches long fresh pieces of stem of Jatropha plant into active rat holes makes the field rat free (Kanojia, et al., 2005).

- To prevent rats from climbing coconut trees, a large palm leaf is split along its mid rib; one set of leaflets is wrapped around the trunk below the crown and the other set is wrapped in the opposite direction.
Trapping insects with Indigenous Techniques

**Trapping rhinoceros beetles (RB) of coconut:** A mud pot with three quarters of it is to be filled with water and to this 250 g of powdered castor cake is added. The pot is then buried in the soil with its mouth in level with the soil. The smell of the cake attracts the beetles which fall into the water. Just 3-5 such pots in one hectare of plantation can clear beetles from the coconut garden. Slices of pine apple are also used to attract RB. In a cylindrical plastic container 2 slices of pineapple are taken and an exit hole is made to allow the rain water to drain. The trap is hung near the crown of the coconut tree. The beetles are attracted to wards the pineapple and get trapped.

**Trapping red palm weevil (RPW) of coconut:** The mid rib of coconut leaf is cut into small pieces and crushed, place it in an earthen pot either with 1 lit of water 100 g jaggery and 10 g tobacco powder or with sugarcane molasses 2½ kg or toddy 2½ litres + acetic acid 5 ml + yeast 5 g. Another pot with hole at its bottom is placed over it. This arrangement is made at 3-4 corners of the coconut orchard to attract and trap the beetles. The mixture of jaggery, tobacco and water is to be added once in a month in case the above bait is choosen.

**Trapping fruit flies:** Fruit fly (*Dacus dorsalis* and *D. cucurbitae*) incidence is normally seen in mango and cucurbits. A low-cost fruit fly trap to combat this insect pest can be made as per the following procedure;

(a) 20 g of *Ocimum sanctum* (holy basil) leaves are crushed and the extract along with the crushed leaves are placed inside a coconut shell, which is then filled with 100 ml water. To increase the keeping quality of the extract, 0.5 g citric acid is added and the extract is then poisoned by mixing 0.5 g carbofuran 3G. The traps are suspended from mango tree branches at a rate of 4 traps per tree. The fruit flies feed on the ocimum extract and are killed.

Make a trap using a 2-liter disposable water bottle: Two holes at a height of 5cm from the bottom of bottle are made and for hanging the trap, use a string which is pushed through a hole drilled in the centre of the cap from inside. The attractant mixture for fruit flies is then prepared by mixing 1 cup of vinegar, 2 cups of water and 1 tablespoon of honey and shakes this well before use. Fill the trap with this mixture up to the level of holes and hang the container about 5 feet high. Flies will enter the container and fall into the attractant.

**Trapping sucking insect pests:** Bright yellow sticky traps are used for monitoring/controlling aphids, thrips and whiteflies. While, bright blue traps can exclusively be used for monitoring thrips and bright white sticky traps for flea beetles (Bissdorf, 2008). Set up sticky traps for monitoring whitefly, thrips etc. @ 10 traps per ha. Locally available empty tins or disposable plastic glasses can be painted yellow / coated with white grease / vaseline / castor oil (see picture). Place traps near the plants, preferably 25 cm away from the plant to ensure that the leaves will not stick to the board, but not facing direct sunlight. Position the traps at 50-75 cm above the plants. Alternatively, yellow water pan traps also proved useful for simple population counts of alate aphids based upon which insecticidal control can be initiated.

**Trapping gundhi bugs in rice:** Dead crabs, frogs or even pieces of jackfruit (*Artocarpus heterophyllas*) are tied to bamboo sticks and are place in rice fields before milky stage. This will attract gundhi bugs and keep them busy till the dough stage is over. Farmer’s of Ranchi (Jharkhand) burn discarded rubber tyre which attracts gundhi bugs (Kispota, et al., 2003).

**Trapping blister beetles:** Blue containers, filled with water with little detergent are claimed to attract blister beetles.

**Trapping Slugs in Kitchen garden:** Set the rinds of grapes with a little pulp left inside with upside down (like an igloo-style) in kitchen garden. The slugs will hide underneath the grapefruit and die.

(3) **Use of botanicals:** Botanicals are readily available than commercial products as they grow in the local environment. So, timely control of pests can be initiated with locally available botanicals for which the farmers need not pay. Moreover, they are safer to use and are more flexible in their usage than commercial synthetics. Reviving and modernizing the age-old farmer practice through optimization of ethnobotanicals has shown that farmers are more comfortable using plant
materials than commercial synthetics and those botanicals can offer a similar level of control when certain guidelines are followed to their use (Belmain, 2002). Most plants have shown to possess either pesticidal or antifeedant activity and extracts showing antifeedant effect are more successful in practical application as they evoke some behavioral response in insects (Jermy, 1990). A few plant extracts display bimodal activity i.e. at high concentration they act as feeding deterrent and at low concentrations as growth inhibitors (Nawrot, et al., 1991). The ITKs’ for crop protection are based on preparation of aqueous extracts or decoctions or fermented products of different botanicals either alone or with animal dung or urine (Prakash and Rao, 1997, Vijayalaxmi et al., 1999). Cow urine diluted with water in ratio of 1: 20 is not only effective in the management of pathogens and insects, but also acts as a growth promoter of crops. A few traditional practices as in vogue or attempted to validate through field experiments in Odisha are cited below;

- Traditionally the farmers of Odisha (more specifically in districts of Mayurbhanj, Keonjhar, and Nabarangapur, Chhattisgarh and Jharkhand, incorporate the leaves of karra or Karada (in Odia), Cleistanthus collinus (Euphorbiaceae) in rice fields (about 50-60twigs of 4-5 feet long / acre or 10 kg leaves are required for 1000m²) twice i.e. at transplanting and tillering stage. The leaves of this plant are known to possess insecticidal properties and in rice it is reported to control insects like leaf folder, gallfly and caseworm (Prasad, 2003; Ahirwar, et al., 2011).

- A pot mixture or popularly called as pot medicine (“Handi Aushodha” in Odia) is recently being in use by the rice farmers of western Odisha. This is prepared by mixing cow urine (5lit), jaggery (50g), fresh cow dung (1kg), karanj leaves (1kg), neem leaves (1kg) and calotropis leaves (1kg) in a pot and this mixture is kept for a week to get a fermented. After fermentation, the surface liquid is utilized for spraying the crop @ 15-20 ml/litre of water. The farmers suppress insect pests like yellow stem borer, leaf folder and case worm incidence in rice.

The cow urine decoctions of botanicals have been reported as effective against the various insect pests without any detrimental effect on their natural enemies (Poonam, 2003; Gupta, 2005). However, a few research workers observed that tulsi extract (2%) was most harmful for coccinellids and reduced their population by 32.14% which was followed by neem seed and lemon grass (21.24%) in rice ecosystem (Firake, et al., 2010). Earlier, Rao et al. (2005) also indicated that dhatura (1%) extract was more harmful than neem oil (1%) for coccinellids. So, there is a need to examine such findings in experiments with botanicals in order to evolve recommendations compatible with natural enemies.

**Botanicals having scope for use against insect pests**

**Coriander (Coriandrum sativum) for spider mite control:** It acts as a repellent and the extract is prepared by boiling about 200 grams of crush coriander seeds in 1 liter of water for 10 minutes. This extract is diluted with 2 liters of water and sprayed early in the morning on infested plant parts to control spider mites (Bissdorf, 2008).

**Five-leaved Chaste tree or Monk’s Pepper (Vitex negundo; Verbenaceae):** This plant is reported to possess insecticidal activity against stored product insects, mosquito larvae, houseflies and tobacco leaf eating caterpillar (Hebbalkar, et al., 1992). A decoction is prepared by first soaking 2kg leaves for overnight in 5 liters of water and then this is boiled for 30 minutes. After filtering the decoction, 10 liters of water and 10ml soap are added for spraying the crops. This controls diamond back moth of cabbage/cauliflower, hairy caterpillars, rice leaf folder, rice stem borer and semilooper (Bissdorf, 2008).

**Milk weed or Giant weed, Calotropis spp. (Arakha in Oida):** Several indigenous practices using the leaves of *Calotropis* plant have been indicated by Srivastava, et al. (2006). According to the above authors, *Calotropis procera* leaf extract used @ 15% and 20% solution for the dipping of sugarcane sets was found effective in controlling termite (*Odontotermes obesus* Rambur). Besides, the leaves can also be preserved in big earthen pot filled with water for two weeks and can be used @ 0.5 l / fruit tree to control termites. The leaves should be replaced at 2 months interval adding water intermittently to adjust the initial volume.
(4) Use of Milk and Butter Milk for Pest Control

Research evidences showed that cow’s milk acts as an excellent sticker and spreader due to presence of casein protein. It can be used at 10% aqueous suspension for effectively controlling powdery mildew. Milk sprays induced systematically acquired resistance in chilli against leaf curl, a viral disease (Arun Kumar et al., 2002).

In some parts of central India fermented curd water (butter milk) is used for the management of white fly, jassids aphids etc. Studies showed that when about 10 L of buttermilk is fermented for 2 days in a closed earthen pot and sprayed on okra after diluting with water (1 L fermented solution mixed with 9 L water) it effectively controlled whiteflies (Karthikeyan, et al., 2006).

(5) Use of Ash for Pest Control

Ash provides phosphorus for plants and also acts as a physical poison causing abrasion on insect’s body cuticle and the insect dies due to desiccation. A thick layer of ash is either spread on the soil around plants or sprinkled on foliage to protect it against a variety of pests. Besides acting as a physical poison ash on crop foliage interferes in the chemical signals emanating from the host plants thus obstructing the initial host location by pests. The treated foliage further becomes unpalatable for foliage feeders like cutworms, caterpillars, grasshoppers, etc. Examples of traditional use of ash as evident from the available literature are cited below;

- Field experiment conducted at Bhubaneswar indicated that application of ash @50kg/ha + kerosene5% and spinosad 45SC generated maximum benefit cost ratio of 4.8:1in brinjal (Sakhinetipalli, 2012).
- Rice seedlings raised in nursery beds amply sprinkled with ash grow healthy and tolerate pest attack subsequently in the main field.

(6) Use of Kerosene for Pest Control: The use of Kerosene-soap-water emulsion has earlier been reported as a contact insecticide for piercing and sucking insects (Jex-Blake, 1950). Similarly, the usefulness of this emulsion against scale insects, bugs, mites, aphids and leaf miners has been documented by Van der Werf (1985). Oparaek, et al. (2006) reported the effectiveness of SABRUKA (a mixture of soap, water and kerosene) against insect pests of cowpea in the northern Guinea Savanna. Kerosene exhibits phytotoxicity at higher concentrations and therefore, its use as foliar spray should be restricted up to 1 or 2%. Moreover, as kerosene is readily available with the farmers it can be used with soap instantly to suppress the insect pests at the beginning of outbreak situation and subsequently the desired/recommended strategies may be followed.

Indian farming, is steadily and progressively adopting the ways and means of pest management for sustainable agriculture (Dhandapani et al., 2003). As per the National Agricultural Policy “IPM and use of biotic agents, in order to minimize the indiscriminate and injudicious use of chemical pesticides will be the cardinal principle covering plant protection”. In this context adoption of ITK based crop protection measures as an alternative to pesticides might help in restoring the biodiversity of natural enemies. However, there is a need to create opportunities for educating the farmers on alternatives to pesticides.

References


Insect Pests and Disease Management in Organic farming systems

Rajasekara Rao Korada*, Namashya Mishra and AksimaPriyadarshini

Principal Scientist & Borlaug Fellow*,
ICAR-Central Tuber Crops Research Institute,
Regional Centre, Bhubaneswar, Odisha 751019, India.

Pests and diseases are generally not a significant problem in organic systems, since healthy plants living in good soil with balanced nutrition are better able to resist insect pests and disease attack. However, major insect pest and disease damage is sometimes seen in organic crops, which are very susceptible to damage. Insect Pest and disease problems can be particularly severe in large holdings, where several hectares of a single crop species may be grown. Insect Pest and disease control strategies in organic farming systems are mainly preventative rather than curative. Organic farming tends to tolerate some pest and disease populations while taking a longer-term approach. Organic pest and disease control involves the cumulative effect of many techniques, including allowing for an acceptable level of pest and disease damage, encouraging predatory beneficial insects to control pests, encouraging beneficial microorganisms and insects, choosing disease-resistant varieties, planting companion crops that discourage or divert pests, using row covers to protect crops during pest migration periods, using pest regulating plants and organic or biological pesticides (insecticides, fungicides, weedicides), rotating crops to different locations from year to year to interrupt pest/disease reproduction cycles, using insect traps and pheromone traps to monitor and control insect populations that cause damage as well as transmit viral diseases.

Managing the ecosystem on an organic farm is very challenging. It is made even more complex when factoring in insect and disease pests. Since the use of synthetic pesticides is prohibited, the organic cropping systems should be focused on the prevention of pest outbreaks rather than coping with them after they occur. No single method is likely to be adequate for all pests. Successful pest management depends on the incorporation of a number of control strategies. Some strategies will target insect and diseases separately and others will target them together. Organically managing insect and disease pests is in principle removing pesticides from the Integrated Pest management, by definition (IPM minus pesticides). Any outbreak or resurgence can be tackled by pesticides as last resort in normal agriculture, but in organic farming systems, managing the insect pests and diseases not to cross Economic threshold levels (ETLs) is very difficult, and requires, comprehensive and well-studied insect pest and disease management programmes. Management of the insect pests and diseases, involves, very robust and sound insect pest and disease monitoring system, pest forecasting and simulation models, insect growth models, pest degree day thresholds, strong bio-ecology studies, chemical ecology, sound knowledge on pest/pathogen-host plant-beneficial organisms (predators, pathogens, microbes etc) interactions.

The farmers in north eastern region of India, manage the insect pests and diseases of rice, colocasia, sweet potatoes, and some vegetables in complete organic way. Sex pheromones are one of the best monitoring and management methods for insect pests. Pheromones are successfully tested and used in Rice against rice stem borer (Scirpophagaiuncertulas), groundnut, vegetables, fruits (Spodopteralitura, Helicoverpaarmigera), crucifers (Diamond backed moth, Plutellaxylostella) etc. Botanical pesticides though, have short periods of action against insect pests, but do not leave any residues on crops. Entomopathogens are most powerful agents in limiting the insect and disease management programmes. Entomopathogenic fungi, Beauveriabassiana, Metarrihizhiumanisopliae, and entomopathogenic nematodes, Steinernemacarpocapsae, Heterorhabditisindica, are mostly suitable in all organic farms in kharif season or in any season, provided sufficient soil moisture is available in fields.
Success story: Sex pheromone Technology to manage Sweet potato weevil in Dhenkanal, Odisha

In Odisha, farmers in Dhenkanal sex pheromones for managing the most important insect pest of sweet potato, ie. Sweet potato weevil (SPW), *Cylas formicarius*. Farmers in this district of Odisha, successfully managed the sweet potato weevil using 10 sex pheromone traps/ha in an area of 500 ha in the last three years. In a crop like sweet potato, SPW is the single most serious pest that causes 60 to 90% tuber damage if pest management strategies are not adopted in time. Sex pheromone technology was the single most organic way of pest management against *C. formicarius* in sweet potato. These sex pheromones are easy to use, cheaper than any other pest management techniques, and long lasting unlike chemical pesticides. Each pheromone trap (lure + plastic box) costs Rs. 25 (cost per ha is Rs. 250) and works for entire duration of the sweet potato, ie. 100-120 days, suitable to use in all climates and temperatures (10°C to 50°C wherever the crop is grown). These sex pheromone traps, lures and kill male sweet potato weevils in an area of 900 to 1000 sq.m of the crop. The pheromone traps, start attracting male sweet potato weevils within 5 to 10 minutes of trap installation in field, and continue to trap day and night upto 120 days, thus preventing the mating with females, resulting in 50% weevil population in a span of one week. Within a period of 30-40 days, all generation males will get trapped and killed thus leaving only females in the crop. These female weevils cannot enter the tubers as, farmers practice earthing-up of the crop at the base of the plant, which is the entry point of the female sweet potato weevils. As no pesticides are used in sweet potato when pheromone traps are used, the crop ecology favours build up several pathogens, beneficial insects that feed on the weevils including migratory birds. By using sex pheromone technology in sweet potato, the farmers in Dhenkanal district could able to manage the SPW upto 90% and harvested 90% SPW-infestation free tubers, thus enhancing the marketable value. Sex pheromone technology was widely tested across different states of India, and is most promising, single best method to manage the sweet potato weevils, fits in all organic farming systems.

The yield reduction, sometimes, in organic farms in other crops is compensated by reduction in pesticide usage, reduced or no food contamination with pesticides, no pesticide residues in crops, lessening environment (air, soil and water) contamination, and no or lessening labour involvement in pesticide sprays and several innumerable benefits which are only qualitative and have countless advantages which is difficult to quantified.
Disease Management in Organic Farming

P. Srinivas

Central Horticultural Experiment Station (ICAR-IIHR),
Aiginia, Bhubaneswar -751019, Odisha

Organic Farming is recognised globally as a priority area in view of the growing concerns on environmental pollution due to increased awareness about the fallouts of the indiscriminate use of agro-chemicals. Demand for safe and healthy food has been increasing with every passing day. The ill effects of plant protection chemicals on the flora, fauna, humans and environment as a whole are the major concerns. Though the use of chemical inputs in agriculture is inevitable to contain dreaded pests and meet the growing demand for food in a populous nation like India, there are opportunities in selected high value fruit and vegetable crops where organic production can be encouraged to meet the domestic and export demand for fresh fruit and vegetables. There are several non-chemical environmentally techniques which can be prudently and strategically incorporated in a well crafted organic production technology module for specific crops. Modification in cultural practices, mechanical destruction of source of inoculum, clean cultivation use of organic amendment and bio-fumigation, developing pesticides of organic origin, encouraging natural biological agents, use of cover and trap crops, use of heat treatment, cold temperature, solar energy etc. can be conveniently used to manage disease incidence below economic injury level. Some of such technologies are discussed briefly in this script.

Introduction

Disease management is an essential component of the commercial farming. Disease tends to reduce the potential production levels of a crop as per its time of incidence and intensity. The disease management interventions need to be taken up at different stages of cultivation of a given crop. The management differs with crop, type of pathogen, source of inoculum, season of cultivation, stage of infection, plant part affected, number of generations of pathogen in a crop cycle, and several other factors. The disease management options and specific recommendations, hence, vary accordingly. Past century has seen development of a number of fungicides and other chemical based pesticides to manage other plant pathogens. Unjustified overuse of chemical pesticides to control various insect pests and diseases over the years has decimated many naturally occurring effective antagonistic microorganisms. Slowly the fight back from the pathogens was evident from the emergence of pesticide resistant strains in the agricultural ecosystems. The scientists realised that the pathogens tend to modify their genetic profiles under heavy pressure of plant protection chemicals. Scientists changed the strategy from ‘pest control’ to ‘pest management’. However, past couple of decades has seen increasing awareness among the farmers and consumers about the futility of some of the highly poisonous chemicals in disease management and their collateral hazards to environment due to their indiscriminate application. Though safer chemicals are being produced in recent times, the stake holders now want to revert to the natural pesticide-free farming based on the organic principles. Managing the ecosystem on an organic farm is very challenging. Most management practices are long-term activities that aim at preventing diseases occurrence, maintenance of biological diversity and improving soil health. Organic cropping system focuses more on the prevention of disease outbreaks rather than managing them after they occur. It advocates dealing with the causes of a disease problem rather than treating the symptoms of the diseases after their occurrence. Further, more than one strategy may be needed for tackling a single pathogen or a group of pathogens and a single set of interventions can target a variety of pathogens. There have been two excellent reviews recently dealing with disease management under organic farming (van Bruggen et al., 2016; van Bruggen and Finckh, 2016) useful for further reading in this regard.
Disease management strategies in organic farming

Occurrence of a disease requires a balanced interaction of host, pathogen, and environment. The disease management strategies under organic farming aim to disrupt this balance and disallow the pathogen to cause disease beyond economic injury level. Pathogens need suitable environmental conditions like humidity, temperature, moisture, host exudates etc to germinate, survive and infect. In absence of these pathogens cannot survive and perish. Most of the strategies described below interfere with the micro-environmental conditions to make them ungenial for pathogen propagation, multiplication and initiating infection. Further majority of these strategies are specific to particular disease in a crop and hence a combination of strategies based on the crop growth stages and disease cycle need to be integrated as a module for a crop in a particular agro-climatic region.

1. Growing disease resistant varieties: For low external input organic farming, resistant crops represent an important alternative to pesticides. Exploiting the diversity and variability in the host genetic constitution for resistance against a pathogen in a crop is the best strategy for disease management without application of hazardous pesticides. It can individually restrict the incidence of a particular disease in a crop. Successful disease establishment depends on the compatible gene for gene interaction between a host and a pathogen. Resistant varieties tend to remain disease free for a long period of time owing to morphological manifestation of their genetic constitution in form of leaf and stem toughness, time of maturity, nutrient content, plant architecture, growth habit which can deter growth of pathogen, their reproduction and host preference. Care need to be taken to include more than one resistant variety in a region to dissipate selection pressure on the pathogen. However this strategy is very specific and tends to tackle only one or two diseases at a time owing to its resistance.

2. Exclusion of pathogen: Preventing the potent and viable disease propagules to interact with the host results in reduction in disease incidence. Use of disease-free seeds and planting material would prevent seed borne disease, management of vectors, and in situ destruction of soil borne pathogens through soil solarisation or Anaerobic soil disinfestations (ASD) involves the incorporation of fresh organic material in moist soil under airtight plastic for 3–6 weeks, depending on the outside temperature (van Bruggen et al., 2016; Khulbe, 2000).

3. Application of organic amendments: Soils with low microbial diversity promote establishment of plant pathogenic organisms. Healthy soil is the mainstay of organic agriculture. Improved soil biological activity is known to play a key role in suppressing weeds, pests and diseases (IFOAM, 1998). Improving soil health through use of cover crops, green manures, animal manures to fertilize the soil not only helps in restricting soil borne pathogens but also maximizes biological activity and maintains long-term soil health. Application of composts and organic amendments tends to increase quantity and diversity of soil microbial diversity and consecutive disease suppressiveness. Organic amendments are biodegradable and are generally available on the farmer’s fields. Neem cake used for soil amendment @ 0.25 to 0.5 t/ha contributes significantly in control of nematodes and soil borne pathogens. Soils rich in organic matter are high on soil biodiversity with abundance of beneficial soil microorganisms.

4. Cultural control: Cultural control is more like habit of good agricultural practices, which promotes healthy soils and healthy plants. From choosing the date of planting to field sanitation and weed management, the specific cultural measures reduce the initial load of inoculum and favourable conditions for growth of pathogens. Rotations can also be designed to minimize the spread of weeds, pests and diseases. Litterick et al. (2002) opined that pest control strategies in organic farming systems are mainly preventive rather than curative. The management of cropped and un-cropped areas, crop species and variety choice and the temporal and spatial pattern of the crop rotations is actually aimed to reduce interaction between susceptible host and virulent pathogen while maintaining a diverse population of beneficial organisms in the field. The development and implementation of well-designed crop rotations is central to the success of organic production systems (Stockdale et al., 2000). However, crop rotation can be ineffective if the pathogen is long-lived in the soil with a wide host range. Ensuring good drainage
is essential for disease management. Poor drainage in the fields not only reduces general health of the plant but also allows the pathogen to multiply rapidly. Many pathogens can survive on debris and weeds. Tilling and cleaning of plant residue at the end of the season allows break down of the organic matter, leaving potential pathogens without a host. Moderate fertilization induces steady growth and makes a plant less vulnerable to infection.

5. **Orchard bio-intensification**: The orchard bio-intensification concept envisages habitat modification for beneficial organisms, development of healthy and biologically active soils, maintaining uncultivated lands for diversity of flora and fauna, developing entomophage parks within orchard for food and shelter to diverse beneficial insects, weed strips, hedge rows, wind breaks, inter crops and conservation of insect bio diversity (Singh and Srinivas, 2016).

6. **Physical methods**: Soil solarisation of nursery beds reduces soil borne inoculum. Hot water/steam treatment of seeds/planting material has been successful in many crops (Cohen *et al*., 2005). Post harvest hot water treatment of mango fruits was able to reduce the incidence of anthracnose (Srinivas *et al*., 2012).

7. **Botanicals, essential oils, baking soda, butter milk etc**: Spraying of neem oil, cow urine, *panchgavya*, and fermented butter milk are some of the most predominant methods of controlling pests and diseases by the organic farmers in India. Several researches indicate that application of many plant extracts may reduce incidence of foliar diseases. Application of horticultural grade oils has also proven to reduce disease incidence in many crops. Baking soda has been used to control mildew and rust diseases on plants. Application during hot weather and may though lead to possible phytotoxic effects. Butter milk sprays have been popular against blights, mildew, mosaic viruses and other fungal and viral diseases. Application of soft soap solutions and neem oil against viral vectors like aphids and other sucking insects is also effective. Cow dung ferments like ‘*Amrit-Paan*’ are widely used by organic farmers for enhancing crop growth and disease management. Such fermented solutions are known to have high bacterial population of cellulose degraders, nitrogen fixers, P-solubilizers, plant growth promoters and antagonists of disease-causing fungi (Venkateswarlu *et al*., 2008).

8. **Application of biocontrol agents**: Microbial bio-control agents isolated from native environments are relatively safe, host specific and do not disturb other biotic systems (Srinivas and Ramakrishna, 2005). They are ideal for both short and long term pest suppression and are also compatible with most other control methods. Their mechanisms of action include competition, antagonism, antibiosis, enhanced nutrient uptake, induction of host resistance (Kloepper *et al*., 1997) etc. Unlike chemical pesticides, they are harmless to humans and other non-target organisms, they do not leave chemical residues on crops, are easy and safe to dispose of and do not contaminate water systems. Commercial bio-fungicides are containing beneficial living organisms are can be locally produced and used for pest management in Organic farming. These are available as powders for seed treatments, as granulars for soil application, and as suspensions for root drenches and foliar sprays. Biological control agents like *Trichoderma* spp, *Pseudomonas* spp and *Bacillus* spp. have proven their worth in managing a range of plant diseases. Some of them have also shown to promote plant growth too.

9. **Application of mineral based fungicides**: Prophylactic sprays of Sulphur are mostly used against plant diseases like powdery mildew, downy mildew and other diseases by preventing spore germination. Copper based fungicides and Bordeaux mixture (Copper sulphate and lime) have been successfully used on fruits, vegetables and ornamentals. Unlike sulphur, Bordeaux mixture is both fungicidal and bactericidal. It is effective against diseases such as leaf spots caused by bacteria or fungi, powdery mildew, downy mildew and various anthracnose pathogens. The ability of Bordeaux mixture to persist through rains and to adhere to plants is one reason it has been so effective. Copper hydroxide and copper oxychloride are accepted in organic farming provided that the number of applications is moderated to prevent copper accumulation in the soil.
Mango under organic mode of cultivation at CHES (ICAR-IIHR), Bhubaneswar

Cultivation of mango (cv mallika) under organic mode at Central Horticultural Experiment Station (ICAR-IIHR) in Bhubaneswar, indicates that there no significant variation in growth pattern of the trees grown in organic system compared to the trees grown using chemical fertilizers. In the experiment different levels of farm yard manure viz., 5 kg, 7.5 kg and 10 kg per plant were provided in different treatment plots. The dosage of the manure was increased by 100 percent of the initial FYM dosage every year. Positive and negative control plots were maintained with recommended dosage of fertilizer (RDF) and no fertilizer, respectively.

Mango orchards are the permanent ecosystems, akin to forest ecosystems, with certain human interventions. However the pest population is not in equilibrium in orchard ecosystems as observed in undisturbed forests. However such natural balance is disturbed in the orchard ecology due to regular cultivation practices especially application of chemical pesticide. Several pests and diseases occur in the organic plots similar to the non-organic plots. However the options for pest management in these plots are limited. Major emphasis is give in bio-intensification of orchards, application of mineral based fungicides, and application of botanicals. For management of foliar leaf spots and anthracnose in leaves and fruits, application of copper based fungicide is done based on the observations of field scouting. The downy mildew disease affecting the inflorescence is managed by application of sulphur based fungicides with prescribed precautions. Field sanitation, proper plant architecture, and application of enriched organic amendment are the mainstay of disease management in the organic mango cultivation. Further, for long term sustainable pest and disease management there is a need to strike a balance for appropriation of various interventions for suppression of pests, which can be achieved through orchard bio-intensification (Singh and Srinivas, 2016).

Disease management in tree crops grown in organic conditions is a challenging task due to limited and unproven options available. Higher powdery mildew and black mildew severity was observed in case of organically grown plants compared to control plants probably due to luxurious growth in the former (Srinivas and Singh, 2011). Different combinations of ecofriendly disease management options were evaluated for their efficiency against powdery mildew and red rust in mango (cv mallika) orchard under organic mode of cultivation at the Station. Treatments viz. Milk (10%), Vermiwash (10%), Cow urine (10%), Neem oil (0.2%). Sulphur (2g/l), and their combinations were imposed in mango plants grown in two nutrient levels (5 kg and 7.5 kg farm yard manure first year basis). The dosage of the manure was increased by 100 percent of the initial FYM dosage every year. Two control treatments of spray with plain water and no spray were also maintained. The disease score of powdery mildew was found to be least in case of the treatments with sulphur and neem oil, while highest disease was observed in treatments with milk and plain water. Incidence of the red rust was least in treatments with sulphur, neem oil and control plots.

There was a marked difference in the incidence of powdery mildew disease among the treatments. The 10 kg treatment plot was relatively free (37.7% incidence) from the powdery mildew disease followed by the negative control plot (34.4% incidence). In contrast highest disease powdery mildew incidence was observed in positive control plots (87.0% incidence) closely followed by 5kg and 7.5kg plots with 76.8% and 76.3% disease incidence. Though it was interesting to note that there was comparatively low and delayed flowering in 10kg and control plots, which also had lower powdery mildew incidence (Srinivas et al., 2010). Further the 5kg, 7.5kg and RDF plots contained more trees with inflorescence with higher coverage of the powdery mildew fungus (60% and more area of inflorescence). Based on the data of first three years of experimentation it is concluded that there is no significant negative effect of organic mode of cultivation in the major growth parameters and powdery mildew incidence.

Post harvest losses in mangoes in majority of cultivars due to fruit fly, anthracnose and Non-uniform ripening continue to be a concern in major mango growing area of Odisha (Srinivas et al. 2012). Fruit damage due to post harvest diseases in mangoes needs to be minimised to increase the marketability of the harvested mangoes to minimise revenue loss and heavy damage to mango exports within the state. Hot water treatment has been well known method to minimise post harvest losses due to pest and diseases. In a study, different combinations of temperature and fungicidal treatments
were evaluated for their effect in reducing post harvest fruit diseases in the cv. Amrapali, which covers the maximum mango growing area in Odisha. Among twelve treatments imposed, hot water treatment (HWT) in solution of Bavistin (1 gm/lit.) at 52°C for 10 min. (0%) was found to be the best treatment with least anthracnose symptoms, followed by Bavistin (1 gm/lit.) HWT at 46°C for 1hr. (2.5%), HWT at 56°C for 3 min. (4%) and HWT 52°C for 10 min. (5%) after twelve days of treatment. No incidence of stem end rot (SER) was found in the HWT 52°C for 10 min. treatment, HWT with Bavistin (1 gm/lit.) at 46°C for 1hr. and HWT 56°C for 3 min. Effect of treatments on fruit quality parameters were also recorded, which indicated no significant adverse effect of treatments (Srinivas et al., 2012).

References:


Use of farmyard manure/compost, crop rotation, legume inclusion, fallowing and other crop husbandry/management practices were the major strategy for maintenance of soil fertility and land productivity in the pre-green revolution era. Global agriculture noticed revolutionary changes after the second world war. There was dramatic increase in cereal grain production, especially of wheat, rice and maize, in several developing countries viz. India, Mexico, Pakistan, Philippines, Sri Lanka, China, Afghanistan, Indonesia, Iran, Kenya, Malaysia, Morocco, Thailand, Tunisia and Turkey. The change was designated as ‘Green revolution’ in 1968 by William Goud, the then Director of United States Agency for International Development(USAID). The revolution began with initiation of research on wheat by Dr Norman E. Borlaug in 1944 in Mexico. Dr Borlaug termed the 20-year research period from 1944 to 1964 as ‘Silent revolution’. Dwarfing(Gibberellins biosynthesis) genes of wheat(Norin 10B) and rice(Dee-geo-woo-gen) were transferred to traditional tall types during this period to develop varieties with short stature. Growing of these varieties in conjunction with assured irrigation, chemical fertilizers, plant protection chemicals and agricultural machinery made many countries self-reliant in food grain production and proved the prediction of Thomas Malthus wrong who in 1798 predicted serious famine in the world because of imbalance between population and their ability to produce food. Green revolution had many positive effects and reduced many risks in farming. Simultaneously, it has many negative impacts also. The important ones include salinity, alkalinity and water logging, low water table, topsoil erosion, nutrient deficiencies, low organic carbon, chemical toxicities, residues, tolerance and resurgence of pests, pollution of atmosphere, groundwater contamination, regional disparity, class-class disparity, the decline of family farms, continued neglect of the living and working environment for farm labourers, illness/injury/casualty of farm workers due to over exposure and mishandling of agro chemicals, increase in cost of production and the disintegration of economic and social fabric of rural communities. To counteract these ill effects, movement for ‘organic farming’ and ‘sustainable agriculture’ are gaining momentum within mainstream of agriculture. This movement aims at not only addressing these environmental and social issues, but also providing innovative and economically viable opportunities to producers, processors, market forces, consumers, labourers, planners.

**Organic farming**

The term organic farming was coined by Lord Northbourne in his book ‘Look to the Land’ (written in 1939, published 1940). He considered “the farm as organism” and described a holistic, ecologically balanced approach to farming. Organic farming is variously described as organic agriculture, nature farming, ecological farming, holistic farming, biological farming, regenerative farming etc. It is not a technology, but a system of agriculture which is close to nature.

**Goals of organic farming**

The goals of organic farming has been defined by International Federation of Organic Agriculture Movements (IFOAM).

1. Organic farming is a production system that sustains the health of soils, ecosystems and people.

2. Organic farming relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects.

3. Organic farming combines tradition, innovation and science to benefit the shared environment and promotes fair relationships and a good quality of life for all involved.
Principles of organic farming

According to IFOAM, organic farming is based on four principles.

1. Health – Healthy soil, plants, animals, humans = a healthy planet
2. Ecology – Emulating and sustaining natural systems
3. Fairness – Equity, respect and justice for all living things
4. Care - For the generations to come

Cropping system

Pattern of crops taken up on a given piece of land or order in which crops are cultivated on a piece of land over a fixed period and their interaction with farm resources (land, labour, capital, water and other agricultural requirements), other farm enterprises and available technology which determine their make-up.

Classification of cropping System

Based on available resources and technology, cropping system is broadly divided into two groups i.e. mono-cropping and multiple cropping. Multiple cropping is further divided into two sub-groups namely intercropping and sequence cropping. There are five types of intercropping systems viz. mixed cropping, strip cropping, row intercropping, relay intercropping and multi-storey/tier intercropping. Sequence cropping is of two types i.e. double/triple/quadruple cropping and ratoon cropping.

Organic farming in cropping systems

In organic farming concept, the farm is regarded as one organism. In a system, a group of interacting, interrelated, or interdependent elements form a complex whole. In cropping system, the component crops of the system are inter-related and interacting. In organic farming, nutrient management is not done for individual crops, rather, the soil is managed for the whole cropping system. The benefits of integration of organic sources in integrated nutrient management of rice based cropping systems have given below.

Integrated nutrient management in Rice+pigeonpea(5 : 2) intercropping

Behera et al. (2009) and Behera et al. (2012) studied performance of pigeon pea+rice (2 : 5) intercropping system for six years during 2001-2006 under various weather environment. Application of organic manures improved physic-chemical properties of soil and sustained productivity of intercropping system comprising both cereal and legume components over years in spite of adverse weather (Table 1). Integrated nutrient management ensured higher productivity, profitability, sustainability and better soil quality in Kandhamal district of Odisha. Application of only inorganic fertilizer affected growth and yield of legume component. Application of only organic could not meet stage-wise demand of the cereal component. The treatment comprising 20 kg/ha N from FYM and 25 kg/ha N from chemical fertilizer gave mean maximum rice equivalent yield of 3.73 t/ha over years as against 3.13 t/ha in chemical fertilizer alone and 3.21 t/ha with green leaf manure alone. The system gave the maximum rice equivalent yield of 4.18 t/ha during the driest year 2002 as compared to 2.80 t/ha in 2001 (wet year), 3.04 t/ha in 2003 (normal year), 2.53 t/ha in 2004 (normal year), 2.55 t/ha in 2005 (wet year) and 3.86 t/ha in 2006 (wet year).

Table 1. Rice equivalent yield(t/ha) and sustainability yield index(SYI) in pigeon pea + rice intercropping as influenced by various nutrient management practices during 2001–2006
Field experiments were conducted at Phulbani, Odisha for 5 years during 2002-03 to 2006-07 to find out appropriate integrated nutrient management practice for yam+maize (1:2) intercropping system under rainfed condition to achieve higher system productivity, profitability and sustainability. Yam (100% population) and maize (45% population) received nutrient dose of 80 kg N+26.2 kg P+66.7 kg K and 36 kg N+7.9 kg P+15 kg K ha⁻¹, respectively. Nutrient sources included various proportions of chemical fertilizer (CF), FYM or green leaf (GL). Integrated nutrient management practices influenced yield of both yam and maize significantly during all the years. Over seasons, integration of 50% chemical fertilizer with 50% N as FYM proved significantly better than all other nutrient management practices and registered maize green cob yield of 3.81 t ha⁻¹, yam tuber yield of 8.81 t ha⁻¹ and yam tuber equivalent yield of 10.97 t ha⁻¹ and benefit:cost ratio of 1.30. This was followed by 50% chemical fertilizer+50% N as greenleaf with maize green cob yield of 3.45 t ha⁻¹, yam tuber yield of 8.35 t ha⁻¹, yam tuber equivalent yield of 10.27 t ha⁻¹ and benefit:cost ratio of 1.21. Both the INM practices were equally and highly sustainable with SI value of 0.57. After five years of experimentation, INM practices and Farmers’ Practice of FYM only recorded higher organic carbon content and available P in soil as compared to application of chemical fertilizer only. Application 50% chemical fertilizer (40 kg N+13.1 kg P+33.3 kg K and 18 kg N+3.9 kg P+7.5 kg K ha⁻¹ for yam and maize, respectively) coupled with 50% N as FYM (11.6 t ha⁻¹) or greenleaf (Glyricidia leaves @ 14.5 t ha⁻¹) may be recommended for sustained higher productivity and profitability of yam+maize (1:2) intercropping system under rainfed conditions (Behera et al., 2004).
Effect of organic inputs on production and quality of scented rice

Bora et al. (2014) reported that application of different treatment significantly increased the grain yield. Among the different treatment application of enriched compost @ 2.5 t/ha recorded the highest grain yield (2.45 t/ha) and it also enhanced the other quality parameters of the grain. The organic inputs as a whole improved the quality parameters and economics of scented rice (var. Keteki joha). However, no significant differences were observed in quality parameters viz. length and breadth of grain, L/B ratio, protein content and aroma (concentration of 2-acetyl-1-pyrroline). The net return was highest in case of green manure @ 2.5 t/ha + azolla duel cropping @ 0.5 t/ha but among different organic inputs benefit cost ratio was found to be highest in green manuring @ 5t/ha due to low cost of the inputs (Table 2).

Table 2. Effect of organic inputs on production and quality of scented rice

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Length (mm)</th>
<th>Breadth (mm)</th>
<th>L/B Ratio</th>
<th>Protein content(%)</th>
<th>Concentration of 2-acetyl-1-pyrroline (ppm)</th>
<th>Grain yield(t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>8.32</td>
<td>2.56</td>
<td>3.25</td>
<td>8.812</td>
<td>3.28</td>
<td>1.83</td>
</tr>
<tr>
<td>FYM @ 10 t/ha</td>
<td>8.35</td>
<td>2.61</td>
<td>3.20</td>
<td>9.314</td>
<td>3.48</td>
<td>2.09</td>
</tr>
<tr>
<td>Green manuring (Sesbania rostrata) @ 5 t/ha</td>
<td>8.33</td>
<td>2.57</td>
<td>3.24</td>
<td>8.938</td>
<td>3.32</td>
<td>2.02</td>
</tr>
<tr>
<td>Vermicompost @ 2.5 t/ha</td>
<td>8.36</td>
<td>2.61</td>
<td>3.20</td>
<td>9.439</td>
<td>3.50</td>
<td>2.18</td>
</tr>
<tr>
<td>enriched compost @ 2.5 t/ha</td>
<td>8.38/</td>
<td>2.62</td>
<td>3.20</td>
<td>9.625</td>
<td>3.52</td>
<td>2.45</td>
</tr>
<tr>
<td>Biofertilizer (Azospirillum+ PSB) @ 3.5 kg/ha each as seedling root dip + FYM @ 5 t/ha</td>
<td>8.34</td>
<td>2.58</td>
<td>3.23</td>
<td>9.126</td>
<td>3.42</td>
<td>2.08</td>
</tr>
<tr>
<td>Green manure @ 2.5 t/ha + azolla dual cropping @ 0.5 t/ha</td>
<td>8.34</td>
<td>2.33</td>
<td>3.68</td>
<td>9.063</td>
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Green manuring in lowland rice

While reviewing works on green manuring in lowland rice, Selvi et al. (2005) concluded in no case substituted entirely the chemical N indicating the essentiality of integration of fertiliser N with green manures. Sesbania aculeata and S. rostrata were predominantly grown for organic manuring in rice. Among the green manures, S. aculeata and S. speciosa exhibited higher organic carbon content with wider C-N ratio than S. rostrata. Green manure contains two N fractions. One which decomposes immediately after incorporation is named as ‘Fast N’ and the other which decomposes slowly over several years as ‘Slow N’. With most of the green manures, ‘Fast N’ accounts for 50-80 per cent of total N. During the first crop period 65 per cent of the green manure decomposes and it is 14 per cent in the next crop. It was found that incorporation of young green manure ensured adequate mineralisation of N and the optimum
age for incorporation is 45 days. *S. aculeata* adds more biomass in shorter period than *S. rostrata* and it was also not necessary to allow any decomposition period to dainchhl before planting. *S. cannabina* and *S. restrata* are found to be more promising in soils with low P levels. *Sesbania rostrata* seemed to be sensitive to high pH whereas, *S. aculeata* can be grown in soils which are saline and also found promising in reclamation of the soil. From the review, it could be concluded that daincha is a most appropriate green manure crop for low land rice.

**Effect of organic and conventional farming on growth, yield and grain quality of scented rice and soil fertility**

Quyen and Sharma (2003) reported grain yield of rice increased significantly with increasing rate of fertilizer application only up to 60 kg N + 13 kg P + 17 kg K ha⁻¹. The effect of 10 t ha⁻¹ farmyard manure (FYM) was found to be similar to 60 kg N + 13 kg P + 17 kg K ha⁻¹, whereas the effect of *Sesbania* green manuring (SGM) was similar to 120 kg N + 26 kg P + 34 kg K ha⁻¹. Inoculation of BGA (Blue green algae) with FYM or SGM had no additional advantage over FYM or SGM alone. The highest yield (5.2 t/ha) of rice was obtained when FYM + SGM + BGA + PSB (Pseudomonas striata) were applied together. The yield obtained with this combination was significantly more than that obtained with 180 kg N + 39 kg P + 51 kg K ha⁻¹. A similar trend was observed in N, P, and K uptake of rice. Inorganic nutrients had no significant effect on grain quality parameters like head rice recovery (HRR), kernel length (KL), kernel breadth (KB) and KL : KB ratio, whereas organic manures and biofertilizers resulted in an increase in HRR, KL and KL : KB ratio. A combination of FYM + SGM + BGA + PSB also resulted in highest organic C and available N content in soil and thus holds a promise for sustainable production.

**Organic farming of rice (*Oryza sativa* L.) - wheat (*Triticum aestivum* L.) cropping system**

While reviewing the works on Organic farming of rice (*Oryza sativa* L.) - wheat (*Triticum aestivum* L.) cropping system, Ram et al. (2011) concluded sustainability problem caused by factor productivity decline due to indiscriminate use of chemical fertilizers and pesticides in rice-wheat cropping system can be solved with production of the cropping system under organic farming. Organic farming enhances soil organic carbon, available phosphorus content and microbial population enzymatic activity of soil thus making it sustainable for organic crop production. Use of different organic amendments in combinations and in a cumulative manner can meet the nutrient requirement of organic rice and wheat in rice-wheat cropping system. The main weed control strategies used in organic farming of rice-wheat cropping system is often combine cultural or husbandry techniques with direct mechanical and thermal methods. Pests are generally not a significant problem in organic system, since healthy plants living in good soil with balanced nutrition are better able to resist pest and disease attack. However, commercial production of biopesticides containing different bacteria, fungi and viruses has been undertaken to control certain insects, pests and diseases in organic crop production systems. Owing to positive influence of organic components in rice-wheat cropping system, it is therefore, be assumed that those farmers who adopted organic management practices, found a way to improve the quality of their soil, or at least stemmed the deterioration ensuring productive capacity for future generations.

**Weed management in in rice organic agriculture**

Dhanapal (2017) concluded that despite the serious threat which weeds offer to organic crop production, relatively little attention has so far been paid to research on weed management in organic agriculture, an issue that is often approached from a reductionist perspective. Compared with conventional agriculture, in organic agriculture the effects of cultural practices (e.g. fertilization and direct weed control) on crop: weed interactions usually manifest themselves more slowly. It follows that weed management should be tackled in an extended time domain and needs deep integration with the other cultural practices, aiming to optimize the whole cropping system rather than weed control. In this respect, cover crop management is an important issue because of its implications for soil, nutrient, pest and weed...
management. It is stressed that direct (physical) weed control can only be successful where preventive and cultural weed management is applied to reduce weed emergence (e.g. through appropriate choice of crop sequence, tillage, smother/cover crops) and improve crop competitive ability (e.g. through appropriate choice of crop genotype, sowing/planting pattern and fertilization strategy). Problem of weeds can be minimized by adopting right and integrated organic weed management approach’s which, helps in reducing the competition by weeds without any adverse effect on yield, quality of produce and soil/ ecosystem.

References


Bora, D., Goswami, J., Saud, R.K.and Begum1, M. Effect of organic inputs on production and quality of scented rice (Oryza Sativa) variety keteki joha in Assam and its economic aspect. Agricultural Science Digest 34 (2) : 115 – 118


Conservation Agriculture-One step closer to sustainability

Pravat Kumar Roul\textsuperscript{1} and Aliza Pradhan\textsuperscript{2}

\textsuperscript{1}Orissa University of Agriculture & Technology, Bhubaneswar
\textsuperscript{2}M S Swaminathan Research Foundation, Chennai

The need for a sustainable cropping system

More than 50 years after the start of the Green Revolution, increasing population growth in many developing countries continues to make achieving food security a challenge. There appears to be no alternative but to increase agricultural productivity to meet future food demand and to alleviate poverty and hunger. However, agricultural intensification to increase crop production has had negative effects on natural resources such as surface and ground water pollution, sinking of ground water levels, water logging and salinization of irrigated land, soil erosion, increasing pest resistance and resurgence, loss of biodiversity and ecosystem services. These negative effects are especially pronounced in marginal crop production areas, where intensification practices have sometimes failed to sustainably increase crop yields. This realization has shifted the agricultural movement towards sustainable crop intensification that optimizes productivity while conserving and even enhancing natural resources. Even though an increased food supply is integral to eliminating hunger, malnutrition and poverty, it alone cannot solve the problem. It is perhaps more important that we ensure people have access to the technology, knowledge and purchasing power necessary to produce the food they need. Of the developing world’s 5.5 billion people, 3 billion (nearly half of the entire world’s population of 7 billion) live in rural areas. Of these rural inhabitants, an estimated 2.5 billion are in households involved in agriculture, and 1.5 billion of these are in smallholder households (World Bank, 2008). Poor farmers need low-cost and readily available technologies and practices to increase both local food production and their income.

In India specifically, there are several other key issues besides poverty and malnutrition. One of the most pressing is the limited future for expansion of irrigated areas. Even though India’s agricultural growth has been sufficient to move the country from the severe food crises of the 1960s to aggregate food surpluses today, most of the increase in agricultural output over the years has taken place under irrigated conditions. However, opportunities for continued expansion of irrigated areas are limited due to unsatisfactory performances of formal large canal systems, the massive public investment required in building the infrastructure of efficient irrigated systems, corruption in the construction process, and acknowledgement of the environmental impacts of irrigation projects (FAO, 2009). Thus, future productivity increases must largely come from rainfed agriculture. Despite a historic bias towards irrigated agriculture in terms of research and infrastructure development, rainfed agriculture has always been an important part of the agricultural sector. Rainfed agriculture in India currently accounts for about two-thirds of the total cropped area and nearly half of the total value of agricultural output. Nearly half of all food grains are grown under rainfed conditions, and hundreds of millions of the rural poor depend on rainfed agriculture as the primary source of their livelihoods. This is a major concern because nearly 20\% of an estimated 450 million smallholders operating farms of less than 2 ha in size worldwide are in India (Nagayets, 2005). However, farming without the aid of irrigation leaves farmers vulnerable to erratic or unpredictable rainfall, creating risk and yield uncertainty.

Under India’s current rainfall pattern, most rain occurs during a few months as part of the monsoonal cycle. These rain events tend to be intense with strong erosive force. At the same time, agricultural land is often open to unrestricted grazing during the prolonged dry season. This leaves little plant cover making fields highly vulnerable to accelerated erosion, especially on sloping lands. As a result, crops fail, yield becomes uncertain, and relative land productivity decreases, ultimately affecting livelihoods of many poor and marginalized farmers.
This precarious food situation is especially dangerous in a country such as India, in which 260 million people live below the poverty line (Ansari and Akhtar, 2012). Of these, 75% live in rural areas and are totally dependent on agriculture and produce much of what they eat. Small land holdings and their low productivity, along with uncertainties in rainfall patterns, increases economic and social risks for these farmers. This increased risk reduces their capacity and willingness to make investments in the farm system improvements associated with the Green Revolution, such as purchasing improved crop variety seeds, labour-saving equipment like tractors, and fertilizers. With degraded soils and unreliable weather patterns, return on investment is uncertain and likely to be much lower overall than under irrigated conditions with better soils.

Under such conditions, a sustainable cropping system such as conservation agriculture is the one that helps in reversing soil degradation and improving crop production as well as socio-economic condition of the smallholder farmers.

**Definition and description of conservation agriculture**

Conservation agriculture (CA) strategies and practices have been developed and promoted to reduce risk and improve natural resource conditions, as well as address the combination of low yields, production risks and poor natural resource conditions. According to the United Nations Food and Agriculture Organization (FAO), CA is an approach to managing agro-ecosystems for improved and sustained productivity, increased profits and food security while preserving and enhancing the resource base and the environment. It is based on enhancing natural biological and ecological processes above and below ground. Interventions such as mechanical soil tillage are reduced to an absolute minimum, and the use of external inputs such as agrochemicals and nutrients of mineral or organic origin are applied at an optimum level and in a way and quantity that does not interfere with or disrupt biological processes (FAO, 2008). Conservation agriculture is characterized by three linked principles, namely:

1. Continuous no or minimal mechanical soil disturbance (i.e. no-tillage and direct sowing or broadcasting of crop seeds or direct placing of planting material in the soil; minimum soil disturbance from cultivation, harvest operation or farm traffic);
2. Permanent organic soil cover, especially from crop residues and cover crops;
3. Diversified crop rotations in case of annual crops or association of plants in case of perennial crops, including a balanced mix of legume and non-legume crops.

While CA principles are universal, implementation must obviously be adapted to local agro-ecological conditions and farmer capabilities and preferences. Currently, CA is being practiced on over 105 million ha world-wide with some farms practicing it for 30 years and more (Friedrich et al., 2012). CA has been reported to reduce production costs, increase water use efficiency and improve yields (FAO, 2009; Thierfelder and wall, 2010). Since improved crop varieties are generally compatible with CA practices, long-term yields in CA systems are comparable with conventional intensive tillage systems (FAO, 2011). The loss of tillage to reduce weed presence and aerate soil is offset by improved soil quality. With reduced tillage and higher organic soil cover, soil structure and structural integrity increase, resulting in higher water infiltration and thus, lower runoff and erosion (Six et al., 2004; Bronick and Lal, 2005). Increased soil organic matter improves soil water- and nutrient-holding capacity, and water and nutrient use efficiency, increasing the capture and availability of these resources, and increasing the efficiency of crop fertilizer uptake (Lal, 2002). Crop rotations and diversification reduce nutrient depletion and break up pest and disease cycles, improving overall crop and soil health (Denef and Six, 2005). These improvements in various production factors result in long-term yield increases. In areas where the actual yield levels of tillage-based systems are low compared to the genetic and agro-ecological potential of the crops, the changeover to CA often results in yield increases even in the short-term (Vogel, 1993). Thus, ideally CA achieves sustainable crop intensification by improving natural resource quality and reducing farmers’ risks.
Conservation agriculture systems also tend to be better suited for smallholder and resource-poor farmers. Labour requirements are reduced by about 50% as the generally male-driven heavy work of soil tillage is reduced. This also reduces the need for heavy machinery and implements to turn the soil (Bishop-Sambrook, 2003) which is particularly appropriate for resource poor farmers living on sloping hills. The labour savings can then be devoted to other tasks, including off-farm employment. Crop diversification with intercropping and rotation helps in improving nutritional security of the farm families and reduces the risk of total crop failure in unfavourable or erratic weather. Increased water and nutrient use efficiencies reduce the need and thus costs for irrigation and fertilizers. Better crop health reduces the need for pesticides. Thus, there should be long-term benefits to food security and agricultural income for farmers and rural communities.

Conservation agriculture is thus best conceptualized as an integrated production system that is universally applicable. However, depending on the variability of agro-ecological environments, cropping systems, and farmer capacities and preferences, location specific production systems should be adapted to achieve sustainable crop production.

References


Climate change is reality. It is considered as the biggest environmental threat in human history and the defining human challenges in twenty first century. Consequences of climate change are already felt throughout the earth system. The current change in global climate is a phenomenon that is largely due to the burning of fossil energy (coal, oil, natural gas) and to the mineralization of organic matter as a result of land use. These processes have been caused by mankind’s exploitation of fossil resources, clearing of natural vegetation and use of these soils for arable cropping.

These activities have primarily led to a measurable increase in the carbon dioxide ($CO_2$) content of the atmosphere, an increase which results in global warming, as $CO_2$ hinders the reflection of sunlight back into space, and thus more of it is trapped in the Earth’s atmosphere. Molecules of methane ($CH_4$) and nitrous oxide ($N_2O$) have a similar, but far greater effect: the global warming potential of methane is twenty five times that of $CO_2$ while that of nitrous dioxide is as much as 300 times greater. IPCC has published greenhouse gas emissions classified by different sectors as shown in figure 1. When calculating the climate impact of a certain production type it is always a question, where to put the cut-off points of a particular system. For instance, agricultural emissions as shown in figure 1 do not comprise emissions from fertilizer production, which are counted under ‘industry’. This needs to be taken into account when comparing farming systems. When considering the total food chain from the farm to the consumer, emissions from all the other sectors need to be included. Thus, the greenhouse gas emissions from all sectors related to agriculture may potentially sum up to 25-30% of all GHG emissions.

Fig. 1: Main sources of greenhouse gas emissions in the agricultural sector in 2005 (Smith et al., 2007)

As per the fifth assessment report of the Intergovernmental panel of climate change the atmospheric $CO_2$ concentration has already crossed 400ppm, methane concentration has increased from 800 to 1800ppb and the $N_2O$ concentration has increased from 270 to 320 ppb. Increasing concentration of such GHGs are not new, but the rate of change in the recent past (1.3% during 1970-2000 where as 2.2% during 2000-2010) poses a serious threat contributing a lot to the global warming (IPCC, 2014). Agriculture is not only affected by climate change but also contributes to it. Ten to twelve
percent of global greenhouse gas emissions are due to human food production. In addition, intensive agriculture has led to deforestation, overgrazing and widespread use of practices that result in soil degradation. These changes in land use along with agriculture and forestry (AFOLU) responsible for around 25% to the global climate change. An account of GHG emissions from different sector and the emissions from various sub sectors of agriculture in India is illustrated in Fig.2. Sustainable agriculture and food supply systems are thus more urgently needed than ever before. They must boost the capacity of agricultural production to adapt to more unpredictable and extreme weather conditions such as droughts and floods, reduce greenhouse gas emissions in primary food production and halt or reverse carbon losses in soils. Organic agriculture is claimed to be the most sustainable approach in food production. It emphasizes recycling techniques and low external input and high output strategies. It is based on enhancing soil fertility and diversity at all levels and makes soils less susceptible to erosion.

Fig.2. Greenhouse gas emissions from a. different sectors and b. various sub sectors of agriculture in India

“Organic farming as holistic food production management system, which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity. It emphasizes the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems. This is accomplished by using, where possible, agronomic, biological and mechanical methods, as opposed to using synthetic materials, to fulfil any specific function within the system”. Organic farming is not only a specific agricultural production system, it is also a systemic and encompassing approach to sustainable livelihoods in general, where due account is given to relevant factors of influence for sustainable development and vulnerability, be this on physical, economic, or socio-cultural levels (Eyhorn, 2007).

Challenges addressed by organic farming

The main organic strategies are diversification and an increase of soil organic matter, which both could enhance resilience against extreme weather events. Organic farming avoids nutrient exploitation and increases soil organic matter content, hence soils under organic farming capture and store more water than soils under conventional cultivation. Production in organic farming systems is thus less prone to extreme weather conditions, such as drought, flooding, and water logging. Organic farming accordingly addresses key consequences of climate change, namely increased occurrence of extreme weather events, increased water stress and drought, and problems related to soil quality (IPCC 2007a).

- Organic farming comprises highly diverse farming systems and thus increases the diversity of income sources and the flexibility to cope with adverse effects of climate change and variability, such as changed rainfall patterns. This leads to higher economic and ecological stability through optimized ecological balance and risk-spreading.
Organic farming is a low-risk farming strategy with reduced input costs, therefore, lower risks with partial or total crop failure due to extreme weather events or changed conditions in the wake of climate change and variability (Eyhorn 2007). As such, it is a viable alternative for poor farmers, because of lower input costs and higher sale prices. The coping capacity of the farms is increased and the risk of indebtedness is lowered. Risk management, risk-reduction strategies, and economic diversification to build resilience are also prominent aspects of adaptation, as mentioned in the Bali Action Plan (UNFCCC 2007).

By its nature, organic farming is an adaptation strategy that can be targeted at improving the livelihoods of rural populations and those parts of societies that are especially vulnerable to the adverse effects of climate change and variability (Eyhorn 2007).

By its systemic character, Organic farming is an integrative approach to adaptation, with potential to “eradicate extreme poverty” and “ensure environmental sustainability” (the United Nations Millennium Development goals). The pivotal role organic farming plays in achievement of these and the challenges climate change poses to this task are widely acknowledged.

Agriculture as a contributor to climate change

Agriculture is the main emitter of nitrous oxides and methane according to current practice and knowledge.

Emissions of nitrous oxide originate mainly from:

- high soluble nitrogen levels in the soil from synthetic and organic nitrogen sources (fertilizers).
- animal housing and manure management.

The main sources of methane emissions are:

- enteric fermentation by ruminants (e.g. cows, sheep, goats).
- anaerobic turnover in rice paddies.
- manure handling.
- compaction of soils resulting from the use of heavy machinery.
- biomass burning, e.g. from slash-and-burn agriculture, emits both methane and nitrous oxide.

Mitigation potential of organic farming

Agriculture can help to mitigate climate change by a) reducing emissions of greenhouse gases (GHGs) and b) by sequestering CO$_2$ from the atmosphere in the soil. The potential of organic agriculture for both effects is high,

Reduction of GHG emission

The first is achieved through:

- Lower N$_2$O emissions (due to lower nitrogen input)—it is usually assumed that 1–2 percent of the nitrogen applied to farming systems is emitted as N$_2$O, irrespective of the form of the nitrogen input. The default value currently used by the IPCC is 1.25 percent, but newer research finds considerably lower values, such as for semi-arid areas (Barton et al. 2008).
- Less CO$_2$ emissions through erosion (due to better soil structure and more plant cover)—there usually is less erosion in organic farming systems than in conventional ones.
- Lower CO$_2$ emissions from farming system inputs (pesticides and fertilizers produced using fossil fuel).
Methane accounts for about 14% of the greenhouse gas emissions (Barker et al., 2007). Two-thirds of this is of anthropogenic origin and mainly from agriculture. Methane emissions stem to a large extent from enteric fermentation and manure management and in consequence are directly proportional to livestock numbers. Avoidance of methane emissions of anthropogenic origin and especially of agricultural origin is of particular importance for mitigation. Organic agriculture has an important, though not always superior, impact on reduction as livestock numbers are limited in organic farms (Olesen et al., 2006).

Composting and biogas production are often suggested as measures for mitigating climate change. In the context of climate change, the benefits of aerobic fermentation of manure by means of composting are ambiguous, as a shift from anaerobic to aerobic storage of manure can reduce methane emissions, but will increase emissions of nitrous oxide by a factor of 10 (Kotschi and Müller-Sämann 2004). A very promising option, however, is controlled anaerobic digestion of manure and waste combined with biogas production. While this option is not restricted to organic production methods, organic agriculture has been at the forefront of bio-gas production systems for decades. Attention must be paid however to the economic viability of biogas production systems.

**Carbon sequestration**

Arable cropland and permanent pastures lose soil carbon through mineralization, erosion (water and wind-driven) and overgrazing. Global arable land loss is estimated at 12 million ha per year, which is 0.8% of the global cropland area (1513 million hectares) (Pimentel et al., 1995). If agricultural practices remain unchanged, the loss of organic carbon in typical arable soils will continue and eventually reach a new steady state at a low level. The application of improved agricultural techniques (e.g. organic farming, conservation tillage, agro forestry), however, stops soil erosion (Bellamy et al., 2005) and converts carbon losses into gains. Consequently, considerable amounts of CO$_2$ may be removed from the atmosphere.

Organic land management may help to stop soil erosion and convert carbon losses into gains (Reganold et al., 1987), particularly due to:

- the use of green and animal manure.
- soil fertility-conserving crop rotations with intercropping and cover cropping.
- composting techniques.

Agro forestry is a management system that integrates perennial and annual crops in a two-canopy or multi-canopy production system. This guarantees better exploitation of light, water and soil nutrients and protects soil more effectively from erosion and leaching. It leads to a more diversified and sustainable production system than many treeless alternatives and provides increased social, economic and environmental benefits for land users (Sanchez et al. in Kotschi and Müller-Sämann, 2004). In the humid tropics, agro forestry is seen as viable alternative to slash-and-burn agriculture.

The CO$_2$ sequestration potential of agro forestry in the short and medium term is mainly above ground. The additional carbon in the standing vegetation may increase by 50 tonnes per hectare; in the soil by an additional 7 tonnes per hectare. These increases were measured 20 to 25 years after recultivation of previously cleared forests. (Palm et al., 2000, cited in Kotschi and Müller-Sämann, 2004).

**Benefits of organic farming**

The benefits of organic farming regarding climate change can be summarized as follows:

- Organic agriculture has considerable potential for reducing emissions of greenhouse gases.
- Organic agriculture in general requires less fossil fuel per hectare and kg of produce due to the avoidance of
synthetic fertilizers. Organic agriculture aims at improving soil fertility and nitrogen supply by using leguminous crops, crop residues and cover crops.

- The enhanced soil fertility leads to a stabilization of soil organic matter and in many cases to a sequestration of carbon dioxide into the soils.
- This in turn increases the soil’s water retention capacity, thus contributing to better adaptation of organic agriculture under unpredictable climatic conditions with higher temperatures and uncertain precipitation levels. Organic production methods emphasizing soil carbon retention are most likely to withstand climatic challenges particularly in those countries most vulnerable to increased climate change. Soil erosion, an important source of CO2 losses, is effectively reduced by organic agriculture.
- Enhances biological diversity within the whole system and increase soil biological activity
- Organic agriculture can contribute substantially to agro forestry production systems.
- Organic systems are highly adaptive to climate change due to the application of traditional skills and farmers’ knowledge, soil fertility-building techniques and a high degree of diversity.

Organic agriculture is so far the most promising approach for mitigation and adaptation to climate change. Organic agriculture represents a positive example of how farmers can help mitigate climate change and adapt to its predictable and unpredictable impacts. It can serve as a benchmark for allocating development resources to climate change adaptation, or to measure progress in implementing climate-related multilateral environmental agreements.

References


Value Addition In Organic Produce

Kalpana Rayaguru and Sanjaya K Dash

Department of Agricultural Processing and Food Engineering
College of Agricultural Engineering and Technology
Orissa University Agriculture and Technology Bhubaneswar-751003, India
E-mail: rayagurukalpana@yahoo.com

Organic products are grown under a system of agriculture without the use of chemical fertilizers and pesticides with an environmentally and socially responsible approach. This is a method of farming that works at grass root level to preserve the reproductive and regenerative capacity of the soil, plant nutrition, and soil management, to produce nutrient rich food. Literature indicates that India’s rank in terms of world’s organic agricultural land was 15 in 2013. The total area under organic certification was 5.71 million Hectare (2015-16). This includes 26% cultivable area with 1.49 million Hectare and rest 74% (4.22 million Hectare) forest and wild area for collection of minor forest produces. India produced around 1.35 million MT (2015-16) of certified organic products which included all varieties of food products namely Sugarcane, Oil Seeds, Cereals and Millets, Cotton, Pulses, Medicinal Plants, Tea, Fruits, Spices, Dry Fruits, Vegetables, Coffee etc. The total volume of export during 2015-16 was 263687 MT. The organic food export realization was around 298 million USD. Organic products are exported to European Union, US, Canada, Switzerland, Korea, Australia, New Zealand, South East Asian countries, Middle East, South Africa etc. Oil seeds (50%) lead among the products exported followed by processed food products (25%), Cereals and Millets (17%), Tea (2%), Pulses (2%), Spices (1%), Dry fruits (1%), and others.

Organic Food

Organic farming is a combination of techniques to build up soil fertility for sustainable production, mainly using local, natural resources and with least external inputs. Production and protection of crops mainly depend on indigenous wisdom combined with latest scientific techniques such as bio control and microbial fertilizers. Organic farming aims not only at sustained productivity, but also at safe and nutritious food, which is increasingly demanded by conscious consumers within and outside India. Organic foods are minimally processed without the use of toxic and synthetic pesticides and fertilizers, genetic engineering, antibiotics, synthetic growth hormones, artificial flavors, colors, preservatives, sewage sludge and artificial ingredients and maintain the integrity of the product that began with practices on the farm. For example, the use of GMOs, irradiation is prohibited during the production and processing of certified organic products. A rigorous certification process, including periodic testing, is required. Organic food must be processed to make sure the organic ingredients are not co-mingled or contaminated with non-organic materials while ensuring animal welfare and environmental sustainability. Australia, North America, Europe are the leading processors of organic food and upcoming leading processors are China, Brazil and India. Sales of organic products are steadily increasing, and so is organic production in low and middle income countries. Important factors for global market growth are growing health-consciousness, support of governments for organic farm conversion, organic research, marketing, and consumer information campaign. There is an ever growing export market for organic products, and also the domestic market in India is emerging. Products that are certified and sold as organic can fetch a premium price compared with conventional products. Therefore, it is an opportunity for farmers to increase their income and manage their land in a more sustainable way. Getting the produce from the field to the market in an organic form requires standardized steps to be followed. Organic standards clearly define the allowed and prohibited production and processing methods.
Organic Food Processing

Food processing is the treatment of a food substance to change its properties with the intention of preserving it, improving its quality, or making it functionally more useful. Food processing regulations are very specific for each food and/or process. A grain, fruit or vegetable is considered “processed” as soon as the protective outer layer of the skin or husk is broken. Packaging of processed animal as food, pasteurizing milk and making cheese from raw milk is governed by food processing regulations. Processing or handling includes cooking, baking, curing, heating, drying, mixing, grinding, churning, separating, distilling, extracting, slaughtering, cutting, fermenting, eviscerating, preserving, dehydrating, freezing, chilling, or otherwise manufacturing, packaging, canning, jarring, or otherwise enclosing food in a container. Both the ingredients and the facility where the food is processed must be certified organic. This means that buildings where ingredients are stored, equipment, product packaging, and storage areas used for final products must meet the national standards specified by NOP requirements. Certified organic food avoids artificial colorants and extracts caramel brown colors from organic sugar cane and one from organic rice. Organic processors desiring orange color are using carrot and pumpkin juice concentrates.

Unlike other eco-labels, the organic label is backed by a set of rigorous production and processing standards. These standards require that products be grown, processed and ingredients used in organic products must originate from organic farms. There are a few exceptions to these rules for organic processors, the ingredients essential to processed products that can’t be produced organically, like baking soda, and certain vitamins and minerals and non-toxic sanitizers. But all of the substances on the list are required to fulfill three critical criteria: 1) Not be harmful to human health or the environment; 2) Be necessary to production because of unavailability of natural or organic alternatives, and 3) Be consistent with organic principles. National organic standards set out the methods, practices and substances used in producing and handling crops, livestock and processed agricultural products. The standards include a list of approved synthetic and prohibited non-synthetic substances, not only for organic production but also for organic processing. The list is not a static one and is reevaluated to ensure emergence of new information for any natural or organic alternative. In 2008 the synthetics added include a sanitizer in processing facilities used only for secondary and indirect food contact, a cheese wax used for organic mushroom production, a mite control product for organic honey production. Substances like bleached lecithin, unmodified rice starch and dozens of synthetic substances no longer allowed. Recent requirement is to use organic yeast in certified products for human consumption. These standards are developed through a transparent process providing traceability from the farm to the consumer, ensuring that the consumers can have confidence in the organic products they buy.

Organic food is the most heavily regulated and closely monitored food system. Organic producers and processors also are subjected to rigorous announced and unannounced certification inspections by third-party inspectors to ensure that they are producing and processing organic products that consumers can trust and should not be confused with ‘natural’ which does not mean organic and comes with no guarantees. The organic processing system has to take caution with tracking the products ingredients and keep highly detailed records of how the food or beverage is processed. Also, food processing equipment has to be extremely easy to clean if plants are switching between organic and non-organic products. Some of the left over ingredients that would be banned in organic-labeled products could still exist on tough-to-clean equipment. Stainless steel shell and tube heat exchangers are sanitary and corrosion resistant, and can handle numerous cleanings each day, which makes them an ideal solution for those who make both organic and non-organic food products.

Facilities and Storage for Organic Processing

A food processing facility is anywhere food for human consumption is processed or prepared, whether a farm, factory, slaughterhouse, packing plant, dairy, shared-use kitchen, or home kitchen. Facilities are licensed or permitted to handle specific types of food production and sales, such as direct-to-consumer, retail, or wholesale. The facility license
correlates to the type of food processing the facility is designed for, the type of equipment and infrastructure required, and the processes specified in food safety regulations. Food safety regulations specify conditions under which food may be stored before it is sold. Storage conditions are critical to avoiding contamination and spoilage. With farms, farm stands, farmers’ markets, and food buying clubs, food is often stored in more than one place before it is purchased. Storage regulations specify time and temperature, conditions for the place where the food is stored, be it a truck, cooler, warehouse, or pantry shelf. Storage regulations may also specify packaging requirements, e.g., packaging materials and method of packaging.

Grain Processing industry should have facility with precleaners, aspirators, fine cleaners, gravity separators, destoners, suction blowers, sorters machines, dryers to clean, grading and packing grains of high purity. This set-up enables the farm grade material to be cleaned to a super clean material. The fumigation technology should be safe to treat the grains and to prevent infestation. No chemicals are used for fumigating the grains and spices. The grinding technology in Flour Milling should ensure that the natural balance of bran, germ and endosperm to produce gluten free and non-allergen free products and to give the taste, aroma and texture with maximum fiber content than any other whole wheat flour of conventional brands. Aseptic processing: organic fruits processing into aseptically packed pulps, purees, juices and concentrates at audited and certified units of equipments and facilities. Processing facility should have a well-equipped lab and trained technicians to continuously monitor, evaluate and process the product.

Value Added Organic Products

In general, adding value is the process of changing or transforming a product from its original state to a more valuable state. Many raw commodities have intrinsic value in their original state. More specific definition would be to economically add value to an agricultural product (such as wheat) by processing it into a product (such as flour) desired by customers (such as bread bakers). Value addition can also involve product differentiation: food grown and processed organically; regionally branded food; and specific certification. On-farm value-adding activities can increase the income of farming households, while off-farm ones can create allied enterprises with employment opportunities. However, the key objective is to attract consumers willing to pay premium prices for such products. Value can be added to the organic raw materials by converting high quality inputs from organic farms into a variety of food ingredients for food manufacturers, to supply the organic food industry with superior ingredients. Included in the range are value-added grains, along with vegetables and fruit-based foods with high quality traceable Farm to Fork Approach. Value addition to agricultural products refers to primary processes such as cleaning, sorting, grading, processing, packaging, and branding. Jams, jellies, preserves, fruit sauces and toppings for ice creams or desserts, fruit or nut spreads, breads and pastries, pickles, preserved vegetables and fruits, jarred fruit pie fillings, hot chili sauces, snack packs of seeds and nuts, dried fruits, vinegars, salsas, baby food and much more are current popular examples of secondary value added agricultural products. One need to get creative and choose products that highlight the best of the organic farm grows.

The number of food categories as organic in India can start with organic tea and spices to flour, breakfast cereals, ghee, fruits, vegetables, milk, honey and many more. **Common value-added food products may include** Basmati and Non-Basmati rice and its products. India is home to one the largest collection of rice varieties to suit various requirements and is one of the largest producers of Organic Non-basmati rice. Quality: Short grain fine, Long grain fine, coarse, parboiled, Brown, and White rice, Gluten-free Grains and Flours, Millets, Amaranth, Flax seeds. With the in depth understanding of various grains, their properties and applications various gluten-free ingredient options are available as whole grains, cracked grains or flours. Whole and Split pulses of different varieties, with and without husk can be produced. Spices and condiments can be colour sorted, sterilized and made free of aflatoxin and weed seeds. Few examples are whole and ground Turmeric, whole, flakes and ground Chilly, Fenugreek, Cloves, Mustard, whole and ground Black Pepper etc. these are used as an ingredient in most Indian preparations and can be customized according to the requirement. Soy meal and soy beans which are popular for being a dietary food can be enriched with protein and free from cholesterol. Dehydration of fruits and vegetables is one of the oldest and easiest methods of food
preservation. It removes the water/moisture from the food products completely and makes the food items smaller and lighter. Canning process which involves placing various fruits and food products in jars or similar containers and heating them to a temperature that destroys micro-organisms causing food to spoil can be made organic. Individually Quick Frozen (IQF) products have a long lasting freshness, taste, and texture. Organic IQF mango dices, slices, Papaya dices, cubes, pomegranate kernels, banana slices and vegetables like Sweet Corn/Okra/Green Peas may be developed to ensure specifications as per the customer requirement. Purees, Concentrate and Juices from Mango, Guava, and Pineapple can serve as ideal Ingredient/base to Fruit Beverages, Baby Food, Yoghurt, and Smoothies and Ice-creams etc. Rich in Vitamins and essential nutrients, these can be easily incorporated into frozen juices, drinks, fruit cheese, fruit cream, baby food items, yogurt and other desserts. Further, there can be huge market for organic instant food products. Ready-to-Eat food having combined benefits of convenience, health and preservative-free and Ready-to-Cook containing the perfect blend of organic spices and other organic ingredients to give authentic taste with original/natural flavor every time. Ready-to-Drink organic juices are pure, natural and free of pesticides and chemicals.

**Labeling organic products:**

Labels provide information to trace a food back to its source, identify ingredients, warn of potential health hazards, processing and storage conditions. Organic products have strict production and labeling requirements. Any food offered or promoted for sale as ‘organic food’ shall comply with all the applicable provisions of National Programme for Organic Production (NPOP) or any other system or standards as may be notified by the Food Authority (FSSAI) from time to time. Raw or processed agricultural products in the “100 percent organic” or “made with” organic multi-ingredient agricultural products in the “made with” category must meet corresponding criteria.

**Certification**

The Government of India has implemented the National Programme for Organic Production (NPOP). The national programme involves the accreditation programme for Certification Bodies, standards for organic production, promotion of organic farming etc. The NPOP standards for production and accreditation system have been recognized by European Commission and Switzerland for unprocessed plant products as equivalent to their country standards. Similarly, USDA has recognized NPOP conformity assessment procedures of accreditation as equivalent to that of US. With these recognitions, Indian organic products duly certified by the accredited certification bodies of India are accepted by the importing countries.

A very important aspect of supply chain management is certification. Different importing countries have different sets of approved certifications so food companies need to set a standard of organic farming and choose an appropriate agency for certification. These agencies include the USDA, EU, Control Union and OU Kosher. To help increase parity between India and its export markets, the Government has implemented the National Programme for Organic Production (NPOP). It has also launched PGS-India (Participatory Guarantee System of India) which is a quality assurance initiative that is locally relevant, emphasizes the participation of stakeholders including producers and consumers and operates outside the frame of third-party organic certification. **The Food Safety and Standards Authority of India (FSSAI)** has been established under Food Safety and Standards, 2006 which consolidates various acts and orders that have hitherto handled food related issues in various Ministries and Departments. FSSAI has been created for laying down science based standards for articles of food and to regulate their manufacture, storage, distribution, sale and import to ensure availability of safe and wholesome food for human consumption. It has brought out the approval of standards of NPOP for organic food products in May, 2017.

For organic product development, from preservation of seed to sowing, from cultivation to harvesting, from processing to production through sales and marketing, each step needs to be responsible for holistic quality assurance. The adoption of food safety and quality assurance mechanisms such as Total Quality Management (TQM) including ISO 9000,
ISO 22000, Hazard Analysis and Critical Control Points (HACCP), Good Manufacturing Practices (GMP) and Good Hygienic Practices (GHP) by the food processing industry offers several benefits. It would enable adherence to stringent quality and hygiene norms and thereby protect consumer health, prepare the industry to face global competition, enhance product acceptance by overseas buyers and keep the industry technologically abreast of international best practices have Organic Certifications from Control Union and SGS as per USDA, EU and NPOP Organic Standards and FSSAI.

Business with Organic Products

Another key factor behind the recent pickup in growth is e-commerce which provides organic companies with an appealing route to market. There are more than 25 e-commerce platforms selling organic foods online in India now, plus generalist grocery sites are selling organic categories. In addition, there are specialised organic retailers. It takes about three years to convert a field from conventional to organic. An organic food company, which obtains the organic certification, usually works with a group of farmers. The company provides those farmers with support in terms of inputs and education in organic growing practices. It also assures the buyback of the crop throughout the conversion process.

Conclusion

India is bestowed with lot of potential to produce all varieties of organic products due to its various agro climatic regions. In several parts of the country, the inherited tradition of organic farming is an added advantage. This holds promise for the organic producers to tap the market which is growing steadily in the domestic market related to the export market. Companies that handle or process organic food must comply with organic standards set by regional organizations, national governments and international organizations and must be certified well before it reaches supermarkets and restaurants. The consumers generally follow the markets that make life easier with convenient, nutrient rich, disease preventing, and safe foods. The new product development will have its challenges in formulating novel, creative value added products. Future research should attempt to incorporate measures that will contribute significantly to the success of consumer demanding organic food products.

References


Revised report.2014. National Programme for Organic Production.Agricultural Processed and Food Products Export Development Authority (APEDA), Chapter 2, Appendix 5:103-113


http://www.fssai.gov.in
Legal Aspects of Organic Farming

Ekadashi Nandi

Ex-Chief Seed Certification Officer, OSSOPCA,
Freelance Consultant(Seeds & Organic Farming),
OLC Alumni, IFOAM- Organics International.
Mob: 9437412411

ABSTRACT

Food security is not just enough but, to provide safer and healthy food is also imperative to build a healthy nation. Safe food is a key to healthy living which builds productive and happier citizens. It is better to have “Gross National Happiness (GNH)” in place of “Gross Domestic Products (GDP)”. Organic Agriculture has become an increasingly important component of efforts to promote a healthy and sustainable food system. Consumer demand for food that is not laced with toxic pesticides has risen dramatically, with many growers benefitting from the premium that comes with an organic label; however, organic farmers face the continuing threat of drifting genetically modified organisms (GMOs) and pesticides contaminating their production. Efforts to protect organic farming practices are ongoing.

The word “ORGANIC” itself denotes that the product is organic only because the production process has been certified and stands as a guarantee of quality between the producer and the consumer who live far from each other. Certified organic farmers operate under a complex set of regulations that can be subject to interpretation, and their certification can be threatened by external circumstances. Organic farmers also enter into sometimes unique contracting arrangements. The certification assessment is based on a set of standards framed to satisfy the four principles of Organic Agriculture- Principle of Health, Principle of Ecology, Principle of Fairness and Principle of Care.

Many nations and organisations round the world, especially IFOAM- Organics International are engaged continuously on overviewing the current legal and policy framework surrounding the protection of organic agriculture from drift. In order to protect organic agriculture, advocates should focus on policy initiatives at various levels of government to promote and protect the rights of organic farmers to be free from pesticide and GMO drift. Statutory amendments would be most effective if the law requires more meaningful environmental risk analysis that considers existing research and requires ongoing environmental monitoring.

KEYWORDS: Organic Farming, Legal aspects, Farmers’ interest, Organic Certification.

INTRODUCTION:

Food safety and sustainability in Agriculture is the call of the hour round the world. At present people are more conscious of health. The world trade scenario at present is focusing on food safety and sustainability in agriculture. Strict quality measures of the food production, keeping in mind the conservation of natural resources and environment are to be achieved. In this regard, the developed nations (i.e. European Union and United States) and the World Trade Organization have already setup their own lives for sustainable agriculture and the production of safe food. Indiscriminant use of artificial fertilisers and pesticides in conventional agriculture since 19 sixties (green revolution era) though has sown increase in production of cereals and oilseeds, has resulted into poor soil fertility, human and animal health hazards, disturbed eco-balance, all leading to low productivity at high input cost as well as soil, air and water pollution. Farmers are bound to go for loans for arranging inputs for cultivation. Once in debt and low production...
coupled with imbalanced market facility, the farmers think of either abandoning agriculture or extreme situations. Organic Farming is the only alternative left to fight such problems.

WHAT ORGANIC AGRICULTURE IS:

“Organic” agriculture may be understood and practiced in different ways by different people.

In simple terms, organic growing occurs when the farming practices are aimed at “feeding the soil, not the plant”. We can describe organic agriculture as food production methods that preserve the environment, avoid most synthetic materials, such as pesticides. Both commercial and non-commercial operations may produce food using organic practices.

Organic Agriculture is based on the following four Principles as advocated by IFOAM-Organics International.

1. Principle of Health: Healthy soil, plants, animals, humans = a healthy planet.
3. Principle of Fairness: Equity, respect and justice for all living things.
4. Principle of Care: For the generations to come.

The system of organic agriculture arose in the early twentieth century and has since gone through several stages, including Organic 1.0 and Organic 2.0, with Organic 3.0 currently under development. Organic 1.0 is defined as the period of organic pioneers, developing the vision of organic agriculture (OA). Organic 2.0 is the period of growth and marketing of organic, which has taken place in recent history. Finally, Organic 3.0 addresses future challenges and aims at entering organic agriculture on the global stage.

ROLE OF IFOAM (International Federation of Organic Agriculture Movement)

[at present IFOAM-Organics International]:

The word “ORGANIC” refers to legal status of a product only after passing through certification process. The IFOAM-Organics International is the world federation for organic movement organisations. Established in 1972, IFOAM sets guidelines for organic farming at the international level, which helps different countries to set their own standards, which take into account different farming systems. As such different countries have passed Production Organic Food Acts, which paved the way for national standards for organic production and an accompanying CERTIFICATION PROGRAMME and award a symbol to farms which have followed the the standards. This symbol then allows farmers to market certified organic product. This is important, as it ensures that the consumers know that the food which they buy is ORGANIC.

ORGANIC CERTIFICATION:

Organic certification system is a quality assurance initiative, intended to assure quality, prevent fraud and promote commerce, based on set of standards and ethics. It is a process certification for producers of Agricultural Food and Fibre commodities and Medicinal and Herbal plants/ Products (Cultivated and Wild harvested). In general, any business directly involved in food production can be certified, including seed suppliers, farmers, food processors, retailers and restaurants.
PRINCIPLES OF STANDARDS:

- Conversion (24-36 months)
- Use of sustainable practices and judicious use of resources
- All inputs to be of natural origin and organic
- Using natural cycles, best management practices to avoid diseases and pests
- No synthetic inputs directly or indirectly
- No GMO, No irradiation
- Ensure integrity through out the process-no mixing and co-mingling
- Processing – Physical, mechanical and biological
- Additives, aids and preservatives as per approved list.

Requirements vary from country to country ([List of countries with organic agriculture regulation]), and generally involve a set of production standards for growing, storage, processing, packaging and shipping.

In some countries, organic standards are formulated and overseen by the government. The United States, the European Union, Canada and Japan have comprehensive organic legislation, and the term “organic” may be used only by certified producers. Being able to put the word “organic” on a food product is a valuable marketing advantage in today’s consumer market, but does not guarantee the product is legitimately organic. Certification is intended to protect consumers from misuse of the term, and make buying organics easy. However, the organic labeling made possible by certification itself usually requires explanation. In countries without organic laws, government guidelines may or may not exist, while certification is handled by non-profit organizations and private companies.

Internationally, equivalency negotiations are underway, and some agreements are already in place, to harmonize certification between countries, facilitating international trade. There are also international certification bodies, including members of the IFOAM- Organics International working on harmonization efforts. Where formal agreements do not exist between countries, organic product for export is often certified by agencies from the importing countries, who may establish permanent foreign offices for this purpose. In 2011 IFOAM introduced a new program - the IFOAM Family of Standards - that attempts to simplify harmonization. The vision is to establish the use of one single global reference (the COROS) to access the quality of standards rather than focusing on bilateral agreements.

CERTIFICATION METHODS:

1. **Third Party Certification**- Involves more certification fees, specially meant for export of organic products, done by an accredited Certification Agency.

2. **Participatory Guarantee System (PGS)**- The most economic organic certification system in which all the farmers participate in the process and guaranteee for the quality. The product is meant for domestic consumption and creates field for assessing the untouched small and marginal farmers who grow fod organically but unable to go for third party certification.

3. **Alternative Certification Options**: Mutual understanding between producer and consumer on food quality free from public organic certification procedures.

Process of certification includes Receipt of applications; Providing standards and operational documents; Agreement; Demand for Fee; Document audit; Physical field inspection; Risk assessment; Compliance verification; Reporting by inspector; Review by reviewer; Certification decision.
Some of the important third party Organic Certification Programmes associated with India are as follows:

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**Private organic certification:**

Besides the public organic certification regulation, there are various private organic certifications available:

- **Demeter International** certification programme established in 1928, is the largest certification organization for biodynamic agriculture over 50 countries to verify that biodynamic products meet international standards in production and processing was the first ecological label for organically produced foods.

- **Bio Suisse** established in 1981, is the Swiss organic farmer umbrella organization, mainly focused on imports towards Switzerland and don’t support export activities.

- **Global Organic Textile Standard (GOTS)** established in 2002, is a private standard for Organic clothing for the entire post-harvest processing (including spinning, knitting, weaving, dyeing and manufacturing) of apparel and home textiles made with organic fibres (cotton, wool etc.). It includes both environmental and social criteria.

**Indian context:**

The Government of India, through Ministry of Commerce and Industry has launched National Programme of Organic Production (NPOP) in the year 2000 in order to provide a focussed and well developed organic agriculture and quality products which was formally notified in October 2001 under Foreign Trade & Development Act (FTDC Act). The standards and procedures have been formulated in harmony with International Standards such as CODEX and IFOAM. NPOP is implemented by Agricultural and Processed Food Product Export Development Authority (APEDA), Ministry of Commerce and has formulated National Standards for Organic Production (NSOP) for organic certification. The standards have equivalence agreement with European Union and Switzerland. USDA has also accepted NPOP conformity assessment system. As on date there are 28 accredited Certification Bodies (10- Public & 18 Private) in India for third party certification certifying 42.2 lakh ha including 14.8 lakh ha cultivated area both certified and in conversion and rest wild harvest area.

To bring more area under organic farming of potential untouched areas, government of India through ministry of Agriculture and Farmers Welfare, has introduced PKVY (Paramparagat Krishi Vikas Yojana) with low cost/no cost organic certification process called PGS-India following standards of NPOP.
The NSOP as described under Section-5 of NPOP (revised 2015) can be observed from [www.apeda.org](http://www.apeda.org) website.

**Issues:**

Organic certification is not without its critics. Some of the staunchest opponents of chemical-based farming and factory farming practices also oppose formal certification. They see it as a way to drive independent organic farmers out of business, and to undermine the quality of organic food.

1. **Obstacles to small independent producers:** Originally, in the 1960s through the 1980s, the organic food industry was composed of mainly small, independent farmers, selling locally. Organic “certification” was a matter of trust, based on a direct relationship between farmer and consumer. Critics view regulatory certification as a potential **barrier to entry** for small producers, by burdening them with increased costs, paperwork, and bureaucracy.

2. **Manipulative use of regulations:** Manipulation of certification regulations as a way to mislead or outright dupe the public is a very real concern. Some examples are creating exceptions (allowing non-organic inputs to be used without loss of certification status) and creative interpretation of standards to meet the letter, but not the intention, of particular rules.

3. **False Assurance of Quality:** The label itself can be used to mislead many customers that foods labelled as being organic are safer, healthier, and more nutritious.

4. **Erosion of standards:** Critics of formal certification also fear an erosion of organic standards. Provided with a legal framework within which to operate, lobbyists can push for amendments and exceptions favourable to large-scale production, resulting in “legally organic” products produced in ways similar to current conventional food. Combined with the fact that organic products are now sold predominantly through high volume distribution channels such as **supermarkets**, the concern is that the market is evolving to favor the biggest producers, and this could result in the small organic farmer being squeezed out.

**Conclusion:**

In order to protect organic agriculture, advocates should focus on policy initiatives at various levels of government to promote and protect the rights of organic farmers to be free from pesticide and GMO drift. Statutory amendments would be most effective if the law requires more meaningful environmental risk analysis that considers existing research and requires ongoing environmental monitoring.
Schemes programmes and activities of Govt. of India for promoting Organic Farming

Dr. Gagnesh Sharma
Regional Director, RCOF Bhubaneswar, Department of Agriculture & Co-operation, Ministry of Agriculture, GoI.

National Mission for Sustainable Agriculture:

Mission Objectives

- To make agriculture more **productive, sustainable, remunerative and climate resilient** by promoting location specific Integrated/Composite Farming Systems;
- To conserve natural resources through appropriate **soil and moisture conservation measures**;
- To adopt comprehensive soil health management practices based on **soil fertility maps, soil test based application of macro & micro nutrients, judicious use of fertilizers etc.;**

Mission Structure:

- **Climate Change Cell (CCC):** of DAC along with Soil & Land Use Survey of India (SLUSI) will serve as knowledge networking centre for facilitating collaborative and interactive processes among stakeholders
- **Subordinate Offices/Institutions of DAC:** Following two subordinate organizations/attached offices of Department of Agriculture & Cooperation will also be associated in the implementation and monitoring of the this Mission:
  1. **Soil and Land Use Survey of India (SLUSI):** SLUSI will house Technical Support Unit (TSU), monitor & coordinate implementation of mission in the states, undertake soil resource mapping, develop a GIS-based web server, support training and skill development in the areas of soil health management, water management, integrated farming etc.
  2. **National Centre of Organic Farming (NCOF):** NCOF will be involved in promotion of organic farming through technical capacity building of stakeholders, technology development, transfer of technology, promotion & production of quality organic and biological inputs, awareness creation &publicity, quality control requirements of bio-fertilizers & organic fertilizers

**ORGANIC PERSPECTIVE:**

Organic farming is gaining importance world-over.

- The present day intensive agriculture practices have resulted into soil fatigue, and gradual deterioration of soil health. To overcome these growing problems emphasis is being given to restore soil health by reducing the use of chemical inputs and increasing the use of biological and organic inputs.
- Nutrient mobilization and plant protection through natural and biological route should be the first option followed by chemical option to fill the gap.
Growing awareness for safe and healthy food has underlined the importance of organic farming, which is a holistic production management system based on basic principle of minimizing the use of external inputs and avoiding the use of synthetic fertilizers and pesticides.

Need for organic Inputs while converting to organic:

- For conversion of a conventional field to organic, first step is to build up the lost fertility of the soil. This can be achieved by complete ban on use of synthetic inputs and increased use of organic and biological inputs.
- For nutrient management and soil fertility build up crop residue, animal dung, forest leaf litter, bone meal, slaughter house waste, blood meal and green manures are important organic sources. All such organic material needs to be composted properly for appropriate impact.
- Nutrient value of the raw material and composting methodology determines the quality of produce. Biological resources such as biofertilizers and other microbiological inputs have also attracted lot of attention and are being promoted on large scale.
- Under National Project on Organic Farming incentives are available for establishment of production facility for Vegetable market waste and ago-waste compost, biofertilizers and vermiculture. Under various other schemes of Central and State Governments assistances are available for setting up of vermicompost production facilities.

Basic spirit on use of inputs in organic agriculture:

- In present day organic farming, stress is given on on-farm management.
- In this on farm management nutrient management is looked after by crop rotation, multiple cropping, mixed cropping, incorporation of legumes as intercrops, crop residue management and by use of on-farm made compost.
- Plant protection is achieved by habitat management, multiple cropping, cropping combinations, crop rotations, release of pest predators and parasitoids and use of botanical and bio-pesticides.
- The requirement of these inputs is managed by their production at farm with available on-farm resources in the first stage and by purchase from off-farm resources to a limited extent in the second stage.

Organic inputs:

- In promotion of organic farming use of organic inputs has assumed an important position. Contrary to conventional farming where synthetic inputs are used to feed the crop and protect the crop by direct action, in organic farming inputs are used to feed the soil and to create an environment which can rejuvenate the soil and collectively keep the pests below economical threshold limit (ETL).
- In this endeavor although quantity may not be an important issue, but quality of input is of prime importance. In the recent years efforts have been made to promote appropriate production methodologies among farmers for effective conversion of organic waste into nutrient rich compost and for preparing botanical extracts for pest management.
- Mass adoption of vermicompost technology and use of neem seed kernal sprays by farmers is an indicative of the usefulness of such strategy. But still there is a scope for the entrepreneurs to come forward and establish production facility to produce consistent quality product and made available to farmers at reasonable price.
- To take the advantage of growing awareness of organic agriculture various types of organic and biological inputs have been launched and are being sold to farmers. Some of such products are the results of research and are being promoted by state agencies also, but some of the products have been launched without much scientific understanding and their quality and usefulness is questionable.
To prevent such unfair practices, awareness among the users is most essential. At Government level some efforts have been made to regulate the production and quality control of some organic inputs. In this, some organic fertilizers and biofertilizers have been covered under Fertilizer Control Order and their standards and quality control parameters have been defined. Manufacture and sale of biopesticides are being governed by the Central Insecticide Act.

**Requirement of registration and license under Fertilizer Control Order:**

- Since April 2006, quality of Biofertilizers such as Rhizobium, Azotobacter, Azospirillum and PSB and organic fertilizers such as City waste compost, vermicompost and press mud are being monitored under the Fertilizer Control Order (Amendment November 2009).
- All manufacturers, distributors and dealers are required to obtain necessary registration and license from state authorities as per the requirement of the act.
- Concerned state’s Agriculture Department has been delegated with the powers for inspection and issue of registration. All District and sub-district officers of Agriculture Department and Fertilizer Inspectors authorized under FCO shall function as sampling officers.
- National Centre of Organic Farming, Ghaziabad and its six Regional Centres of Organic Farming at Bangalore, Bhubaneswar, Panchkula, Imphal, Jabalpur and Nagpur have been declared as authorized testing laboratories for biofertilizers and organic fertilizers. States can also develop their own testing laboratories and after fulfilling requisite infrastructure and facilities can notify such testing laboratories under the act through their Gazette Notification.

**Biofertilizers and some of the important quality issues:**

- Biofertilizers or microbial inoculants are carrier based ready to use live bacterial or fungal formulations, which on application to plants, soil or composting pits, help in mobilization of various nutrients by their biological activity. To ensure a good quality biofertilizer, a formulation should possess following traits
  - a. The product must be carrier based or liquid formulation, capable of holding very high population of specific micro-organisms for sizeable period of time.
  - b. In case of carrier based formulations the product should have 30-50% of moisture throughout the shelf life period to sustain microbial population.
  - c. For carrier based formulations the microbial population should be in the range of 107 to 109 cells/gm of moist product. In case of liquid formulations the cell load should be in the range of 1x108 to 1x1010 during the entire period of shelf life.
  - d. It should be free from other contaminating microorganisms.
  - e. The microbial strain present in the product should be able to produce adequate nodulation in case of Rhizobium, be able to fix at least 10-15 mg of N/gm of carbon source used in case of free living N2 fixers and be capable of solubilizing significant quantity of fixed soil P.
  - f. It should have sufficient shelf life (minimum 6 months for carrier based and 12 months for liquid).
- Keeping in view of all these requirements a production technology has been developed which involves 3 steps:
  - (a) Isolation and identification of appropriate strains of targeted microorganisms.
  - (b) Up-scaling of microbial biomass.
  - (c) Impregnation of carrier with fully grown microbial broth or immobilization of grown cells to obtain liquid formulations.
Promoting Organic Farming in Odisha: State Initiatives

Dr. Akshay Kumar Sahu
Water management Specialist
Govt. of Odisha

Organic farming system is as old as civilization. India had ancient wisdom on farming since human civilization inhabited settled community lifestyle. Knowledge was brought forth by enlightened Rishis who lived in forests and understood the rhythms of nature. Rapid advances in the field of science and technology have made us more dependent on it for every facet of our life. The traditional wisdom is slowly becoming extinct day by day. Sir Albert Howard, often referred to as the father of modern organic agriculture, worked at Pusa, Bengal. He documented traditional Indian farming practices, and came to regard them as superior to his conventional agriculture science. Thus, these practices do not deserve to be put aside in the name of nurturing a scientific temper. The process need to be reversed for sustainability to prevail.

Understanding Organic Farming

Organic Farming is a farming system which primarily aimed at cultivating the land and raising crops in such a way, as to keep the soil alive and in good health by use of organic wastes (crop, animal and farm wastes, aquatic wastes) and other biological materials along with beneficial microbes (biofertilizers) to release nutrients to crops for increased sustainable production in an eco-friendly pollution free environment (Wikipedia).

As per United States Department of Agriculture (USDA) study team on organic farming – “organic farming is a system which avoids or largely excludes the use of synthetic inputs (such as fertilizers, pesticides, hormones, feed additives etc) and to the maximum extent feasible rely upon crop rotations, crop residues, animal manures, off-farm organic waste, mineral grade rock additives and biological system of nutrient mobilization and plant protection”.

“Organic agriculture is a unique production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity, and this is accomplished by using on-farm agronomic, biological and mechanical methods in exclusion of all synthetic off-farm inputs” – (FAO).

“Only action in accordance with nature will simultaneously satisfy the interests of the individual, society and the cosmos” – Maharishi Mahesh Yogi

Policy initiatives

The State Agriculture Policy (SAP) in force hovers around the concepts of sustainable agriculture. If one goes through the objectives of SAP, most of them seem to imbibe sustainable agriculture in one form or the other. The excerpts of the objectives are as under.

- To promote sustainable agricultural development;
- To focus on horticultural crops including dry-land horticulture;
- Focus on poultry, dairy and fisheries to augment farmers’ income
- To encourage crop substitution
- To encourage modern farming system approach & organic farming;
- To enhance water use efficiency through peoples’ participation;
• To facilitate increased long term investment in agricultural sectors particularly for post- harvest management, marketing, agro processing and value addition, etc;
• To encourage contract as well as compact farming;
• To increase access to credit for small and marginal farmers;
• To facilitate appropriate market linkages;
• Natural Resource Management (NRM) etc

Besides, the SAP has specific chapters dedicated to Organic farming, Integrated Farming and Soil Health Management based on the principles of Sustainable Agriculture. More so, the government is contemplating to bring into force an **Organic Farming Policy** for the state very soon and have floated the Draft Organic Farming Policy in the web inviting constructive criticisms and comments from the stake holders. All these together, clearly indicate the pro-organic intentions of the State Administration.

At present, Govt. of Odisha is giving emphasis for promoting organic farming in the State with the following objectives.

• To bring in an agro-ecological frame work for farming in the state
• To improve the soil fertility & productivity
• To make the farmers less dependent of supply of inputs and take up crop cultivation with available local resources and thus making the farming less expensive and profitable
• For judicious use of water which is very precious.
• To improve the depleted soils of rain fed areas by addition of organic manures to make them input responsive and better performing even in drought conditions
• To reduce the debt need of farmers and enable them to attain sustainable status
• To prepare the farmers to face the challenges posed by WTO through production of quality produce and also to improve the farmers income.
• To increase rural employment opportunities and prevent migration to urban areas.
• To facilitate ‘Self Help Groups’ among farmers to meet their requirements.
• To make the environment safe and pollution free and also to protect health of human beings and animals.
• To bring about suitable institutional changes in teaching and research on organic farming.

In line with the State Policy, a plethora of different interventions are being undertaken to reinvigorate the organic processes and bring in sustainability in the farm sector. With an ever burgeoning population giving rise to the demand for food, feed and fodder adding to the state’s concern for providing its citizens food and nutritional security, leaves very narrow scope for such an organic overhaul amidst large scale adoption of modern crop husbandry. Although, adoption of technology in the past decades have brought about Green Revolution making us not only self-sufficient in food grains but also generating adequate surplus, at the same time, it has taken a toll of the natural resources and their dynamic balance unequivocally. Concerns of sustainability have triggered the Scientists, Planners, Policy Makers and farmers to reorient their production strategy to a more environmental friendly one. In this backdrop, integration of Organic farming systems into the crop production process assumes greater importance.
Scope

The advent of scientific and technological revolution has led to a greater understanding of the environment and interactions within its elements. In the modern days the human concerns for health and nutritional quality has given rise to a geometrical surge in the demand for organic and safe produces. Not only there is rise in demand in the global market but also such produces do command a higher price. Odisha is endowed with diverse agricultural production systems owing to its varied agro-climatic situations, soils differing widely, rich vegetation and industrious farmers possess unlimited potential for adoption of organic farming practices. Comparatively among the Indian states, although the state boasts of having a larger area already under Organic Farming, it is barely 1% of its cultivated area (Table-I). Even one such study taken up by ASSOCHAM infers -“Organic farming certification can change fate of Odisha farmers and create huge employment Opportunity”. Considering the facts, it is clearly evident that there is a greater scope to enhance the coverage under Organic farming.

Table-I: State wise Farm area (excluding Forest Area) under Organic Certification during 2013-14

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>State Name</th>
<th>Organic Area (in Ha)</th>
<th>% Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Andaman &amp; Nicobar Islands</td>
<td>321.28</td>
<td>0.04</td>
</tr>
<tr>
<td>2</td>
<td>Andhra Pradesh</td>
<td>12325.03</td>
<td>1.70</td>
</tr>
<tr>
<td>3</td>
<td>Arunachal Pradesh</td>
<td>71.49</td>
<td>0.01</td>
</tr>
<tr>
<td>4</td>
<td>Assam</td>
<td>2828.26</td>
<td>0.39</td>
</tr>
<tr>
<td>5</td>
<td>Bihar</td>
<td>180.60</td>
<td>0.02</td>
</tr>
<tr>
<td>6</td>
<td>Chhattisgarh</td>
<td>4113.25</td>
<td>0.57</td>
</tr>
<tr>
<td>7</td>
<td>Delhi</td>
<td>0.83</td>
<td>0.00</td>
</tr>
<tr>
<td>8</td>
<td>Goa</td>
<td>12853.94</td>
<td>1.78</td>
</tr>
<tr>
<td>9</td>
<td>Gujarat</td>
<td>46863.89</td>
<td>6.48</td>
</tr>
<tr>
<td>10</td>
<td>Haryana</td>
<td>3835.78</td>
<td>0.53</td>
</tr>
<tr>
<td>11</td>
<td>Himachal Pradesh</td>
<td>4686.05</td>
<td>0.65</td>
</tr>
<tr>
<td>12</td>
<td>Jammu &amp; Kashmir</td>
<td>10035.38</td>
<td>1.39</td>
</tr>
<tr>
<td>13</td>
<td>Jharkhand</td>
<td>762.30</td>
<td>0.11</td>
</tr>
<tr>
<td>14</td>
<td>Karnataka</td>
<td>30716.21</td>
<td>4.25</td>
</tr>
<tr>
<td>15</td>
<td>Kerala</td>
<td>15020.23</td>
<td>2.08</td>
</tr>
<tr>
<td>16</td>
<td>Lakshadweep</td>
<td>895.91</td>
<td>0.12</td>
</tr>
<tr>
<td>17</td>
<td>Madhya Pradesh</td>
<td>232887.36</td>
<td>32.21</td>
</tr>
<tr>
<td>18</td>
<td>Maharashtra</td>
<td>85536.66</td>
<td>11.83</td>
</tr>
<tr>
<td>19</td>
<td>Manipur</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>20</td>
<td>Meghalaya</td>
<td>373.13</td>
<td>0.05</td>
</tr>
<tr>
<td>21</td>
<td>Mizoram</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>22</td>
<td>Nagaland</td>
<td>5168.16</td>
<td>0.71</td>
</tr>
<tr>
<td>23</td>
<td>Odisha</td>
<td>49813.51</td>
<td>6.89</td>
</tr>
<tr>
<td>24</td>
<td>Pondicherry</td>
<td>2.84</td>
<td>0.00</td>
</tr>
<tr>
<td>25</td>
<td>Punjab</td>
<td>1534.39</td>
<td>0.21</td>
</tr>
<tr>
<td>26</td>
<td>Rajasthan</td>
<td>66020.35</td>
<td>9.13</td>
</tr>
<tr>
<td>27</td>
<td>Sikkim</td>
<td>60843.51</td>
<td>8.41</td>
</tr>
<tr>
<td>Sl. No.</td>
<td>State Name</td>
<td>Organic Area (in Ha)</td>
<td>% Share</td>
</tr>
<tr>
<td>--------</td>
<td>----------------</td>
<td>----------------------</td>
<td>---------</td>
</tr>
<tr>
<td>28</td>
<td>Tamil Nadu</td>
<td>3640.07</td>
<td>0.50</td>
</tr>
<tr>
<td>29</td>
<td>Tripura</td>
<td>203.56</td>
<td>0.03</td>
</tr>
<tr>
<td>30</td>
<td>Uttar Pradesh</td>
<td>44670.10</td>
<td>6.18</td>
</tr>
<tr>
<td>31</td>
<td>Uttaranchal</td>
<td>24739.46</td>
<td>3.42</td>
</tr>
<tr>
<td>32</td>
<td>West Bengal</td>
<td>2095.51</td>
<td>0.29</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>723039.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Source – APEDA (2013-14)

Odisha has 92% of its farmers belonging to small and marginal category who use little or lesser quantity of modern synthetic inputs. Even some of the districts especially in hilly and tribal tracts organic farming come as a natural practice. There are many areas which can be considered organic by default and scientific approach to adopt organic farming in these areas can be a win-win situation for farmers and environment.

Odisha has large areas under spice crops like Turmeric, Ginger which as high export value. By promoting organic production in mango the state can capture greater International Markets. Farmers still grow several traditional varieties which can be promoted and marketed. In Odisha, the tribal and forest areas have huge potential for collection and marketing of naturally grown Non Timber Forest Produce (NTFP) and crops under cultivation without application of chemicals. Government envisages declaring all such areas as default organic and implementing necessary regulatory and incentive systems (Odisha Draft Organic Farming Policy).

Organic farming can be promoted in a big way in rainfed areas where the yield potential is still to be expressed and soil fertility is to be improved. Organic farming also helps in adapting to changing climate. The Govt is aiming to promote organic farming to ensure that quality and safe food is available to the agri - rural communities, urban areas and explore export markets for the marketable surplus in a) Fruits - mangoes, bananas, citrus etc, b) Spices like chillies, ginger etc, c) Food grains - Rice, millets, Pulses & oilseeds, d) Plantation crops - Cashew, Coconut, e) Medicinal & Aromatic plants, f) Cash crops like cotton etc. The production of vegetables in organic way has good potential as it has good local market and demand from people (Odisha Draft Organic Farming Policy).

‘Adoption of organic farming can increase net per capita income of a farmer in the state by a whopping 250 per cent...’, said D.S. Rawat, National Secretary General of ASSOCHAM while releasing the report containing the findings of the study. ‘This will also arrest migration of people from Odisha to other states in search of jobs’, he added. ‘Odisha has a huge role to take India’s share in global organic exports. This opportunity need to be harnessed by the state especially when the entire country is strategizing to “Double Farmer’s Income” by 2022. Organic Farming in the state can substantially contribute to achieve the target within the timeframe.

Present scenario.

The Odisha State Seeds and Organic Products Certification Agency (OSSOPCA) has already been commissioned from 30.05.2008 in view of the opportunities in the offing in the sector. OSSOPCA has been working as a designated body for organic products certification since then and as a National Accredited Agency under National Programme for Organic Production (NPOP) to function as Inspection & Certification body for organic crop production with effect from 01.06.2012 in the name of Odisha State Organic Certification Agency (OSOCA). This has encouraged expansion of area under Organic farming to about 95, 897 hectares of cultivated area (Dr AK Yadav). About 18 CBOs, 1 individual and 4449 farmers have registered under OSOCA for 5113 hectares of different organic crops constituting Mango, Banana, Paddy, Guava, Litchi, Ginger, Turmeric, vegetables etc (OSSOPCA Bulletin, 2016). The overall Scenario of Organic farming in the state is given below-
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Parameter</th>
<th>Quantum/ Crops</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Total cultivated area under organic certification (including in-conversion)</td>
<td>95,897 ha</td>
</tr>
<tr>
<td>2.</td>
<td>Total under wild harvest collection</td>
<td>13,327 ha</td>
</tr>
<tr>
<td>3.</td>
<td>Total certified production</td>
<td>40,788 tons farm produce 715 tons wild harvest</td>
</tr>
<tr>
<td>4.</td>
<td>Important crops being grown under organic</td>
<td>Cotton, Cashew nut, Mango, Fresh vegetables, Ginger, turmeric,</td>
</tr>
<tr>
<td>5.</td>
<td>Important crop commodity exported directly from state (based on export TC issued by Certification Bodies)</td>
<td>Nil</td>
</tr>
</tbody>
</table>

(Source: Presentation of Dr. AK Yadav, Advisor, NAB (Organic), APEDA, New Delhi)

The district-wise scenario of organic farming in Odisha is as under-

<table>
<thead>
<tr>
<th>District</th>
<th>Organic area (in hectares)</th>
<th>In-conversion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balangir</td>
<td>17660.962</td>
<td>7815.408</td>
</tr>
<tr>
<td>Boudh</td>
<td>0.00</td>
<td>1464.944</td>
</tr>
<tr>
<td>Cuttack</td>
<td>500.00</td>
<td>2099.62</td>
</tr>
<tr>
<td>Dhenkanal</td>
<td>572.301</td>
<td>258.23</td>
</tr>
<tr>
<td>Gajapati</td>
<td>336.08</td>
<td>0.00</td>
</tr>
<tr>
<td>Ganjam</td>
<td>0.00</td>
<td>486.74</td>
</tr>
<tr>
<td>Jajapur</td>
<td>497.75</td>
<td>101.74</td>
</tr>
<tr>
<td>Kalahandi</td>
<td>11206.818</td>
<td>32459.981</td>
</tr>
<tr>
<td>Kandhamal</td>
<td>604.441</td>
<td>4216.539</td>
</tr>
<tr>
<td>Kendujhar</td>
<td>543.867</td>
<td>0.00</td>
</tr>
<tr>
<td>Khordha</td>
<td>0.00</td>
<td>800.612</td>
</tr>
<tr>
<td>Koraput</td>
<td>500</td>
<td>2545.468</td>
</tr>
<tr>
<td>Mayurbhanj</td>
<td>815.289</td>
<td>790.954</td>
</tr>
<tr>
<td>Nayagarh</td>
<td>0.00</td>
<td>926.90</td>
</tr>
<tr>
<td>Nuapada</td>
<td>1805.531</td>
<td>5342.902</td>
</tr>
<tr>
<td>Puri</td>
<td>0.00</td>
<td>54.58</td>
</tr>
<tr>
<td>Rayagada</td>
<td>2394.756</td>
<td>1353.386</td>
</tr>
<tr>
<td>Sambalpur</td>
<td>0.60</td>
<td>0.00</td>
</tr>
<tr>
<td>Sundargarh</td>
<td>0.00</td>
<td>279.80</td>
</tr>
<tr>
<td>State Total</td>
<td>37438.395</td>
<td>60997.804</td>
</tr>
</tbody>
</table>

(Source: Presentation of Dr. AK Yadav, Advisor, NAB (Organic), APEDA, New Delhi)

The cotton produced in the state fetches better price in the national market. Organic turmeric & ginger produces from Kandhamal have found the shelves of many advanced countries. Kandhamal turmeric is famous for its colour, texture, aroma, flavour and long shelf life. Odisha Milk Federation (OMFED) started a government-sponsored project called
Kandhamal Women’s Organic Turmeric Project (KWOTP) in 2003. Currently, OMFED directly supervises 305 all-women societies that work for the project and the production increased exponentially. Besides, the Kandhamal turmeric is being processed and packaged to be sold through OMFED’s existing distribution channel (marketing outlets and booths) across the state. This apart, two other units named Samanwita and Kasam, who have their processing plant where the OMFED turmeric is packed and independently marketed.

Floriculture having tremendous potential in the state, the government have established a Floriculture market in Bhubaneswar. Steps are also taken for promoting aromatic rice in Koraput district. Women Self Help Groups are being encouraged to undertake fishery activities.

The state has gone ahead with establishing a Gene Bank to preserve all its land races for future breeding programmes. By now around 1000 land races of Rice and 50 races of pulses have been collected and being screened for potential traits. Out of these the state has been able to register 750 nos. of paddy varieties as farmer’s varieties. This effort has also been recognised at national level twice and the state awarded. The state has gone further ahead in improving local variety and released a paddy variety “Kala Champa” and some are in the pipeline.

There have been many such interventions to give a boost to organic farming and use of organics in the state during last 3 decades funded both by state and the Centre; Promotion of composting farm and domestic wastes, Promotion of biological Control, Production and popularisation of bio-fertilisers (1990-91), National Project on Promotion of Bio-fertiliser (from 1996-97), INM, IPM, Promotion of Bio-fertiliser (BGA) production, Vermi-Compost Production, Support for establishment of vermin-hatcheries etc. Some of the targeted programmes like National Project Organic Farming started to be implemented from 2006-07 for two years. Then it was supplemented by State sponsored programme “Organic Farming” from 2014-15. All these promoted the production and use of organic fertilisers/ composts besides organic farming. During 2015-16, “Paramparagat Krishi Vikas Yojana (PKVY)” commenced under National Mission on Sustainable Agriculture and being implemented in the state.

**Paramparagat Krishi Vikas Yojana**

“Paramparagat Krishi Vikas Yojana” – a Centrally Sponsored Plan Scheme funded by the Center and the State on a 60:40 sharing basis, started to be implemented as an elaborated component of Soil Health Management (SHM) of major project “National Mission of Sustainable Agriculture (NMSA)”. Under PKVY, Organic farming is promoted through adoption of organic village by cluster approach and PGS certification.

**The Scheme envisages:**

- Promotion of commercial organic production through certified organic farming.
- The produce will be pesticide residue free and will contribute to improve the health of consumer.
- It will raise farmer’s income and create potential market for traders.
- It will motivate the farmers for natural resource mobilization for input production.

Under the scheme, during 2017-18, around 320 clusters of 50 acres each will be taken up under Organic Farming. A total of 10 districts are being covered. The programme is being implemented in PPP mode. Nine nos. of Resource Organizations have been selected for implementation of the Scheme. Besides two State Resource Centres viz. SAMBHAV, Nayagarh & Rajendra Desi Chasa Gabesana Kendra, Narisho, Niali, Cuttack have been selected to facilitate the capacity building of the stakeholders. Extension functionaries have been trained and Regional Councils have been constituted. This is expected to take organic farming in the state to greater heights. In the coming 3 years it is envisaged to bring around 50000 hectares under Organic Farming. Efforts are also being made to promote production and use of organic manures and other agri-inputs which will supplement the Organic Industry as a whole.
Challenges

Resorting to Organic farming in a big way may bring down the production and productivity jeopardising the present surplus scenario in the food grain sector. Organic farming is disciplined agriculture and it may be vitiated depending on the sincerity of the farmer entrepreneurs. Water, air & soil pollution may hinder organic processes and would need efforts by all citizens. Testing of samples from organic produces would need a Internationally accredited Quality Control Laboratory to be established in the state. Food security and livelihood considerations of small and marginal farmers may stand as an obstacle for the spread of Organic Farming. Absence of adequate forward linkage in the state also drags down the spread.

Strategies

The state is having full potential to adopt organic agriculture and Govt. is planning carefully to exploit the existing opportunities. The Govt. is committed to formulate comprehensive package and policy changes vital for increasing the farm income and for making the sector nationally and globally competitive. The strategies for promoting organic farming will broadly cover the following aspects –

(A) Programmatic Scaling up - Focused approach


(C) Programmatic approach and incentives to farmers

(D) Support Systems- Restoring Biodiversity, Encouraging Forestry

Some Specific strategies would be-

- Promote low cost input agriculture in the state gradually in a stage wise manner, especially in rainfed areas
- Organic practices will also be promoted in selected zones of high input intensive agriculture where agriculture has become unsustainable and expensive
- Default organic growing areas in the districts of Kandhamal, Boudh, Koraput, Keonjhar, Mayurbhanj, Nuapada, Kalahandi, Balangir, Rayagada, Gajapati would be declared as organic and efforts would be made to get them a recognition and marketing
- Existing organic farming groups will be brought under PGS/ ICS certification
- The focus will be on small and marginal farmers, in the rainfed and ecologically fragile areas/bio-diverse areas in addition to crisis-ridden farming belts
- Capacity Building through organising Farmer Field Schools
- Encourage formation of Farmers Producer Organisations
- Few Government agriculture farms in the State will be converted into Centres for excellence for organic farming
- Local farming systems, restoring locally suitable crops and varieties
- Promoting Crop rotations, multiple cropping, intercropping, Green manuring, Composting, use of homemade and commercial Bio fertilizers and Bio-pesticides
- Encouraging Tree crops and on farm forestry.
- Promoting Animal Husbandry
• Soil & Water Conservation Practices
• Extension of credit to promote organic farming
• Incentives to Organic farmer for Production of Organic inputs on farm
• Payments for Ecosystem Services: direct payment for ecosystem services rendered by organic farmers.
• The organic farmers will be given preference in various Government schemes.
• Promotion of eco-tourism in organic villages
• Protection of areas rich with bio diversity
• Promotion of Farmers field schools as a step towards organic farming
• Establishment of Laboratories for quality control of Bio/ Botanical formulations & pesticide residue testing

Financial assistance/ incentives are proposed to be extended
• for encouraging renewable energy sources and for installation of Bio gas plants, solar energy units, wa-
ter-harvesting and wind energy units in organic farms.
• for farming processing activities taken up by individual farmers or groups of farmers in the value addition of their produce.
• for storage facilities of organically grown produce.
• for organic processing industries for development of infrastructure facilities.
• for organic processing units for obtaining ISO & other International certification.
• Following an integrated approach by all the related departments towards promotion of organic farming.

Conclusion
Odisha has a significant presence in the field of Organic farming since ancient period. Howsoever challenges may be faced by the endeavour to promote organic farming but concerns of environment and sustainability makes this inevitable for the future. The state has immense potential and shall have to resort to Organic farming and sustainable scientific practices to achieve an evergreen revolution.

References
‘Organic Odisha: Inching towards Organic Farming’, released by The Associated Chambers of Commerce and Industry of India (ASSOCHAM), 2014- Excerpts of the study hotnhitnews@yahoo.com
“Draft Odisha State Organic Farming Policy”- Floated on the Govt. website “odisha.gov.in”.
Internet sites.
OSSOPCA website “ossopca.nic.in”.
National Programme for Organic Production and Export Prospects in Odisha Presentation by Dr. AK Yadav, Advisor, NAB (Organic), APEDA, New Delhi.
Success story by farmer entrepreneur

Sustainability of Organic Farming – A Farmer’s Perspective

Lalatendu Pratap Deo

B Sc (Engg.), MCM
KORAPUT ORGANIC
New Janiguda, Koraput, Odisha

We all know that Organic foods are better for human consumption. It tastes better as compared to foods prepared with ingredients grown by means of conventional inputs. Here, the conventional way of farming means, growing agriculture produces with input of chemical fertilisers and pesticides. And this automatically would mean that we brand organic inputs as non-conventional - it certainly is not the other way round. Given a chance, we all will like to have all the food stuff that we eat to be fully organic. But, we wish the price of these to be at par with those which are prepared conventionally. Fair enough.

We also know that the chemical fertilisers and pesticides we use for cultivation, degrade the land mass and the productivity of the land property decreases, as a result of prolonged exposure to chemical fertilisers and pesticides. We have assembled here to hear experts telling us as to how sustainable the Organic Agriculture is and as to what, as responsible citizens of the world, we should do to retain the sanity.

There might have been lots of fine tuning on our thinking-line about boosting Organic Agriculture, but these are all that we have been hearing since about last 30 years or so. Have we seen any increase in the percentage of availability of organic food stuff? Rather, it has declined drastically, as a percentage to the population that consumes madly. Even the chemical fertilisers and pesticides input percentage per available cultivable land has increased in folds. This is because many more farmers have started using these so-called poisons, which they were not expending earlier due to various reasons and many are using these, in increased proportion. There have been many million farmers, well-educated or otherwise, who earlier swayed away with these simple fascinating reasoning to go organic, have already wilted out from the chosen path. The Job Attrition here is very very high. There are so many now, who are determined to take the plunge, many of them may not endure the inevitable harsh realities. Many fellow organic farmers have already abandoned their dreams in Organic Farming. One may find only handful, who are here in the arena enduring a prolonged time period. Being exposed to realities of Organic Farming since more than last 20 years I urge you all to take my words seriously.

Why is this anomaly? Normal economics says us that as the demand has been ever increasing with more and more persons getting into the ‘Affluent Basket’ day in day out, willing to dole out for all those fancy things and for these Organic Food Stuff, we must have had more of these Organic Farms around. The increase in demand is also due to increased Health Consciousness amongst the masses. Adding to it, there has been constant emphasis from Governments, Groups, Societies, and individuals towards seeing a world full of Organic Farms around. But, at the end of the day, why do we not see the desired growth in Organic Agriculture? No, it is not because the cost of Organic Food-stuff is so high that these are beyond common man’s means. There are a whole lot of prospective buyers of organic farm products at every nook and corner, who do not get a chance to consume these for the simple reason that these are not reaching them due to one reason or other. Therefore, we must go little deep into all these to locate the real culprit. And it would then be
Where lies the problem that we all are here to address to and discuss about? Is it due to the unavailability of appropriate techniques on as to how one should go about cultivating organically? The answer to this is there is no dearth in the knowledge base available on the subject. Though there always is and there always will be scopes for improvement, every farmer knows on as to how to go about cultivating organically. So why is he not getting fascinated towards these supposedly lucrative proposition? He is not attracted to it as he sees the whole thing as lacklustre, as risky, as time consuming process, which will never give a better Return on Investment, at the end of the day. It is delinquency on our part to convince a farmer to produce less by not ensuring a better realisation for his produce. The focus now is as to how an organically managed farm can produce as much as a farm managed with conventional inputs. The simple logic will say that this will never help the farmer to switch over. We are wasting our time here.

No lecture on how sustainable this organically practised agriculture is, will drag him to follow it, when the basic survival of his family is at stake. If we truly wish him feed us good wholesome food, we must refocus on as to how he will accomplish better than the conventional counterparts financially, with whatever he is producing with his own capability. And this is not at all a difficult job. If we can do so, we will get an everlasting solution to one of our earth’s deafening problems, automatically. He will himself find ways to improve his production. And THAT will be the Sustainable Agriculture. Otherwise it will only be lifelong labour all along for him and for the intellects who wish him success that way, with no triumph in sight.

Coming to me, it has been a struggle all along - and it still is. Why is it so? None of my friends who adopted the so called Conventional Agriculture, is doing as badly as I am doing financially, even after ploughing in lots more into my fields than what they have done into theirs. Rather, all my contemporary farmers are doing exceedingly well. So, why am I here, pleading for a lasting solution? All the adversary reasons accompanying my lust for organic agriculture urge me to abandon such practice and join the Band Wagon. You will agree with me that, at the end of the day, unless I perform I cannot sustain - this is a harsh truth in case of any damn profession in the world, one picks. The very sustainability of my organic farm is at stake. Therefore, what am I talking about Organic Farming as Sustainable Agriculture? It is surely not the pure scientific technicalities of Sustainable Agriculture that are involved. On the whole, I would rather put Organic Farming as A Sustenance Agriculture. I need to elaborate.

I am drawing you all to the fact that I am producing about one-half to one-third of what my counterparts in conventional agriculture are producing. Sometimes it is even less. And just a week back, I sold a part of my produced Certified Organic White Pepper at a rate about 25% less than that my buyer had paid to a Conventional White Pepper producer in the region, about 2 months back. I see the day is not far away, when I shall have to sell the entire stock of my prime possession that I have piled up, at the respective conventional bulk rates – and there is no way out for me. This is because I must sustain my workers, my Bankers, and my Family. And this is Sustainable Agriculture for me, as a Farmer. You can say me that here is a super-duper organic farmer, who is producing as much as any conventional farmer does. No, we are not looking at a million copy of him, in the field. That is simply impossible. We, as Organic farmers, will definitely produce much less than our conventional counterparts, on an average. I must emphatically say that trying to increase production is not at all a primary solution for me. I do not think the plight of most of the other capable Organic Farmers are drastically different. Therefore, let us talk about a re-focus on our strategy.
I am a farmer and I would like to stick to the profession of my choosing. I must venture into neither processing of my produce, nor packaging of the same and sell those myself too, as I, as a mortal, cannot give justice to all these Jobs in hand, concurrently. Well said advice. For the information of all of you present here, my problem to sustain lays here and not in increased production, notwithstanding the scores of scopes to improve on my farming capabilities that you can surely provide me, more than willingly. Side-by-side, there are professionals in the respective other fields, and they would have definitely done the job better than the one I did, in bringing my produces out in Retail Consumer Packs, which, after all, was a logical conclusion right from the day I begun thinking of going Organic at the first place. I think I did a fairly good job, nevertheless. Is it not so?

I must confess here that I went on to come up with my own retail consumer packs, as a forced measure. I involuntarily opted to do so because an immediate prospective Certified Organic Buyer of my prized Black Pepper, some 3 years back, offered to give me a pittance more, in comparison to the conventional ones, which I refused to swallow. And, invariably, the same was the case with all other prospective bulk buyers of my produces. The attitude there has not changed a bit ever since. I do not blame these traders, as it is expected out of them to maximise their own profit & we farmers are their sitting petty ducks, to aim at. The extra money that you pay as an end-consumer for my hard work, never reaches me as a farmer, exactly due to this reason. Can we do something for it? I must tell you that we can. It is as easy as I say it is. Not many have given a deep thought about it until now.

Let us talk on sustaining me as an organic farmer, who is lying hopelessly under the sword hanging loosely attached to a thin hair at one end. With all the overall experiences that I gained at the hindsight and with an exceedingly long exposure to Organic Farming, I am here to say to all of us present here, that we will definitely bag this attainable objective of the conference - for which we have gathered - if we prop all the Organic Farmers up, with all our expertise and capabilities. Let it be albeit indirectly, but conquer we will.

I must let you know the advantages that I, as a typical Organic farmer, have. I have got an instant worldwide acceptability and it is easy for someone interested, to reach the shelf where my produces are stocked in any huge mall. Furthermore, in this internet era, any discerning end-consumer, sitting at any end of the Globe can reach me, if he chooses so. So, selling should not be a problem for me. But I am not selling as much as I should be. My products are well appreciated by those, both Indians as well as foreigners, who have physically consumed these. Last year, I participated in India International Coffee Festival held at Mumbai, organised by Coffee Board of India, where the Fine-Coffee-Cup awardee of the year, chosen by a team of International Juries appointed for the purpose, was placed just besides my stall. Believe me, so many of those visitors there came back to say specifically that the Coffee prepared with the Organic Input of mine tasted appreciably different than the other one. But, I am repeating once again, I am not selling as much as I should be.

All said and done, the selling of my produces is far too less than what I have been hoping to achieve all along. I do not know as to how I can make you try out my stuff, unless you desire to do it yourself. After all, I do not know who you are, as an end-consumer of one of my produces. Can this International Conference on Organic Farming for Sustainable Agriculture (OFSA) find an acceptable way for ME to find that “YOU”? If it does so, the day is not far when we all will see an exponential growth in Organic Farming, world over.

God forbid, I see myself, having to go back to bulk selling with a namesake premium, not many days from today. That would surely dissuade me from continuing with the noble idea that you all here are willing to promote. Let us discuss it out. Surely, I am a tough nut to crack. But not many of these Organic Farmers are.

God can only say as to what is laying ahead for me. As an Organic Farmer.
Success story by farmer entrepreneur

My experience with organic farming

Mr. Udaya Chandra Patra
Sundargarh

• In Odisha’s scenic Sundargarh is known as one of the most prominent industrial area of Odisha. Rapid expansion of urbanization and industries, Agricultural land, water, air and human health is gradually depleting in this region. Villages are shrinking day by day and exploitation of natural resources is on peak. Peoples are not getting sufficient water for drinking even, then from where farmers will get water for crop irrigation? Everywhere harmful chemicals are being used like chemical fertilizer for crops, which pollutes the water, air and our food, then from where peoples will get pure food?

• These above burning issues motivated to Mr. Udaya Chandra Patra to take responsibility to provide fresh and chemical less food to peoples for preserving their health besides keeping environment pollution free and decided to promote an economic organic model of farming for the marginal and semi-marginal farming communities to resolve the issue of their livelihood. “Initially, we had started to provide basic training and demonstration to farmers about preparation of organic compost, organic pesticides, organic insecticides and organic nutrients for better and chemical free food production.

• Nearly 12 years back from today, Udaya Chandra Patra, a progressive farmer of Kunarmunda of Sundargarh district of Odisha have taken the challenge to provide chemical less agriculture produces to society, for that he has been started Crop cultivation in nearly 40 decimal land with help of Organic and Natural technique of farming. He have started the preparation of Organic mixture, Organic soil, Jaivikkhad, Organic pesticide and insecticide by using different wastes like dry leaves, paddy straw, grasses, food waste, cow urine and cow dung for eliminating the chemical fertilizers and pesticide.

• First year of his cultivation of fruits and vegetables, he earned profit of 20000 Rs/season (40000 Rs/Year by two cropping). Due to good profit and local demand of pure and chemical input free agricultural crops, next year he have expanded his cultivable land up to 1.5 acre.

• In 2009, he have started own production unit of Organic fertilizer, pesticide, insecticide, and liquid manure on large scale and started to supply to the local farmers on subsidies rate for increasing the practice of Organic farming in his locality.

• In present, Mr. Patra is cultivating Organic crops in 10 Acre land. His farm is fully sustainable, self-sufficient and profit oriented. Now he is producing tones of fruits, vegetables, organic fertilizers and organic pesticide and supplying these finished products in local besides Rourkela, Angul, Bargarh and Sambalpur district.

• He always used to tell “He is Agriculture expert and nature lover by birth”.

• Lack of alternative modes of livelihood has also led to large scale migration of youth to other states as labourers, he deciding to do something to help them and now he is providing employment to 10 labours and 01 farm manager.

• He is promoting Organic farming and use of Organic package and practices in 5 surrounding district of Sundargarh district and till now he have trained more than 7000 farmers in Organic cultivation.

• Now, he is 65 years old but always ready to learn and teach to others about agriculture and always saying “since we have to travel a long path to eliminate chemical farming completely from Indian soil”.

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At present, Mr. Patra and his team are planning a socio-entrepreneurship model for integrated and sustainable development of tribal and rural communities of Odisha, by setting up small and home-scale units of organic fertilizer and pesticide preparation, mushroom cultivation and dairy. The team is also preparing plans for organic soil and a bio-intensive orchard and provides training to farmers for sustainable organic farming.
Success story by farmer entrepreneur

Through organic / natural farming with a different Approach

Dr. N. Rout

Email: drnrout@gmail.com, Ph:9438730865

Background….

Three years Back…Met a Young farmer, Mr. Bijay Biswal in a Women Group Meeting @ Jagatsinghpur…my home district.

He was desperately looking for any alternative Agri-based livelihood business to financially support his family and was interested to start Mushroom farming in his backyard…..But was lack of Tech-Knowhow, finance to start etc.

- My commitment grew up with him and the journey started…
- I met Prof K.B.Mohapatra of OUAT, who guided me strategically to address such issues…
- I established my own Low Cost, Protected, Hygienic and Organic Mushroom Farm(1000 Sq.Ft) and a small Spawn Unit (with 100 bottle Capacity)… as advised, guided by Prof.Mohapatra.
- Then I gathered experience and started mobilizing unemployed youths, women groups in adopting the same…..
- The waste of Mushroom Substrate used as Bio-manure for vegetable production in the kitchen garden…
- Meeting with Farmers, Youths and Women groups to understand the Issues…..
- Now I work with more than 1200 House Holds in doing Mushroom and Organic Vegetable farming by Learning, Doing approach…..
- A Lab to Land Passion and Motivation to support and strengthen Social Entrepreneurship and to create Socio-Economic impact is the need of the hour as we all understand.
- Now, have started a demonstrative Organic Farming centre at Village Gundichapur, GP:Dorada, near Kuleilo, Athagarh….

The Broader Issues

- Unemployment,
- Landless families have no access to agriculture,
- Marginal and small farmers are the worst sufferer of conventional farming
- Current Agricultural practice is a loss making effort
- Chemical based farming is the root cause of many kind of disease
- Youth farmers have least knowledge on Organic Farming
- Climate Change effect on agriculture, regular flood, cyclone and disaster
- Not aware of Govt Schemes, plans and provisions
- No access to skill and training for any kind of Social startups
• No convergence and PPP mode approach for such families
• No social counseling centres at community level
• Poor health and hygiene
• Lack of Community level institutions
• Distress migration

Goal
• To introduce Climate Resilient Adaptation Strategies through promoting & strengthening Community level Institutions,
• Mainstreaming Women and ensuring Good Governance by developing creative and innovative integrated and sustainable livelihood models and methods.

Objectives:
• To create a pool of community level barefoot experts in the field of Organic farming/Natural Farming, Herbal Literacy and Practices, Organic Mushroom Farming, Honey Bee Farming, etc..
• Creating a field based centre of Excellency through demonstration and training on the above…

Strategy…
• Formation of Community Library (The Book Speaks:-Bahi Kahe Katha) in each and every ward/village…. 
• Formation of Women Farmer Science Centre (WFSC) or in local Language in Oriya called as: Mahila Krushak Bigyan Kendra(MKBK), involving all section of women in the community.
• Promoting Progressive Organic Farmers
• Preparing Climate Change Adaptation and Mitigation plans at Community level….Focusing on Climate Resilience Cropping systems..

Activities…
• Organic Mushroom Farming (different models of Low cost Shednet design ): Oyster and Paddy Straw
• Organic vegetable Nursery raising and farming
• Organic Manure Preparation and Formulation
• Organic Pesticide Preparation and formulation
• Herbal gardening for Backyard
• Different types of Organic farming models
• Vermi-composting
• NADEP compst and other compost methods
• Different irrigation moethods ( espl Drip & sprnller)
• Mulching methods
• Seed collection and preservation ( OP varieties…Traditional)
Organising committee

Patron
Prof. S. Pasupalak, Hon’ble Vice Chancellor, OUAT, Bhubaneswar

Advisory Committee
1. Dr. Prabhash Singh, Hon’ble Member of Parliament, Lok Sabha
2. Sj. Balabhadra Majhhi, Hon’ble Member of Parliament, Lok Sabha
3. Dr. Trilochan Mohapatra, Director General, ICAR and Secretary, DARE, Govt. of India
4. Sj. Santosh Kumar Satapathy, IAS, Principal Secretary, Govt of Jharkhand
5. Shri Amarendra Khatua, IFS, Director General, Indian Council for Cultural Relations
6. Dr. P. N. Jagadev, Dean of Research, OUAT, Bhubaneswar
7. Dr. R. C. Patra, Dean, CVSc and AH, OUAT, Bhubaneswar
8. Dr. L. K. Babu, Dean, Students Welfare, OUAT, Bhubaneswar
9. Dr. B. C. Panda, Director, C B Sc and H, OUAT, Bhubaneswar
10. Dr. M M Hussain, Dean, College of Forestry, OUAT, Bhubaneswar
11. Dr. (Mrs.) Manashi Mohanty, Director, College of Home Science, OUAT, Bhubaneswar
12. Dr. D. Satapathy, Director, College of Fisheries, OUAT, Bhubaneswar
13. Dr. Gagnesh Sharma, Director, RCOF, Bhubaneswar

Convenors
1. Dr. Ashutosh Mohanty, Director, MIU, Mongolia
2. Prof. Pravat Kumar Roul, Director, Planning, Monitoring & Evaluation, OUAT, Bhubaneswar
3. Prof. Gautam Budha Sitaram, Professor, RDIAS, GGSIP University, New Delhi
4. Prof. L M Garnayak, Dean, College of Agriculture, OUAT, Bhubaneswar

Organising Secretary
Dr. S. K. Dash, Prof. & Head, Dept. of Agrl. Processing & Food Engineering, OUAT, Bhubaneswar

Joint Organising Secretary
Dr. K. K. Rout, Prof. (Soil Science) and OIC, AICRP on LTFE, OUAT, Bhubaneswar

Reception
1. Dr. P. N. Jagadev, Dean of Research, OUAT, Bhubaneswar
2. Dr. R. C. Patra, Dean, CVSc and AH, OUAT, Bhubaneswar
3. Dr. L. K. Babu, Dean, Students Welfare, OUAT, Bhubaneswar
4. Dr. B. C. Panda, Director, C B Sc, OUAT, Bhubaneswar
5. Dr. (Mrs.) Poonam Agrawal, Director, College of Home Science, OUAT, Bhubaneswar
6. Dr. M M Hussain, Dean, College of Forestry, OUAT, Bhubaneswar  
7. Dr. (Mrs.) S K Mishra, Director, College of Fisheries, OUAT, Bhubaneswar  
8. Dr. S. K. Panda, Professor and Head, Entomology, OUAT, Bhubaneswar  
9. Dr. S K Dash, Director, Agro-Polytechnic, OUAT, Bhubaneswar  
10. Dr. P. K. Sarangi, Director, Farms, OUAT, Bhubaneswar

**Invitation**

1. Dr. L K Babu, Dean, Students Welfare, OUAT  
2. Mr. Rajendra Kumar Mohanty, Sports Officer  
3. Mr. Parsuram Das, Sports Officer

**Registration**

1. Dr. Manmohan Mishra, OIC, AICRP on Weed Control  
2. Dr. (Mrs.) Diptimayee Jena, Assoc. Professor, College of Home Science  
3. Dr. (Mrs.) S. Tripathy, Assoc. Professor, AICRP on Forage Crops  
4. Dr. (Mrs.) Preetinanda Pati, Assoc. Professor, AICRP on Rapeseed and Mustard  
5. Dr. (Mrs.) Kavita Sethy, Assoc. professor, AICRP on Cashew  
6. Mrs. Sanjivani Sudha Patnaik, Asst. Professor, MCA

**Transport and Accommodation**

1. Dr. B. D. Pradhan, Professor, PBG  
2. Dr. T. K. Mishra, Prof., Soil Science  
3. Dr. Subash Sarkar, AICRP on Vegetable Crops  
4. Mr. Mohit Kumar Behera, AICRP on Weed Control  
5. Dr. B. C. Sahoo, Assoc. Professor, CAET  
6. Mr. Bipin Pradhan, AICRP on Fruits

**Hall and Meeting arrangement**

1. Dr. D. K. Dash, Prof and HOD, FSHT  
2. Dr. L K Rath, Professor, Entomology  
3. Dr. S Palai, Assoc. Professor, AICRP on Floriculture  
4. Dr. S. K. Swain, Assoc. Professor, CAET  
5. Dr. S. K. Mohanty, Assoc. Professor, CAET

**Technical Sessions Management**

1. Dr. B. B. Mishra, Professor and HOD, Botany, C B Sc  
2. Dr. Ch. S K Mishra, Professor and HOD, Zoology, C B Sc  
3. Dr. Bibhuti Prasad Mohapatra, Assoc. Professor, Extension Education, CA  
4. Dr. Ambika Prasad Sahoo, Assoc. Professor, CAET

**Publication and Technical**

1. Dr. B Behera, Professor and HOD, Agronomy, CA
2. Dr. B. S. Rath, Professor and HOD, Agricultural Meteorology, CA
3. Dr. P. K. Pati, Professor and HOD, LPT, CVSc&AH
4. Dr. Mahendra Kumar Mohanty, Assoc. Professor, CAET
5. Dr. R. K. Nayak, OIC, AICRP on Micronutrients
6. Dr. Rabi Ratna Dash, Sr. Scientist, AICRP on Weed Control
7. Dr. Manoranjan Satpathy, Assoc. Professor, Agronomy, CA
8. Dr. Sukanti Bala Mohapatra, Assoc. Professor, Microbiology
9. Dr. G. R. Sahoo, Assoc. Professor, Vety. Biochemistry, CVSc&AH

**Poster session management**

1. Dr. S K Pattnaik, HOD, Soil Science, CA
2. Dr. Chandi Charan Rath, Assoc. Professor, Botany, CBSc and H
3. Dr. Bijaya Kumar Mohapatra, Joint Director, Extension, DEE
4. Dr. Debi Prasanna Das, Asst. Professor, Vety Pathology, CVSc and AH

**Food and Refreshment**

1. Dr. R K Paikray, Professor, Agronomy
2. Dr. J. Padhi, Assoc. Professor, Entomology
3. Dr. K. N. Mishra, Assoc. Professor, AICRP on IFS
4. Mr. Bilas Senapati, AO, Directorate of Extension Education

**Exhibition**

1. Dr. K. C. Barik, ADR, Seeds
2. Dr. Manoranjan Mohapatra, Joint Director, Extension, DEE
3. Dr. Subash Chandra Mohapatra, Joint Director, Video Project
4. Dr. S. M. A. Mandal, Assoc. Professor, Entomology
5. Dr. R. K. Patra, Professor, Soil Science and Ag Chemistry
6. Dr. A K Goel, Assoc. Professor, CAET
7. Dr. A K Dash, Assoc. Professor, CAET

**Cultural Programme and Invocation**

1. Dr. P K Sarangi, ADR, RRTTS, Bhubaneswar
2. Dr. Chintamani Panda, Assoc. Professor, FSHT
3. Dr. Debasish Dash, Asst. Professor, CBSc and H

**Press and Media**

1. Dr. A P Kanungo, Professor, Ag Extension
2. Dr. M P Nayak, JDE (Inf)
3. Dr. S C Sahoo, Directorate of PME, OUAT

**Co-ordination**

Shri Laxmi Narayan Boxi, Editor, exploreodisha.in