Organic Agriculture

Crop Rotation | Green Manure
Biological Pest Control | Compost | Crop Diversity
Soil Management | Weed Management | Livestock

Edited by

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Dr. P Chandra Shekara
Director General

MESSAGE

Indian agriculture has been witnessing constant and continuous innovations after the much acclaimed 'Green Revolution' in the country. The modern agriculture advocating use of high doses of fertilizers and use of chemical pesticides helped the small and marginal farmers who constitute majority of the population thriving on agriculture as the main means of livelihood for decades in getting better yields though not better prices for their produce. However it is realized, though late, that the damage caused by this system to soil, water, air and the environment has reached alarming proportions to the extent of threatening the sustainability of agriculture in the long run and survival of human, plant and animal life on this planet.

It is firmly believed that this book will act as a torch bearer for the developmental agencies involved in upliftment of the farmer's health & wealth to replicate their programmes in accordance with the lines of the information available in this book.

I indubitably appreciate Dr. Anil Kumar Sharma, Director, Extension Education & SAMETI-Uttarakhand, G.B. Pant University of Agriculture & Technology, Pantnagar (Uttarakhand) for having accepted to take up this responsibility of organising Collaborative training programme on "Organic Agriculture" during April 27-29, 2021 and bringing e book for publication. The team from MANAGE & Directorate of Extension deserves special appreciation for their active involvement, participation and cooperation.

Dr. .P. Chandra Shekara

Anil Kumar Sharma
Director EE & SAMETI-Uttarakhand

FOREWORD

It is a matter of pleasure that SAMETI Uttarakhand, Directorate of Extension Education, G.B. Pant university of Agriculture and Technology, Pantnagar and MANAGE Hyderabad has jointly organized a virtual training programme on Organic Agriculture during April 27-29, 2021 for Assistant Professors of SAU's, SMS, Extension Functionaries and Farmers.

Agriculture has been the backbone of Indian economy and provide the livelihood support to nearly 70 percent population of the country. Organic Agriculture works in harmony with nature rather than against it. This involves using techniques to achieve good crop yield without harming the natural environment or people who live and work upon it. Here, agriculturist uses all the knowledge, techniques and materials available to work with nature. In this way, farmer create a healthy balance between nature and farming. In today's context, organic agriculture is very relevant as everyone is conscious about health. If we see the agricultural scenario of last 3-4 decades, indiscriminate use of pesticides, chemical fertilizers and synthetic growth regulators etc. resulted into degradation of soil quality, hazardious produce, adverse effect on microbes, health issue of human and cattle as well environment.

I am sure that with the help of this common platform scientist, extension functionaries, entrepreneurs and farmers shared their views and experiences with each other which would be beneficial for all.

I express my sincere thanks to Dr. P. Chandra Shekara, DG. MANAGE, Hyderabad for identifying us for organizing training programme and all the necessary guidance and help as and when required.

I am specially thankful to Dr. P.L. Manohari, Assistant Director (Agril Extension), MANAGE, Hyderabad and Dr. B.D. Singh, Professor (Agronomy), Directorate of Extension Education, G.B. Pant University of Agriculture & Technology, Pantnagar for organizing such a wonderful training programme and publishing compendium. I must say that this compendium will enhance the knowledge and skill of agriculture officers and farming community. I am also thankful to all the speakers for delivering very organized lectures and staff associated with this programme.

(Anil Kumar Sharma)
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Extension Education & SAMETI-Uttarakhand
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Organic Agriculture

Overall Scenario of Organic Agriculture in India

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Organic Agriculture

Green revolution technologies catalysed by high yielding varieties, fuelled by synthetic chemical inputs and supported by increased irrigation has no doubt transformed the Indian agriculture from subsistence farming to surplus generating enterprise. But now it is being realized that the success was mostly on the cost of resources, environment and sustainability. Depleting natural resources, especially the ground water, deteriorating soil health and fertility, increasing dependence on synthetic inputs from non-renewable sources, ever-growing costs of cultivation and diminishing returns have raised many questions on the long-term sustainability of the technology. Scientists and policy makers are now increasingly diverting their attention in search of alternative technologies, which are not only productive and meeting today's requirements but are also resource conserving, environment friendly and ensuring safe and healthy food with long term sustainability promise.

Organic agriculture, a mainstay of farming since centuries is fast emerging as the viable option to fulfil all the sought after requirements. Growing awareness among consumers for safe and healthy food and supporting organic farming technologies for ensuring higher productivity with quality has boosted the confidence of policy planning process for its adoption as a viable system of food production.

Initial hiccups on its suitability and fears of low productivity are being dispelled with the results of long term experimentation and it is being accepted that if appropriate technologies are brought in and adopted, the organic agriculture can yield the same in resource rich areas and can give much higher productivity in less endowed resource poor and rainfed areas.

Global Scenario of Organic Agriculture

As per the latest statistics released by FiBL Switzerland and IFOAM Germany (base year 2019) 72.3 million ha farm land managed by 3.1 million farmers is being certified as organic in 187 countries. Australia, Argentina and Spain are the largest countries.

India with 2.3 million ha (2018-19) stands at 5th position. The entire data statistics world over is based on the registration of farmers under third party certification. PGS and other initiatives are not part of this data.

Distribution of organic agricultural land by region 2019
Source: FiBL survey 2021

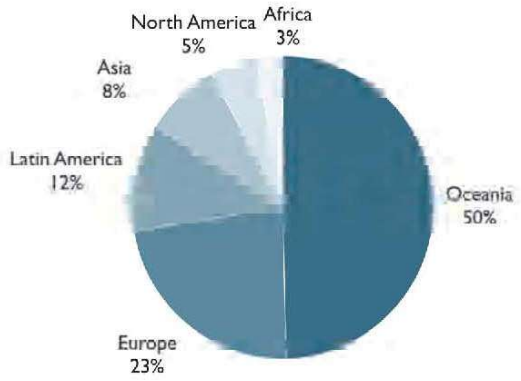

Figure 1: World: Distribution of organic agricultural land by region 2019

Source: FiBL survey 2021, based on information from the private sector, certifiers, and governments. For detailed data sources see annex, page 317

The ten countries with the largest areas of organic agricultural land 2019
Source: FiBL survey 2021

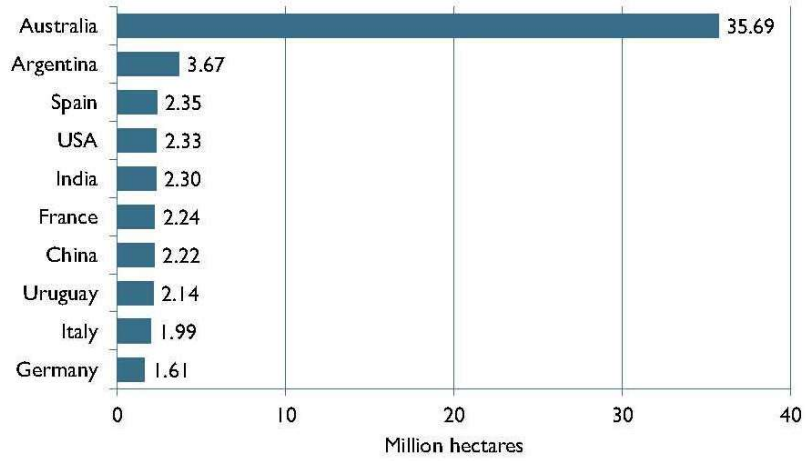

Figure 2: World: The ten countries with the largest areas of organic agricultural land 2019

Source: FiBL survey 2021, based on information from the private sector, certifiers, and governments. For detailed data sources see annex, page 317

Key features of Global organic agricultural scenario

- More than 72.3 million hectares of organic farmland
- Australia has the largest area
- Globally, 1.5 percent of the farmland is organic
- Liechtenstein has the highest organic share with 41.0 percent
- Growth in organic farmland - Increase of 1.1 million hectares or 1.6 percent

- Increase of organic farmland in almost all regions
- Over two-thirds of the organic agricultural land was grassland/grazing areas
- Arable land constitutes 18 percent of the organic agricultural land
- Permanent crops account for seven percent of the organic agricultural land
- Organic producers on the rise – 3.1 million producers in 2019

Global Organic Products Market

Organic food and drink sales reached more than 106 billion euros (126 million US$), according to FiBL in 2019. In 2019, the countries with the largest organic markets were the United States (44.7 billion euros), Germany (12.0 billion euros), and France (11.3 billion euros). The largest single market was the United States (42 percent of the global market), followed by the European Union (41.4 billion euros, 39 percent) and China (8.5 billion euros, 8.0 percent). The highest per-capita consumption in 2019, with 344 euros, was found in Denmark. The highest organic market shares were reached in Denmark (12.1 percent), Switzerland (10.4 percent) and Austria (9.3 percent).

Status of Organic Agriculture in India

Although, India had been traditionally organic and its farmers are 40 century farmers with large pool of traditional wisdom on best practices in organic agriculture, the modern standards based organic agriculture started only recently with the growing demand for organic food and fiber in the western world. National Programme for Organic production (NPOP) launched during 2001 laid the foundation for systematic development of organic agriculture sector in the country.

Setting up of National Centre of Organic Farming under Ministry of Agriculture, Cooperation and Farmers Welfare and launching of ICAR-Network Project on Organic Farming Research during 2004 provided the much-needed push to organic farming movement in the country. Right from beginning, the reliable data on area under organic farming was a big issue and in the absence of any mechanism for area determination, only the area registered under certification systems is being taken as the area under organic farming.

Starting with 42,000 ha area during 2003-04 (registered under NPOP certification), organic farming has spread to over 28.6 lakh ha, out of which 22 lakh ha is registered under NPOP and nearly 6.5 lakh ha under PGS certification (Year 2017-18).

Status of Organic Farming under National Programme for Organic Production (NPOP)

Area & Production - By the end of March 2020, India has brought more than 4.23 million ha area under organic certification, comprising of 2.86 million ha under

cultivation and 1.37 million ha under wild harvest collection. Overall growth, status of cultivated farm area under organic certification process over years, share of states in terms of total area, total production, important crop categories being produced, trends in exports and important export destinations are given in Fig 3, 4, 5, 6 and 7.

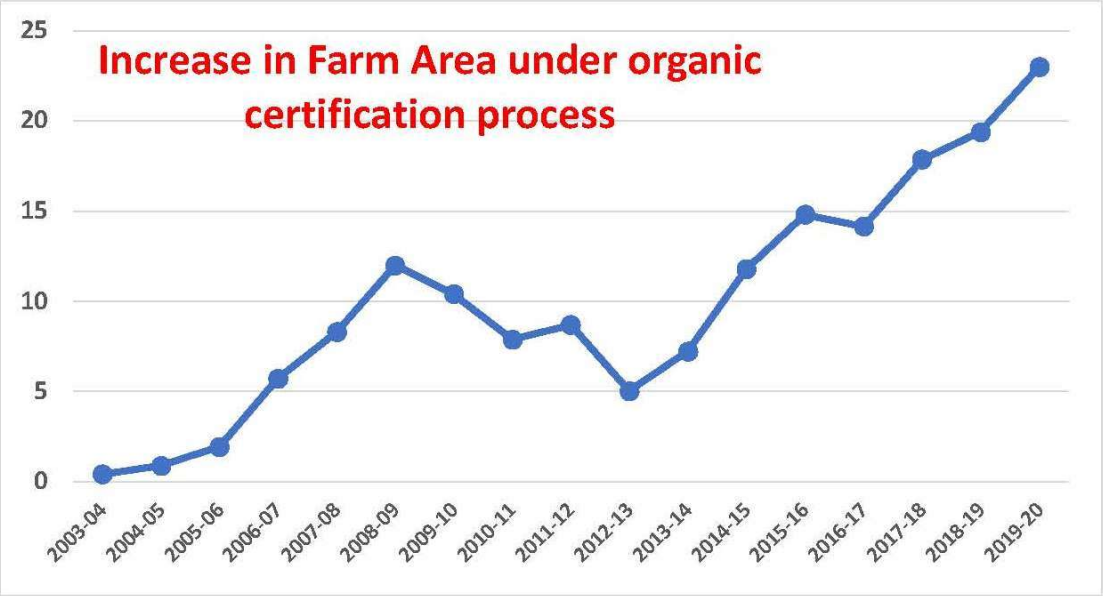

Fig. 3 Increase in area under organic certification process in lakh ha over years

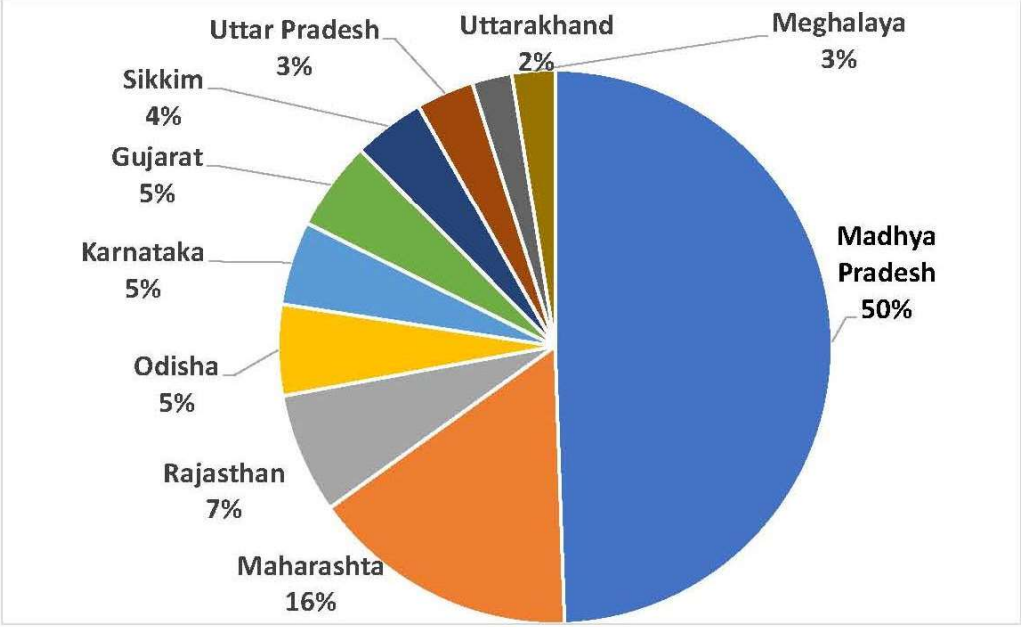

Fig. 4. Major state players in terms of area (in% share of total)

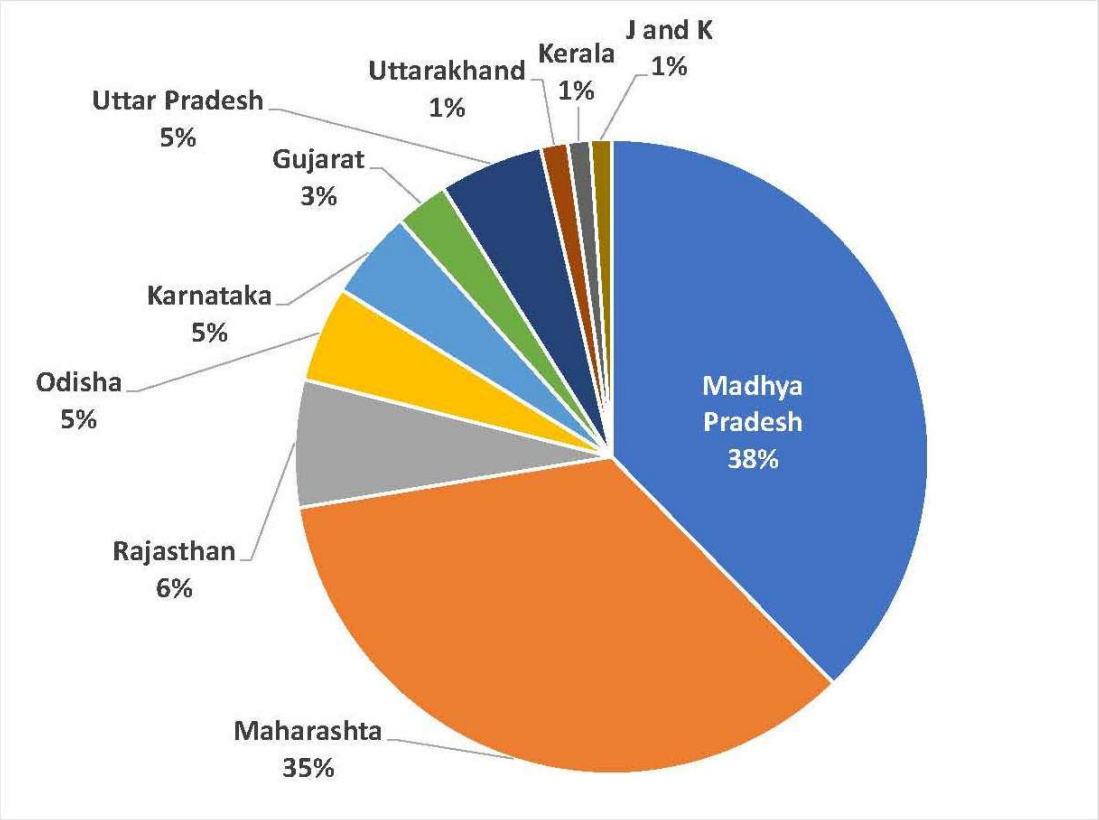

Fig 5. Share of States in total production of certified produce in India under NPOP.

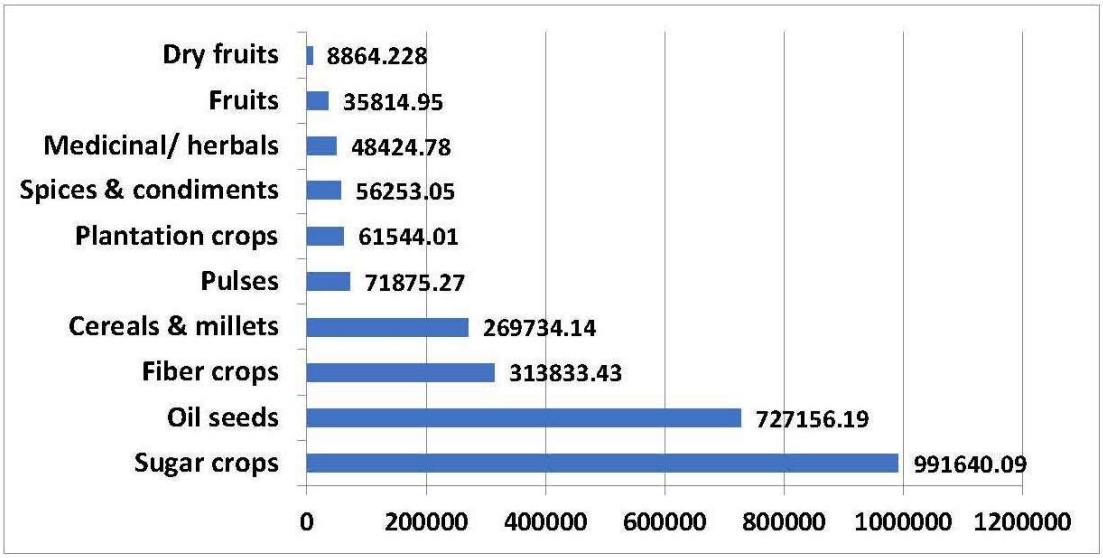

Fig. 6 Production of different crop commodities during 2019-20

Trade - Although export was the main driver for the growth of organic agriculture in the country for almost one decade, but now domestic market has also started to show

strength and is growing at a CAGR of about 19%. But still the exports account for major revenue realization by the growers, processors and traders. As per the estimates Indian export kitty for organic food products was about US$ 775 million. Domestic market accounts for approximately US$ 368 million (ASSOCHEM study, 2016). It has now grown to an industry of about 8500 crore with 5000 crore share for exports and 3500 accounting for domestic sales. Trends of growth in organic products export and important export destinations Fig. 7 and 8.

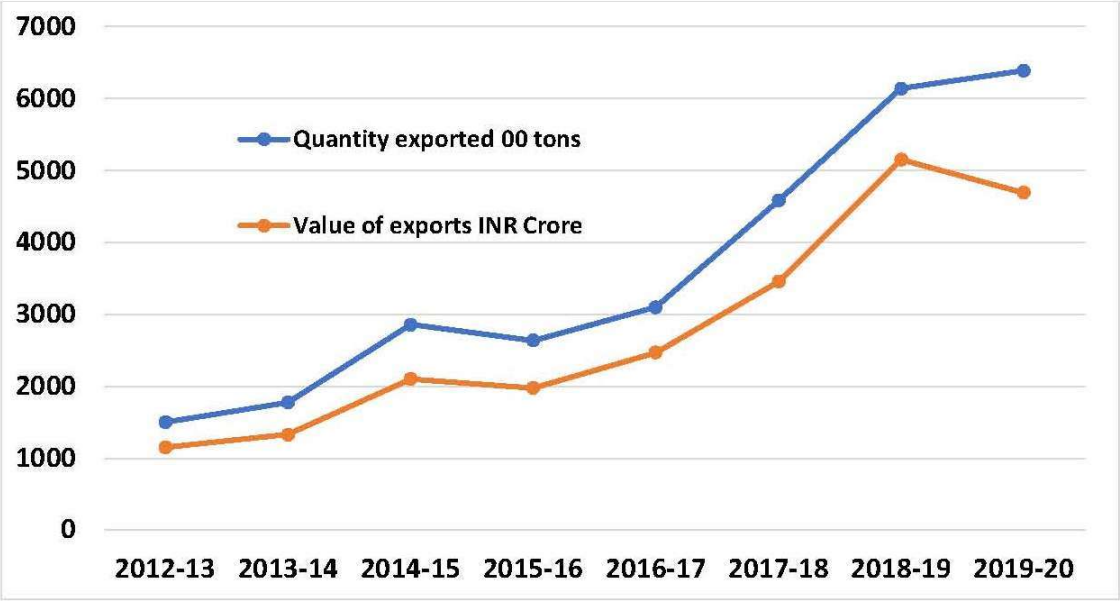

Fig 7. Trends in Exports of organic products

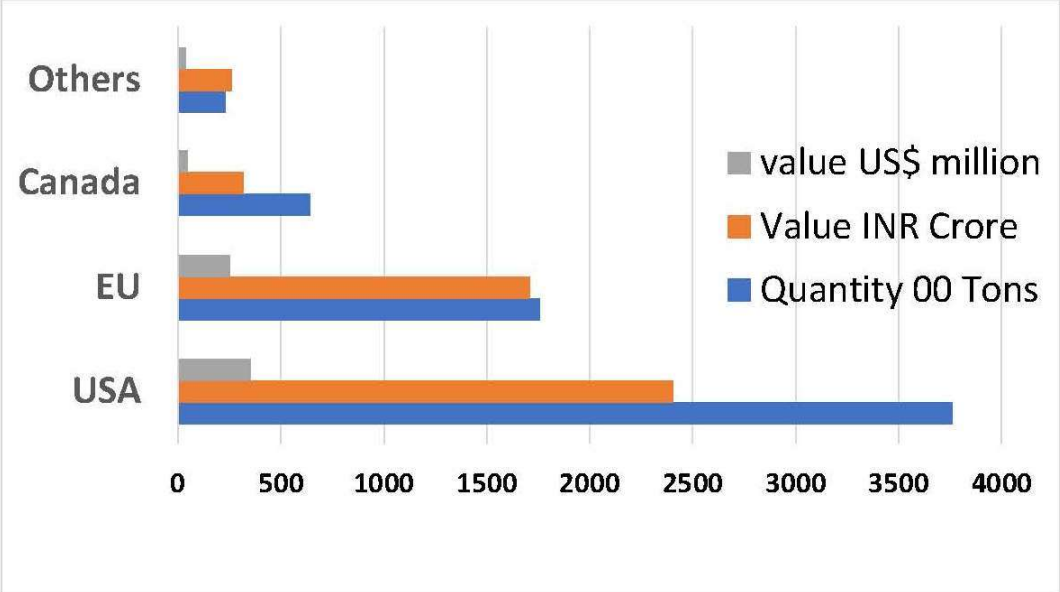

Fig 8. Important export destinations, quantity exported and value realised

Status of organic farming under PGS-India

Keeping in mind the complex documentation system needed for third party certification under NPOP, prohibitive cost and institutional management requirement for internal control system under grower groups which is beyond the reach of small and marginal farmers without any external support, Ministry of Agriculture and Farmers Welfare launched a farmer group centric certification system named as Participatory Guarantee System under PGS-India programme.

PGS certification system requires a group of minimum five members with in the village or from nearby villages. Documentation systems have been kept limited to just peer appraisal reports twice a year and inspection and decision making is collectively by the group. Regional Councils, authorized by the PGS-National Advisory Committee provide necessary technical support and endorse groups decision. PGS-India certification system has following benefits over third party certification:

1. Documentations are simple
2. No third party intervention
3. Farmers are owners of the group without any institutional requirements
4. Entire activity is done by the group members.
5. Size of the groups are small and members are known to each other
6. Certificate is granted to each and every farmer.

Area and farmers under PGS-India

As on December 2018, PGS-India system has registered more than 15.0 lakh farmers with 6.5 lakh ha area under certification process. State-wise details in terms of total and total number of farmers are given in Fig 9 and 10.

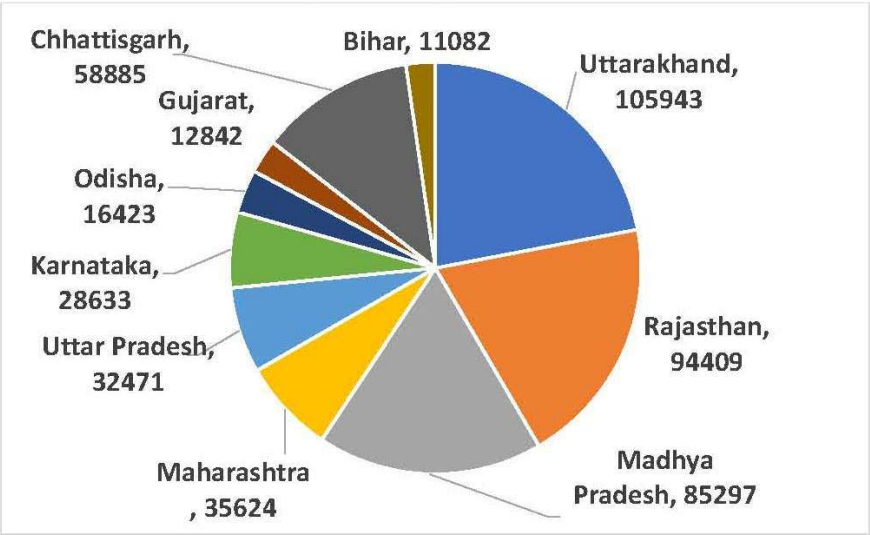

Fig. 9 State-wise area under PGS Certification

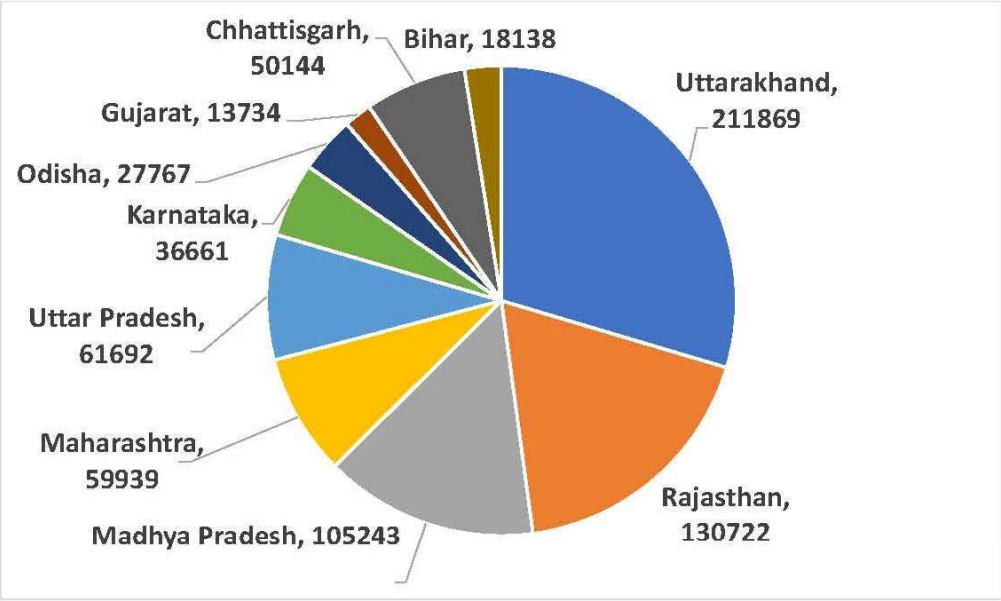

Fig. 10 State-wise number of farmers registered under PGS certification

Expected growth in Post-Covid 19 Scenario

Early estimates (Tentative)

- 42% increase in exports over previous year
- Quantity exported (End of Feb 2021) – 9.10 lakh tons
- Value of export in USD 948 million
- Value of export in INR 7110 crore
- Domestic market has also far exceeded the expectations
- It is estimated to have grown to nearly 35% (11000-11500 crore)

Government Initiatives

Public sector institutional promotion of organic agriculture started with the launching of "National Programme on Organic Production" (NPOP) by the Ministry of Commerce during the year 2001, which defined the National Standards for Organic Production (NSOP) and the procedure for accreditation and certification. India now has 30 accredited certification agencies for facilitating the certification to growers.

For area expansion and technology transfer, Ministry of Agriculture, Govt. of India launched a National Project on Promotion of Organic Farming (NPOF-DAC) and earmarked funds for setting up of organic and biological input production units, vermin-compost production units and earmarked funds for organic adoption and certification under various schemes such as National Horticulture Mission (NHM) now known as Mission for Integrated Development of Horticulture (MIDH), National Mission for Sustainable Agriculture (NMSA) and National Agriculture Development Scheme (RKVY).

To empower farmers through participation in certification process and to make the certification affordable for domestic and local markets, Ministry of Agriculture, Government of India has also launched a farmer group centric organic guarantee system under PGS-India programme.

Recently to give domestic organic agriculture further push, the Ministry of Agriculture has launched a new scheme under NMSA entitled *Paramparagat Krishi VikasYojna* (PKVY or say Traditional Agriculture Development Scheme). Recently under Prime Minister's special initiative for North Eastern states a scheme "Mission Organic Value Chain Development for North Eastern Region (MOVCDNER)" was launched.

To address research needs, ICAR launched a Network Project on Organic Farming Research during 2004 and started taking up research activities through its 13 collaborating centers across the country. Recently ICAR has increased the number of collaborating centres to 20 and launched an additional Network Project on Organic Horticulture Research.

Some state Governments have also launched their state specific research centres such as Institute of Organic Agriculture at University of Agriculture Dharwad and Bangalore; Centre of Excellence for Organic Agriculture at Palampur under CSK Himachal Pradesh University of Agriculture and Technology. During February 2016, Government of India also announced for the setting up of National Organic Farming Research Institute (NOFRI) at Sikkim. Recently some other state universities in Karnataka, Madhya Pradesh and Maharashtra have also launched dedicated research and extension institutions for organic farming.

Many state Governments has also put in their efforts for the promotion of organic agriculture. Efforts initiated by the Government of Sikkim in converting the entire state into organic and Government of Uttarakhand of converting their hill districts into organic are some noteworthy developments.

Quality Assurance and Regulatory Systems

National Programme for Organic Production (NPOP) launched during 2010 by the Ministry of Commerce and Industry with APEDA as the secretariat was the first milestone in the history of organic agriculture in India and laid the foundation stone for systematic institutionalization of quality assurance system. NPOP is now a widely acclaimed system accepted world over. It enjoys equivalence with organic certification systems of European Union and Switzerland and has conformity assessment

recognition agreement with USDA. NPOP was launched with export markets in focus and is better known as third party certification system.

To make the certification system affordable and making farmers as stakeholders in quality guarantee, Ministry of Agriculture and Farmers Welfare launched "Participatory Guarantee System" (PGS) a farmer group centric certification system under PGS-India programme. PGS is applicable for group of farmers and is valid for domestic markets.

Recently in December 2017, Food Safety and Standards Authority of India (FSSAI) has brought organic food under the ambit of Food Safety and Standards Act 2006 and mandated that any food to be sold as organic in India need to be certified under NPOP or PGS certification system. The domestic regulation under FSS Act 2006 has been implemented since 01 July 2018. Logos of NPOP and PGS certification systems and unified quality assurance logo launched by FSSAI are given below:

Developments in Policy Framework

First ever attempt to define a policy frame work was initiated with the constitution of Task Force on Organic Farming by the Government of India during 2001 which was headed by Shri Kunwarji Bhai Jadhav, Member Parliament. This was followed by a working group on Organic and Biodynamic Farming by the Planning Commission during 2004, Expert Panel on Organic Farming during 2007 and Taskforce on Organic Farming during 2015.

Many states have also embarked upon developing their own state specific policy documents. So far 14 states, namely Sikkim, Nagaland, Mizoram, Uttarakhand, Karnataka, Kerala, Andhra Pradesh, Madhya Pradesh, Maharashtra, Himachal Pradesh, Tamil Nadu, Gujarat, Arunachal Pradesh and Chhattisgarh have developed policies for systematic promotion of organic farming. Recently Haryana had also constituted a working group for drafting a promotion policy. The group has already submitted its report.

Out of these 14 states, although 3 states namely Sikkim, Nagaland and Mizoram declared their intention to go 100% organic and Uttarakhand declared to convert their all hill districts to organic, but it is only the Sikkim which has been able to successfully convert their dream into reality. Interestingly although many states have drafted and developed policies, but promotion of organic agriculture was largely driven by federal government policies and financial assistance schemes.

Recently entire territory of Union Territory of Lakshadweep and four islands of Car-Nicobar and Nan cowrie island under UT of A&N Island have been transformed to certified under Large Area Certification scheme of PGS-India programme.

Journey so far and Way forward

Major Achievements

- Organic farming getting main streamed
- Research proved that it is equally productive
- Area has grown up to more than 2.3 million ha under NPOP and about 11 lakh ha under PGS
- Production is more than 3.5 million tons (raw crop produce)
- Confidence of farmers are growing
- Government support is also growing
- Market demand is robust
- Participatory Guarantee Systems getting acceptance in market

Major Constraints

- Consumers face problems of integrity
- Uncontrolled organic products in market with no quality assurance
- High prices for consumers (50-200%)
- No or low-price premium for farmers
- Farmers search for market – but unable to access, consumers do not get access

Core Issues to be Addressed

- Absence of integrated organic farming system approach – Many does organic with input replacement – Not sustainable. Need promotion of Integrated Organic farming System Model
- Mandators/ICS personals lacked knowledge – Poor knowledge transfer. Massive capacity building is the need of hour
- Poor on-farm input production – crops not adequately fertilized. Innovations need to be promoted and adopted.

- Poor yields in many cases – farmers at loss. Ensure that appropriate integrated packages for optimum yields
- Problems in pest management – resulting into default. Wide publicity for effective management practices
- Contamination control not properly addressed – Samples failed in testing
- Majority of them partly converted (parallel production – high risk). Let us encourage farmers those are willing to be organic.
- Absence of organic seeds. Organic seed production to be promoted as commercial venture.
- Entire attention under government schemes was only on certification management. Market focus missed.
- Malpractices leading to loss of trust among consumers. Need effective regulatory systems.

Epilogue

Organic farming has come a long way in India during last two decades. From a niche subject it is getting mainstreamed and India has emerged as the 1st largest in terms of producers and 5th largest in terms of the total area. Phenomenal growth in exports and double digit growth in domestic market indicates bright future for producers. Developing institutional networks for production, promotion, research and marketing are providing much needed support. Emerging policies of central Government for reduction in chemicals and shift of Indian agriculture towards organic or non-chemical methods is indication of determination of the nation for securing health of our citizens.

Need and Importance for Extension of Organic Farming

Dr. P.L. Manohari

Assistant Director (Agri Extension), MANAGE, Hyderabad

Plants require a number of soil nutrients like Nitrogen, Phosphorus, Potash, Sulfur etc. for their growth. But, soil nutrient levels can decrease over time when crop plants are harvested, as nutrients are not returned to the soil. Hence, these essential nutrients needs to be compensated either through chemical fertilizers or through natural process of decomposition like Farm Yard Manure, Green manures and Green leaf manures etc.

The Standing Committee on Agriculture submitted a report on 'Impact of chemical fertilizers and pesticides on Agriculture and Allied sectors in the country' on August 11, 2016. The following observations were made by the committee.

Imbalance in use of fertilizers: The Committee observed that out of the 525 districts only 292 districts (56%) in the country account for 85% of its fertilizer use. In addition, the ratio of consumption of fertilizer has been skewed towards nitrogen. The ratio of usage of Nitrogen, Phosphorus and Potassium fertilizers is 6.7:2.4:1, as compared to the recommended usage ratio of 4:2:1. The Committee recommended that a strategy should be initiated to promote the balanced use of fertilizers. Chemical fertilizers increase crop production. But overuse of chemical fertilizers will harden the soil, decrease fertility, pollute air, water and release greenhouse gases, thereby bringing hazards to human health and environment as well. Accordingly, scientists and researchers are arguing in favour of organic fertilizers as the best solution to avoid soil pollution and many other threats to environment

Excessive use of pesticides: The Committee observed that the consumption of chemical pesticides in the country increased from 55,540 tons in 2010-11 to 57,353 tons in 2014-15, while their imports increased from 53,996 tons to 77,376 tons in the same period. The Committee noted that excessive use of pesticides may have a deteriorating effect on the health of both humans and animals. However, inadequate funds are a constraint in taking up comprehensive research in this regard. The Committee recommended that a policy should be put in place regarding the import and usage of pesticides.

Organic farming is very much native to this land. Whosoever tries to write a history of organic farming will have to refer India and China. The farmers of these two countries are farmers of 40 centuries and it is organic farming that sustained them. India has been traditionally a country of Organic Agriculture, but the growth of modern scientific, input intensive agriculture has pushed it to wall. But with the increasing awareness about the safety and quality of foods, long term sustainability of the system and accumulating evidences of being equally productive, the organic farming has emerged as an alternative system of farming which not only address the quality and sustainability concerns, but also ensures a debt free, profitable livelihood option.

Concept of organic farming

This concept of organic farming is based on following principles:

Nature is the best role model for farming, since it does not use any inputs nor demand unreasonable quantities of water.

a) The entire system is based on intimate understanding of nature's ways. The system does not believe in mining of the soil of its nutrients and do not degrade it in any way for today's needs.
b) The soil in this system is a living entity
c) The soil's living population of microbes and other organisms are significant contributors to its fertility on a sustained basis and must be protected and nurtured at all cost.
d) The total environment of the soil from soil structure to soil cover is more important.

In philosophical terms organic farming means "Farming in Spirits of Organic Relationship. Since Organic farming means placing farming on integral relationship. We should be well aware about the relationship between the soil, water and plants, between soil-soil microbes and waste products, between the vegetable kingdom and the animal kingdom of which the apex animal is the human being, between agriculture and forestry, between soil, water and atmosphere etc. It is the totality of these relationships that is the bed rock of organic farming.

Aim

Organic farming aims at sustaining and increasing the productivity by improving the soil health and overall improvement of agro- ecosystem.

Dimensions of Organic Agriculture

The growth of organic agriculture in India has three dimensions and is being adopted by farmers for different reasons. First category of organic farmers are those which are situated in no-input or low-input use zones, for them organic is a way of life and they are doing it as a tradition (may be under compulsion in the absence of resources needed for conventional high input intensive agriculture). Second category of farmers are those which have recently adopted the organic in the wake of ill effects of conventional Agriculture, may be in the form of reduced soil fertility, food toxicity or increasing cost and diminishing returns. The third category comprised of farmers and enterprises which have systematically adopted the commercial organic agriculture to capture emerging market opportunities and premium prices. While majority of farmers in first category are traditional (or by default) organic they are not certified, second category farmers comprised of both certified and un-certified but majority of third category farmers are certified. These are the third category commercial farmers which are attracting most attention. The entire data available on organic agriculture today relates to these commercial organic farmers

Strategic importance and growth of organic farming: In view of increasing consumption of fertilizers, pesticides, deteriorating soil productivity and soil health, the concept of organic farming is gaining growing importance world over, in order to develop sustainable and eco-friendly agricultural production systems. As per the definition of FAO “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".

Advantages of organic farming

- Organic matter supplies all the essential macro and micro plant nutrients.
- Organic matter improves physio-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 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.

Can organic farming produce enough food for everybody?

We should realize that our demand for food production is increasing and on the other hand the land resources are shrinking. Therefore, we can't effort to organic farming in all the ecosystems and areas. Rather, we should think rationally and select only those areas that remained organic due to wisdom and/or by default. Hill regions of the country can be easily converted to organic food production zone mainly to meet domestic and international demand and for higher farm income.

Government Initiatives

National Project on Organic Farming (NPOF) is a continuing central sector scheme since 10th Five Year Plan. NPOF is being implemented by National Centre of Organic Farming at Ghaziabad and its eight Regional Centres at Bangalore, Bhubaneshwar, Panchkula, Ghaziabad, Imphal, Jabalpur, Nagpur and Patna. Besides working for realization of targets under NPOF, NCOF and RCOFs are also performing specific roles in promotion of organic farming.

Ministry of Agriculture and Farmers Welfare has launched a Central Sector Scheme named "Mission Organic Value Chain Development for North Eastern Region" (MOVCDNER) for implementation in the States of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura during 2015-16 to 2017-18. The scheme aims at development of certified organic production in a value chain mode to link growers with consumers and to support the development of entire value chain starting from inputs, seeds, certification and creation of facilities for collection, aggregation, processing, marketing and brand building initiative.

The assistance is provided for cluster development, on/off farm input production, supply of seeds/planting materials, setting up of functional infrastructure, establishment of integrated processing unit, refrigerated transportation, pre-cooling/ cold stores chamber, branding, labelling and packaging, hiring of space, hand holdings, organic certification through third party, mobilization of farmers/processors etc.

Department of Commerce is operating an organic product certification programme for export market through a National Programme of Organic Production (NPOP) which has been notified under Foreign Trade Development and Regulation (FTDR) Act. Recently, NPOP has also been notified under Agricultural Produce (Grading & Marking) Act, 1937 (APGMC) as Organic Agricultural Produce Grading and Marking Rules, 2008 with Agricultural Marketing Advisor (AMA) in Department of Agriculture and Cooperation as its controller. Under these programmes a mechanism has been launched to authorize/accredit certification and inspection agencies for certification of organically produced agricultural goods.

(ii) Assistance for organic farming is available under National Horticulture Mission (NHM) launched in 2004-05 and Rashtriya Krishi Vikas Yojana (RKVY) launched in 2007-08. Under NHM, assistance is provided @ 50% of cost subject to a maximum of Rs. 10,000 per hectare (upto 4 hectares per beneficiary) for organic horticulture cultivation. Assistance is also provided for setting up vermi-compost units @ 50% of cost upto Rs. 30,000 per beneficiary. For organic farming certification, assistance of Rs. 5 lakh is provided to a group of farmers covering an area of 50 hectares. RKVY is an omnibus scheme in which 2 any organic cultivation activity can be taken up. Substantial funds have been released under these two schemes for organic cultivation in recent years as brought out below:

Emergence

The growth of organic agriculture in India has three dimensions and is being adopted by farmers for different reasons. First category of organic farmers are those which are situated in no-input or low-input use zones, for them organic is a way of life and they are doing it as a tradition (may be under compulsion in the absence of resources needed for conventional high input intensive agriculture). Second category of farmers are those which have recently adopted the organic in the wake of ill effects of conventional agriculture, may be in the form of reduced soil fertility, food toxicity or increasing cost and diminishing returns. The third category comprised of farmers and enterprises which have systematically adopted the commercial organic agriculture to capture emerging market opportunities and premium prices. While majority of farmers in first category are traditional (or by default) organic they are not certified, second category farmers comprised of both certified and un-certified but majority of third category farmers are certified. These are the third category commercial farmers which are attracting most attention. The entire data available on organic agriculture today, relates to these commercial organic farmers

Future prospects

Although, commercial organic agriculture with its rigorous quality assurance system is a new market controlled, consumer-centric agriculture system world over, but it has grown almost 25-30% per year during last 10 years. In spite of recession fears the growth of organic is going unaffected. The movement started with developed world is gradually picking up in developing countries. But demand is still concentrated in developed and most affluent countries. Local demand for organic food is growing. India is poised for faster growth with growing domestic market. Success of organic movement in India depends upon the growth of its own domestic markets.

India has traditionally been a country of organic agriculture, but the growth of modern scientific, input intensive agriculture has pushed it to wall. But with the increasing awareness about the safety and quality of foods, long term sustainability of the system and accumulating evidences of being equally productive, the organic farming has emerged as an alternative system of farming which not only address the quality and sustainability concerns, but also ensures a debt free, profitable livelihood option.

Nutrient management

Maintenance of soil fertility may be achieved through organic matter recycling, enrichment of compost, vermi-composting, animal manures, urine, farm yard manure, litter composting, use of botanicals, green manuring, etc.

Use of bio-fertilizers like Azolla, Azospirillium, Azotobacter, Rhizobium culture, PSB, etc. to be used.

Blood meal, bone meal and human excrement may be applied with the approval of the Certification Agency (CA).

Saw dust from untreated wood, calcified seaweed, limestone, gypsum, chalk, magnesium rock and rock phosphate can be used.

Various sprays like vermi wash and liquid manures etc. can be used in crops for nourishing the soil and plant.

Ref:

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Nutrient Management in Organic Farming

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Organic farming

Organic farming system in India is not new and is being followed from ancient time. 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 (crop, animal and farm wastes, aquatic wastes) and other biological materials along with beneficial microbes (bio-fertilizers) to release nutrients to crops for increased sustainable production in an eco-friendly pollution free environment.

As per the definition of the 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".

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".

Need of organic farming

With the increase in population our compulsion would be not only to stabilize agricultural production but to increase it further in sustainable manner. The scientists have realized that the 'Green Revolution' with high input use has reached a plateau and is now sustained with diminishing return of falling dividends. Thus, a natural balance needs to be maintained at all cost for existence of life and property. The obvious choice for that 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.

The key characteristics of organic farming include:-

- Protecting the long term fertility of soils by maintaining organic matter levels, encouraging soil biological activity, and careful mechanical intervention.
- Providing crop nutrients indirectly using relatively insoluble nutrient sources which are made available to the plant by the action of soil micro-organisms.

- 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.
- 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.
- 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.
- Careful attention to the impact of the farming system on the wider environment and the conservation of wildlife and natural habitats.

Basic Steps of Organic Farming

Organic farming approach involves following five principles:-

- 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 management 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.

Avoid these common mistakes

- Underestimating the need for good transitional and marketing plans.
- Underestimating the need to fully understand the Organic Standard. Organic producers must understand the standard in order to know what is permitted and prohibited.
- Failing to think prevention. Transitional farmers should consider improving their crop rotation, soil and crop management skills, livestock management practices (feeding program, heard health program, grazing system, housing facilities, and husbandry).

Nutrient Management

Plant root system is always in close association with multitude of microorganisms and other nutrients. The microbes in root zone are maintained due to a variety of secretions from the roots and constitute what is often described as ‘rhizosphere’. These microbes in their turn supply nutrients to the soil system through their heterotrophic activity. Maintenance of these microbes in the rhizosphere, therefore, is also necessary for soil health. Crop productivity and nutrient cycles, however, are integral parts of the exploitation of soil health and have led to soil degradation through nutrient depletion and erosion, so that long term strategies are needed to avoid the use of chemical fertilizers without adversely affecting crop productivity. The use of organic manures, composts, Bio fertilizers has received increased attention in our cropping systems. Following are the components in Nutrient management system:-

1. Biodynamic Farming

2. Bio fertilizers Technology

3. Composting

4. Vermicompost

5. Coir Compost

6. Panchakavya

7. Dasakavya

8. Effective Microorganism

An ecological production management system that promotes and enhances biodiversity, biological cycles and soil biological activity. It is based on minimal use of off-farm inputs and on management practices that restore, maintain or enhance ecological harmony. The primary goal of organic agriculture is to optimize the health and productivity of interdependent communities of soil life, plants, animals and people. In simple words, it is a practice that does not use or limited the use of any chemical fertilizers, pesticides, growth regulators and genetically modified organisms (GMOs).

- Over a century, resource poor farmers are doing such practices in traditional way which is similar to organic farming and farmers' knowledge and skills about organic farming would be positive point for promoting organic farming in India.
- Besides, the ecological advantages have proved that India has potential to produce quality organic fruits, vegetables, tea, coffee, cardamom, vegetable seeds, mushroom, honey and medicinal plants & herbs.
- In the past, the conventional agricultural focused on short-term productivity goal and paid little attention to available local resources both natural and human endowments.

1. Nutrient Management in Organic Farming

The management of nutrients in organic farming systems presents a formidable challenge, as the use of inorganic fertilisers is not permitted.

Therefore organic must optimise a range of soil, crop rotation and manure managements to ensure a nutrient supply which will guarantee optimum crop yields and minimize losses to the environment.

To achieve this objective, an appreciation of the nutrient cycles in farming systems is essential which is possible through various practices as below

- Crop rotation
- Cover cropping
- Addition of compost/FYM
- Application of green manures
- Application of crop residues
- Supplemental application of organically approved amendments
- Animal manures
- Use of bio fertilizers

2. Nutrient Management Practices

Crop Rotation:

- The practice of growing a sequence of plant species on the same land.
- One of the very basic building blocks of organic farming systems.
- The crop rotation in organic farming must provide the soil fertility required for maintaining productivity and it must prevent problems with weeds, pests and diseases.
- A proper sequence of crops in time and space and through the use of N2 fixing crops and cover crops.
- Pivotal parts of every organic farmer's management scheme.
- They are crucial to the main goals of building soil health and preventing soil erosion.
- Tools for increasing fertility and controlling weeds, pathogens, and insects in organic crops.
- Non leguminous cover crops, typically grasses or small grains, do not fix nitrogen but can be effective in recovering mineralized nitrogen from soil after crops are harvested.
- When legume or grass cover crops are killed and incorporated into the soil, living microorganisms in the soil go to work to decompose plant residues.
- The biomass nitrogen is mineralized and converted first to ammonium (NH4) and then to nitrate compounds (NO3) that plant roots can take up and use.

Addition of Compost/FYM:

- A biological process that requires careful monitoring of air and moisture levels in compost piles or windrows to produce specific temperature ranges that promote the growth of beneficial microorganisms.
- The regular addition of compost is one of the best ways to enhance soil organic and humic content, which helps to build a fertile soil structure.
- Populations of microorganisms that make soil come alive with productivity and enable plants to battle diseases and pests thrive in such an environment.
- A way to recycle manures and plant residues that otherwise might present some environmental problems. Soil with 4% OM contains 4000 lbs total nitrogen/acre.

3. Application of Green Manures

A practice of ploughing or turning into the soil, undecomposed green plant tissues for the purpose of improving the soil fertility. Objective: To add an organic matter into the soil and thus, enrich it with 'N' which is most important and deficient nutrient. Types of green manuring: 1. Green manuring in-situ: When green manure crops are grown in the field itself either as a pure crop or as intercrop with the main crop and buried in the same field, it is known as Green manuring In-situ. E.g.: Sannhemp, Dhaicha, Pillipesara, Shervi, Urd, Mung, Cowpea, Berseem, Senji, etc. 2. Green leaf manuring: It refers to turning into the soil green leaves and tender green twigs collected from shrubs and trees grown on bunds, waste lands and nearby forest area. E.g.: Glyricidia, wild Dhaicha, Karanj.

4. Application of Crop Residues

- Serve as soil cover and organic manure.
- Both the amounts produced and their nature varies between crop types.
- For example, cereal straw contains only around 35 kg N/ha and has a wide C:N ratio, compared with more than 150 kg N/ha for some vegetable residues, with a narrow C:N ratio.
- The narrow C:N ratio of green leafy residues means that N is released much more rapidly than from cereal straw.

5. Crop Residues Incorporation after Harvesting

- Soil amendments are also known as conditioners.
- Improve a soils structure and ultimately its ability to deliver water, air, and nutrients to plants.
- Encourage nutrient recycling by developing the innate structure of a soil.
- Organic amendments are the safest and most effective means to promoting soil fertility.

For acidic condition:

Apply lime but depends on crop rotation and soil conditions.

For alkali condition:

- Apply gypsum supplemental application of organically approved amendments.
- Poultry and animal manures also provide nutrients to the plants.
- Fresh manure, especially slurry and poultry manure, contains considerable proportion of N in readily available (principally ammonium-N) forms, which can be easily and rapidly lost to the atmosphere.
- Animals and poultry should be fed with organic feeds.
- High organic matter and macro nutrients.

7. Animal Manures

- One of the important components of integrated nutrient management
- Cost effective and renewable source of plant nutrients to supplement the chemical fertilizers for sustainable agriculture.
- Accelerate certain microbial processes in the soil which augment the extent of availability of nutrients in a form easily assimilated by plants.
- Several microorganisms and their association with crop plants are being exploited in the production of bio fertilizers.

8. Bio-Fertilizers

These are the Groups Examples N2 fixing Bio fertilizers.

1. Free-living Azotobacter, Beijerinkia, Clostridium, Klebsiella, Anabaena, Nostoc.

2. Symbiotic Rhizobium, Frankia, Anabaena azollae.

3. Associative Symbiotic Azospirillum P Solubilizing Biofertilizers.

B. Bacteria Bacillus megaterium var. phosphaticum, Bacillus subtilis Bacillus circulans, Pseudomonas striata

C. Fungi Penicillium sp, Aspergillus awamori P Mobilizing Biofertilizers

1. Arbuscular mycorrhiza Glomus sp. Gigaspora sp. Acaulospora sp., Scutellospora sp. & Sclerocystis sp.

2. Ectomycorrhiza Laccaria sp., Pisolithus sp., Boletus sp., Amanita sp.

3. Ericoid mycorrhizae Pezizella ericae

4. Orchid mycorrhiza Rhizoctonia solani Biofertilizers for Micro nutrients

D. Silicate and Zinc solubilizers Bacillus sp. Plant Growth Promoting Rhizobacteria

E. Pseudomonas Pseudomonas fluorescens

9. Soil Health

- Optimizing soil 'health' is the foundation of organic agriculture.
- Emphasis being placed on maintaining high levels of soil biological activity and organic matter, coupled with balanced / optimum nutrient levels.
- Organics aims to 'feed the soil to feed the crop' by maintaining soil biology and nutrients at optimum levels throughout the rotation rather than the non-organic approach of applying nutrients to feed the current crop to maximize yield.
- Organics therefore takes a long term, whole farm / systems approach to nutrient management based on regular soil tests and nutrient budgets to determine when soil nutrients must be replaced.

Conclusion

Bio fertilizers increase the availability of plant nutrients and can help in maintenance of the soil fertility over a long period. As discussed earlier, some microorganisms have the beneficial role of biological nitrogen fixation to supply nitrogen to crops, solubilizing insoluble phosphates to plant-available (soluble) forms and synthesizing biomass for manuring of crops like rice. Bio fertilizers are, therefore, economical, renewable and eco-friendly, but they cannot totally replace chemical fertilizers. Bio fertilizer use is an important component of Integrated Nutrient Management and organic farming. These technologies are becoming vital in modern-day agricultural practices. The changing scenario of agricultural practices and environmental hazards associated with chemical fertilizers demand a more significant role of bio fertilizers in coming years.

Organic Crop Production

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Introduction

Organic farming is a production management system excluding of all synthetic off-farm inputs but rely upon on-farm agronomic, biological and mechanical methods like crop rotations, crop residues, animal manures, off-farm organic waste, mineral grade rock additives and biological system of nutrient mobilization and plant protection, etc which promotes and enhances biodiversity, biological cycles and agro-ecosystem health.

Organic production systems are based on management practices that promote and enhance farm biodiversity, biological cycles, and soil biological activity. Organic agriculture strives to minimize use of off-farm inputs and relies on management practices that restore, maintain, and enhance soil ecology and the farm landscape. Growers considering organic grain crops need to recognize that success will depend on developing a diversified crop management system, including an appropriate rotation plan. We developed the recommendations in this guide to help growers tailor soil health and pest management strategies to fit their specific conditions.

Organic agriculture is a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity. It emphasises the use of management practices in reference to the use of off –farm inputs, taking into account that conditions required locally adopted systems. This is accomplished by using, where possible, agronomic, biological and mechanical methods as opposed to using synthetic materials to fulfill any specific function within the system*" (*FAO/WHO Codex Alimentarius Guidelines)"

The key characteristics of organic crop production include

Protection the long-term fertility of soils by maintaining organic matter levels, encouraging soil biological activity, and careful mechanical intervention.

Providing crop nutrients indirectly using relatively insoluble nutrient sources which are made available to the plant by the action of soil micro-organisms;

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.

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.

The extensive management of livestock, paying full regard to their evolutionary adaptations, behavioral needs and animal welfare issues with respect to nutrition, housing, health, breeding and rearing;

Careful attention to the impact of the farming system on the wider environment and the conservation of wildlife and natural habitats.

Principles of Organic Crop Production

These are the four principles of organic farming are mentioned below.

- **Principle of health:** Organic agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible. Healthy soils produce healthy crops that foster the health of animals and people. Health is the wholeness and integrity of living systems. The role of organic agriculture, whether in farming, processing, distribution, or consumption, is to sustain and enhance the health of ecosystems and organisms from the smallest in the soil to human beings.
- **Principle of ecology:** Organic agriculture should be based on living ecological systems and cycles, work with them, emulate them and help sustain them. This principle roots organic agriculture within living ecological systems. It states that production is to be based on ecological processes, and recycling. Nourishment and well-being are achieved through the ecology of the specific production environment. Organic management must be adapted to local conditions, ecology, culture and scale. Inputs should be reduced by reuse, recycling and efficient management of materials and energy in order to maintain and improve environmental quality and conserve resources. It should attain ecological balance through the design of farming systems, establishment of habitats and maintenance of genetic and agricultural diversity.
- **Principle of fairness:** Organic Agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities. This principle emphasizes that those involved in organic agriculture should conduct human relationships in a manner that ensures fairness at all levels and to all parties - farmers, workers, processors, distributors, traders and consumers. It aims to produce a sufficient supply of good quality food and other products. Natural and environmental resources that are used for production and consumption should be managed in a way that is socially and ecologically just and should be held in trust for future generations. Fairness requires systems of production, distribution and trade that are open and equitable and account for real environmental and social costs.
- **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. Organic agriculture is a living and dynamic system that responds to internal and external demands and conditions. This principle states that precaution and responsibility are the key concerns in management, development and technology choices in organic agriculture.

Components of Organic Crop Production Systems

Organic crop production as the application of a set of cultural, biological, and mechanical practices that support the cycling of on-farm resources, promote ecological balance, and conserve biodiversity. These include maintaining or enhancing soil and water quality; conserving wetlands, woodlands, and wildlife; and avoiding use of synthetic fertilizers, sewage sludge, irradiation, and genetic engineering. Organic producers use natural processes and materials when developing farming systems—these contribute to soil, crop nutrition, pest and weed management, attainment of production goals, and conservation of biological

diversity. The following list of tools and practices is not intended to be comprehensive, though the primary organic crop production practices are addressed. Note, too, that each farm operation will employ its own combination of tools and practices to build a working organic system. Therefore, there is no simple cookbook formula for combining tolls and practices in ideal proportions.

Crop diversity

Organic crop production encourages Crop diversity. The science of agroecology has revealed the benefits of polyculture (multiple crops in the same space), which is often employed in organic farming. Planting a variety of vegetable crops supports a wider range of beneficial insects, soil microorganisms, and other factors that add up to overall farm health. Crop diversity helps environments thrive and protects species from going extinct

Crop Rotation: In organic farming, the use of crop cycle principles is very effective to make available the crop nutrients mainly nitrogen and increase fertility status of soil. For this, cereal crops should be taken followed by pulses and pulses followed by cereal in the system. The use of pulses in crop cycle increases the environmental nitrogen fixation and which will be available for the next crop and also reduces the consumption of organic manures. In the initial years of organic farming, rice- wheat cropping system should not be included in crop cycle because it reduces the productivity of wheat. Therefore, after rice, pulses like lentil, chickpea, vegetable pea etc. should be used.

If organic farming methods are adopted properly, self resistance of pest and disease resistance in plants develops itself. Under this organic farming system, a good environment is created in the field and therefore the attack of pests and disease reduces in the crop.

Soil management

Organic farming relies more heavily on the natural breakdown of organic matter then the average conventional farm, using techniques like green manure and composting, to replace nutrients taken from the soil by previous crops. This biological process, driven by microorganisms such as mycorrhiza and earthworms, releases nutrients available to plants throughout the growing season. Farmers use a variety of methods to improve soil fertility, including crop rotation, cover cropping, reduced tillage, and application of compost. By reducing fuel-intensive tillage, less soil organic matter is lost to the atmosphere. This has an added benefit of carbon sequestration, which reduces greenhouse gases and helps reverse climate change. Reducing tillage may also improve soil structure and reduce the potential for soil erosion.

Green Manures and Cover Crops: Green manures and cover crops are grown primarily for reasons other than short-term economic gain. In other words, they are not produced for sale, but rather for the benefits they provide to the production of subsequent cash crops. Cover crops are so-called because they protect otherwise bare soil against erosion; green manures improve soil fertility. Because a cover crop is inevitably added to the soil, it becomes a green manure, so the terms are reasonably interchangeable.

Manuring and Composting: In organic farming, soil is considered as living medium. Soil has numerous microorganisms, which are complimentary to each other and it also play major role in availability of essential nutrients in addition to growth of crop. In organic farming, the

essential nutrients are fulfilled through various nutrient management practices. In order to keep soil fertile (physically and chemically), biofertilizers and other organic manures are used in addition to green manures. Available resources used in organic farming for nutrient management are:

Farm yard manure (FYM), poultry manure, cow urine etc.
Crop residues, weeds
Compost (vermicompost, enriched compost, EM compost etc.)
Various types of cakes
Biofertilizers, rockphosphate, lime etc.
Crop rotation, inclusion of legumes in cropping systems
Waste from different agriculture based industries.

Intercropping and Companion Planting: Intercropping is the growing of two or more crops in close proximity to promote beneficial interactions. Companion planting refers to the establishment of two or more species in close proximity so that some cultural benefit, such as pest control or increased yield, may be achieved between them.

Agronomic practices: Various crop activities can also be a process of management of extremely effective low-cost and environmentally safe pest management practices. Agronomic practices changes the environment of crop and also changes the stage of crop and behavior of disease and pests and lastly reduces its attack. These processes breakup the relationship between pest- diseases and plants, thus making the life cycle of insects- disease different. In agronomic practices, inclusion of crop rotation, timely sowing of crop and changes in harvesting time, control in plant population, adequate distance between plant to plant and maintain appropriate soil fertility etc. has proved important.

Selection of appropriate seed and variety: The main basis of good crop is healthy seed, farmers always take risks in the selection of seeds and often use non-certified seeds. Most of the diseases are seed borne or soil borne. If the variety of particular crop is selected accordingly to the local environmental condition then the risk of crop damage is very less.

Weed management

Organic weed management promotes weed suppression, rather than weed elimination, by enhancing crop competition and phytotoxic effects on weeds. Organic farmers integrate cultural, biological, mechanical, physical and chemical tactics to manage weeds without synthetic herbicides. Organic standards require rotation of annual crops, meaning that a single crop cannot be grown in the same location without a different, intervening crop. Organic crop rotations frequently include weed-suppressive cover crops and crops with dissimilar life cycles to discourage weeds associated with a particular crop. Research is ongoing to develop organic methods to promote the growth of natural microorganisms that suppress the growth or germination of common weeds.

Other cultural practices used to enhance crop competitiveness and reduce weed pressure include selection of competitive crop varieties, high-density planting, tight row spacing, and late planting into warm soil to encourage rapid crop germination.

Mechanical and physical weed control practices used on organic farms can be broadly grouped as:

Tillage - Turning the soil between crops to incorporate crop residues and soil amendments; remove existing weed growth and prepare a seedbed for planting; turning soil after seeding to kill weeds, including cultivation of row crops.

Mowing and cutting - Removing top growth of weeds.

Flame weeding and thermal weeding - Using heat to kill weeds.

Mulching - Blocking weed emergence with organic materials, plastic films, or landscape fabric.

Biological Pest Control: Biological pest control is the use of one or more beneficial organisms, usually called natural enemies, to reduce the numbers of another type of organism, the pest.

Sanitation: Sanitation can take on many forms including removal, burning, or deep plowing of crop residues that could carry plant disease or insect pest agents, the destruction of nearby weedy habitats that shelter pests, cleaning accumulated weed seeds from farm equipment before entering a new, and sterilizing pruning tools.

Tillage: Merely maintaining soil organic matter levels are difficult if soil is intensively tilled (such as with annual use of a moldboard plow.) Reducing tillage means leaving more residues, and tilling less often and less intensively than conventional tillage. No-till is the most extreme version of reduced tillage, but is not desirable on some soils and is not the only way to conserve soil organic matter.

Mulching: Organic mulches, such as straw or spoiled hay, can reduce the need for cultivation, protect soil from erosion and crusting, and replenish organic matter.

Supplemental Fertilization: Organic farming management relies on developing biological diversity in the field to disrupt habitat for pest organisms, and the purposeful maintenance and replenishment of soil fertility. Organic farmers are not allowed to use synthetic pesticides or fertilizers.

Bio rational Pesticides: This term refers to synthetic, organic, or inorganic pesticides that are both low toxicity and exhibit a very low impact on the environment. "Biorationals" also have minimal impact on species for which they are not intended (called non-target species). Bio rational pesticides include oils, insecticidal soaps, microbials (such as *Bacillus thurengienesis* and entomopathogenic nematodes), botanicals (plant-based) and insect growth regulators.

Buffers and Barriers: In the context of organically managed systems, buffer and barriers are required under NOP rules if there is a risk of contamination, via drift or flow, of substances not allowed under organic regulations.

Components of Sustainable Organic Crop Production:

Economic Profitability

To be truly sustainable, a farm must be economically viable. The environmental and social benefits of sustainable production methods do not always translate into immediate economic gains. That said, sustainable agriculture practices can have a positive economic impact on a farm.

Environmental Stewardship

Environmental concerns are central to sustainable organic crop production. Sustainable agriculture is frequently described as: ecologically sound practices that have little to no adverse effect on natural ecosystems. However, more than that, sustainable agriculture also seeks to have a positive impact on natural resources and wildlife.

Social Responsibility

Social sustainability relates to the quality of life for those who work and live on the farm, as well as those in the local community. Fair treatment of workers, positive farm family relationships, personal interactions with consumers, and choosing to purchase supplies locally (rather than from a more distant market) are just some of the aspects considered in social sustainability.

Upholding Animal Welfare

Sustainable farmers and ranchers treat animals with care and respect, implementing livestock husbandry practices that protect animals' health and wellbeing.

Organic Certification: Organic production certification is to communicate, inspect/ evaluate etc. by the authorized way to insure compliance with standards from production processes. The organic agriculture certification is the process certification in which various stages of organic production like production processing, storage and packaging etc. are certified. Certification letter is issued only after ensuring compliance with the standards. Presently, the Government of India has authorized 18 organic certification agencies which is doing organic certification work in the country. The infrastructure is the key agency. Presently Uttarakhand Organic Certification Agency is the first organic certification agency in public sector.

Key stages of Organic certification

Application by the Producer to the certification agency on the prescribed format.

Reviewing the application form received by the certification agency and seeking other information if required.

On receipt of full information, registering the producer, estimating the estimated duty and determining the date / time of inspection.

To supervise / audit all production processes by the inspectors as per the standards and submit the inspection report to the agency office.

Evaluation of inspection data by the agency and submission of certification decision (buggy / unqualified) to the production agent.

Issuance of certificate by certification agency only after compliance with standards.

Basic Principles of Organic Authentication:

Soil Fertility

- Use of certified organic manure, blue green algae, azola, green manure to maintain soil fertility and land fertility balance
- In terms of nutrient management, crop cycle and mixed farming, which includes pulses, must be included.
- After harvesting, the residues (roots, straw, leaves, stems, etc.) and weeds should not be burnt, but it needs to be cleaned

Land and water conservation

- Use grass and mulching can be done on the ridges to prevent soil erosion.
- Such trees should be planted in the area which prevents soil erosion and helps in water conservation.
- Natural water source and ground water should be created due to unnecessary exploitation and pollution.

Seed and plant protection-

- In seed and plant protection, micro-organisms, liquid / extracts of marked flora, cow-urinary vermiwash can be used.
- Priority should be given to mixed farming and crop diversification and local species as per requirement.
- Composting of weeds and crop residues should be done to develop pest and disease resistance in the plants.
- Agnihotra can also be done daily for plant protection.

Animal Husbandry:

- Animal husbandry is an important component in organic farming.
- Ensure availability of fodder, grain and water etc. to the animals on time by the certification agency.

- According to the physical nature of animals, animal enclosure, independent description and regular cleaning is necessary.
- It is necessary to make proper arrangements for sick and old animals and to treat the animals with humanity.

Forest and Environment Safety Management:

- Promotes plants of local and multi-use species which are helpful in conservation and feeding of wildlife and birds.
- Use of trees that help in water conservation and air purification should be planted more and more.
- Biodiversity should be promoted for conservation of organisms.
  Use plastic/ polythene and items manufactured from them at low price. Safe management is necessary to destroy them.

Certification will be required to get the value of the organic product. No product without certification will be known as organic product. Even after certification, you will get the appropriate price of the product. For this it would be very good to do organic farming in the farmers group, which will reduce the cost of certification and it will be easy for them to sell their product if the quantity is present. Sometimes certification agencies are also helpful in selling organic products. However, organic produce market is also being developed by various government where the farmer can take his produce and sell it directly. Many organizations are also working for marketing organic products. Organic products can also be sold online.

Future prospects

India is poised for faster growth with growing domestic market. Success of organic movement in India depends upon the growth of its own domestic markets. India has traditionally been a country of organic agriculture, but the growth of modern scientific, input intensive agriculture has pushed it to wall. But with the increasing awareness about the safety and quality of foods, long term sustainability of the system and accumulating evidences of being equally productive, the organic farming has emerged as an alternative system of farming which not only address the quality and sustainability concerns, but also ensures a debt free, profitable livelihood option.

Conclusion

Organic crop production works in harmony with nature rather than against it. This involves using techniques to achieve good crop yields without harming the natural environment or the people who live and work in it. In another way organic crop production is kind of agricultural that provide the consumers, with fresh, tasty and reliable food while regarding natural life cycle systems. In addition to health benefits of organic products for consumers, there are vital environmental benefits for the earth. An organic crop production keeps biodiversity and reduce environmental pollutions such air, water and soil. Organic agriculture has grown out of the conscious efforts by inspired people to create the best possible relationship between the earth and men.

Organic Vegetable Cultivation

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Vegetables are important constituents of Indian agriculture and nutritional security. Diverse agro climatic conditions of India permit to grow more than 60 cultivated and about 30 lesser known vegetable crops. Systematic research efforts backed by developmental activities and policies have resulted in development of numerous improved varieties/ hybrids and production technologies resulting in phenomenal increase in area, productivity and production of vegetables during the last 6 decades. Increasing population, per capita income, health consciousness, urbanization, and working women are responsible for increasing demand for nutritionally rich foods in the country. High returns, favourable income elasticity of demand and annual growth rate for domestic demand are also important catalysts for attracting farmers to vegetable cultivation and promoting its growth.

With the increasing awareness about the safety and quality of foods, long term sustainability of the system and accumulating evidences of being equally productive, the organic farming has emerged as an alternative system of farming which not only addresses the quality and sustainability concerns, but also ensures a profitable livelihood option. The success of organic vegetables farming depends to a great extent on the efficiency of agronomic management adopted to stimulate and augment the underlying productivity of the soil resources. All the management practices followed in organic farming are governed by the principles of ecology and are within the ecological means. Organic vegetable cultivation offers one of the most sustainable farming systems with recurring benefits not only to long-term soil health but provides a lasting stability in production by importing better resistance against various biotic and abiotic stresses. Although the cost of certification and the time and labor involved in managing the organic system are high, returns potential are also high in the area where markets are well developed for organic products. Generally, organic vegetables fetch a premium price of 10%-50% over conventional products. Market of organic products is growing at faster rate (20%) as compared to conventional ones (5%). This growth rate is highest in Japan, USA, Australia and EU. Export preference of organic vegetables offers a great scope to even small countries in Asia and African continents, which has inculcated the skill of growing organically since time immemorial. Considering the above facts, the present international training program was planned to impart an insight to technologies available for sustainable production, processing & marketing of organic vegetables in Asia and African countries.

Contamination of vegetables, fruits and other food commodities with harmful pesticide residues and pollution of the environment due to indiscriminate use of inorganic fertilizers and pesticides is a matter of concern all over the world. Development of suitable organic farming modules in vegetable crops would help in production of safe vegetables, minimizing environmental pollution and improving soil health through enhanced carbon sequestration and biological activity.

Organic farming, especially of vegetables is gaining momentum worldwide due to increasing awareness and concern on adverse effects of indiscriminate use of chemical fertilizers and pesticides on food quality, soil health, human health and environment. The studies conducted at IIVR on tomato, cabbage, cowpea and okra revealed that application of poultry manure @ 7.5 t/ha can ensure 28-35 % higher yield as well as 17-25% higher vitamin-C content in these crops over the inorganic management system and the soil health in terms of organic carbon, bulk density, water-holding capacity, microbial biomass carbon and dehydrogenase activity was improved under organic system as compared to inorganic system

Key Focus areas of organic vegetable cultivation are –

Selection of improved varieties/planting materials
Nursery management in vegetable crops
Organic production technology for - Solanaceous crop, Cole crop, Root crop, Bulb crop, Peas and Beans, Okra, Cucurbits, Leafy vegetables and Rare vegetables
Weed Management, Water Management, and Integrated Plant Nutrient Management for organic vegetables production.
Vegetable based cropping system for organic farming
Pre & Post harvest management of organic vegetables produce.
Processing and value addition of organic vegetables produce.
Disease and insect-pest management in organically grown vegetable crops
Seed Production and Management of organic vegetable crops
Certification of organic produce
Marketing, export of organic vegetables

Objectives of organic cultivation of vegetable crops:

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

Nutrient Management in organic vegetable cultivation:

The use of soil tests is suggested as a means of determining nutrient availability status in soils. The results from these tests will provide a producer with guidelines on how much fertilizer material will be needed for successful crop growth and yield. It should be remembered that soil tests are site specific and any given soil sample should not be used to base fertilizer needs for soils in additional fields or farms not tested. Based on soil tests, there are several inputs that can be used for vegetable cultivation in organic system, like green manures, animal manures, and farm yard manures.

Green, undecomposed plant material when used as manure is called green manure. Green manure crops usually belong to leguminous family. On an average one tonne of well grown green manure is equivalent to 2.8 to 3.0 tonnes of FYM or 4.5 to 4.7 kg of nitrogen which is equilent to 10 kg of urea. Eg. Sunnhemp, Dhaincha, Greengram and Sesbenia rostrate.Animal manures are an excellent source of organic matter and nutrients for the soil.

Farm yard manure is most readily available to the farmers. It is a decomposed mixture of cattle dung and urine with straw and litter used as bedding material and residues from the fodder fed to the cattle. Well rotten farm yard manure contains 0.5% N, 0.25% P_2O_5 and 0.5% K_2O. some more organic fertilizers that can be used in organic vegetable cultivation are rock phosphate, green sand, alfalfa pallets, bone meal, fish emulsion, wood ashes, soybean meal and gypsum etc.

Disease and Pest Management in Organic Vegetable Cultivation: its tough task to control diseases and pests of vegetable crops, once they have established the field. Therefore, the most obvious and fruitful way for their management is the use of approached that inhibit their occurrence in the crop field. One simple method is the use of resistant or tolerant varieties that have been bred against major biotic stresses of vegetable crops. Because by now, no vegetable variety has been developed for growing specifically under organic conditions.

A list of such resistant/ tolerant varieties of vegetable crops is given as under –

Brinjal	Bacterial wilt	ArkaNidhi, ArkaKeshav, ArkaNeelkanth, Pant Rituraj, Pusa Purple Cluster
	Phomopsis blight	PusaBhairav, PusaUpkar, Florida Market, Florida Beauty
	Fruit and shoot borer	PbBarsati, PbNeelam, Pusa Purple Long, ArkaMahima, ArkaSanjivans
	Aphids, thrips, white fly, jassids	GB 1, GB 6, PBR 91
	Little leaf	Pusa Purple Cluster
	Jassids	ManjariGota
Chilli	LCV	Pant C1, PusaJwala, PusaSadabahar, PhuleJyoti, PhuleSuryamukhi
	Anthracnose	Pb Lal
	Mosaic, Wilt, Dieback	PbSurkh
	Virus complex	LCA 235
	Powdery mildew	PhuleMukta
Cabbage	Black rot	PusaMukta,
	Black leg	Pusa Drumhead
	Aphid	Red Drumhead, Sure Head, Express Mail
Cauliflower	Black rot	PusaShubhra, Pusa Snowball K1
	Downy mildew	Pusa Hybrid 2, Kunwari-7, Kunwari-8

	Stem borer	Early Patna, EMS3, KW5, KW8
Cowpea	Bacterial blight	PusaKomal
	Yellow mosaic virus	ArkaGarima, Kashi Unnati, Kashi Kanchan
French bean	Common mosaic virus and rust	Pant Anupama
	Anthracnose, leaf crinkle, wilt	PhuleSureksha
Musk melon	Downy mildew	PbRasila
Okra	YVMV	ArkaAnamika, VarshaUphar, PhuleKirti, ArkaAbhay, PbPadmini, ParbhaniKranti, Pusa A4
	Jassids	PbPadmini
Onion	Thrips	ArkaNiketan, PusaRatnar
Pea	Powdery mildew	JP-3, JP-4, NDVP-4,
	Fusarium wilt	Alaska, Grey Badger, Sylvia
Pumpkin	Fruit fly	ArkaSuryamukhi
Tomato	Bacterial wilt	ArkaAbhijit, ArkaShreshta, BWR5, BWR1
	Leaf curl virus	Hisar Anmol, Hisar Gaurav
	Verticilium wilt	Pant Bahar
	Root knot nematods	ArkaVardan
	Drought/ rainfed conditions	ArkaMeghali
Water melon	Anthracnose, powdery & downy mildew	ArkaManik
	Fusarium wilt	Conqueror, Crimson Sweet
Cucumber	Powdery & downy mildew	Poinsette
Musk melon	Powdery mildew	ArkaRajhans, PbRasila
	Fusarium wilt	Hari Dhari, PusaMadhuras
Potato	Early blight, late blight, wart	KufriSwarna, KufriJyoti
	Late blight, wart, hopper burn	KufriAnand
	Late blight, early blight, PVX	KurfiBadshah
	Gemini virus, wart	KufriBahar

	Early blight, charcoal rot, wart	KufriChamatkar
	Late blight, wart, frost	KufriChipsona 2

Other approaches for biotic stress management are –

Providing a habitat for beneficial insects
Use of trap crops, row covers and mulches
Use of bio-control agents and natural pesticides

Weed management in organic vegetable production: at each level, different approaches need to be followed like –

Preventive methods like use of clean seeds, machinery and compost etc.
Eradication before they produce seeds
Physical/ mechanical methods like hand weeding, hoeing, use of mulch, alternate row irrigation etc.
Biological control methods

Constraints faced by farmers in adopting organic vegetable cultivation:
Low yield in initial years
Knowledge about usable resources
Lack of markets
Difficulty in getting access to different resources
Lack of organically produced seed
Absence of vegetables varieties bred for organic vegetable cultivation
Lack of knowledge about certification procedure
Lack of package of practices for cultivation of vegetable crops in organic mode

Conclusion:

Though cultivation of vegetables in organic way is a bit challenging specially during initial stages, but due to its several advantages like improving the biological cycle by using microorganisms, soil health and ecosystem along with the higher returns for their organically grown vegetables is highly advantageous to farmers.

Role of Microbes and Organic Farming

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Human has been relaying on Agriculture throughout the evolution and would be depending on it for ever. The impact of globalization, transition in the technology lead a negative shade on agriculture in the developing countries and declined the percentage of the farming community drastically resulting in raising demand for food commodities. Growing global population demands the safe and sufficient food for the survival. Soil heath has become the greatest assertion for the scientific community in this ever-growing polluted globe. Uncertainty in the agro climatic conditions (edapho-climatic factors), monsoon failures by the priceless human activities, lack of proper awareness among the farming community are the direct causes for the agriculture failure. The raising demand for the fields like food processing, packing industries, ready to eat foods etc., witness the demand for raw materials in agriculture sector. Crises of agricultural land day by day, vertical increase in the cost of agriculture input technologies is leading to transitions in farming community. In such an agro critical scenario, a multifaceted solution for different constraints in agro industry is necessary. It is evident that microbe-based technology has inaugurated a new era in biological input technology and recorded a tremendous raise in the annual agriculture production particularly in the past two decades.

While conventional agriculture relies on synthetic fertiliser, chemical pesticides or other technological inputs for crop production, organic agriculture aims to make optimal use of the natural capital of the soil and its microbial population through methods such as the selection of indigenous crop varieties, and the production of crops appropriate to soil conditions. A number of different soil microorganisms are involved in these processes. Many show potential bio-control activities against weeds, crop diseases and pests, while Rhizo-bacteria and mycorrhizal species can play an important role in sustainable fertility management. Microorganisms are currently being used as a replacement for synthetic pesticides and fertilizers for many different crops.

A more holistic concept of farming in terms of agro-ecology has begun to challenge the traditional reductionism approach to the study of agriculture. As a result, we have become more aware of the importance of microorganisms in such processes as soil formation, plant nutrition, and the suppression of plant pathogens, pests and weeds. Moreover, it has become clear that many farming practices – intensive tillage, pesticide use, fertiliser use and mono cropping in particular – are directly or indirectly harmful to soil microbes and therefore to the processes mediated by them. It is concern that since much industrialised agriculture now relies heavily on manufactured inputs rather than using natural resources, the sustainability of agriculture is threatened and a move towards resource conserving agriculture is essential. Farming practices must be designed to optimise soil microbial life as part of a wider strategy aimed at conserving and replenishing natural resources. The practical application of this

technology and the role of naturally occurring populations of microorganisms in agroecosystems form the basis of this article.

Soil microbial biomass is composed of eukaryotic (fungi, yeasts, protozoa and algae), and prokaryotic (eubacteria, actinomycetes and archaea) organisms, whose populations vary from soil to soil. Many microorganisms possess urease enzymes which play a role in soil enrichment through the degradation or hydrolysis of organic nitrogen. Soil microbial biomass is dictated by a variety of soil and environmental parameters including soil texture and structure, pH, air/moisture content, and soil temperature. One of the prime factors that determine soil microbial status is the type and amount of organic material that enters the soil ecosystem. The vast majority of soil microorganisms are heterotrophic and require organic materials as both carbon and energy sources. Management practices in particular, the manipulation of the quality and quantity of organic inputs might, therefore, be predicted to modify soil microbial populations, the soil food web, and the biological processes involved in nutrient transformation. Microorganisms play a fundamental role in soil creation and stability through the binding of soil aggregates by hyphae and by the secretion of exudates. There are many examples of the ways in which soil microbial systems help ecosystem health and stability. In a study examining the influence of the microbial community of a Senegalese Sahel soil on the interactions between root knot nematodes and Pasteuria. Penetrans, a parasite of plant-parasitic nematodes, the actinomycetes was associated with a larger soil microbial population, including mycorrhizal and nematophagous fungi, which together stimulated the attachment of P. Penetrans to the nematodesto reduce nematode infection.

Antagonistic and antibiotic microorganisms

There are many reports that soil organisms might be antagonistic to plant pathogens, pests and weeds. For example, over 100 species of fungi trap and prey on nematodes, and many fungi are hyper parasites of other fungi. These activities not only influence the general nutrition, health, and vigour of higher plants (which also affects disease susceptibility), but they also determine the competitive behaviour of root-infecting fungi and their microbial antagonists. *Streptomycetes*, filamentous bacteria that are effective and persistent soil saprophytes of ten associated with plant roots, are well-known producers of antibiotics and extracellular hydrolytic enzymes. It is reported that they have the potential to contribute significantly to an integrated disease management system that includes alfalfa and other crops such as potato, maize and soybeans due to their ability to colonize plants and decrease damage from a broad range of pathogens. Mechanisms by which endophytes can act as bio-control agents include production of antibiotic agents, side rophore production, nutrient competition, niche exclusion and induction of systemic acquired host resistance. Bacterial endophytes canthus play a role in pathogen suppression and complementary crop sequences can encourage beneficial allelopathy. Rhizobacteria, particularly the so-called plant growth-promoting rhizobacteria (PGPR), can directly suppress plant pathogens by the production of antibiotics and hormones and by competition with pathogens for resources. Some of these bacteria also promote root and shoot growth, nodule formation by *Rhizobium* (when they are known as nodule promoting rhizobacteria, NPR), and mycorrhiza establishment (as mycorrhiza helper bacteria, MHBs)

Organic Fertilizer

Group of Microorganism	Kind and Name
Microorganism can fix Nitrogen. - Free living	A. Blue Green Algae (*Anbaena , Nostoc*, etc.) B. Bacteria *(Azotobacter, Azospirillum, Rhodopseudomonas*)
- Living with other plants	A. Blue Green Algae (*Azolla-Anabaena azollae*) *B. Bacteria* (*Rhizobium* sp.)
Microorganism melts Phosphate. -Free living	*Bacillus sp., Scherichia freundii, Pseudomonaa* sp.etc. B. Fungus (*Aspergillus sp., Penicilium sp., Fusarium oxysporum* etc.)
-Symbiosis	A. Fungus (Mycorrhizal fungi) - Arbuscular Mycorrhizae – Ectomycorrhizae
Microorganism melts Phosphate.	*Trichoderma viride, Chaetomium abuanse, Myrothecium roridum, Aspergillusniger, A. terreus, Cellulomonas., Cytophaga sp., Bacilluss sp*. etc.
Microorganism can get rid of insects destroy weed.	A. Virus (DNA viruses, RNA viruses) B. Bacteria (*Bacillus thuringgiensis, B. popilliae, B. lentimorbus, B.sphaerius* etc.) C. Fungus (*Entomophthora, Masospora, Cordyceps, Aschersonia* etc.) *D. Protozoa (Nosema Locstae, N. bombycis* etc.) E. Nematode (*Neosplectona, Carpocasae, Romanomernos culicivorax*, etc.)
Microorganism can control weed diseases.	A. Bacteroal Pathogens Control (*Agrobacteroum radiobacter, Pseudomonas fluorescens, Streptomyces scabiobies* etc.) B. Fungal Pathogens Conteol *(Peniophora giganta, Pseudomonas fluorescens* etc.) C. Nematode Pathogens Control (*Bacillus penet*
Microorganism can control unwanted weed.	*Cercospora rodmanoo, Celletortrichum glocoaporipeds, Punccinia chroudrillina* etc.
Fungus can produce antibiotic substances.	Cyclohexinide (*Streptomyces griseus*) Blasticidins (*S. griseochromogenes*)

	Polyozins (*S. cacaoi*)
Bacteria can produce antibiotic substances.	Streptomycin (*S. griseus*) Oxytetraccycline (*S. viridifaciens*)
Insects can produce antibiotic substances	Tetranctin (*S.aureus*)
Food and people and animals	A. Algae and Plankton (*Sprieulina, Nostoc* etc.) B. Yeast C. Protean from fungus mushroom (*Fusarium graminearum, Choetomium cellulolyticum*)
Using for Analysis	A. Algae (Pullutanis) B. Bacteria (Amino acids, Vitamins, Pollutanis)

Economic Importance in terms of Food quality

Microorganisms, despite their small size, play an important role in the assessment and maintenance of food quality and safety in food processing and manufacturing industries. This microscopic form of life has been recognised by enforcement authorities at the local, national and international levels. The phrase "Economic Importance" is a double-edged sword, it has its advantages and disadvantages at the various area of applications. Putting into consideration the diverse areas of which includes organisms display their economic imponance which includes pharmaceutical, clinical, environmental etc, this paper will be restricted to food processing and manufacturing. Economic Importance of microorganism in food processing and manufacturing is directly proportional to microbiological specifications, standards or control. In the light of the above, its objectives could be summarized as follows: i) To ensure a safe product for the consumer. ii) To ensure an adequate keeping quality. iii) To pin-point faults in processing/manufacturing. iv) To improve the quality of the product. v) To educate the employees in hygiene and other aspects of their work.

Economic Importance

This could be divided into two groups: desirable and undesirable importance. Desirable importance is those cost saving and revenue generating activities exhibited by microorganism under controlled conditions. These include:

Fermentation

This is a biochemical process which involves the conversion of simple sugar to acid, ethanol and Carbon dioxide through the metabolic pathways, e.g. the conversion of lactose to lactic acid by Lactobacillus bugarirus and Strep. Thermophiles during yoghurt production. And also the decomposition of glucose to ethanol and Carbon dioxide by yeast (S. calbergeneis and S. cerevisea) during alcoholic beverages production (beer, cider, wine, spirit etc.)

By the above processes, microorganisms have been found to play important roles in saving cost and revenue generation. Processing of foods such as Gari, Cheese, and Yoghurt etc; is successfully done by the activities of these organisms. These organisms also assist man in

ensuring the safety of these products for consumption and the keeping quality of such products, e.g. the production of lactic by Lactobacillus bulgaricus and strep. Theremphiflus during yoghurt production. This lactic acid does not only improve the keeping quality of such products but also eliminates the growth of pathogenic organism which is of primary importance to the consumer. This same process could be applicable to quite a number of consumable food items. Xanthan Gum called Ticaxan - is a naturally fermented product derived from pure culture of an improve strain of Xanthomonas camperstris. This microorganism ferments aerobically in a primarily carbohydrate medium which contains micronutrient. Xanthan gum exhibits high viscosity at low concentration, it is a significant additive in many food industries; it may be used to provide body in relishes; add smoothness to cream cheese; control ice crystal growths and improve freeze/thaw properties in frozen foods; helps retain moisture in baked goods; inhibits syneresis in fruit blends; and acts as a stabilizer in beverages. All these are possible with microorganism as the principal actor. Micrococcus lysodeikticus produces liquid enzyme called Microcatalase through a controlled fermentation process. This enzyme catalyzes the decomposition of hydrogen peroxide to water and molecular oxygen (used in treatment of raw milk). Microbial rennet used for cheese making is produced from controlled pure culture fermentation of Mucor pusillus Lindt; "Emporase" microbial rennet is suitable an economical alternative to animal rennet.

Ripening Process

This is the process of making a particular product ready for eating. Microorganism play a role in ripening process of foods such as Cheese, Fruits, and Cream etc. In cheese the characteristic organisms involved include Brevi-bacterium linens, Penicillium Roquefort; P. camemberti etc. B. linens produces a brownish red surface growth on Cheese (during surface ripening) and breaks down part of the Cheese protein to amino nitrogen thereby releasing a subtle, pleasing flavour into the Cheese. P. Roquefort is also added to semi-hard Cheese (Sitilton, Roquefort etc.) to make them ready for eating. And by this singular act, enormous funds are conserved and revenue is generated from this organism. In similar manner, a culture containing lactococcus lactic subsμ. Cremoris, lactic leuconostoc mesenteroides subsp. cremoris is added to cream to make it ripened for Butter production. Concentrated Banana juice is extracted from ripened banana imparts a natural banana flavour to foods without adding insoluble solids. Suitable for use in ice cream, candy, clarified beverages, and a variety of refrigerated or frozen dairy beverages and bakery products.

Aroma and Flavour Development

Aroma and flavour development is an important aspect of food processing involving microorganism. These, in addition to revealing the natural characteristic of a particular product, primarily assist in organoleptic assessment of such product. These could be grouped in to four (4) categories: -

- Non-volatile acids e.g. lactic, pyruvic. Oxalic or succinic.

- Volatile acids e.g. fom1ic, acetic, propionic or butyric.

- Carbonyl compounds e.g. acetone acetaldehyde, diacetyl etc.

- Miscellaneous compound, e.g. constituents formed by thermal degradation of protein, fat or lactose.

The aroma and flavour of yoghurt are basically due to the production of lactic acid and carbonyl compounds. Again, funds are conserved through this act. Tamari soy sauce - a naturally fermented product made from soybeans, used in a variety of oriented and non-oriented foods including frozen entrees, prepared meats and sea foods, baked goods, dairy products, salad dressing, sauces, soups and snacks. Tamari soy sauce is a versatile flavour enhancer which can bring out subtle qualities in food as well as provide a rich aroma and full-bodied flavour. This is success fully achieved with the help of microorganisms.

Bread, Cake and Bakery Goods

Microorganism (yeast) play very useful role in the Bakery industries. Not only that they decompose carbohydrate to produce ethanol and Carbon dioxide which is responsible for rising the dough, aldehydes and aromatic compounds are also produced by these organisms and these accounts for the organoleptic and keeping quality of such products. 3.5 In the processed meat factory, species of Ll1clobacifli, Micrococci, Pediococcus and S. cerevisae are used for summer sausage production, and salami (polish sausage) production. 3.6 The fruit juice industries are no exception. Species of yeast are often used for various purposes such as volatile acid productions, ethanol and carbonyl compounds.

Undesirable Activities

These are activities that result in loss of revenue, ill-health, fall in profit margin etc, as it may be viewed from different perspectives. Below is a highlight of few of these activities. 4.1 In the dairy industry, a well-define microbiological fault are characterized by high count of the causative organism e.g. Bacillus cereus for "bitty cream" in pasteurized milk. 4.2 Bacillus sp. for defects in sterilized and evaporated milk, Proteus for bitterness in canned cream ("leakers") Closlridium sp. for "stinker" or blown cheese; moulds for colour defect in butter, and yeast for blown tins of sweetened condensed milk.

Bacillus ciralans for phenolic or carbolic taint, Coliaerogenes group for sourness; Bacillus sp. for sweet clotting and gassiness in milk. Streptococcus lactic var. ma/ti gene for maltytaints. Yeast for blowing in fruit yoghurt and Carbon dioxide production. 4.4 In fruit industries, bottled fruit juices and squashes which may contain preservatives and have been pasteurized may contain cells of acetic acid bacteria which can cause off flavours and organoleptic failures. Citrus fruit are greatly destroyed by activities of Penicillium spp. especially P. italicum, P. digitatum. 4.5 Some species of fungi are responsible for fruit spoilage e.g. Blue and Green mould rot which is caused by penicillin, while the fluffy grey mould growth is caused by Botrytis cinerea and is typical of pome fruit. 4.6 In the bakery factory, Ropiness in bread, cake and other bakery products, is caused by Bacillus spp. 4.7 Vegetables which are prepacked in an insufficiently ventilated water impermeable wraps can be affected by bacterial soft rots caused by particularly gram-negative organism of the genera Erwinia and Pseudomonas. 4.8 The meat industry is not an exception; meat-spoilage by mould in refrigeration or frozen at temperature down to about -5°C can occur without spore production giving rise to a white fluffy appearance caused by mucor. Some obvious spoilage could include; white spot caused by Sporotriclium. Black spot caused by Clasdoporuim and green patches caused by Penicillium. In addition, surface slime on meat is caused by Pseudomonas and Acinetobacter but Streptococcus and lactobacillus could also be responsible. Several losses are being incurred as a result of the above undesirable activities. assertion for the scientific community in this ever-growing polluted globe. Uncertainty in the agro climatic

conditions (edapho-climatic factors), monsoon failures by the priceless human activities, lack of proper awareness among the farming community are the direct causes for the agriculture failure in the developing countries. The raising demand for the fields like food processing, packing industries, ready to eat foods etc., witness the demand for raw materials in agriculture sector. Crises of agricultural land day by day, vertical increase in the cost of agriculture input technologies are leading to transitions in farming community. In such an agro critical scenario, a multifaceted solution for different constraints in agro-industry is necessary. It is evident that Biofertilizers technology has inaugurated a new era in biological input technology and recorded a tremendous raise in the annual agriculture production particularly in the past two decades. To combat the threat of global food crises, the alternative technologies in the agriculture like liquid Biofertilizers are obligatory.

Farming Systems Approach

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Introduction

Public sector extension in India has undergone several transformations since independence in 1947. Initially, the focus of extension was on human and community development, but during the remainder of the 20th Century there was a steady progression toward technology transfer within the policy framework of food security. The most significant development during the mid-seventies was the introduction of the Training and Visit (T&V) Extension management system.

By the 1990s, the Indian Extension system was at a crossroads. Since Extension had focused on disseminating Green Revolution technology for the major cereal crops for the past two decades, extension activities were largely carried out by state Departments of Agriculture (DOA). Other line departments, like Animal Husbandry (DAH), Horticulture (DOH) and Fisheries (DOF), had very limited extension capacity and primarily focused on the provision of subsidized inputs and services to farmers. In addition, these line departments operated largely independently, with very little collaboration between the departments and their field staff.

In the late-1990s, the Government of India (GOI) and the World Bank pilot-tested a new, decentralized, market-driven extension model under the National Agricultural Technology Project (NATP). This new approach was designed to help farmers diversify into high-value crops and livestock enterprises as a means of increasing farm incomes and rural employment (i.e. poverty alleviation). The key institution in implementing this new approach was the Agricultural Technology Management Agency (ATMA), which was to facilitate and coordinate "farmer-led" extension activities within each district.

The key elements of the ATMA model included: 1) organizing small-scale farmers, including women, into farmer interest groups (FIGs), 2) linking these groups to markets, 3) decentralizing extension decision-making down to the district and block levels; 4) taking a more **"farming systems" approach**, requiring the integration of extension activities across the different line departments. Now let us understand the farming system approach (FSA) through concept and definitions.

Concept

Farming system is an integrated set of activities that farmers perform in their farms under their resources and circumstances to maximize the productivity and net farm income on a sustainable basis. The farming system takes into account the components of soil, water, crops, livestock, labour, capital, energy and other resources, with the farm family at the centre managing agriculture and related activities.

The farming system conceptually is a set of elements or components that are interrelated which interact among themselves. At the centre of the interaction is the farmer exercising control and choice regarding the types of results of interaction. The income from cropping

alone from small and marginal farm is insufficient now to sustain the farmers' family. A judicious mix of any one or more of these enterprises with agronomic crops. Should complement the farm income and help in recycling the farm residues / wastes. The selection of enterprises must be based on the cardinal principles of minimizing the competition and maximizing the complementary between the enterprises. Of late, the researchers on multi-disciplinary approach greatly realized and started developing the various farming systems models in accordance with the agro-eco systems zones. Since 1978, both scientists, extensionists, anthropologists, social workers, administrators have been publishing many articles on FSRE in different journals.

Simmonds in 1984 clarifies the Farming System Approach as follows: It is an academic activity comprising of theory, concepts, principles, approaches etc. It creates an opportunity for developing diversified models for different type of farmers and different category of farmers. New farming system approach models could be developed by means of on farm research and extension. It causes consequential a complex change which demands for Government interventions for farming systems development

BIGGS (1985) explained the concept of FSA as follows: it is a problem solving approach for the farmer. Farming system approach requires commonly homogenous type of farmers. It is an inter-disciplinary approach. It is a participatory and bottom up planning. It requires on farm trials. It depends on the concept learning by doing and farming system approach needs socially desirable technologies.

Thus the concept of Farming System Approach can be summarized as it is a holistic approach, complex in nature, interrelated of components, matrix of soils, plants, animals, power, implements, labour, capital and other inputs, influenced by political, economic, institutional and social forces.

Definitions

Farming systems approach relates to the whole farm rather than individual elements; it is driven as much by the overall welfare of farming households as by goals of yield and profitability. Farming systems are closely linked to livelihoods because agriculture remains the single most important component of most rural people's living and also plays an important role in the lives of many people in semi-urban areas.

Farming systems involve a complex combination of inputs, managed by farming families but influenced by environmental, political, economic, institutional and social factors. Research and extension institutions are increasingly aware that a holistic approach, drawing on both local and external knowledge, is necessary if they are to be effective in addressing poverty and sustainability.

" Farming System is defined as a complex inter related matrix of soil, plants, animals, implements, power, labour capital and other inputs controlled in part by farming families and influenced to varying degrees by political, economic, institutional and social forces that operate at many levels. The farming system therefore, refers to the farm as an entity of inter dependent farming enterprises carried out on the farm".

The farm is viewed in a holistic manner. The farmers are subjected to many socio-economic; biophysical, institutional, administrative and technological constraints.

Need for Farming System Approach

The need for Farming Systems Approach in the present scenario is mainly due to high cost of farm inputs, fluctuation in the market price of farm produce, risk in crop harvest due to climatic vagaries and biotic factors. Environmental degradation, depletion in soil fertility & productivity, unstable income of the farmer, fragmentation of holdings and low standard of living add to the intensity of the problem.

What it is and What it does

It is an approach for developing farm-household systems, built on the principles of productivity, profitability, stability and sustainability. All the components are complimentary and supplementary to each other. And the development process involves the participation of rural communities. The farming system approach emphasizes understanding of farm household, community inter linkages, reviews constraints and assesses potentials. And it combines improvements desired from better technology. It needs efficient support services and requires better policies. It is continuous, dynamic and interactive learning process based on analysis, planning, testing, monitoring and evaluation.

Why Farming Systems Approach

To develop farm – house hold systems and rural communities on a sustainable basis

To improve efficiency in farm production

To raise farm and family income

To increase welfare of farm families and satisfy basic needs.

An intensive integrated farming system addresses two issues, reduction in risk with the monoculture activities and promoting enterprise diversification, value addition and Development of alternative income sources with efficient utilization of farm resources. And it brings about enterprise diversification for sustainability and additional benefits, better management of important farm resources like land, labour and capital etc. Provides an opportunity for effective recycling of the product and by-products, helps to generate flow of cash to the farmers round the year by way of disposal of milk, fruits, fuel, manure etc., beside other agricultural output.

Farming Systems Strategy

In view of serious limitations on horizontal expansion of land and agriculture, only alternative left is for vertical expansion through various farm enterprises required less space and time but giving high productivity and ensuring periodic income specially for the small and marginal farmers located in rainfed areas, dry lands, arid zone, hilly areas, tribal belts and problem soils.

The following farm enterprises could be combined:

Agriculture alone with different crop combinations

Agriculture + Livestock

Agriculture + Livestock + poultry

Agriculture +Horticulture + Sericulture

Agro-forestry + Silvipasture

Agriculture (Rice) + Fish culture

Agriculture (Rice) + Fish + Mushroom cultivation

Floriculture + Apiary (beekeeping)

Fishery + Duckery + poultry

For meaningful execution of integrated farm-enterprises, the following activities should be undertaken by a multi-disciplinary team of extension professionals with farmer's participation and involvement at all stages.

Thorough understanding of existing farming systems and their components

Assessment of resource availability in the farm environment and identification of bio-physical, socio-economic, institutional, administrative and technological constraints

Developments of economic viable and efficient integrated farming systems suitable for various domains

Diffusion of improved technology and receiving 'feedback' for further improvement of the system as a whole.

Continuous improvement in components technology to fit into a given farming system

Improvement in quality of farming system

Research Extension linkage through "On farm Adaptive Research"

Development of National and International linkages

Methodology adopted for grounding the concept of FSA

I. Identification of major socio-economic situations

Understanding dominant enterprises and most common existing farming system

Analysis of economic viability of existing farming systems

Understanding relationship between different enterprises

Analysis of linkages between different farming systems

II. Understanding the modifications made in existing farming system by innovative farmers

Understanding the changing scenario in rural areas and its impact on existing farming system

Identification of new market opportunities and its impact and relevance to socio- economic situation

Suitable modification made by innovative farm families in existing farming system

Type of modification made (diversification or intensification of the enterprises)

III. New options recommended by the Researchers/ Extensionists

- Identification of new suggested options by researchers/extensionists around each dominant enterprise
- Understanding the technological details about new options

IV.Economic analysis of recommended options and working out alternatives:

Analysis of relative profitability of recommended options as compared to existing farming system

Understanding of implications of each options with regard to reallocation of resource

v. In the absence of any recommendations, work out an alternate model by fine tuning the existing model (without major changes) considering the resources, market, profitability and sustainability

Propose an alternate model by fine-tuning the existing farming system by working out the possibilities of diversification or intensification of an enterprise.

Work out the economic analysis and benefits of alternate model compare to existing and identify the gaps in knowledge and skill so as to adopt the new model

Develop strategies and activities to overcome the gaps in knowledge and skills

Testing the effectiveness of recommended options over a period of time

Carryout SWOT analysis in respect of different Farming Systems. SWOT analysis is very useful tool in developing strategies as it helps in identification of -

Current strengths within existing farming systems and success stories,

Weaknesses within the existing farming systems,

Opportunities, which are advantageous for optimal exploitation of the existing farming systems in terms of providing, scope for new market opportunities, new technologies, services etc.

Real potential threats to the natural resource base, existing farming systems and markets etc.

The identified issues and also the findings of SWOT analysis are to be shared with the farmers to prioritize the issues with commonality of understanding.

Summary

Due to ever increasing population and decreasing in per capita availability of land in India, there is little scope for horizontal expansion of land for food, feed, and fuel and fibre production. Only vertical expansion is possible by integrating various farm enterprises

requiring less space and time and ensuring periodic income to the farmer. The farming system approach, therefore, assumes great importance for sound management of farm resources to enhance farm productivity, reduce the degradation of environmental quality and improve the quality of life of farmers and above all to maintain sustainability in farm production and productivity.

Key Words

Farming: A piece of land on which crops / animals are raised

System: Different components of a farm working as whole

Enterprise: Business – profit and loss rupee to rupee

Intervention: Bringing a change

Diversification: Bring a change on enterprise

Intensification: Bringing changes in production practices of an enterprise

Supplementary: One enterprise adopting something else to improve production of other

Complimentary: Performance of one enterprise depends on another

Trends: Changing scenario

Extension strategy: Activities to bridge the gaps

Horizontal expansion: Expansion in area

Vertical expansion: Increasing productivity

Suggested Books for Further Reading

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प्रचलित आधुनिक खेती का स्वरूप एवं परिणाम

भारत भूषण त्यागी

ग्राम-बिहटा, वाया भवन बहादुर नगर, जनपद-बुलन्दशहर (उत्तर प्रदेश)

(जैविक कृषि के क्षेत्र में पद्मश्री पुरस्कार से सुशोभित)

प्रचलित खेती मे परिवर्तन के प्रयास में मूल अवधारणा कृत्रिम लागत पूर्वक अधिकतम उत्पादन बढ़ाए जाने की रही । जिसमे पानी रसायनों व मशीनो के भरपूर प्रयोग से मात्रात्मक उत्पादन बढ़ाए जाने में चमत्कारित सफलता भी मिली । पूरी दुनिया में कृषि अनुसंधान, शोध, तकनीकी, विज्ञान, शिक्षा और नीतिगत स्तर पर खेती में जो भी परिवर्तन हुए उसमें मानव के द्वारा पूरी तरह प्रकृति की स्वयं स्फूर्ति उत्पादन व्यवस्था की अनदेखी की गयी । विगत कुछ दशको में खेती की उपलब्धियां और संकट सभी हमारे सम्मुख है ।

आज इकोलोजी और इकोनोमी के अन्तर संबंध को असन्तुलन के रूप देखा जा रहा है । टिकाऊ अर्थव्यवस्था, आत्मनिर्भरता, स्वरोजगार तथा स्वास्थ एवं पर्यावरण को समृद्ध करने वाली खेती की उपेक्षा और दुर्दशा भी सभी के सामने है।

खेती और प्रकृति में गहरा संबंध है शुद्ध भोजन, हवा, पानी, पर्यावरण तथा ऋतु संतुलन का सीधा संबंध मानव के जीने के साथ है । कृत्रिमता से जीने की परिकल्पना मानव को मशीन भी नहीं बना पाएगी तथा मशीन व कृत्रिमता की पराधीनता से मानव को मानव भी नहीं रहने देगी ।

अतः कृषि क्षेत्र में बदलाव के लिए खेती की लागत, तरीके, तकनीकी व संसाधनो मे बदलाव से ज्यादा मानसिक चेतना मे ही गुणात्मक परिवर्तन की आवश्यकता है ।

समीक्षा गत बिन्दु

– 1 खाधान्न के भण्डार तो भर गए लेकिन उत्पादन के स्तर पर विविधता और गुणवत्ता में कमी के कारण भोजन श्रंखला पर कुपोषण का संकट गहराने लगा ।

-2खाधान्न में जहरिलापन बढ़ने से असाध्य रोग बढ़ने लगे जिसका असर अन्य जीव जानवरों के साथ साथ जैव विविधता पर भी पड़ा । जिससे प्राकृतिक नियंत्रण प्रभावित होने से भूमि उर्वरता एवम फसल सुरक्षा के नाम से और अधिक कृत्रिम रसायनों का दवाब खेती पर बढ़ता गया जिससे किसानों के लागत खर्च में भी इजाफा हुआ । तथा खाधान्न में रसायनिक अवशेष की मात्रा मानकों से भी अधिक होने से अंतर्राष्ट्रीय बाजार पर भी इसका प्रभाव आया।

-3किसानों के लागत खर्च बढ़ने के साथ साथ मंडी व बाजार की मनमानी व शोषणकारी नीतियों से उत्पादन की उचित कीमत नहीं मिलने के कारण किसानों की आर्थिक हालत कमजोर होती गई । जिसे बैंक ऋण के माध्यम से राहत मिली लेकिन कर्ज बढ़ना समाधान नहीं है । आज आमदनी के अनुपात में किसानों की कर्जदारी प्रतिवर्ष बढ़ रही है । अनुदान और कर्जमाफी प्रयास तत्काल राहत के रूप में अच्छे लगते हें लेकिन इनके दूरगामी परिणाम बहुत भयानक है । पराश्रयता बढ़ने से अपनी ज़िम्मेदारी से वंचित होना है । इससे किसान खेती की उपेक्षा में चले गये । सरकारों पर पराधीनता बढ़ने लगी ,जिसका पूरा होना संभव नहीं है ।

-4कृषि अनुसंधान संस्थान एवं अन्य कृषि संबन्धित तंत्र आज भी अधिकतम उत्पादन बढ़ाये जाने के विकल्प खोजने में लगे हें । किसानों की आमदनी एवं अन्य भयावह संकेत जैसे जमीन का बंजरपन बढ़ना ,जैव विविधता मे कमी ,प्राकृतिक असंतुलन की तरफ ध्यान नहीं है बल्कि कृत्रिमता पूर्वक प्रकृति के समानान्तर संघर्ष पूर्वक चलने को उपलब्धियां मान रहे है । विज्ञान और तकनीकी के बल पर समस्याओं के समाधान खोज लिए जाएंगे , यह भ्रम है । प्राकृतिक उत्पादन व्यवस्था को समझने से हि विज्ञान एवं तकनीकी की उपयोगिता है अर्थात करके समझने से ज्यादा अच्छा समझकर हि किया जाय । ज्ञान –विवेक –विज्ञान की साझा भूमिका है। इस पर संवाद की आवश्यकता है ।

पद्धति विशेष किसी भी प्रयोग नामक खेती प्राकृतिक एवं खेती जैविक -5, लागत और विचार धारा से प्रभावित रहे | वैज्ञानिक कसौटी पर इनका मूल्यांकन भी नहीं हुआ तथा विशेषज्ञता के प्रभाव में विरोध होने से सफलता का कोई संतुष्टि बिन्दु या सूत्र - पायें कर नहीं प्रेरित को किसानों प्रयोग व्यवहारिक| वैज्ञानिक स्तर पर इसकी स्वीकृति नहीं हो पाई विरोध बना रहा |

-6प्रचलित खेती में प्रकृति के घटनाक्रम को अनुकूल बनाने तथा व्यापार के अवसर के रूप में देखे जाने से ,प्रकृति की स्वयं स्फूर्त उत्पादन व्यवस्था का अध्ययन नहीं हो पाया | बल्कि व्यवस्था को समझे बिना प्रयोजन भी परिभाषित नहीं हो पाया जिससे कार्यक्रम एक होते हुए भी लक्ष्य अलग 2-बने रहें |

सरकारी लक्ष्य में जनसंख्या के पेट भरने की प्राथमिकता रही |
वैज्ञानिक स्तर पर अधिकतम उत्पादन बढ़ाये जाने के कृत्रिम विकल्पो की तलाश रही |
किसान वर्ग कृत्रिम लागत के बल पर उत्पादक बना रहा |
व्यापारी वर्ग हर स्थिति परिस्थिति को लाभ के अवसर में बदलने को प्रयास रत रहा ।

अधिकतम उत्पादन बढ़ाये जाने की खोज में –

विशेषज्ञता से संस्थानों की बनावट टुकड़े टुकड़े में बिखर गई । अलग अलग विभाग अपनी अपनी खोज में लगे रहे जिनमें समग्रता नहीं आ पाई । पूरकता तो दूर की बात है । इंटीग्रेशन के नाम से पूरकता के लिए प्रयास भी अधूरे ही रहे । तर्क प्रधान विधि से विश्लेषणपूर्वक वस्तु को देखना,समझने की एक क्रिया है ,समझने का मूलमंत्र सह अस्तित्व में सजी हुई स्वयं स्फूर्त व्यवस्था है । विश्लेषण का तात्पर्य यही है कि व्यवस्था की पूर्णता को टुकड़े टुकड़े में भी समझा जाये। व्यवस्था का स्वरूप निश्चित है इसलिए विशेषज्ञता पूर्वक विज्ञान व तकनीकी की उपयोगिता प्रकृति की व्यवस्था को समझने और जीने के लिए हे । प्रकृति के विरोध में कृत्रिम तंत्र बनाये जाने के लिए नहीं ।

यह संवाद के लिए महत्वपूर्ण बिन्दू है –

-1विज्ञान का तात्पर्य विगत और भविष्य में मानव की उत्पत्ति और प्रलय को खोजना नहीं ,बल्कि वर्तमान स्वरूप में इस धरती पर सभी मानव खुशहाली पूर्वक कैसे जी सकें इस व्यवस्था को समझना है । धरती पर चारों अवस्थाओ की पूरकता के सह अस्तित्व सूत्र कों अध्ययन वस्तु के रूप मे स्वीकारा जाना है ।

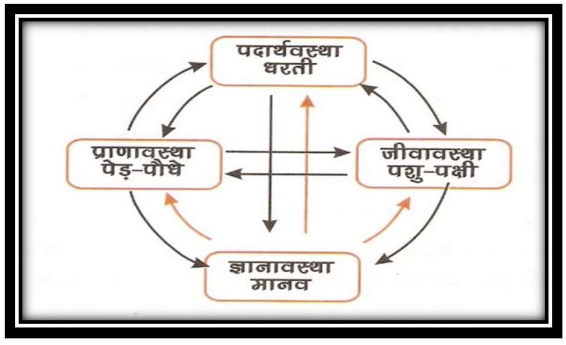
-2हम सभी मानव अव्यवस्था नहीं चाहते हें फिर व्यवस्था विरोधी प्रयास क्यों ? इस पर संवाद की आवश्यकता है । व्यवस्था की चाहना में बनाये गए सभी कानून कैसे अव्यवस्था झेलने के शर्तनामे व समझोते बनते गए । जिनमे अनुकूलता का अधिग्रहण और प्रतिकूलता को दूसरों पर थोपने के अवसर बढ़ने लगे । इस कलह के साथ आधुनिक विकास के क्या मायने हें इस पर साझा विचार की आवश्यकता है ।

अंत में अर्थचिंतन की द्रष्टि से एक ज्वलंत प्रश्न यह है कि किसान एक दाने से हजार दाने पैदा करता है । गुणात्मक उत्पादन प्रकृति की व्यवस्था है । फिर भी किसान कर्जदार क्यों और कृषि वैज्ञानिक अधिकतम उत्पादन के लक्ष्य में गुमराह क्यों ?

विकल्प की वस्तु एवं अवधारणा

प्रकृति की स्वयंस्फूर्त उत्पादन क्रिया ही विकल्प की वस्तु है जिसका स्वरूप नियम, नियंत्रण,संतुलन पूर्वक नित्य वर्तमान है जिसमे न संघर्ष है न अनिश्चिता । सम्पूर्ण प्रकृति में गुणात्मक उत्पादन व्यवस्था है। एक दाने से हजार दाने पैदा होते है फिर कृषि क्षेत्र आर्थिक रूप से उपेक्षित क्यो । व्यवस्था का मूल सूत्र सह –अस्तित्व है । सह–अस्तित्व मे पूरकता है केवल मानव के स्तर पर विरोध है । अतः विकल्प के लिए प्रकृति मे पूरकता-उपयोगिता और समृद्धि को समझना खेती मे समाधान के लिए मौलिक आवश्यकता है ।

मानव प्रकृति की ही ईकाई है फिर मानव के कार्यकलाप प्रकृति विरोधी क्यो



प्रकृति का मोलिक स्वरूप सह- आस्तित्व रूप में सभी के लिए अध्ययन वस्तु के रूप में नित्य वर्तमानहै परिभाषित है।

समाधान की अध्ययन वस्तु

धरती पर चारों अवस्थाओं का सह- आस्तित्व रूप

सम्पूर्ण प्रकृति में पूरकता- उपयोगिता पूर्वक समृद्धि है । न शोषण न संघर्ष और न ही विश्वासघात है ।

सह- आस्तित्व ही नियम-नियंत्रण एवं संतुलन पूर्वक नित्य निरंतर क्रियाशील है । व्यवस्था निश्चित है अतः कृत्रिमता एवं मनमानी केवल भ्रमात्मक क्रियाकलाप है । उत्पादन व्यवस्था में विविधता है एकल फसल उत्पादन क्रिया नहीं पोषण – संरक्षण निरंतर क्रिया है ।

धरती पर उत्पादन व्यवस्था का सतही घनत्व अर्थात ल0xचौ0xऊ0 व गहराई मे समयावधि पूर्वक क्रियाशील है जिसमे विविधता से उत्पादन का सतही घनत्व बढ़ने से किसी भी प्रकार के खाधानं व कुपोषण की संभावना ही नहीं है । निरंतर आर्थिक समृद्धि है ।

नैसर्गिक संतुलन- स्थानीयता के साथ साथ वर्षामान, तापमान, ऋतुमान के संतुलन पूर्वक विविधता मे उत्पादन है। जमीन मे जीवांस कार्बन एवं जीवाणु तंत्र वृद्धि की निरंतर व्यवस्था है।

A Common Minimum Program under Organic Farming for Small Farmers

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Vegetable cultivation is vital to sustain economy of small farmers. Being low volume and high value crops they are rated to be potential cash earners. There is however the necessity for increasing vegetable production, whilst at the same time ensuring that currently renewable resources were preserved. Unfortunately, however, all these cash crops suffer recurrent chronic losses due to a variety of seed and soil borne diseases and impact of insect pests.

Rainfed farming and intensive cultivation on small farms is characteristic of Indian agriculture. On an average land holding of less than a hectare, production per kg seed sown is low and, which is on the decline. Such a situation has arisen due to intensive cropping and declining fertility of soil, increasing impact of plant diseases, not being able to follow crop rotation, deep ploughing and leaving the field fallow even for a short period, greater reliance on the use of chemicals, vagaries of weather, etc. Yet pressure of producing more out of a meager land is ever mounting. Less land per person requires more high yielding agriculture. To increases yield from existing land requires good crop protection against losses before and after harvesting, which, must be achieved within the framework of Integrated Pest Management (IPM). IPM offers an important principle on which sustainable crop protection can be based. It offers the best combination of cultural, biological and chemical measures that provides the most cost effective, environmentally sound and socially acceptable method of managing diseases, insects and pests.

Farmers over the time have been fighting to save their crops from the onslaught of diseases and pests. Infact, their agricultural practices are making their crops more vulnerable to the attack of biotic and abiotic agents. The amount of profit on small farms is less, thus farmers do not have capacity to bear any amount of losses. The problems faced by the farmers are consistent with the mandate of IPM. The challenge is to apply research to issues that lead to insecurity amongst small and marginal farmers as regards crop management and protection. While threats with regard to biotic and abiotic causes vary from region to region, there is a range of common challenges that warrant a regional approach through a Common Minimum Programme (CMP). Key elements of CMP have been designed to be particularly useful for the small farmers taking vegetable cultivation under organic mode, and are following:

Plastic mulching (soil solarization) of nursery beds and fields

Bio-composting including vermi composting

Use of bio agents for seed treatment, seedling treatment, soil treatment and foliar application

Use of value-added vermicompost and FYM

1. Soil solarization: For most vegetables, nursery is raised from the seeds and transplanted in the field. In the nursery, the seed and the emerging seedlings encounter a plethora of soil pathogens and insects. As a result, substantial portion of the nursery is lost due to seed rot, damping off, root rot, collar rot, stem rot, and insect damage. The left over seedlings are usually infected and poor in growth, and carry infection to the field. Soil solarization or solar heating involves the use of heat as a lethal agent for pest control by capturing solar energy by means of transparent plastic mulch to increase soil temperature to the extent lethal to soil borne pathogens, pests and weeds. Under the technique, nursery beds are prepared 5-8 weeks in advance of seed sowing and are irrigated. Subsequently, they are covered with a transparent polythene sheet (50-100 μ thick) in such a manner that there is no leakage of air from any point in the nursery. Polythene sheet is removed 3-4 days ahead of the seed sowing time. The polythene sheet gives a greenhouse effect whereby sunrays are trapped underneath. As a result, temperature of the soil increases to a level that it becomes injurious to the soil microorganisms. Besides, it reduces weed population, improved physical and chemical properties of the soil and increases population of useful (friendly) micro flora in the soil. Since, plant pathogens are weakened through the effect of solarization; they are over powered by the fast growing bio agents. In order to get maximum benefit from soil solarization, it is necessary to perform the practice for about 5-8 weeks during hottest months of the year using a transparent polythene sheet. Nursery beds must be irrigated before being covered by polythene sheet and organic compost must be incorporated.

2. Preparation and use of vermicompost: Traditionally farmers use undecomposed farm yard manure, which is deficient in nutrients and does more harm than good to the crop. Undecomposed FYM promotes diseases, insects and pests and weed populations in the soil. On the other hand, vermicompost is more nutritious and gets ready in lesser time. For its preparation, dung, crop residue, green manure and other wastes are used by the earthworms to convert these to nutritious compost. Vermicompost is balanced natural compost for vegetables, fruits and cereal crops. Use of vermicompost reduces the cost of production, increases plant's health and resistance against biotic and abiotic causes and fertility and water holding capacity of the soil. Since the waste material consumed by the earthworms passes through their guts, where it is acted upon by enzymes and hence becomes nutritious for the crops. In order to prepare vermicompost, a pit (6'x2.5'x1.5') is prepared and filled with animal dung and other waste material available on farm. The pit can be a 'kuccha pit' or made by stone masonry. The dimensions of the pit can be manipulated as per one's convenience. Thereafter, earthworms are released in the pit. The worms reproduce and increase in population and eat away the waste material to convert it to nutritious 'vermicompost' in about 3 months. Of other species of earthworms, *Eisenia foetida* has been found to be efficient in compost making. Some precautions should be observed while making vermicompost:

i). Vermipits should be protected from direct sunlight. For this, pits should remain

Covered.

ii). Proper moisture and aerations should be maintained in the pit.

iii). Fresh or much old animal dung should not be used for the preparation of

vermicompost.

iv). Vermipits should not be covered with polythene sheets.

v). Vermipits should be protected from birds, frogs, lizards, termites and ants.

vi). Moisture in the pits should be maintained by sprinkling water once a week.

vii). Pit should not be flooded with water.

3. Use of bioagents: Biological control is the sum total of harmful activities, which an organism (Bioagent) inflicts on the other. Continuous use of pesticide results into the development of resistance in the pests, therefore use of bioagents is a better alternative. Further, they are environment friendly and improve soil ecology and health**.** During last two decades many bioagents have become commercially available in the market of which Trichoderma and Pseudomonas spp. are quite popular for management of plant diseases. Bioagents could be used in one of the following ways:

i) Seed treatment: Bigger seeds such as pea, soybean, French bean, wheat, etc. are treated at the rate of 8-10 grams bioagent per kg seed, while small seeds such as cabbage, cauliflower, tomato, brinjal, etc. are treated at the rate of 4-6 gms per kg seed. It should be ensured that seeds are not already treated with fungicides. If so, they should be washed before seed treatment with bioagents. For effective treatment seeds should be moistened with water before adding bioagents. Subsequently, seeds are dried under shade. This ensures proper deposition of bioagent on the seed surface.

ii) Rhizome treatment: Rhizomes of ginger, potato and colocasia are dipped in the solution of bioagent (@ 8-10 gram/ litre water for 30 minutes, dried in shade and are planted.

iii) Seedling treatment: Before transplanting roots of seedlings after proper washing are dipped in the solution of bioagents (@ 8-10 gram/ liter) for about 30 minutes. This can be done with seedlings of cabbage, cauliflower, brinjal, tomato etc.

iv) Compost treatment: Before application, well decomposed compost is treated with bioagents (250 grams/ q) and mixed properly. Bioagents can also be added to the pits itself during preparation of composts.

v) Spray: Bioagents also manage/ control air borne diseases as well. For this, bioagents are sprayed @ 8-10 grams/litre on standing crop at 10-12 days intervals.

vi) Drench: Bioagents can also be drenched (@ 8-10 grams/ liter) in soil in the nurseries from time to time. It would ensure health and proper growth of seedlings.

Use of bioagents offers several advantages: (i) it reduces cost of cultivation, (ii) it is eco-friendly and does not affect the health of humans and animals, (iii) through its use pathogens do not develop resistance and (iv) use of bioagents promotes seed germination and plant growth.

Use of bioagents also warrants certain precautions such as: (i) bioagents should be used within 6 months of their production, (ii) soil should have proper moisture and organic content for proper growth of bioagents and (iii) bioagents should not be stored at temperature more than 25C, etc.

4. Value addition of vermi compost or FYM: Vermicompost or FYM should be supplemented with bioagents (@ 250 g/q). This increases the nutritive value of the compost as well as provides opportunity to the bioagent to grow faster on the compost so that it can compete well with plant pathogens in the soil. Further, it facilitates rapid spread of bioagent in the soil.

In an organic system it is appropriate to develop disease control strategies that have an ecological base. The organic system should encourage the growth and diversity of soil inhabiting and epiphytic microorganisms that can exert beneficial and pathogen antagonistic influence. Biological control of plant pathogens, broadly refers to the use of one living organism to curtail the growth and proliferation of another, undesirable one, is promising alternative to the use of chemicals. In nature, some microorganisms affect or suppress growth of pathogenic microorganisms. These beneficial organisms are collectively called as 'biological control agents or biocontrol agents'. Biological protection against infection is accomplished by destroying the existing pathogen inocula, by preventing the formation of additional inocula, or by weakening and displacing the existing virulent pathogen population. This is achieved through protection of plant material and roots with biological seed treatments, or suppression of pathogens by the introduction of plant associated antagonists into the rhizosphere. Microbial agents may be stimulated in the plant rhizosphere by the addition of suppressive composts such as vermicompost. Vermicomposting, is a natural process by which earthworms and micro-organisms convert organic waste into humus that is used as a nutrient-rich soil conditioner. Earthworms play a key role in soil biology. They harness beneficial soil microflora, destroy soil pathogens, convert organic wastes into valuable products such as Biofertilizers, bio pesticides, vitamins, enzymes, growth hormones, and proteineous worm biomass. Use of vermicompost has been found to reduce the menace of white grub, which more often propagates and spreads through undecomposed farm yard manure. Soil solarization is a 'low-investment high value' technology and leads to disease and weed control, better plant stand, health and vigour, and early readiness of seedlings for planting. Plants emerged out of solarized beds are healthier, grow faster and the beds have lesser weed population. Value addition of vermicomposts through the incorporation of bioagents ensures goodness of vermicompost and adds value of the bioagents.

Seed and soil borne pathogens cause much of the recurrent losses (nearly 80%) in vegetables each season in the region. The cost of soil borne pathogens to society and the environment far exceeds the direct costs to growers and consumers. The use of chemical pesticides to control soil borne pathogens has caused significant changes in air and water quality, altered natural ecosystems resulting in direct and indirect effects on wild life, and caused human health problems. Long-term chemical applications may permanently alter the microbial community structure to an extent that sustainable agriculture may be impossible. The opportunity, therefore, exists to address the issues relating to IPM across ecosystems through a **Common Minimum Programme,** which can alleviate considerable losses to vegetables that result only from soil borne problems. Other location-specific problems could be addressed through supplementary intervention(s).

Root rot complex (caused by *Fusarium solani*. f.sp. *pisi* and *Rhizoctonia solani*) and collar rot (caused by *R. solani*) are the serious most threats to most vegetables in the nurseries as well as in the field in most farming situations. Inadequate rotations aggravate crop losses. Use of synthetic chemicals for management of diseases is largely uneconomical and does not fit within the framework of 'organic farming', the state policy. Through adoption of Common Minimum Programme losses through seed and soil borne diseases could be severely minimized. The ultimate aim is to raise healthy plant, which can resist/ withstand attacks of biotic and abiotic agents and host plant growth promoting rhizobacteria and antagonists. This is achieved through maintaining microbial diversity in the soil, creating conditions suitable for their growth and development through providing habitats for their growth. Common minimum programme tends to fulfil these objectives. Through the adoption of CMP farmers can reduce cost of production, minimize losses due to pests and diseases, increase benefit-cost ratio and raise value-added crop. Small farmers are experimenters and inventors. Improving farmers' ability to manage disease requires knowledge, capacity for innovation and on-farm decision-making. The 'zero' or 'low cost technology' while on one hand offers a solution to the recurrent diseases and pest problems, on the other falls within the framework of organic farming.

Organic Certification and Marketing

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Introduction

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.

Strength of Organic Farming

After almost a century of development organic agriculture is now being embraced by the mainstream and shows great promise commercially, socially and environmentally. While there is continuum of thought from earlier days to the present, the modern organic movement is radically different from its original form. It now has environmental sustainability at its core in addition to the founders concerns for healthy soil, healthy food and healthy people.

Employing organic farming methods will lead to higher profits for farmers not only because of price premiums, but also because of lower production costs. Organic farming can decrease the costs of production as chemical inputs are substituted by locally available and cheaper organic inputs like 1. biofertilizers (Rhizobium, Azotobacter, Acetobacter, Azospirillum, Phosphate solubilizing microorganisms, Phosphate mobilizing Microorganisms (VAM), Potash mobilizing bacteria, and Plant growth promoting Rhizomicroorganisms (PGPRM) like Pseudomonas and micro-nutrient mobilizing bacteria (MNMB) like Thiobacillus spp.) 2. Organic Fertilizers (Organic manure, city compost, vermicompost, Phosphate rich organic manure (PROM), Potash rich organic manure (KROM), bio-enriched organic manure, bone meal either raw or steamed, potash derived from rhodophytes) and 3. Traditional Organic inputs (jeevamrut, panchgavya, sanjivak, neemastra, agniastra etc).

Further nutrient management is one of the important aspect which 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. Adoption of Organic farming systems also lowers the need for credit and thus makes farmers self-reliant by using local/indigenous resources for cultivation.

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 organic food and other organic plant products. In India, the following two systems of organic certifications are available

1. Participatory Guarantee System for India (PGS-India) implemented by Ministry of Agriculture and Farmers Welfare
2. National Programme for Organic Production (NPOP) implemented by Ministry of Commerce and Industry.

Organic certification of the farm and its produce shall further benefit farmers, as the certified organic products have very good demand in both the domestic and international market. Obtaining organic certification for products for export market is little bit costly affair due to the third party certification process, whereas for marketing organic products domestically shall be of low cost due to the Participatory Guarantee System for India (PGS-India).

Third Party Certification and PGS-India Organic Certification logos in India

Participatory Guarantee System for India

"Participatory Guarantee Systems are locally focused quality assurance systems. They certify producers based on active participation of stakeholders and are built on a foundation of trust, social networks and knowledge exchange". In the case of organic agriculture, PGS is a process in which people in similar situations (in this case producers) assess, inspect and verify the

production practices of each other and collectively declare the entire holding of the group as organic. Ministry of Agriculture, Govt. of India launched PGS-India during March, 2011.

PGS is followed in more than 72 countries and named like PGS-South Africa, PGS-IFOAM.

So, to avoid confusion, it is named as **PGS-India** as it is run by Govt. of India

Guiding principles

- Participation
- Shared Vision
- Transparency
- Trust
- Horizontality : non-hierarchical at group level, collective responsibility
- National networking

Salient features

- Locally relevant
- Quality assurance system
- Participation of producers (Farmers) and Consumers (including Traders/retailers)
- Assess, inspect and verify the production practices, Documentation and
- Certification decision
- Sale products with PGS-India Logo and Unique Identity Number

Marketing of Organic Produce/Products

The market for organic products/food is currently escalated in India. The key factor driving the demand of the India organic food market is health awareness. Consumers have started giving attention to the nutrient content and the quality of the food they eat, thereby leading to a rising demand of organic food. Moreover, driven by factors such as strong economic growth, urbanization, and rising income levels, the consumer expenditure on health and wellness products have increased significantly.

The demand of organic food in India is also being catalysed by the strong support of the government. The Indian government is promoting organic farming by providing financial

Support to farmers who are adopting organic farming under various government schemes such as Paramparagat Kirshi Vikas Yojana (PKVY), Mission Organic Value Chain Development for Noth Eastern Region (MOVCDNER), Mission for Integrated Development of Horticulture (MIDH), National Food Security Mission (NFSM), National Mission for Sustainable Agriculture (NMSA), Rashtriya Krishi Vikas Yojana (RKVY) etc.

Govt. of India recently launched Jaivikkheti portal (https://www.jaivikkheti.in/) which is a unique initiative of Ministry of Agriculture (MoA), Department of Agriculture (DAC) along with MSTC to promote organic farming globally. It is a one stop solution for facilitating organic farmers to sell their organic produce and promoting organic farming and its benefits. E-commerce section of the portal provides the whole bouquet of organic products ranging from grains, pulses, fruits and vegetables.

Jaivikkheti portal an e-commerce platform for organic products

Current market trends according to natural marketing institute reveals that organically produced products are becoming widely accepted throughout the world. The annual sales of organic products have increased three fold with increased establishment of natural food stores selling varieties of organic products. The farmers markets also offer commercialization of regionally and locally produced organic products. Accordingly, the retail sales of organic products are expected to continue rising in the coming years at a rate more than 20% yearly.

Conclusion

Success of organic movement in India depends upon the growth of its own domestic markets. With the sizable acreage under naturally organic/default organic cultivation, India has tremendous potential to grow crops organically and emerge as a major supplier of organic products in the world's organic market.

Role of ITK's in Organic Agriculture

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Indigenous Technical Knowledge (ITK) is the information base for a society which facilitates communication and decision making. The rural people have intimate knowledge of many aspects of their surroundings and adopt them based on needs to solve local problems in managing agricultural and related activities. ITK, envisages the villagers to diagnose the particular disorder or disease in field crops, vegetables and livestock etc., and subsequently its prevention and control measures being adopted by them through their inherent and indigenous capabilities as proved by their ancestors from the long passage of time. This technique is largely based on the farmer's assumption, reliable evidences, economically viability, farming community consent, traditional sound knowledge and positive result.

The increasing attention of indigenous knowledge is receiving by academia and the development institutions have not yet led to a unanimous perception of the concept of indigenous technical knowledge (ITK). ITK is the local knowledge-knowledge that is unique to a given culture or society. It is the basis for local level decision making in Agriculture, health care, food preparation, education, natural resource management and a host of other activities in rural communities. Indigenous information systems are dynamic and are continually influenced by internal creativity and experimentation as well as by contact with external systems. This knowledge system is usually not found in written form and transmits from generation to generation through words of mouth. It includes concepts, belief and perception and usually found in various folk forms. All traditional knowledge are not indigenous but all indigenous knowledge are traditional.

Today, many ITK systems are at risk of becoming extinct because of rapidly changing natural environment and fast pacing economic, political and cultural changes. Many practices vanished, as they became inappropriate for new challenges or because they adapt too slowly. However, number of practices disappears only because of intrusion of foreign technologies or development concepts that promise short term gain or solution to problems without being capable of sustaining them.

In the present agriculture scenario, the insecticides, fungicides, herbicides etc. are being used in larger quantity in field crops, vegetables and orchards. Due to the imbalanced and excessive use of chemicals on large scale, the fields are becoming barren and infertile leading to decline in productivity .On the other hand, in the indigenous technique there is no or little use of chemicals because of farmers eco-friendly attitude, less expensive, subsidiary benefits, long terms sustainability of soil and crop productivity, less insect pest & disease incidence in crops.

There are some indigenous technical knowledge prevalent in Kumaon region has been documented on the basis of meeting, group discussion, interaction with villagers/senior citizen or villagers experience and more over exploring such knowledge by traveling in remote/interior areas.

1. Weed control and moisture conservation in crops

In hilly areas, the crops like upland spring/jethi rice, finger millet, kala bhatt, horse gram etc. are germinated through conserved moisture. After monsoon rains they come up very fast however, a number of weeds also emerged in the field which affect the growth and yield of crop, To over come from the problem, instead of manual weeding or use of chemicals, farmer used to plough the field in July August with an implement called *Danala.* It breaks the soil crust favouring moisture conservation and uprooting of many weeds.

2 Control of White grub insect (*Kurmula*) in crops

During field preparation, farmers used to broadcast the mixture of salt and Dichlorovas/Nuvan in the field for white grub control. Since white grub is one of the major problem in Kharif season rain fed crops, therefore, it is practiced for various rainfed crops say spring/jethi rice, finger millet, kala bhatt/horse gram etc.

3. Control of white grub (*Kurmula)* in green vegetables specially cauliflower and potato

The green tender leaves of Bakine *(Melia azedarach)* / Rambas (*Verbascum* spp) plant weighing 2-3 kg are crushed and mixed in 5-10 litres of water to be used as stock solution.. Now it is used as spray @ 50-100 ml /Nali* by dissolving in 8-10 liters of water. Some villagers also use *ritha* powder solution as spray for the above purpose.

** 1 Nali =200 m^2*

4. Control of insect pest in vegetables

A weed locally known as *Mirchiya* grown abundantly in marshy land is used for the purpose. The morphological characters of the plant is just like Makoya (*Solanum nigrum*) having chillies shaped violet colored flower. The weed leaves weighing 2-3 Kg are crushed and are diluted in 15lt. of water. This solution may sprayed in 1 Nali area in June-July in vegetables especially, capsicum and cucurbits grown**.**

5. Control of aphids in oilseed

Aphids are the major pest of oilseed crops, causing heavy yield loss. Therefore, to minimize the problem villagers crush 2-4 kg leaves of weed Rambas (*Verbascum* spp) and is mixed in 15 litres of water and sprayed @50 ml/Nali to control aphids in the mid of February.

6. Weed control in transplanted rice

Villagers spread the dry pine leaves (*Pinus kesiya*) in the mid-June in the field where rice has to be transplanted and is burnt before transplanting i.e. first week of July. This practice control the germinating/prevailing weeds in the field .Villagers use this practice as preventive measure for weed control in rice. Another advantage of this technique is that the stalks of wheat left during harvesting also burnt which otherwise create difficulties during transplanting and other cultural activities. However, looking to environmental issues and damage/burning of eco-friendly pests, this practice should be avoided.

7. Enhancing vegetative growth of transplanted rice

In hilly areas, it is fact that farmers give equal importance to rice grain and straw because rice stalk kept as *lutta* on the pine (*Pinus kesiya*) trees are the main source of fodder during winters. Keeping in view, villagers cut the upper 8-10 cm tip of rice leaves just one month after transplanting.

This practice helps in increasing the vegetative growth of plant as well as farmer use cutted plant leaves as nutritious fodder. However, by the cutting of leaf tips, unknowingly they are also controlling the stem borer population because in early stage the insect lays eggs on the tips of leaf.

8. Enrichment of transplanted rice through bio-fertilezer-Algae

Villagers bring the locally available algae from the pond or stagnated water in low lying field and spread in the transplanted rice @ 2-4 kg/Nali 1-2 weeks after transplanting. This nourishes the plants resulting into higher yield.

9. Drying of wheat in the field

Sometime rainfall occurs during harvesting period resulting into wetness of soil surface and there is no dry space in the surroundings. On the other hand farmers are bound to harvest the wheat crop; otherwise some other villagers left their castles for grazing which destroy the crop. Under the circumstances farmer just cut the ears, make small bundle and keep on the stem of crop as shown in the picture. The ears are dry very soon by this practice and then may be kept at safer place.

10. Control of rodent in rice crop

Generally 5-8 plants of Dhatura *(Datura stramonium)* are planted on the border of one Nali rice field. Before the maturity of rice, dhatura weed plant matures and its seed shatter in the border area. Now, when rats go towards the field, Dhatura seeds which are very much bitter in taste are eaten up by them resulting into afraidness among them and they never enter in the field of rice. In some areas, green leaves and flowers of ornamental plant Kanair (*Thavetia peruviana*) is also kept near the mouth of holes of rats to protect the crop from their attack.

11. Control of insect pest in vegetables

Widely available Bicchu grass (*Urtica dioica*) weighing nearly 4-8 kg soaked in 8-10 litres cow urine for 24 hours. Now the grass is taken out and prepared solution is sprayed as organic fungicide or in some areas as repellents against many fungal diseases of vegetables mainly tomato, capsicum, onion, radish and cucurbits etc. A precaution should be taken during cutting of bicchu grass that it should not touch to person otherwise painful itching would take place for 2-4 hours

12. Storage of rice straw

Rice stalks are the major source of fodder during winters that's why mostly hilly area farmer prefer the rice varieties having higher plant height. After the manual threshing, small bundles of these rice stalks are prepared. Now heap like structure are made by binding all the bundles on the mid of Pine tree by some trained villager. Locally, the heap like structure is very popular as *lutta.* In the lean months i.e. winters, when there is acute shortage of fodder, this rice stalk is taken out, chopped and fed to cattle.

13. Green fodder to milch cattles

The stem along with leaves of Bheamel tree (*Grewia optiva*) is cutted periodically and fed to especially milch cattles. The practice is adopted in lean months i.e. December-February when there is no availability of any fodder due to extreme cold. Further, after separating the leaves, stem are fermented in water and fiber is separated which is used to make various kinds of ropes. ***Left photograph*** *- Bheamel tree after cutting of green foliage.* ***Right photograph*** *Bheamel tree with full vegetative growth.*

14. Protection of grains from insect pest infestation in storag

The grains of cereals, pulses, oilseeds, etc. are treated with cow urine and are dried in shade over night. These grains are kept in the bins along with dry leaves of walnut (*Juglans regia*), timur (*Zanthoxylum armatum*), and bakain *(Melia azedarach)* and sealed with the paste of cow dung and soil mixture.

15. Breaking of clods during ploughing

After the harvest of crop especially transplanted rice, the soil becomes very hard. Under the situation when ploughing is done, many big clods appear on the soil surface which are required to break for subsequent easy ploughing and sowing. For the purpose, villagers use an implement locally called *Dilar* (shown in picture). The Dilar is beated on the clod for breaking into small pieces. The implement is easily available in the

villages or local market costing nearly Rs.30-60.00

16. Breaking of hard pan of soil and weed control in upland crops

After sowing of French bean, soybean or other crops, if rainfall occurs, after drying a hard pan is formed which hinders the germination of crops. To overcome from the problem villagers use a small implement known as *Rake.* It is attached with a wooden stick for easy handling. The farmer moves the rake gently in the field. This practice not only breaks the hard pan but prevailing weeds are also uprooted. Breaking of pan facilitates easy germination of seeds and also destroys the capillaries through which evaporation takes place, resulting into moisture availability for longer duration.

17. Bee keeping

Villagers make a hollow space of 1.5 sq ft area from the inner side of the wall of home. After keeping a few amount of honey, gur or sugar, the inner wall is blocked with copper net /wooden chips supplemented with the paste of cow dung and soil mixture .This fencing prevents the movement of bees inside the home .Similarly, in the outer wall, about 1-3 holes are made by which bees are attracted in the hollow space and the queen and other worker bees are started to make honey in subsequent intervals. After around 4-5 months period, the inner walls is gently broken and fired stick is inserted in the hollow space resulting into the bees move away from the hole and honey is collected and sold almost @ Rs 300-500 per litre.

18. Fishing

The green leaves of about 4-5 kg Ram bans (*Verbascum* spp) are crushed and thrown in the stagnated water of fish pond or water stagnated area in the river. Due to the poisonous effect of weed i.e. ram bas, the fishes feel uneasiness in breathing and become fainted, and come up on the surface of water which are easily caught by villagers. Though, this technique of fishing should be banned because it may kill many fingerlings and other important fish species.

19. Bone fracture treatment in animals

Bone fracture in animals can be treated by making a paste consisting of green leaves of pine, red soil (geru) and lime. After heating the above ingredients, it is placed on the fractured portion and tight with cloth/bamboo sticks. The affected cattle get relief very soon.

20. Control of muscle pulling in legs of cattle

After crushing the abduntely available 500g Bicchu grass (*Urtica dioica*) is collected crushed and paste is prepared. Now it is placed on the stretched portion of leg to get relief from it.

21. Recovery from throat and tonsil swelling in animals

The ash of Babila weed (*Tridax procumbens*) is rubbed about 3-4 times on the swollen portion of throat. There after the hot *taav* is also pinched about 4 times on the same point .This practice gives relief to the patient.

In case of tonsil, the villagers make the paste of Finger millet (*Eleusine coracana*) flour, oil, gur and water and placed on the affected area and covered with cloth. Through this treatment the animal recovered soon. Some time this treatment is also used for human beings.

22. Protection of animals from stomach worm/ ring worm (Damari) infection

Many treatments are practiced by farmers say the paste of *kala bhatt* and black pepper, fish oil mixed with wheat flour and mixture of raw turmeric and medicinal plant *Gania* and *Ganjaro* etc are fed to sick animal for the relief from the infection.

23. Control of leach in animals

The animals that are left for grazing are mostly infested with leach. Some time during grazing, leach reached in the cattle's nostril. It results laziness in the cattle due to sucking of blood by the leach. For its control, villagers provide drinking water mixed with the tobacco leaves and salt crystals contained in copper vessel .After drinking water, animals sneeze out with high pressure and leach comes out and can be easily pulled.

24. Control of foot and mouth disease in cattle

The infected cattle's are isolated from the heard and shifted in shady and muddy palace .The paste consisting of tender leaves of peach (*Prunus persica*), bakaine *(Melia azedarach),* chilles mixed in heavy clay soil is placed on the wounded place of the animals .Sometimes people also use the paste of the mixture of gur, turmeric and mustard oil on wounded portion. This practice checks the infection of this disease.

25. Remedy in snake bite in animals

Banana bark, grinded coriander seeds and *deshi* ghee are fed to snake bitted cattle .This reduces the poisonous effect of snakes on animals.

26. Protection of maize cobs from birds and monkeys

Birds and many other wild animals damage the cobs of maize resulting to heavy yield loss. To minimize the problem, farmers cover the cob with polythene/cloth etc. after seed setting as shown in the picture. This technique protects the crop form birds and other animals.

27. Nourishment and timely maturity of garlic

IN Kumaon hills farmers use to wrap the garlic plant from the tip. This technique is practiced in the month of March with the view to check the vegetative growth of plant, utilization of food material by tuber for its own vigorous growth and up to some extent forced maturity because immediately after harvest of this crop, next crop has to be taken.

28. Germplasm preservation from generation to generation by farm families

Now a days several seeds of hilly crop and vegetables are at the stage of extinct only because of

availability of high yielding varieties(HYV) seed and relatively high yield through these seeds. However, still it is believed that the taste and cooking quality of traditional seed is far better than to any HYV. Therefore, it is important to maintain or preserve such materials for sustaining livelihood of hill people. Hilly areas farm women plays very crucial role in the preservation of such seed. The Rajmash of Munshyari (Pithoragarh) and Harshil (Gangotri), rice bean (Kulthi), horse gram (Gahat), kala bhatt, finger millet (Mandua), buck wheat (Oogal/Kuttu), amaranth etc. are some of the unique crops of hill which if not conserved, may forgotten in near future. Similerly, Kahuva (Rabi pulse crop), Duna (just like onion, used as spice) and Chitarsil (Spice) are also some of the germplasm which are required to conserve for future use.

Therefore, it can be made a concluding remark that above techniques would be more beneficial, easily adaptable, less costly, economically viable, helping in insurance against insect pest and disease occurrence in field crops, vegetable, fruit orchards, and cattle and even in human beings. However, before going to any conclusion, these techniques, however, requires validation for future use.

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