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# Entrepreneurship Development Program on

# Organic Farming Systems

## 15-20 February, 2021



***Editors***

Annie Poonam
Ajay Singh Rajput
B.S. Satpathy
Upendra Kumar
Debarati Bhaduri
Niranjan Swain
Sai Krishna Repalli


150 YEARS OF CELEBRATING THE MAHATMA


*Sponsored by:* Rashtriya Krishi Vikas Yojana (RKVY) Odisha (EAP-252)

*Organized by:* Agribusiness Incubation Centre
ICAR-National Rice Research Institute, Cuttack - 753006, Odisha


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एक कदम स्वच्छता की ओर

# Compendium

## Entrepreneurship Development Program
## on

# *Organic Farming Systems*

## 15-20 February, 2021


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भाकृअनुप-राष्ट्रीय चावल अनुसंधान संस्थान, कटक-७५३००६, ओड़िशा

## PREFACE

The growth story of organic farming is unfolding with increasing demand both locally and globally. In a world battered by the COVID pandemic, the demand for healthy and safe food is shooting up. This is providing an opportunistic moment for farmers, consumers and the environment.

India ranks first in number of organic farmers and ninth in terms of area under organic farming. With the aim of assisting farmers to adopt organic farming and improve remunerations due to premium prices, one of the most dedicated programs- Paramparagat Krishi Vikas Yojana (PKVY) was launched in 2015 to encourage chemical free farming. With the simultaneous thrust given by the Agri-export Policy 2018, India can emerge as a major player in global organic markets.

Natural farming is not a new concept in India, with farmers having tilled their land without the use of chemicals - largely relying on organic residues, cow dung, composts, etc. since time immemorial. The philosophy underlying organic farming is integration of the elements – soil, water, microbes, 'waste' products, forestry and agriculture is the correct recipe for sustainable use of natural resources, which are undergoing severe stress due to ever increasing requirement of food and feedstock for agri based industry. This is also in sync with the Sustainable Development Goal 2 targeting 'end hunger, achieve food security, improved nutrition and promote sustainable agriculture'.

This training program aims in providing greater awareness and capacity building to the producers with a future note that Indian organic farmers will soon be reinforcing their rightful place in global agri trade.

This course comprises of interaction with scientists, professors, entrepreneurs, discussions and information/idea exchange with participants for the benefit of prospective entrepreneurs. This compendium comprises of the lecture notes given by eminent scientists and professors in the relevant fields. We had organized this course material for participant's future needs and reference. Contact details of all the participants and faculty members were furnished.

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# Contents


| S. N | Topics | Page No. |
|---|---|---|
| 1 | Organic Farming: Guideline & Standards for Entrepreneurship<br>Debarati Bhaduri | 1-7 |
| 2 | Scope and Operational Structure for Organic Farming<br>Ajay Singh Rajput | 8-14 |
| 3 | Organic based farming system for entrepreneurship<br>Annie Poonam | 15-19 |
| 4 | Crop Production technologies in Organic Farming<br>B.S.Satpathy | 20-33 |
| 5 | Organic Farming & Soil Health Management<br>Upendra Kumar | 34-38 |
| 6 | Handling, Processing and Marketing of Organic Produce<br>Niranjan Swain | 39-41 |
| 8 | Know Your Faculty | 41-42 |
| 9 | Contacts of Participants | 42-43 |

# Organic Farming: Guidelines and Standards for Entrepreneurship

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Certification of organic agricultural produces is as important as production or cultivation methods to be followed for the same. Farmers can grow organic produces with a hope to get more remuneration than usual practice, for that it is much relevant to know the certification process. For the entrepreneurs dealing with organic farm produces should get a complete knowledge about the guidelines and standards to make their produces certified and labelled from competent authority.

As on 31st March 2020, total area under organic certification process (registered under National Programme for Organic Production, APEDA, Ministry of Commerce & Industries, Government of India) is 3.67 million ha (2019-20), including 2.299 million ha cultivable area and another 1.37 million ha for wild harvest collection. India produced around 2.75 million MT (2019-20) of certified organic products which includes all varieties of food products namely oilseeds, sugarcane, cereals and millets, cotton, pulses, medicinal and aromatic plants, tea, coffee, fruits, spices, dry fruits, vegetables, processed foods etc. The production is not limited to the edible sector but also expands to organic cotton fiber, functional food products etc. The total volume of export during 2019-20 was 6.389 lakh MT. The organic food export realization was around INR 4,686 crore (equivalent to 689 million USD). Organic products are majorly exported to the countries like USA, European Union, Canada, Switzerland, Australia, Japan, Israel, UAE, New Zealand, Vietnam etc. In terms of export value realization processed foods including soya meal (45.87%) is leading among the products followed by oilseeds (13.25%), plantation crop products such as tea and coffee (9.61%), cereals and millets (8.19%), spices and condiments (5.20%), dry fruits (4.98%), sugar (3.91%), medicinal plants (3.84%) and others.

Among all the Indian states, Madhya Pradesh has covered largest area under organic certification followed by Rajasthan, Maharashtra, Gujarat, Karnataka, Odisha, Sikkim and Uttar Pradesh. During 2016, Sikkim has achieved a remarkable distinction of converting its entire cultivable land (more than 75000 ha) under organic certification. Among different states Madhya Pradesh becomes the largest producer followed by Maharashtra, Karnataka, Uttar Pradesh and Rajasthan. In terms of commodities, oilseeds are the single largest category followed by sugar crops, cereals and millets, tea & coffee, fiber crops, fodder, pulses, medicinal/ herbal and aromatic plants, and spices and condiments.

**Key Features and Principles of Organic Farming:**

United States Department of Agriculture (USDA) defined as: "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".

FAO suggested that "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".

The **key features** of organic farming include:

1. Protecting the long-term fertility of soils by maintaining organic matter levels, encouraging soil biological activity, and careful mechanical intervention
2. Providing crop nutrients indirectly using relatively insoluble nutrient sources which are made available to the plant by the action of soil microorganisms
3. Nitrogen self-sufficiency through the use of legumes and biological nitrogen fixation, as well as effective recycling of organic materials including crop residues and livestock manures
4. Weed, disease and pest control relying primarily on crop rotations, natural predators, diversity, organic manuring, resistant varieties and limited (preferably minimal) thermal, biological and chemical intervention
5. The extensive management of livestock, paying full regard to their evolutionary adaptations, behavioural needs and animal welfare issues with respect to nutrition, housing, health, breeding and rearing
6. Careful attention to the impact of the farming system on the wider environment and the conservation of wildlife and natural habitats.

The **four principles** of organic agriculture are as follows:

I. **Principle of health:** Organic Agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible.
II. **Principle of ecology:** Organic Agriculture should be based on living ecological systems and cycles, work with them, emulate them and help sustain them.
III. **Principle of fairness:** Organic Agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities.

IV. **Principle of care:** Organic Agriculture should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment.

**Basic Steps of Organic Farming**

- Conversion of land from conventional management to organic management
- Management of the entire surrounding system to ensure biodiversity and sustainability of the system.
- Crop production with the use of alternative sources of nutrients such as crop rotation, residue management, organic manures and biological inputs.
- Management of weeds and pests by better control practices, physical and cultural means and by biological control system
- Maintenance of livestock in tandem with organic concept and make them an integral part of the entire system

**Organic Certification of agricultural produce**

- 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 products from crop, livestock, poultry, Aquaculture, food processing, animal feed, mushrooms, Sea weeds, aquatic plants and greenhouse crops.

*Why certification?*

- Third party assurance from producer to the consumer separated by distance
- For uniform label
- Assurance to the consumers that its concern for quality has been addressed.
- Effective marketing tool for image, credibility, visibility, transparency and traceability


*Labelling for what?*

- Easy recognition of organic quality and certification system.
- Confirms the fulfilment of the label regulations and of legal rules.
- Helps to achieve better price for organic products.

**Principles to be followed:**

- 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 throughout the process-no mixing and co-mingling
- Processing – Physical, mechanical and biological
- Additives, aids and preservatives as per approved list.

**Methods of certification for organic produces:**

1. **Third Party Certification-** Involves more certification fees, specially meant for export of organic products, done by an accredited Certification Agency, National Programme for organic certification (NPOP) does this for export purpose
2. **Participatory Guarantee System (PGS)-** The most economic organic certification system in which all the farmers participate in the process and guarantee for the quality. The product is meant for domestic consumption and creates field for assessing the untouched small and marginal farmers who grow food 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.

***Details of Certification Methods***

**NPOP Certification:**


It is a kind of third party certification procedure under which the farm produce or the processing of agriculture produce is certified in accordance with national or international organic standards by an accredited organic certification agency. NPOP certification is thus facilitated by APEDA (Agriculture Processed Food and Export Development Authority), Ministry of Commerce and Industries, GoI.

**Participatory Guarantee System (PGS-India) certification:**


PGS are locally focussed quality assurance systems, built on a foundation of trust, social networks and knowledge exchange. In case of organic agriculture, PGS is a process in which producers of similar situations assess, inspect and verify the production practices of each other, and collectively declare the entire holding of the group as 'organic'. PGGS-India is facilitated by Ministry of Agriculture & Farmers Welfare, GOI, through National Centre of Organic Farming (NCOF, Ghaziabad) as its secretariat.


**Requirements of certification process**

- Documentation of production process
- Inspection
- Assessment of inspection in relation to the requirements of the organic standard
- Decides about issuing of certificates, conditions and sanctions
- Written confirmation that a process or product is in compliance with standards, the certificate is granted
- Monitoring the market for misuse of certification mark or label

**Policy for promotion of organic farming**

1. **Central Policy**

**<u>Organic Farming Policy, 2005</u> (**Ministry of Agriculture, Department of Agriculture & Cooperation)

The **objectives** of the Policy on organic farming are as follows:

(i) Maintenance of soil fertility by encouraging and enhancing the biological cycle within farming systems involving micro-organisms, soil flora and fauna, plants and animals.

(ii) Identification of areas and crops suitable for organic farming.

(iii) Development of organic package of practices.

(iv) Setting up of model organic farms for getting seed material for organic cultivation.

(v) Assurance of production and supply of quality organic input.

(vi) Adoption of biological methods for pest and disease control.

(vii) Adoption of biological and mechanical methods for weed management.

(viii) Harnessing of traditional and indigenous knowledge relating to organic farming.

(ix) Creation of awareness among farmers towards organic agriculture.

(x) Development of Domestic market for organic produce.

(xi) Improvement of farmers' income through production of quality produce.

(xii) Generation of rural employment opportunity.

(xiii) Simplification of certification system and recognition of adequate certification agencies, especially for domestic market.

(xiv) Promotion of group certification.

(xv) Maintaining a diversity of plant and animal species as a basis for ecological balance and economic stability.

(xvi) Improvement in condition of livestock that allow them to perform all aspects of their innate behaviour.

(xvii) Development of regulatory mechanism for various organic input and organic produce.

**Three priority zones for organic farming have been identified:**

**Category 1**: Are those areas which are rainfed and mostly under monocrop and traditionally no chemical input has ever been used. They can easily be classified as organic produce areas. Broadly, these areas exist in the States of N.E. Region, Jharkhand, Uttaranchal and Rajasthan.

**Category-II**: Are those areas primarily under rainfed farming having little irrigation support. These are normally under monocropping rarely under double cropping. Broadly the States of Orissa, HP, J&K, MP, Chattisgarh and Gujarat and also parts of Maharashtra and Karnataka will fall under this category.

**Category-III**: Are those areas which have moderate to heavy use of chemical fertilisers as well as pesticides. The areas are mostly under multiple cropping. The conversion of these areas into organic farming will initially cause some loss of productivity. For these areas balanced and conjunctive use of biomass, organic and inorganic fertilisers and controlled use of chemicals through integrated nutrient and pest management (INM & IPM) will be promoted to achieve the sustainable increases in agricultural production.

**Major thrust will be given to grow the following crops organically-**

i. Major horticultural crops including vegetables. It will include mainly grapes, banana, mango, papaya, pineapple, guava, passion fruits, mausambi, orange, cashewnut, walnut and fresh vegetables.

ii. Export oriented cereals like basmati rice, and few others like sorghum and pearl millets.

iii. All pulses, soybean, groundnut and cotton.

iv. Chillies, garlic, turmeric, coriander, ginger.

2. **State Policy**

**Odisha Organic Farming Policy, 2018** (Notified as on 20th September, 2018 in Odisha Gazette)

1. The Odisha Organic Farming Policy has been formulated to make farming climate-resilient, reduce the risk of farmers and enhance farm income. It has been planned to promote healthier soils with eco-friendly approaches, reduce input costs and provide market for the organic products. It was prepared in consultation with all the stakeholders.

2. The policy aims to promote organic farming in the State through knowledge dissemination, soil health management, production & supply of quality indigenous seeds, maintenance of bio-diversity in crop systems along with livestock & fisheries, availability of agricultural credit, appropriate farm mechanization, post-harvest management of organic produces and market development & export promotion of organic products with regulatory frame work.

3. Odisha Organic Mission (OOM) will be established as an institutional mechanism to coordinate & complement promotion of organic farming in the State. The Mission will also be responsible for developing necessary programs, and operational mechanisms for implementing various policy and programmes under organic farming. The institutional arrangements to support 'Odisha Organic Mission' are: State Level Steering Committee, State Level Implementation & Monitoring Committee. Department of Agriculture & Farmers' Empowerment will identify the Nodal Agency for implementation of the Odisha Organic Mission in the State

4. It has been targeted to cover 2 lakh hectares of land under organic farming through a combination of activities in Agriculture, Horticulture, Forest and Pasture lands within a period of 5 years. The pattern of assistance proposed to promote organic farming is Rs. 10.00 lakh for a single patch of 50 acres, which may change from time to time. It will be funded through a convergence of PKVY, RKVY, MGNREGA and State Plan budgets. Organic farming will be scaled up both as a sustainable and economically viable, alternate methodology for farmers of Odisha.

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# Scope and Operational Structure for Organic Farming

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## Introduction

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. While the development of industries, agriculture, and food preservation technologies have enabled modern man to live life with many creature comforts, the truth remains that the requirements for human survival are quite basic. Physiological needs include air, water, food, fire, sky. But, human activity is causing environmental degradation, which is the deterioration of the environment through depletion of resources such as air, water and soil; the destruction of ecosystems; habitat destruction; the extinction of wildlife; and pollution. That's why the scope of organic farming in India has been tremendously increasing with the help of new researches made in the field of agriculture. It has facilitated the farmers with new measures for more production eliminating the activity of bypass methods. New techniques which are being innovated are purely related to soil health during organic farming. Apart from these reasons, the discovery of various new diseases arising out of chemical production of fruits and vegetables has clearly set the minds of people for a shift to organic farming.

## Need of Organic Farming

As our population is increasing continuously our compulsion towards organic farming would be not only help to stabilize agricultural production but also to increase it further in sustainable manner. The scientists have understood that the "Green Revolution" with high synthetic input use has reached a plateau and is now sustained with diminishing return of falling dividends. Therefore, a natural balance needs to be maintained at all cost for existence of life and property. The obvious choice for that is to divert our farming system towards organic farming which would be more relevant in the present era, when these agrochemicals which are produced from fossil fuel and are not renewable and are diminishing in availability. It may also cost heavily on our foreign exchange in future.

## Scope of Organic Farming

Agriculture became a high investing and low yielding due to unrestricted use of

synthetic chemicals which are now showing harmful effects to the ecosystem. To protect our ecosystem, farming system needs to be converted into organic farming which is well practiced without using harmful chemicals, they are replaced by bio-fertilizers, bio-pesticides etc. Use of chemical fertilizers kills the useful soil organisms but the organic farming can support the life of soil organisms which in turn will help to increase yield.

Conventional farming is based on the use of high yielding and genetically modified varieties of seeds, chemical fertilizer, irrigation water, pesticides etc. to fulfil the constant growing demand for food grains and also to earn foreign exchange at the cost of environmental quality which cannot be sustainable for future generations, because of the adverse changes being caused to the environment and eco- system. As most good land is already under agriculture and the country have exceeded the safe limit, the natural resources availability for further expansion of farming is practically exhausted. So, the necessity of having an alternative agriculture method which can be functioned in a friendly Eco - system while sustaining and increasing the productivity is need of the day among agricultural scientists as well as common men.

**Organic farming** is considered as the best known alternative. The cost of cultivation will be reduced by not depending upon the market and off- farm inputs. Organic farming is not only for the betterment of farming community, it also revival to the consumers for a ***"Happy and Healthy life"***. So a paradigm shift to Organic farming is the need of the day to enhance the quality of life.

**Structure of Organic Farming**

The organic agriculture concept requires strict compliance with established standards that define and restrict applicable techniques. The common and approved organic farming practices include the following.

**1. Crops & cropping systems**

Organic farms should maintain sufficient diversity in a manner that takes into account pressure from insects, weeds, diseases and other pests, while maintaining or increasing soil organic matter, fertility, microbial activity and general soil health. To achieve this, Crop rotation is a valuable management tool for organic farmers, which involves the cultivation of different crops in temporal succession on the same land chiefly to preserve the productive capacity of the soil. Usually the succeeding crop will be of a different variety and species than the previous crops and should involve one leguminous crop in cropping system.

**2. Organic manures (bulky, concentrate)**

Manures are plant and animal wastes that are used as sources of plant nutrients. They release nutrients after their decomposition. The art of collecting and using wastes from animal, human and vegetable sources for improving crop productivity is as old as agriculture. Manures are the organic materials derived from animal, human and plant residues which contain plant nutrients in complex organic forms. Naturally occurring or synthetic chemicals containing plant nutrients are called fertilizers. Manures with low nutrient, content per unit quantity have longer residual effect besides improving soil physical properties compared to fertilizer with high nutrient content.

Based on concentration of the nutrients, manures can also be grouped, into

a. **Bulky Organic Manures:** ex. Green Manures, FYM, Compost etc.
b. **Concentrated Organic Manures:** ex. Bone meal, oil cakes, blood meal, fish meal

**3. Composting of organic wastes**

Composting is the process of decomposition of organic matter by microorganisms under controlled conditions. Raw organic materials like crop residues, animal wastes, kitchen waste, food waste, some municipal wastes and appropriate industrial wastes, enhance their suitability for application to the soil as a fertilizing resource, after having undergone composting. Based on methods of preparation composting methods are Bangalore method, Indore method, Coimbatore method and NADEP method.

**4. Biofertilizers**

Biofertilizers are ready to use live formulates of such beneficial microorganisms which on application to seed, root or soil mobilize the availability of nutrients by their biological activity in particular, and help build up the micro-flora and in turn the soil health in general. e.g. rhizobium, azotobactor, azospirillum, PSB, ZnSb, KMB etc.

**5. Green manuring**

Green manuring is a practice of ploughing or burying the undecomposed green plant tissues into the soil for improving structure and fertility of the soil. It can be of two types.

a. **Green Manuring in situ:** This is the growing and burying of a green manure crop in the same field as the one to be manured. e.g. Dhaincha, sunhemp, cowpea etc.
b. **Green Leaf Manuring:** It refers to turning into the soil green leaves and twigs collected from shrubs and trees grown on bundhs, wastelands or nearby forest areas. e.g. glyricidia, karanj, neem etc.

**6. Biodynamic preparations**

Biodynamic preparations are preparations that are used for the purpose of enhancing soil quality and stimulating plant life. They consist of mineral, plant, or animal manure extracts, usually fermented and applied in small proportions to compost, manures, the soil, or directly onto plants.

**7. Biopesticides**

Biopesticides are certain types of pesticides derived from such natural materials as animals, plants, bacteria, and certain minerals. Biopesticides fall into three major classes: 1) Biochemical pesticides, 2) Microbial pesticides, 3) Plant-Incorporated-Protectants (PIPs).

**8. ITK's.**

Indigenous Technical Knowledge (ITK) is the actual knowledge of a given population that reflects the experiences based on tradition and includes more recent experiences with modern technologies. Indigenous agricultural practices are an unwritten body of knowledge. There is no systematic record to describe what they are, what they do and how they do what they do, how they can be changed, their operations, their boundaries and their applications. It is held in different brains, languages and skills in as many groups, cultures and environments as are available today. Hence, there is immense pressure on the people of India to collect, preserve, validate and adopt IAPs so as to reduce dependence on external inputs, to reduce the cost of cultivation and to propagate eco-friendly agriculture. e.g. Jeebamrit, Amrit pani, Panchagabya etc.

**Organic Farming Do's and Don'ts**

| Do's | Don'ts |
|---|---|
| Study the NPOP norms before start of Organic Farming. | Never use chemical Fertilisers/Pesticides/Weedicides /Herbicides etc. |
| Learn all kind of Composting methods such as Vermicomposting, NADEP, Indore Method, Bangalore Method etc. | Don't fire crop residues |
| Multicroping and Mixed cropping following crop cycles | Don't use GMO crops |
| Minimum tillage or Zero Tillage for sowing | Don't do deep ploughing |
| Use all FCO-1985 recommended Organic inputs such as Biofertilisers/ Biopesticides | Don't take monocropping |
| Use native seeds as far as possible | Don't use tobacco and Alcohol |
| Select the suitable area where chances of chemical/pesticidal residues will not contaminate the organic area | Don't up root pulses from soil |
| Use Jeevamrit, Panchgavya, Dasparni ark, | Don't use dirty water of drains |

| | |
|---|---|
| Amrit jal/EM solutions/Azolla /BGA/Rock Phosphate etc. | |
| Do green manuring/Natural mulching | Don't spray any harmful synthetic material on crops |
| Use scientifically validated ITKs as per recommendations | Don't use plastic in bulk |
| Use Desi Cow dung and Urine regularly | Human faeces should not be used |

**Government Interventions to Promote Organic Farming**

Government of India has been very actively supporting promotion of organic farming. The National Programme for Organic Production (NPOP) was implemented in the year 2001. The first step in this regard involves the accreditation programme for certification bodies, standard for organic production, promotion of organic farming etc. The NPOP standards for production and accreditation system have been recognized by European Commission and United States Department of Agriculture (USDA). Establishment of the National Centre of Organic Farming (NCOF), Ghaziabad (Uttar Pradesh) in the year 2004 was another milestone in organic farming promotion sector. This centre is promoting National Project on Organic Farming (NPOF) at its HQ as well as its 7 regional centers at Bhubaneswar, Bangalore, Panchakula, Imphal, Jabalpur, Nagpur and Patna. In recent years, some more schemes and programs were implemented by Government of India for promoting organic/ natural farming viz., (1) National Mission for Sustainable Agriculture (NMSA) (2) The Paramparagat Krishi Vikas Yojana (PKVY), (3) Mission Organic Value Chain Development in North East Region (MOVCDNER), (4) Rashtriya Krishi VikasYojana (RKVY), (5) The Mission for Integrated Development of Horticulture and (6) National Project on Organic Farming (NPOF). With rising issues about pesticide residue in crops, National Mission on Sustainable Agriculture (NMSA), came into light in 2014-2015 which was one out of eight missions under the National Action Plan on Climate Change (NAPCC). The strategies and programmes of Actions (POA) defined under this project, aim at promoting sustainable agriculture through different key dimensions encompassing Indian agriculture viz., 'Improved crop seeds, livestock and fish cultures', 'Water Use Efficiency', 'Pest Management', 'Improved Farm Practices', 'Nutrient Management', 'Agricultural Insurance', 'Credit Support', 'Markets', 'Access to Information' and 'Livelihood Diversification'. It was a good step towards spreading awareness about organic farming, but not much successful in accelerating the organic and natural farming in India. PKVY and MOVCDNER are two dedicated schemes for the promotion of organic farming through state governments. They are extension of the NMSA strategies ensuring the natural way of soil management and agricultural practices in rural and especially in north eastern region, however they were of inadequate scales and

objectives. PKVY was launched in 2015 as an elaborate part of soil health management under the Centrally Sponsored Scheme i.e. NMSA. Under these two schemes, technical and financial support have been provided for formation of Farmers' Clusters' Farmer Producer Organisations; incentives to farmers for procurement of agri-input, value addition of crops or agri products including post-harvest infrastructure construction, packaging, branding, publicity, transportation, organic fairs, etc. Along-with RKVY, PKVY was also a scheme which observed Zero Budget Natural Farming (ZBNF) Policy which encourages the use of cow-dung based manure for enhancing micro-organisms in soil. Taking into consideration socio-economic and geographical constraints of north east region, MOVCDNER aims to provide connection between the growers and consumers along with the entire value chain focusing on availability of facilities of collection, aggregation, processing, marketing and branding. Another project in this line was National Project of Organic Farming (NPOF) which was conceptualized earlier but could not due to under-funding. Since last few years, efforts have been made to rejuvenate this project, which has the main objective of making available standard good quality organic inputs at optimum price. Even some other schemes like Capital Investment Subsidy Schemes (CISS), National Mission on Oilseeds and Oil Palm (NMOOP) and The National Food Security Mission (NFSM) are also promoting production of bio-fertilizers and organic fertilizers. Besides, Government of India has launched PGS-India portal and jaivik kheti portal for cost free certification and marketing of organically grown crops respectively.

The Indian Council of Agricultural Research (ICAR) has also established a new research institute named 'National Organic Farming Research Institute' (ICARNOFRI) in Gangtok (Sikkim) in the year 2016. The major mandate of this institute is to conduct basic research on sustainable organic farming systems for improving productivity, resource use efficiencies and quality of produce. ICAR's Network Project on Organic Farming, Modipuram (Uttar Pradesh) is actively working on technology packages for cultivation of organic crops suitable for the entire country. Besides, many ICAR institutions and state agricultural universities are also promoting organic farming through their research, training and extension activities.

**Table: 1**
Area wise major states in India
(In Hectares)

| S.N. | State | Area |
|---|---|---|
| 1 | Madhya Pradesh | 6,74,052 |
| 2 | Maharashtra | 250,934 |

**Table: 2**
Production wise major states in India
(In Tonnes)

| S.N. | State | Production |
|---|---|---|
| 1 | Maharashtra | 8,095,734 |
| 2 | Madhya Pradesh | 7,386,877 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 3 | Rajasthan | 223,991 | | 3 | Karnataka | 3,65,848 |
| 4 | Odisha | 95,739 | | 4 | Uttar Pradesh | 1,42,512 |
| 5 | Gujarat | 93,841 | | 5 | Rajasthan | 1,34,611 |
| 6 | Karnataka | 83,098 | | 6 | Odisha | 88,948 |
| 7 | Sikkim | 75,799 | | 7 | Gujarat | 66,106 |
| 8 | Uttar Pradesh | 62,848 | | 8 | Assam | 38,456 |
| 9 | Meghalaya | 48,409 | | 9 | J & K | 33,678 |
| 10 | Uttarakhand | 36,658 | | 10 | Uttarakhand | 29,601 |

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# Organic based farming systems for Entrepreneurship

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**Organic farming methods** are mainly aimed at cultivating **crops** in such a way that it keeps the soil alive. This system mostly makes use of **organic** wastes which comes from the animal, crop, **farm**, and aquatic wastes and other biological materials along with useful microbes (biofertilizers) to release nutrients to **crops**.

**Methods of organic farming to be aware of:**

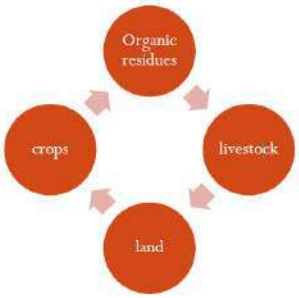
- **Crop rotation:** In this form of organic farming, farmers do not grow the same crops on the same section of land year after year. If you are thinking why there are numerous benefits associated with this practice, this technique naturally replenishes the soil as diverse plants donate nutrients to the soil. Also, disrupting the habitat of weeds and insect pests helps control them.
- **Crop diversity:** Old-style farming practices follow a monoculture in which only one type of crop is cultured in a particular piece of land. Nowadays, diverse crops are cultivated instantaneously on the same plot of land. This is a type of organic farming method which is also known as polyculture and is a great way to meet the rising demand for crops. This technique also helps in producing the required soil microorganisms, restricting weeds and pest.
- **Biological pest control:** The agricultural field contains a mixture of the organism, some of which are used for cultivation and some are damaging. The development of these organisms must be under control to guarantee the protection of the field and the crops. Pesticides and herbicides that comprise of fewer chemicals or are natural can be used for pest control.

**Farming system?**

Farming system is a set of agro economic activities that are interrelated and interact with themselves in a particular agrarian setting. It is a mix of farm enterprises to which farm families allocate its resources in order to efficiently utilize the existing enterprises for increasing the productivity and profitability of the farm. These farm enterprises are crop, livestock, aquaculture, agro forestry and agri-horticulture (Sharma *et al* 1991).

***Key principles of Farming Systems***

- **Cyclic**




The farming system isessentially cyclic (organic resources – livestock –land – crops).Therefore, management decisions related to one component may affect the others

- **Rational**

Using crop residues more rationally is an important route out of poverty. For resource-poor farmers, the correct management of crop residues, together with an optimal allocation of scarce resources, leads to sustainable production.

- **Ecological sustainable**

Combining ecological sustainability and economic viability, the integrated livestock-farming system maintains and improves agricultural productivity while also reducing negative environmental impacts.

***Scope of Farming System***

Farming enterprises include crop, livestock, poultry, fish, agro-forestry etc. A combination of one or more enterprises with cropping when carefully chosen, planned and executed gives greater dividends than a single enterprise, especially for small and marginal farmers. Farm as a unit is to be considered and planned for effective integration of the enterprises to be combined with crop production activity.


**Factors influencing Integration of Farm Enterprises**

- Soil and climatic features of the selected area.
- Availability of the resources, land, labor & Capital.
- Present level of utilization of resources.
- Economics of proposed integrated farming system.
- Managerial skill of farmer

**Time and space concept**

- Time concept relates to increasing crop intensification in situation where there is no constraint for inputs.
- In rainfed areas where there is no possibility of increasing the intensity of cropping, the other modern concept (space concept) can be applied. In space concept, crops are arranged in tier system combining two or more crops with varying field duration as intercrops by suitably modifying the planting method.
- Income through arable cropping alone is insufficient for bulk of the marginal farmers. Activities such as dairy, poultry, fish culture, sericulture, bio-gas production, edible mushroom cultivation, agro-forestry and agri-horticulture, etc., assumes critical importance in supplementing farm income. It should fit well with farm level infrastructure and ensures full utilization of bye-products. Integrated farming system

is only the answer to the problem of increasing food production for increasing income and for improving the nutrition of small scale farmers with limited resources.

**Goals of farming system**

- provide a steady and stable income rejuvenation/amelioration of the system's productivity
- and achieve agro-ecological equilibrium through the reduction in the build-up of pests and diseases, through natural cropping system management and the reduction in the use of chemicals (in-organic fertilizers and pesticides).

**Benefits or Advantages of Integrated Farming System**

- Double productivity
- Increase profitability
- Potentiality or sustainability
- Provide balanced food
- Provide scope for adoption of new technology
- Saves energy through use of natural resources
- Meting fodder crises
- Solving fuel and timber wood
- Environmental safety
- Recycling of organic waste with high efficiency
- Income flow round the year
- Increased employment generation
- Lead to minor Agro-industries
- Climate Resilient reducing risk

***Success example of farming system***

**Integrated rice-duck-fish farming**: It is a low-cost, organic farming method for small entrepreneurs of coastal India where there is a large scope for integration of these three enterprises. By raising ducks in the rice paddy field, a 20 -30 % higher crop yield is obtained per unit of area per unit of time and net income, on a cash cost basis, is increased by 80% eliminating the use of chemicals/ pesticides. The ducks effectively control insect and weed populations in rice crops which encourages cleaner organic agricultural practices. The ducks and fish also add value and provide another source of income for farmers and farm families. Higher income from the rice-fish-duck system is generated in three ways namely: the higher rice yield; the reduced cost of production; and the additional income from the fish and ducks

from the same available resources. Benefit from rice-fish -duck farming practices is a practical way for small-scale farmers to gains opportunities following entrepreneurship through organic way.

# Crop production technologies in organic farming

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Organic farming is a production system in which integration of traditional practice, modern innovation and science in crop management and animal husbandry to ensure production of quality foods in sufficient quantity on sustainable manner. Organic farming promotes and enhances soil health and health of agro-ecosystems through enhancement of soil microbial activity in crop production system. The International Federation of Organic Agriculture Movements (IFOAM) states that "Organic agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of external inputs. In Organic farming use of synthetic compounds such as, fertilizers, pesticides, growth regulators and livestock food additives are completely prohibited. This production system promotes use of locally available natural resources for management of crops with adequate biodiversity and biological activity in the soil which ultimately creates opportunity to farmers to earn their livelihood satisfactorily. The demand for sustainable agriculture helped for shifting of "resource degrading" chemical agriculture to a "resource protective" biological or organic farming. The success of organic farming mainly depends on adoption of suitable agronomic practices for management of soil, crop, water and atmosphere in holistic manner for augmenting crop production without degrading the soil and environment. Well defined crop production technologies for different organic crops under different ecologies for achieving optimum production and profit has been reported by several workers. Crop production technologies particularly management of planting materials, nutrients, weeds, insect-pest and diseases are important cultural practices for profitable crop production in organic farming. Beside the crop production technologies some other aspects like conversion period for establishment of an organic land for safe production of quality organic produce is to be taken care. With the development of suitable organic land, selection of suitable crops, varieties and adoption of organic agronomic practices will help to produce sufficient quality foods to meet the future demand.

## *Basic concept and principles of organic farming*

All the management practices followed in organic farming are governed by the principles of ecology and are within the ecological means. The basic concepts behind Organic farming are:

•It focusses on development of soil fertility and productivity by enhancing biological activities in plant rhizosphere so that the crops can absorb nutrients steadily to meet the requirement in quality and quantity at appropriate growth stage.

• Management of weeds, insect-pest and diseases at economic injury level by the use of bio-pesticides, bio-agents, physical and cultural means to develop ecological balance.

• Organic farming encourages reuse and recycle of all organic wastes with in the production system to manage the nutritional requirements of crops without mining the soil base. It also helps in minimum use of off farm inputs in crop production.

• Conservation of energy and resources to be given priorities to maintain "top up" soil fertility.

Agronomical management practices in organic farming should take full advantage of ecological cycles. According to IFOAM, organic agriculture is guided by following four principles: Principles of health, principles of ecology, principles of fairness and principles of care. Principles of health takes care of soil health, crop health, health of environment and health of human beings and animals. Organic production system should be managed carefully and responsible manner to protect the health and well-being of current and future generations and the environment. These principles of organic farming help in maintenance of long-term fertility of soils, minimises all forms of pollution, reduces use of fossil energy to minimum level and produces foods of high nutritional quality. The crop production in organic farming is based on following objectives

•To produce food of high nutritional quality in sufficient quantity

•To maintain and increase the long-term fertility of soil and biodiversity

• To use renewable resources in locally organized production systems

•To work as much as possible within a close system with regard to organic matter and nutrient elements and draw up on local resources

•To avoid all forms of pollution that may results from agricultural techniques

•To reduce the use of fossil energy in agricultural practice to the minimum

***Status of organic farming in India***

Globally organic agriculture is rapidly gaining popularity and is practiced in more than 120 countries covering in about 1.5% area of total agricultural land (Anonymous, 2020). According to the latest survey conducted by FIBL in 2018, globally about 71.5 mha area is under organic agriculture which includes the area under conversion period. Out of these the Oceania region records 36 mha followed by Europe (15.6 mha), Latin America (3.3 mha) and Africa (2.0 mha). In India area under organic agriculture is increasing slowly in different

regions under different ecologies. In India, prior to green revolution natural farming was most common practice in majority of states particularly in rained regions. The practice of intensive agriculture to feed the growing population led to the increased use of chemicals in crop production system. However, continuous use of these high energy inputs indiscriminately affected the factor productivity and leads to deterioration of soil health and environments. These situations warranted adoption organic agriculture with judicious integration of traditional farming with modern knowledge and technologies to develop a sustainable agricultural production system.

At present morethan 1mha in India is under organic farming covering major area in states like Sikim, Himachal Pradesh, Uttaranchal, Gujarat, Kerala, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu and Odisha where 5,48045 farmers produce 17.11 lakh tonnes of food (Kulkarni, 2011). Madhya Pradesh has the maximum area of 1.1 m ha followed by Maharashtra (0.96 m ha) and Odisha (0.67 m ha). Among organic productions, cotton represents about 75% whereas the cereals, vegetables, fruits and animal products under certified organic production accounts only 25% (Barik, 2011). The crops include cereals (paddy, wheat), pulses (pigeonpea, black gram); oilseeds (mustard, sesame, castor, sunflower); vegetables (aubergine, okra, garlic, onion, potato, tomato); spices (black pepper, cardamom, ginger, turmeric, vanilla, tamarind, clove, cinamom, nutmeg); plantation crops (tea, coffee, cashew nut, walnut) and fruit crops (mango, banana, pineapple, grapes, oranges).

To encourage organic farming the Indian government has established a National Programme on Organic Production (NPOP) in 2001. The activity is coordinated by the National Centre for Organic Farming based at Ghaziabad (Uttar Pradesh) with regional sub-centres at Bangalore, Bhubaneshwar, Hisar, Imphal, Jabalpur and Nagpur. There are 16 NPOP accredited certifying bodies in India. The standards and procedures are formulated in a harmony with international standard prescribed by CODEX and International Federation of Organic Agriculture Movement. This certification assures the buyer of quality of the farm produce and encourages payment of premium prices to farmers. The Agricultural and Processed Food Products Export Development Authority (APEDA) has been actively involved in promoting organic farming through its certification programme. At present, credentials set up by NPOP and APEDA have been well accepted by European Union, USA and other importing countries where appreciation of organic products has gone up tremendously owing to the enhanced awareness for healthy foods among consumers. In India, demand for organic foods in increasing due to issues of adulteration and contamination in

food, growing incomes of middle class citizens, initiative by private sectors in opening retail outlets and technological innovations.

***Crop production technologies in organic farming***

Organic crop production management includes several crop production strategies which are discussed below:

*(i)Crop Production Plan*

To get required certificate from the registered certifying agency the organic grower should follow an appropriated crop production plan which contains the following information's.

•Description of practices and procedures to be performed and maintained.

•List of inputs along with their composition to be use in the production, frequency of usage, application rate and source of commercial availability.

•Source of organic planting material (seeds and seedlings).

•Descriptions of monitoring practices and procedures to be performed and maintained to verify that the plan is being implemented effectively.

•Description of the management practices and physical barriers established to prevent commingling and contamination of organic production unit from conventional farms, split operations and parallel operations.

•Description of the record keeping system implemented to comply with the requirements.

*(ii) Conversion Requirements and duration of conversion period*

To establish an exclusive organic production system in an area an interim period is required to develop natural soil fertility which is known as the conversion period. It is the period in which grower has to take action to meet the requirements prescribed under certification Standards to produce organic products are started. The start of the conversion period may be calculated from the date first inspection of the operator by the Certification Body. In case of annual and biennial crops, plant products produced can be certified organic when the requirements prescribed under these Standards have been met during the conversion period of at least two (2) years (organic management) before sowing (the start of the production cycle). Whereas in case of perennial plants other than grassland (excluding pastures and meadows), the first harvest may be certified as organic after at least thirty-six (36) 22 months of organic management according to the requirements prescribed under these Standards. Organic products in conversion shall be sold as "produce of organic agriculture in conversion" or of a similar description, when the requirements prescribed under these

Standards have been met for at least twelve months. The accredited Certification Bodies is the sole authority to decide the conversion period required under a set of production system.

*(iii) Land scape*

A well-defined farm planning and land scape is desirable under organic production system. Organically managed farm lands should facilitate biodiversity within the system in the following manner

- Presence of extensive pastures, meadows, extensive grassland, extensive orchards, hedges, hedgerows, groups of trees and/or bushes and forest lines.
- Well defined ecologically rich fallow land or arable land.
- Having ecologically diversified (extensive) field margins.

*(iv) Choice of Crops and Varieties*

Selection of appropriate crop and crop varieties are key indicators in production of organic products profitability under a particular ecology. The following criteria to be followed while selection crop, varieties and seed materials for organic production.

•All seeds and plant material used in the cultivation shall be certified organic.

•Species and varieties cultivated shall be adapted to the soil and climatic conditions and be resistant to pests and diseases.

•In the choice of varieties, genetic diversity shall be taken into consideration.

•When organic seed and plant materials are available, they shall be used. Whereas When certified organic seed and plant materials are not available, chemically untreated conventional seed and plant material shall be used.

•The use of genetically engineered seeds, transgenic plants or plant material is prohibited.

*(v)Diversity in Crop Production & Management Plan*

The basic concept of crop production in organic farming is the minimised losses of natural resources particularly plant nutrients from the soil by the development natural fertility in the production system. The organic farms shall be required to maintain sufficient diversity by considering pressure from insects, weeds, diseases and other pests and maintaining or increasing soil, organic matter, fertility, microbial activity and general soil health. Soil fertility shall be maintained through, the cultivation of legumes or deep rooted plants and the use of green manures, along with the establishment of a programme of crop rotation and fertilization with organic inputs.

*(vi) Nutrient management options in organic farming*

Nutrient management is the key factor for all crop production systems. Conventional agriculture is based on concept of fertilizing the crop while in organic agriculture, it is for 'fertilizing the soil. A living soil is the basis of organic farming. The organic farming system takes local soil fertility as a key to successful production. The following points to be taken care in nutrient management under organic production.

- Biodegradable material of microbial, plant or animal origin produced on organic farms shall form the basis of the nutrient management
- Fertilization management should minimize nutrient losses. Accumulation of heavy metals and other pollutants shall be prevented.
- Non synthetic mineral fertilizers and brought-in bio fertilizers (biological origin) shall be regarded as supplementary and not as a replacement for nutrient recycling.
- Desired pH levels shall be maintained in the soil by the producer.
- The certification programme shall set limitations to the total amount of biodegradable material of microbial, plant or animal origin brought onto the farm unit, taking into account local conditions and the specific nature of the crops.
- All synthetic nitrogenous fertilisers are prohibited.

*Sources of nutrient in organic farming*

Use of synthetic fertilisers is totally prohibited and external farm inputs to be kept at minimum level and following components are combined as their compatibility adds to synergistic effect for management soil health and productivity.

(a) *Green manuring*

Green manuring is the practice of growing a short duration quick growing legume crop and incorporation in the field at appropriate vegetative stage to add organic matter and plant nutrients to the soil. Different crops suitable for green manuring are listed in Table 1. Green leaf manuring refers to adding the lopping's from legume plants or trees to a field and then incorporating them into the soil by ploughing. Green leaves, twigs of trees, shrubs and herbs growing on wastelands and field bunds are collected and applied in the field is known as green leaf manuring. The important plant species useful for green leaf manuring are neem (*Azadirachta indica*, 2.83% N), mahua (*Madhuca longifolia,* 1.66% N), wild indigo (*Tephrosia purpurea,* 2.9 – 3.2% N), calotropis (*Calotrophis gigantean,* 2.06% N), glyricidia (*Gliricidia sepium,* 2.76% N), karanj *(Pongamia glabra,* 3.31% N*),* subabul (*Leucaena leucocephala,* 3.83–4.25% N) and other shrubs. Green leaf manuring improves soil structure, increases water holding capacity, decreases soil loss by erosion, reduces weed growth. It is

often recommended for the reclamation of alkaline soils. The application of green leaf manuring enhances rice grain yield by 9.5% .

*Organic manures*

Manures are sources of plant nutrients that originated mainly from plant and animal wastes. Organic manures may be bulky or concentrated. The examples of bulky organic manures are: farmyard manure (FYM), compost, green manure, while the example of concentrated organic manure is oil cakes. Besides increasing the availability of nutrients, organic manures improve soil physical properties like soil structure, water holding capacity, *etc*. Vermicompost is a metabolic product of earthworms. Decomposition is quicker when *Trichoderma* or "*Panchagavya*" is added to organic matter and this process results in compost of greater nutritive value. Nutrient content of some bulky and concentrate organic manures are presented in Table 3.

(b) *Biofertilisers*

Biofertilizers are the substances that contain carrier-based (solid or liquid) microorganism's living or latent cells. They are useful in terms of nutrient mobilization to increase productivity. They increase the nutrient content of host plants when applied as a seed treatment or soil application by colonizing the rhizosphere of the plant. Biofertiliser are key components of nutrient management in organic production system. Major biofertilsers, target crops and economic benefits are mentioned in Table 4 and 5

(c) *Crop residues*

About 502 mt crop residues are produced annually in India out of these 141 mt are surplus available for recycling after meeting other competitive uses. Under conservative estimates of the residues contain 0.5, 0.25 and1.0% of N, P2 O5 and K2O respectively on dry weight basis. The huge potential of these crop residues can be used as a source of plant nutrients in the organic farming. Incorporation of crop residues in the soil not only adds plant nutrients to the soil it also acts as soil amendment thus influences the soil health. Nutrient content of some of the crop residues are described in Table 6.

(d) *Liquid manures*

Application of liquid manure (for soil enrichment) is essential to maintain the activity of microorganisms and other life forms in the soil. 3-4 applications of liquid manure are essential for all types of crops. Liquid manures such as Jivamrutha, vermiwash, cow urine , Panchgavya compost tea and Biosol etc. are excellent growth promoters when used as foliar spray.

(e) *Minerals*

The mineral based materials like rock phosphate, gypsum, lime stone, calcium chloride, Sodium chloride Magnesium rock and chalk etc. can be applied in limited quantities when there is absolute necessity. The product such as Saw dust, wood shaving from untreated wood and plant preparation and extracts products are permitted for use in manuring/soil conditioning in organic field.

***Cultural methods for nutrient management under organic farming***

Important cultural methods to manage soil health and nutritional need of the plants are listed below:

- Effective and useful rotation of crops.
- Ideal intercropping with complimentary interactions.
- Alley cropping with N-fixing trees.
- Practice of homestead farming.
- Soil and water conservation practices
- Fallowing.
- Establishment of vegetative bunds.

Changing crop rotations and multiple crops ensure better utilization of resources. Legume crop like beans, peas, cowpea etc. is to be included in the crop rotation to improve the soil fertility by fixing atmospheric nitrogen. Inoculation of legume crop specific rhizobium strains can further improve their N- fixing ability. The quantity of N fixed by different crops is given in the Table. 8

Products permitted for use in organic farming for management of soil fertility and health are tabulated in Table 8. The products or inputs which to be completely prohibited in organic farming are mentioned in Table 9. Similarly, the materials have restricted used based on production site and region are tabulated in Table 10

***Insect-pest, diseases and weed management in organic farming***

Crop production practices in organic farming ensures that losses from pests, diseases and weeds are minimized. Weeds, pests and diseases shall be controlled through a number of preventive cultural techniques which limit their development in a balanced nutrient management programme, e.g. suitable rotations, green manures, early and pre drilling seedbed preparations, mulching, mechanical control and the disturbance of pest development cycles. Accredited certification programmes shall ensure that measures are in place to prevent transmission of pests, parasites and infectious agents.

Pest management shall be regulated by understanding and disrupting the ecological needs of the pests. The natural enemies of pests and diseases shall be protected and encouraged through proper habitat management of hedges, nesting sites etc. And ecological equilibrium shall be created to bring about a balance in the pest predator cycle. Products prepared at the farm from local plants, animals and microorganisms, shall be encouraged to use for pest management. Integrated insect-pest management, integrated disease management and integrated weed management should be including in crop production under organic agriculture. The use of synthetic herbicides, fungicides, growth regulators, synthetic dyes insecticides and other pesticides are prohibited. The use of genetically engineered organisms or products is prohibited

*Components of weed management under organic farming*

*(a)Preventive methods*

•Avoid the entry of weed seeds onto the farm through manures, mulching material, cultivation equipment's, animals and water etc.

•Always use quality seed fire from wee seeds

*(b)Weed control practices*

•Cultural methods

•Physical methods

•Mechanical methods

• Biological methods

The following cultural methods should be given importance for weed control in organic agriculture.

•The inclusion of a fallow period in the rotation in known to reduce perennial weeds

•The inclusion of cover crops such as rye, red clover, buckwheat and oilseed, radish or over wintering crops like winter wheat or forages in the cropping system can suppress weed growth.

•Cover crop residues on the soil surface will suppress weeds by shading and cooling the soil

Intercropping, tillage operations, mulching, selection of weed competitive varieties, field sanitation, thermal weed control like soil solarisation, stale seed bed technique, biological weed control by allopathy and by use of bio herbicides are viable options available for weed control in organic farming.

*Components of Insect-pest and disease management in organic farming*

Selection of varieties resistance to multiple biotic stresses, use of quality seed/ planting materials, seed treatment with bio-agents, monitoring of pest and diseases are

principle methods to minimize incidence of pest attack. Management of pest by cultural, physical, mechanical and biological methods holds key role in organic production system.

***Integrated crop management in organic rice***

•Use of quality seeds free from weed seeds and insect-pest and disease.

•Green manuring with dhaincha or azolla.

•Hot water treatment of seeds at 53-54 0C against brown spot.

•Seed treatment with *Pseudomonas flourescens* @ 6 g per kg seed or dry seed treatment with *Pseudomonas fluorescens* talc formulation @ 10 g/kg or *Trichoderma* formulation @ 10 g/kg of seeds.

•Seed treatment with *azospirillum*/*azotobacter* and PSB @ 20g/kg of seeds or seedling root dip in solution of *azotobacter*/*azospirillum* and PSB @ 1kg/50 lit of water for 8-10 hrs.

•Apply FYM @10-15 t/ha or vermicompost @ 3-6 t/ha as basal dose

•Apply Neem cake @ 500kg/ha

•Application of goat manure @1-2 t/ha as basal helps to overcome the deficiency of micro nutrients

•Inclusion pulse crops in cropping sequence

•Use of pheromone trap

•Use of light trap

•Spray *azadiractin* (neem)formulation 0.15 EC @ 800 ml/acre at 10 DAT followed by second spray after 20 days interval to control stem borer/ leaf folder.

•Spray *Beauveria bassiana* @ 7 g/l at the boot leaf stage to reduce Gundhi bug population.

•Weed control by using finger weeder at 20 and 40 DAT or manual weeding at 20 and 40 DAT of rice crop.

***Conclusion***

Organic farming is a production system which ensures production of quality foods in sufficient quantity on sustainable manner. The success of organic farming mainly depends on adoption of suitable agronomic practices for management of soil, crop, water and atmosphere in holistic manner for augmenting crop production without degrading the soil and environment. Crop production technologies for different organic crops under different ecologies for achieving optimum production and profit has been established and particularly management of planting materials, nutrients, weeds, insect-pest and diseases are important cultural practices for profitable crop production in organic farming. With the development of suitable organic land, selection of suitable crops, varieties and adoption of organic agronomic practices will help to produce sufficient quality foods to meet the future demand.

**Table 1 Productivity and nitrogen content (fresh wt. basis) in some green manure crops**

| Crop | Green biomass (t/ha) | Nitrogen (%) |
|---|---|---|
| Sun hemp | 09-11 | 0.8 |
| Dhaincha | 20-22 | 0.43 |
| Cowpea | 15-16 | 0.49 |
| Cluster bean | 20-22 | 0.34 |
| Berseem | 15-16 | 0.43 |
| Green gram | 08-09 | 0.53 |

**Table 2 Nutrient content (dry weight basis) in some green manure crops**

| Green manure crop | Nutrient content ( % on dry weight basis) | | |
|---|---|---|---|
| | N | P | K |
| *Sesbania aculeata* | 3.3 | 0.7 | 1.3 |
| *Sesbania speciosa* | 2.2 | 0.5 | 2.2 |
| *Crotalaria juncea* | 2.6 | 0.6 | 2.0 |
| *Tephrosia purpurea* | 2.4 | 0.3 | 0.8 |
| *Phaseolus trilobus* | 2.1 | 0.5 | - |
| Green gram | 2.0 | 0.42 | 2.5 |
| Black gram | 2.0 | 0.40 | 2.0 |
| *Pongamia glabra* | 3.2 | 0.30 | 1.3 |
| *Glyricidia maculeata* | 2.9 | 0.50 | 2.8 |
| *Azadirachta indica* | 2.8 | 0.30 | 0.4 |
| *Calotropics gigantea* | 2.1 | 0.70 | 3.6 |

**Table 3 Nutrient content of some of organic manures**

| | Nutrient content (%) | | |
|---|---|---|---|
| | N | P2O5 | K2O |
| Bulky organic manures | | | |
| Cattle dung and urine mixed | 0.6 | 0.15 | 0.45 |
| Poultry manure (fresh) | 1.0-1.8 | 1.4-1.8 | 0.8-0.9 |
| Sheep dung | 0.95 | 0.35 | 1.00 |
| Farm yard manure dry | 0.5-1.5 | 0.4-0.8 | 0.5-1.9 |
| Rural compost dry | 0.5-1.0 | 0.4-0.8 | 0.8-1.2 |
| Urban compost dry | 1.0-2.0 | 0.9-3.0 | 1.0-2.0 |
| Sewage sludge dry | 2.0-2.5 | 1.0-1.2 | 0.4-0.5 |
| Sewage sludge activated dry | 5.0-6.5 | 3.0-3.5 | 0.5-0.7 |
| Vermicompost | 0.51-1.61 | 0.19-1.02 | 0.15-0.73 |
| Castor cake | 5.5-5.8 | 1.8-1.9 | 1.0-1.1 |
| Neem cake | 5.2-5.3 | 1.0-1.1 | 1.4-1.5 |
| Linseed cake | 5.5-5.6 | 1.1-1.5 | 1.2-1.3 |
| Niger cake | 4.7-4.8 | 1.8-1.9 | 1.3-1.4 |
| Groundnut cake | 7.0-7.2 | 1.5-1.6 | 1.3-1.4 |
| Mahua cake | 2.5-2.6 | 1.8-1.9 | 1.8-1.9 |
| Karanja cake | 3.9-4.0 | 0.9-1.0 | 1.3-1.4 |
| Coconut cake | 3.0-3.2 | 1.8-1.9 | 1.7-1.8 |
| Sesame cake | 6.2-6.3 | 2.0-2.1 | 1.2-1.3 |
| Rapeseed cake | 5.1-5.2 | 1.8-1.9 | 1.1-1.3 |
| Cotton seed (decorticated) | 6.4-6.5 | 2.8-2.9 | 2.1-2.2 |

Source: Fertilizer Statistics, 2003-04

**Table 4 Major biofertilisers and target crops:**

| *Bio-fertilizers* | Target crop |
|---|---|
| *Rhizobium* | Leguminous crops |
| *Azotobacter* | Wheat, maize, cotton, mustard and vegetables (potato,onion, tomato, brinjal and others |
| *Azospirillum* | Cereal crops like wheat, maize, millets, sorghum, barley and sugarcane |
| *Gluconacetobacter diazotrophicus* | Sugarcane, sweet sorghum, tea, coffee |
| Blue green algae ( BGA) | Rice |
| Phosphate solubilizing microorganisms | All |
| Potassium mobilizing bacteria | All crops particularly maize, potato |
| Zinc solubilizing bacteria | All |
| Arbuscular mycorriza | Nursery raised crops and other trees |

**Table 5 Economics of bio-fertiliser application**

| Bio-fertilizers | Rate of application Kg/ha) | Method of application | Cost of application (Rs/ha) | Amount of nutrients fixed/mobilised | Other benefits |
|---|---|---|---|---|---|
| Rhizobium | 0.5 | Seed inoculation | 30-100 | 25 | Plant growth promotion |
| Azotobacter | 0.5 | Seed, seedlings and soil application | 50-100 | 18 | Plant growth promotion |
| Azospirillum | 0.5 | Seed inoculation | 50-100 | 20 | Plant growth promotion |
| Blue green algae | 1.0 | Soil application | 50-100 | 25 | Plant growth promotion |
| P -solubilizer | 0.5 | Seed inoculation | 20-30 | 25 kg of P2O | Plant growth promotion |
| AM inoculants | 5.0 | Soil application | 500-600 | 25 kg of P2O and micronutrients | Plant growth promotion |

Source: Prasanna *et al*. (2014)

Table 6 Nutrient content of some crop residues (%)

| | Nutrient content ( %) | | |
|---|---|---|---|
| | N (%) | Phosphoric acid (%) | Potash (%) |
| Groundnut husk | 1.6-1.8 | 0.3-0.5 | 1.0-1.7 |
| Banana dry | 0.61 | 0.12 | 1.0 |
| Cotton | 0.44 | 0.10 | 0.66 |
| Maize | 0.42 | 1.57 | 1.65 |
| Paddy | 0.32 | 0.08 | 0.71 |
| Tobacco | 1.12 | 0.84 | 0.80 |

| | | | |
|---|---|---|---|
| Pigeon pea | 1.10 | 0.58 | 1.28 |
| wheat | 0.53 | 0.10 | 1.10 |
| Sugarcane trash | 0.35 | 0.10 | 0.6 |
| Tobacco dust | 1.10 | 0.31 | 0.93 |

Table 7: Nitrogen fixation by some of legume crops in crop rotation

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

**Table 8: Products permitted to use in organic farming for nutrient management**

| |
|---|
| Farmyard & poultry manure, slurry, cow urine produced in organic farm, Crop residues and green manure produced in organic farm, Straw and other mulches produced in organic farm, Sawdust, wood shavings, wood provided it comes from untreated wood, Compost from organic household reference, Calcified seaweed, Calcium chloride, Calcium carbonate of natural origin (chalk, limestone, gypsum and phosphate chalk), Sodium chloride, Magnesium sulphate (Epson salt), Gypsum (Calcium sulphate), Clay ((bentonite, perlite, zeolite), Microbial preparations such as bacterial preparations (biofertilizers), Biodynamic preparations , Plant preparations and botanical extracts Vermiculate and peat |

**Table 9: Products/ materials restricted to use in organic farming**

| |
|---|
| Blood meal, meat meal, bone meal and feather meal without preservatives, Compost made from any carbon based residues (animal excrement including poultry), Farmyard manure, slurry, cow urine (preferably after control fermentation and/or appropriate dilution), Fish and fish products without preservatives, Guano, By-products from the food and textile industries of biodegradable material of microbial, plant or animal origin without any synthetic additives By-products from the food and textile industries of biodegradable material of microbial, plant or animal origin without any synthetic additives, Seaweed and seaweed products obtained by physical processes extraction with water or aqueous acid and/or alkaline solution , Sewage sludge and urban composts from separated sources which are monitored for contamination, Straw, Animal charcoal, Compost and spent mushroom and vermiculate substances, By products from oil palm, coconut and cocoa (including empty fruit bunch, palm oil mill effluent (pome), cocoa peat and empty cocoa pods), By products of industries processing ingredients from organic agriculture Basic slag Calcareous and magnesium rock, Mineral potassium with low chlorine content (e.g. |

sulphate of potash, kainite, sylvinite, patenkali), Natural phosphates (e.g. Rock phosphates), Pulverised rock,

Trace elements (Boron, Ferrous, Manganese, Molybdenum, Zinc), Wood ash from untreated wood, Sulphur.

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## Organic Farming & Soil Health Management

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### *Azolla* a potential nitrogen source for enhanced rice yield

Application of urea in rice crop is slowly turning out to be toxic with environmental hazards. Moreover, frequent application of urea is increasing the input cost of agriculture. In this scenario, eco-friendly *Azolla* can be used as bio-fertilizer in rice crop to fix the atmospheric nitrogen in association with blue green algae. Utilisation of *Azolla* as a bio-fertilizer can be taken up as entrepreneurship opportunity.

### Recommended dose

It is recommended that 10-15 tons-fresh weight of *Azolla* is required for one hectare of rice crop, which can supply around 20-40 kg N/ ha/ 20-75 days with increasing grain yield by 10-30%

### Entrepreneurial opportunity

The total annual cost of production for 10 tons of *Azolla* (500 kg per harvest) grown in 500 square meter area (Rs. 2 lakhs) with an additional operational cost (Rs. 2 lakhs) is four lakhs. If it can be sold @ Rs. 50 per / kg, one can reap a benefit of Rs.5.0 lakhs/ year.

### Economics of *Azolla*

*Azolla* has great biological N-fixing ability in rice due to its symbiotic association with cyanobacteria and can fixed around 30–100 kg N per hectare per crop.

### Salient features

- *Azolla* is an aquatic fern found abundantly in lakes, water bodies and rice fields.
- Growth of *Azolla* reduces aquatic weeds in flooded rice fields.
- *Azolla* can be used as fodder for dairy cattle, pigs, chicken, ducks and fish.
- *Azolla* has symbiotic association with nitrogen fixing blue green algae.
- *Azolla* has great biological Nitrogen fixing ability (30–100 kg N per hectare per crop) and hence it has particular value for rice crops.
- *Azolla* used as biofertilizer substantially increases Nitrogen use efficiency due to enhanced Nitrogen uptake and reduced Nitrogen loss.

## Blue green algae a potential biofertilizer to enhance rice yield

Blue green algae (BGA) or cyanobacteria in rice fields are important microbial members that are employed as bio-inoculants for enhancing soil fertility and crop yields. Among the various inhabitants of rice fields, cyanobacteria play a significant role in providing photosynthetically fixed carbon, nitrogen, besides producing phytohormones and polysaccharides which promote plant growth and soil structure, respectively. Due to its agronomic importance, often used as a potential bioinoculant for enhancing crop yields, especially in rice, besides improving fertility and soil structures.

**Recommended dose**

It is recommended that 50-60 kg fresh wt/ha or 6-7 kg dry weight BGA is required for rice crop, which can supply around 20-25 kg N/ha/season with increasing grain yield by 10- 20%

**Entrepreneurial opportunity**

Farmers can earn about 3% greater income along with 41.1% reduction in dosage of urea while reaping 1-5% higher yield of rice.

**Economics of BGA**

The benefits could be to the extent of 20-30 kg N/ha/season under ideal conditions.

**Salient features**

- BGA are free living as well as symbiotic, photoautotrophic micro-organisms.
- They are capable of fixing nitrogen at an average of 20-25 kg N/ha/ season.
- Primary producers in the biosphere.
- BGA can sequester carbon, add organic matter, synthesize and liberate amino acids, vitamins and auxins.
- BGA are the key players to sequester carbon and to improve the nutrient use efficiency.
- It is an important component of integrated nutrient management system due to its significant role in soil sustainability.

## *Azotobacter* a potential biofertilizer to enhance rice yield

The harmful effect of the chemical fertilizers will start during its manufacturing time, whose products and byproducts are also toxic chemicals or gases like $NH_4$, $CO_2$, $CH_4$ etc. which will cause air, water and soil pollution. Moreover, its continuous use degrades the soil health and quality. The adverse effect of these synthetic chemicals on human health and environment can only be reduced or eliminated by adopting new agricultural technology such as biofertilizer for enhancing nutrient use efficiency, crop yield and soil fertility, creates a healthy natural environment and ecosystem.

**Recommended dose**

It is recommended that 5-6 kg solid or 500 ml/ha liquid inoculum of *Azotobacter* is required for rice crop, which can supply around 15-25 kg N/ha with increasing grain yield by 5- 15%

**Entrepreneurial opportunity**

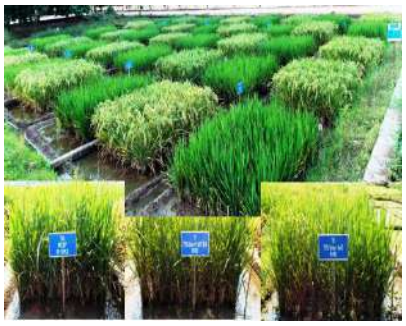
The total annual cost of production for 50 tons of *Azotobacter* grown in 1200 square meter area (Rs. 24 lakhs) with an additional instrumental and operational cost (Rs. 41 + 17 lakhs) is 58 lakhs. If it can be sold @ Rs. 100 per / kg, one can reap a benefit of Rs.51 lakhs/ year.

**Economics of *Azotobacter***

Liquid inoculum of *Azotobacter* (500 ml) @ Rs.150/- is required to mobilize 20 kg of Nitrogen per hectare

**Salient features**

- *Azotobacter* species are free living, non–symbiotic, heterotrophic, N-fixing bacteria.
- They are capable of fixing nitrogen at an average of 20 kg N/ha/year.
- They help in synthesis of growth regulating substances like auxins, cytokinin and gibberellins and regarded as Plant Growth Promoting Rhizobacteria (PGPR).
- *Azotobacter* improves seed germination and enhances crop growth rate.
- They inhibit phytopathogenic bacteria.



- It helps to increase nutrient availability and to restore soil fertility.
- It is an important component of integrated nutrient management system due to its significant role in soil sustainability.

## Phosphate solubilizing bacteria a potential biofertilizer to enhance rice yield

Biofertilizers can replace chemical fertilizers as they are renewable source of plant nutrients and relatively less expensive. Biofertlizers are selected strains of microorganisms which are beneficial to the growth of the plants. Soil microorganism plays an important role in regulating the levels of carbon, nitrogen, phosphorus and sulphur at the rhizosphere. Solubilization of macronutrient is an important aspect in plant growth and development. Phosphorus is one of the vital nutrient required for optimum growth of plant. *Pseudomonas, Bacillus, Aspergillus,* are examples of Phosphate solubilising bacteria (PSB).

**Recommended dose**

It is recommended that 5-6 kg solid or 500 ml liquid inoculum of PSB is required for one hectare of rice crop, which can supply around 10-20% of phosphorus with increasing grain yield by 5-15%

**Economics of PSB**

Liquid inoculum of PSB (500 ml) @ Rs.150/- is required to increase the availability of 20-30 Kg of phosphate per hectare.

**Salient features**


- PSB provokes immediate plant growth by providing easily absorbable form of phosphorus and production of plant growth hormones such as auxins, and gibberellins.
- PSB supports plant growth and increases efficiency of nitrogen fixation.
- PSB results in faster sprouting of seeds resulting in faster growth.
- PSB acts as a biocontrol agent against plant pathogens through production of antibiotics.
- PSB represent potential substitutes for inorganic phosphate fertilizers to meet the phosphorus demands of plants, improving yield in sustainable agriculture.

## Arbuscular mycorrhizal fungi as a potential biofertilizer

Arbuscular mycorrhizal fungi (AMF) form mutuality with roots of most agricultural crops, including rice. These mutualistic associations have shown the potential to increase crop productivity and playing a key role in the functioning and sustainability of agro ecosystems. AMF also facilitate host plants to grow vigorously under stressful conditions like drought, salinity and under disease conditions. Thereby, AMF can be used as a potential bio fertilizer.

**Recommended dose**

It is recommended that 1 tons of soil based inoculum of AMF is required for one hectare of rice crop, which can supply around 30% phosphorus with increasing grain yield by 15-25%

**Entrepreneurial opportunity**

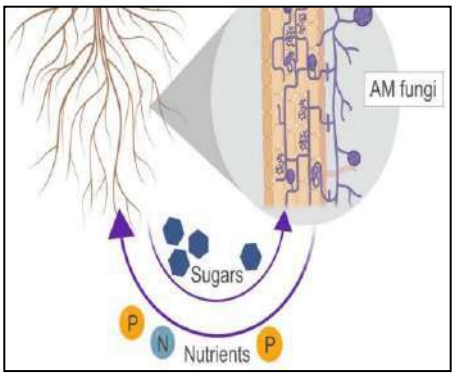
The total annual cost of production for 30 tons of AM fungi in prescribed area (Rs. 2 lakhs) with an additional operational cost (Rs. 5 lakhs) is 7 lakhs. If it can be sold @ Rs. 50 per / kg, one can reap a benefit of Rs.15 lakhs/ year.

**Economics of AMF**

AMF can supply around 30% phosphorus with increase in grain yield by 15-25%

**Salient features**

- AMF are soil microorganisms which represent a key link between plants and soil mineral nutrients.
- They provide the host plant with mineral nutrients and water, in exchange for photosynthetic products
- AM fungal hyphae exclusively colonize the root cortex and form highly branched structures inside the cells, i.e., arbuscules, which are considered the functional site of nutrient exchange.




- Transfer of nutrients such as organic carbon, in the form of sugars and lipids to the fungi by the plants, and the transfer P and N to the plants by the fungi
- The AMF mycelium that emerges from the root system can acquire nutrients from soil volumes that are inaccessible to roots
- AMF improve the quality of soil and plant health.

## Processing, Handling & Marketing of Organic Produce

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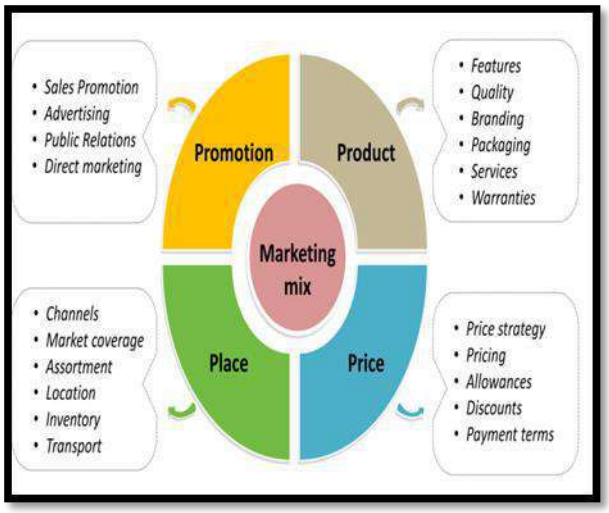
### Introduction:

Organic Farming is the hot topic of discussion now days even though in countries like India it has been practiced since decades. Although, growing human population has necessitated the need of using agrochemicals which on the contrary has adversely affected the fertility of Indian soils in long run. In country like India where farm land holdings are decreasing with every passing year, most of the farmers are marginal with limited land size and other resources which are severely decreasing the profits and making agriculture an unprofitable enterprise. In addition, factors such as monsoon, ups and downs in agriculture produce prices etc. are pressurizing younger generations and as a result they are bound to leave this profession and go on quest to find out other better means of livelihood earnings.




### Organic Food:

In the present scenario of COVID 19, people are not only strenuously realizing the need of having good immunity but also from farmer's perspective organic farming is the need of the hour particularly in countries like India. It is the farming which is mostly based on use of natural/organic inputs and products which are prepared on farm using cow dung, cow urine and other crop residues etc. This type of farming approach can prove to be a boon for farmers having marginal lands as it reduces the input cost involved with the production of different crops. Organically grown foods not only having better shelf life and taste but also fetches premium prices and are produced with minimum input cost, thus helps in elevating the margins of profit for farmers associated with their production. Presently, Ministry of Agriculture & Farmers Welfare, Government of India has introduced some schemes such as Paramparagat Krishi Vikas Yojana (PKVY) for the promotion of Organic Farming across different states of India and launched Mission Organic Value Chain Development (MOVCD) exclusively for the promotion in North Eastern Region of India. Aim of these scheme is to

develop certified organic produce in a value chain mode by linking growers with consumers and to support the development of entire value chain starting from inputs, seeds, certification to creation of facilities for collection, aggregation, processing, marketing and brand building initiative (MOVCD 2018).

**Production of Quality Food**

Sale of agricultural commodities or food items solely depends on their quality. In real sense, quality is one of the major factors that govern sale of food items as well as decides premium prices from buyers. Thus, farmers should focus on production of quality organic food following the norms of NPOP laid down by Government of India. Before growing any crop farmers must do a market survey for demand driven crop production. This will prevent bumper production of any crop and further slashing of sale prices of such commodities.

**Establishment of Exclusive Organic Huts and Markets:**

Special organic huts and markets should be constructed at key and prime locations such as Airports, City Shopping Canters etc. for exclusive sale of organic agriculture produce across the country. Central or State Governments should provide space free of cost or on nominal charges at prime locations of city to promote the sale of organically grown produce among the city residents.

**Protecting the Perishables:**

For protecting the perishable organic agricultural items, cold storage facility should be used. This will definitely help in preventing the post-harvest losses, one of the major factor responsible for making agriculture unprofitable. For transporting the perishable food items from far flung areas of the country to markets or godowns in Metro cities, cold storage vans or air lifting facilities should be used. By reducing Post Harvest Losses, Government may ascertain availability of ample amount of food commodities which may help in maintaining the demand supply gap and this will lead to availability of different food commodities at nominal prices for consumers of the country.

**Government Interventions:**Central as well as State Governments should prepare proper procurement policies with utmost care for surplus food commodities and must develop proper warehouses, Godowns etc. for their safe keeping and to prevent any post-harvest losses. To strengthen the marketing of agriculture produce, Government of India has launched an electronic portal with the name (eNAM) electronic National Agriculture Market. eNAM was introduced with the aim to reduce the involvement of middleman which are actually curbing a major chunk of farmer's profit. Ministry of Agriculture has also launched Jaivik Kheti portal which is an e-commerce platform exclusively for increasing the sale of organically grown produce throughout the country. The portal plays a crucial role and acts as a bridging link between buyers and sellers of the country. Some of the private sector enterprises such as Big basket, reliance fresh, lays and ITC etc are into the business of contract farming. They are making contracts with farmers and procuring the commodities from them either for direct sale to consumers or after making some sort of value addition. Government is focusing hard for the formation of Farmer Producer Organizations (FPO's) and some of these are utilizing the online channels such as Whatsapp groups for sale of organically grown produce to local residents.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