Base Paper on Organic Farming

Organic farming aims for human welfare without harming the environment and follows the principles of health, ecology, fairness and care for all including soil. The modern concept of organic farming combines the tradition, innovation and science. Although, history states that the movement for organic way of life recognized in 1905, it could gain ground after realizing the ill effects of modern agriculture in the late 1990's. In 1905, the British botanist Sir Albert Howard, often referred to as the father of modern organic agriculture, documented traditional Indian farming practices, and came to regard them as superior to conventional agriculture science. During 1940, In Japan, Masanobu Fukuoka, a microbiologist working in soil science and plant pathology, quit job as a research scientist, returned to his family's farm, and devoted the next 30 years to develop a radical no-till organic method for growing grain, now known as "*Fukuoka farming*". Many other practices such as Rishi krishi, Natueco farming, homa farming, panchagavya krishi and bio dynamic farming are associated with organic agriculture. The reports indicates organic farming can minimize energy consumption by 30.7 % per unit of land by eliminating the energy required to manufacture synthetic fertilizers and pesticides and by using internal farm inputs, thus reducing fuel used for transportation. India can emerge as global leader due to the presence of large number of organic producers (almost 7 lakh producers) and they needs to be supported with technical knowledge and inputs besides marketing infrastructure. The research results available for little over a decade confirms the yield advantage in many crops such as basmati rice, maize, cotton, chickpea, soybean, groundnut etc. However, the major impediment for growth of organic farming in India is yield reduction in the initial years due to swift switch over from inorganic to organic, wide gap between availability of organic source of nutrients and requirement and lack of pest and disease management options. Most of the organic growers have expressed that lack of support price for organically grown crops and marketing infrastructure as the major constraint in promotion of organic agriculture. Although, much progress on research in organic farming has been done, the new emerging areas of human health benefits, understanding the economics with environmental markets, climate friendly farms and carbon farming with organic farming system models needs to be addressed in future. The certification systems of grower group, participatory guarantee system, know your farm and know your food should be promoted in large scale.

Status of Organic Farming

Demand for organic products, especially in developed countries, has been increasing. Globally, organic agriculture is practiced in 162 countries and 37 m ha of land are managed organically by 1.8 million farm households. The global sale of organic food and drink reached 62.9 billion US dollors in 2011. The regions with the largest areas of organically managed agricultural land are Oceania (12.1 million hectares of 33 percent of the global organic farmland), Europe (10.6 million hectares or 29 percent of the global organic farmland) and Latin America (6.8 million hectares or 23 percent). On a global level, the organic agricultural land area increased by three percent compared with 2010. The countries with the most organic agricultural land are Australia (12 million hectares), Argentina (3.8 million hectares) and the United States (1.9 million hectares).

In Asia, land under organic management reached 3.6 million hectares for 2009 up from just under 3.4 million hectares reported for 2008 and under 2.9 million hectares for 2007. The

expansion of over 0.2 million hectares, a growth rate of close to 6 per cent comes on top of a 17 per cent growth from 2007 to 2008. It maintains an upward trend albeit a slower pace of conversion. The main contributor of the expansion of cultivated acreage is India. 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. Cultivated area under certified organic farming has grown almost 17 fold in last one decade (42,000 ha in 2003-04 to 7.23 lakh ha in 2013-14). The state wise area under organic farming during 2013-14 is given in Table 1.

Table 1 State wise Farm area (excluding Forest Area) under Organic Certification during 2013-14

S.No.	State Name	Organic Area (in Ha)
1	Andaman & Nicobar Islands	321.28
2	Andhra Pradesh	12325.03
3	Arunachal Pradesh	71.49
4	Assam	2828.26
5	Bihar	180.60
6	Chhattisgarh	4113.25
7	Delhi	0.83
8	Goa	12853.94
9	Gujarat	46863.89
10	Haryana	3835.78
11	Himachal Pradesh	4686.05
12	Jammu & Kashmir	10035.38
13	Jharkhand	762.30
14	Karnataka	30716.21
15	Kerala	15020.23
16	Lakshadweep	895.91
17	Madhya Pradesh	232887.36
18	Maharashtra	85536.66
19	Manipur	0
20	Meghalaya	373.13
21	Mizoram	0
22	Nagaland	5168.16
23	Odisha	49813.51
24	Pondicherry	2.84
25	Punjab	1534.39
26	Rajasthan	66020.35
27	Sikkim	60843.51

28	Tamil Nadu	3640.07
29	Tripura	203.56
30	Uttar Pradesh	44670.10
31	Uttaranchal	24739.46
32	West Bengal	2095.51
	Total	**723039.00**

Source: APEDA (2013-14)

The Government of India has implemented the National Programme for Organic Production (NPOP) in the year 2001. The national programme involves the accreditation programme for certification agencies, norms for organic production, promotion of organic farming etc. States like; Uttaranchal, Karnataka, Madhya Pradesh, Maharashtra, Gujarat, Rajasthan, Tamil Nadu, Kerala, Nagaland, Mizoram, Sikkim have been promoting organic farming.

Organic produces are increasingly preferred by developed countries and major urban centres in India. Huge demand for Indian organic products especially tea, coffee, cotton etc. exists in the international market. A special class of consumers is also emerging in the domestic market who requires quality food. The global trade during 2013-14 was USD 60 billion (Rs. 3,60,000 crores) and may touch USD 100 billion (Rs. 6,00,000 crores) within the next five years. Trade in India may reach Rs. 5000-6000 crore, which is about 1% of the global trade. The International Competence Centre for Organic Agriculture (ICCOA) estimated that the domestic market for organic products in the year 2011-12 was Rs. 300 crore and grew to Rs. 600 crore in 2012-13 i.e. a growth rate of 100%.

Organic agricultural export market is one of the major drivers of organic agriculture in India. India exports 31 organic products. It is estimated that more than 85% of total organic production, excluding wild herbs from Uttar Pradesh and Madhya Pradesh, is exported. India is best known as an exporter of organic tea and also has great export potential for many other products. Other organic products for which India has a niche market are spices and fruits. There is also good response for organic rice, vegetable, coffee, cashew, oil seed, wheat and pulses. Among the fruit crops bananas, mangos and oranges are the most preferred organic products.

State-wise major crops grown under organic farming in India (both certified & In-conversion)

Arunachal Pradesh	Maize/sorghum, Pulses, oilseeds, tea/coffee, herbal/medicinal plants
Andhra Pradesh	Cotton, maize, pulses, oilseeds, fruits and vegetables
Assam	Tea/coffee, fruits and vegetables
Chhattisgarh	Rice, wheat, vegetables
Delhi	Wheat, vegetables
Goa	Fruits, vegetables
Gujarat	Cotton, pulses, oilseeds, vegetables
Haryana	Basmati rice, wheat, maize, vegetables
Himachal Pradesh	Wheat, fruits, vegetables
Jammu and Kashmir	Spices, fruits and vegetables

Karnataka	Cotton, rainfed wheat, maize, sorghum, pulses, oilseeds, vegetables
Kerala	Spices, vegetables, herbals
Manipur	Spices, vegetables, herbals
Maharashtra	Cotton, rice, wheat, pulses, oilseeds, spices, vegetables
Madhya Pradesh	Soybean, wheat, vegetables
Meghalaya	Spices, vegetables
Punjab	Basmati rice, wheat, vegetables
Sikkim	Maize, sorghum, vegetables, spices, herbs
Rajasthan	Cotton, wheat, seed spices, vegetables
Tamil Nadu	Tea, herbs, spices
Uttar Pradesh	Rice, wheat, maize, vegetables
Uttarakhand	Basmati rice, vegetables, maize, sorghum, herbs, spices
West Bengal	Tea and vegetables

Research results of Organic farming experiments conducted at ICAR

Keeping in view, the prospective role of organic farming in mitigating the problems of resource (soil, water, and bio-diversity) degradation and minimize the implications of climate change on agriculture, Indian Council of Agricultural Research took up a research programme on organic farming during 10th Five-Year Plan, by establishing a 'Network Project on Organic Farming (NPOF)', to study some agronomic aspects of organic farming and develop package of practices in arable crops at 13 centres. Further, seven new centres were approved in XII plan to cover additional crops (seed spices and tuber crops) and areas (hilly and rainfed regions).

Cropping Systems being experimented under Network Project on Organic farming under ICAR

Location	**Cropping system**
Modipuram (Uttar Pradesh)	Green manure-Rice-Wheat
	Basmati Rice-Potato-Radish
	Babycorn-Potato-Greengram
	Sorghum (F)-Pea-Okra
Jabalpur (MP)	GM-Rice-Wheat
	GM-Rice – potato -Okra
	GM-Rice – Berseem
	GM-Rice-Pea-Sorghum F
Coimbatore (TN)	Maize-Cotton
	Chilly-Onion
	Brinjal-Sunflower
	Turmeric+ Onion
Raipur (Chhatisgarh)	Soybean-Wheat
	Soybean-Berseem
	Soybean-Mustard
	Soybean-Chickpea

Calicut (Kerala)	Ginger
	Turmeric
	Black pepper
Dharwad (Karnataka)	Groundnut -Sorghum
	Soybean- rainfed Wheat
	Potato-Chickpea
	Chilli + Cotton-Onion
	Maize-Chickpea
Karjat (Maharashtra)	Rice-Groundnut
	Rice-Maize
	Rice-Mustard
	Rice-Dolichos bean
Ludhiana (Punjab)	Basmati Rice-Wheat-GM
	Turmeric - Onion
	Maize -Potato-Moong (S)
	Rice -Wheat-Moong (S)
Bhopal (MP)	Soybean- Wheat
	Soybean-Mustard
	Soybean-Chickpea
	Soybean-Isabgol
Pantnagar (Uttarakhand)	Basmati Rice-Wheat-Sesbania (GM)
	Basmati Rice -Lentil-Sesbania (GM)
	Basmati Rice -Pea (veg.)-Sesbania(GM)
	Basmati Rice -Mustard-Sesbania (GM)
Ranchi (Jharkhand)	Rice -Wheat
	Rice -Potato
	Rice -Mustard / Linseed
	Rice -Lentil
Umiam (Meghalaya)	Rice - Carrot
	Rice - Potato
	Rice – French bean
	Rice - Tomato

Analysis of research data from various centres revealed the following.

- Yield advantage (after 8th cycle across the locations): Basmati rice, soybean, garlic, groundnut, cauliflower, tomato (4-6 %) & greengram, onion, chilli, cabbage, turmeric (7-14 %)-
- Yield reduction (after 8th cycle across the locations): Wheat, mustard, lentil, potato, French bean (5-8 %)
- Soil organic carbon increased by 22 % under organic production over inorganic in 6 years
- Increase in soil microbes (fungi, bacteria, actinomycetes) was observed in all locations
- Slight improvement in nutritional quality was observed in soybean, turmeric, ginger under organic production

Minimum requirements for Organic Farming

In organic farming system, certain minimum requirements are to be met to fulfil its objectives. Then only the farm is certified as organic.

i) Conversion: The time between the start of organic management and certification is called conversion period. The farmers should have a conversion plan prepared if the entire field is not converted into organic at a time. In that case, it is necessary to maintain organic and non-organic fields separately. In the long run the entire farm including livestock should be converted into organic. The conversion period is decided based on the past use of the land and ecological situation. Generally, the conversion period is two years for annual crops and three years for perennial crops. However, the conversion period can be relaxed based on the verification by certification agency if the requirements are fully met. During conversion, steps should be taken to maintain bio-diversity etc. The per cent change in the yield of major crops over the years is given in Table 2.

Table 2. Mean yield of crops tested in cropping systems under organic input management and yield trend over the years

Crop	**No. of observations**	**Mean yield (kg/ha) under organic input management**	**Yield trend under organic system over the years (% increase (+) or decrease (-) over inorganic input management)**						
			1st year	**2nd year**	**3rd year**	**4th year**	**5th year**	**6th year**	**7th year**
Basmati rice	67	3099	-13	-14	-3	2	2	8	7
Rice	56	3639	-12	-13	5	2	1	2	1
Wheat	56	2952	-15	-9	-7	-3	-7	-13	-4
Maize	55	4541	-5	9	4	0	3	10	16
Green gram	12	905	-	-4	-	-9	3	13	13
Chickpea	25	1269	-10	5	9	3	0	1	5
Soybean	58	1697	1	1	5	0	3	0	12
Cotton	29	1243	8	9	11	12	11	14	12
Garlic	9	7878	-10	-19	8	15	-	-	-
Cauliflower	12	10683	-8	-8	4	2	-	-	-
Tomato	11	20577	-13	-13	-30	-28	35	26	20
Mean			**-6.7**	**-4.8**	**0**	**1**	**8.4**	**5.6**	**9.0**

ii) Mixed farming: Animal husbandry, poultry, fisheries, etc. should be practised in addition to agricultural farming. Shifting cultivation is not allowed. Integrated organic farming system model is being developed at Meghalaya and Coimbatore centres under Network Project on Organic Farming. The models could improve the net returns by 3 to 7 times compared to existing systems (Table 3).

Table 3. Performance of integrated organic farming system model

Location	Components	Area (ha)	Total cost (Rs/year)	Net returns (Rs/year)				
				Crop	Livestock	Others	Total	Existing system
Coimbatore (Tamil Nadu)	Crop (Okra, cotton, desmanthus) + dairy (1 milch animal, 1 heifer & 1 bull calf) + VC+ boundary plantation	0.40	1,10,109	64,500 (87 %)	8,216 (11 %)	1,600 (2 %)	74,316	27,200*
Umiam (Meghalaya)	Crops (Cereals + pulses + vegetables +fruits + fodder) + Dairy (1 cow + 1 calf) + Fishery + Vermicompost	0.43	68,255	33,531 (57 %)	13,252 (22 %)	11,538 (21 %)	58,321	8,618**

* fingermillet-cotton-sorghum, ** rice-fallow

iii) Cropping Pattern: Crop rotation should be followed if annual crops are grown. Intercropping should be practised when perennial crops are grown. Crop rotation should cover green manure as well as fodder crops. In case of perennial crops, cover crops like Kolinji (*Tephrosia purpurea*) should be grown to protect the soil. Monocropping should be avoided.

iv) Planting: Species and varieties cultivated should be adapted to soil and climatic condition and resistant to pests and diseases. Seeds/Planting materials should be procured from organic source. If not available, chemically untreated seeds/planting materials can be used one time. Use of genetically engineered seeds or planting materials such as tissue culture, pollen culture, transgenic plants is not allowed.

v) Manurial Policy: Soil fertility should be maintained/enhanced through raising green manure crops, leguminous crops etc. The residues of plants after harvest should be incorporated into the soil as far as possible. Bio-degradable materials of microbial, plant or animal origin shall be applied as manures. (eq. compost, vermicompost, farm yard manure, sheep penning etc.) Use of synthetic/chemical fertilisers is not permitted. The mineral based materials like rock phosphate, gypsum, lime, etc. can be applied in limited quantities when there is absolute necessity.

The following products are permitted for use in manuring/soil conditioning in organic fields:-

- Farm yard manure, slurry, green manures, crop residues, straw and other mulches from own farm
- Saw dust, wood shaving from untreated wood
- Calcium chloride, lime stone, gypsum and chalk

- Magnesium rock
- Sodium chloride
- Bacterial preparations (Bio-fertilisers), eg. azospirillum, rhizobium
- Bio-dynamic preparations
- Plant preparation and extracts, eg. neem cake
- Vermicompost

The following products shall be used when they are absolutely needed and taking into consideration of factors like contaminations, depletion of natural resources, nutritional imbalances, etc. If proposing for certification, the certification agency may be consulted before using inputs such as FYM, slurry, urine, straw etc from other farms, blood meal, bone meal, sulphate of potash without preservatives, minerals like basic slag, sulphate of potash, wood ash from untreated wood, and vermicompost from other farms. Identified nutrient management package for various cropping systems through network project are given in Table 4. Time of application of panchagavya for various crops are given in Table 5.

Table 3. Identified nutrient packages for various locations

Location	**Cropping System (s)**	**Sources**
Jabalpur (MP)	Basmati rice-wheat-berseem (seed)	Vermicompost (VC) + Farm Yard Manure (FYM) + Non Edible Oil Cakes (NEOC) @ 1/3 N
Coimbatore (TN)	Cotton-maize-GM Chillies-sunflower-GM	FYM + NEOC @ ½ N each + Panchagavya (PG)
Raipur (CG)	Rice-chickpea	Enriched compost (EC) + FYM + NEOC @ 1/3 N each + Bio dynamic (BD)+PG
Calicut (Kerala)	Ginger-fallow	FYM + Neem Cake (NC) + 2VC + PG + biodynamic + Rock phosphate(RP)
Dharwad (Karnataka)	Groundnut-sorghum Maize-chickpea Chilli +onion	EC + VC + Green leaf manure (GLM) + biodynamic spray @ 12 g/ha with PG spray
Karjat (Maharashtra)	Rice-red pumpkin Rice-cucumber	FYM + rice straw + gliricidia @ 1/3rd each of N during *kharif* and FYM + NC + VC @ 1/3 each of N during *rabi* along with spray of PG
Ludhiana (Punjab)	Maize-wheat-summer moong	FYM + PG + BD in maize, FYM +PG in wheat and FYM alone in moong
Bhopal (MP)	Soybean-wheat Soybean-chickpea Soybean-maize	FYM+PG + BD

Pantnagar (Uttarakhand)	Basmati rice-wheat Basmati rice-chickpea Basmati rice-vegetable pea	FYM + VC + NC + EC @ ¼ N each + BD + PG
Ranchi (Jharkhand)	Rice-wheat Rice-potato	VC+ Karanj cake (KC) + BD+ PG
Umiam (Meghalaya)	Rice-maize Rice-toria	FYM + VC + PG

Table 5. Time of application of Panchagavya for different crops is given as follows

Crops	**Time schedule**
Rice	10, 15, 30 and 50th DAT
Sunflower	30, 45 and 60 DAS
Black gram	Rainfed: 1st flowering and 15 DAF Irrigated: 15, 25 and 40 DAS
Green gram	15, 25, 30, 40 and 50 DDAS
Castor	30 and 45 DAS
Groundnut	25 and 30th DAS
Bhendi	30, 45, 60 and 75 DAS
Moringa	Before flowering and during pod formation
Tomato	Nursery and 40 DAT: seed treatment with 1 % for 12 hrs
Onion	0, 45 and 60 DAT
Rose	At the time of pruning and budding
Jasmine	Bud initiation and setting

Note: DAT- Days after transplanting, DAS- days after sowing, DAF- days after flowering.

vi) Pest, Disease and Weed management: Use of synthetic/chemical pesticides, fungicides and weedicides is prohibited. Natural enemies shall be encouraged and protected. (for e.g. raising trees in the farm attracts birds which kills pests of the crops, nest construction etc.) Products collected from the local farm, animals, plants and micro-organisms and prepared at the farm are allowed for control of pests and diseases. (eq. Neem Seed Kernel Extract, cow urine spray). Use of genetically engineered organisms and products are prohibited for controlling pests and diseases. Similarly, use of synthetic growth regulators is not permitted. Slash weeding is to be done between the plants. Weeds under the base of the plants shall be cleaned and put as mulch around the plant base. The weeded materials should be applied as mulch in the ground itself. The products that are permitted for control of pest & diseases are Neem oil and other neem preparations like Neem Seed Kernel Extract, Chromatic traps, Mechanical traps, Pheromone traps, Plant based repellants, Soft soap and clay. The following products shall be used when they are absolutely necessary and taking environmental impact into consideration. The certification agency shall be consulted before using these inputs.

- Bordeaux mixture
- Plant & animal preparations e.g. Cow urine spray, Garlic extract, Chilli extract

- Light mineral oils e.g. Kerosene

Natural enemies of crop pests and diseases such as Coccinellids, syrphids, spiders, Micromus, Chrysopa and campoletis were higher under organic management compared to integrated and inorganic management. Coccinellids, which naturally reduce the hoppers and leaf folders was found to be two to three times higher under organic management in cotton, groundnut, soybean, potato and maize crop fields. Similarly, spiders which also control the pests are found to be twice higher under organic management compared to inorganic management. The diversity of arthropod population in soil viz., Collembola, dipluran, pseudoscorpians, cryptostigmatids and other mites population was also found to be higher under organic management compared to integrated and chemical management (Annual Progress Report, 2010-2013, Network Project on Organic Farming, University of Agricultural Sciences, Dharwad, Karnataka). Identified pest, disease and weed management package for various cropping systems through network project are given in Table 6 and 7.

Table 6. Identified weed management packages for various locations

Centre	**Cropping System**	**Recommended practice**
Raipur (CG)	Rice-mustard	Conoweeder with square planting for rice Stale seed bed for mustard
Coimbatore (TN)	Rice-blackgram-GM	2 hand weeding + spray of aqueous leaf extract at 3-4 leaf stage of weeds
Jabalpur (MP)	Rice-wheat	2 hand weeding + spray at 3-4 leaf stage aqueous spray of weeds
Dharwad (Karnataka)	Groundnut	Spray of cassia and *Prosppis juliflora* as post emergent
Ludhiana (Punjab)	Basmati rice-wheat	High density planting + hand weeding at 25-30 DAT
Pantnagar (Uttarakhand)	Basmati rice-wheat-sesbania	one hand weeding at 25-30 DAT during kharif and 2 hand weeding at 25-30 and 45-50 DAS during rabi
Umiam (Meghalaya)	Maize (GC)-mustard	Mulching with fresh eupatorium/ambrosia @ 10 t/ha (after earthing up)

Table 7. Identified pest and disease management packages for various locations

Centre	Cropping System	Pest/disease	Recommended practice
Modipuram (Uttar Pradesh)	Basmati rice-chickpea Basmati rice-mustard	-	Summer ploughing + green manure incorporation
Calicut (Kerala)	Gninger-fallow	Shoot borer	GEB 17 & 18, GRB 57
Bajaura (Himachal Pradesh)	Cauliflower-peas-tomato	Fruit borer & Fruit rot	Karvi (Roylea cinerea) @ 10% aqeous leaf extract + cow urine (3%) + tween-80 (0.05%) as emulsifier
Umiam (Meghalaya)	Maize + Soybean	Monolapta Mylloceros Ephilechma Leaf folder	Derisom (3 ml/l) + PG @ 10% and cow urine 3% Anomin 3 ml/litre or PG @ 3%.
		Rust	PG @ 3% + lantana @ 10% + vermiwash @ 10%

Preparation of bio-pesticide inputs recommended for organic farming

Name of the input	Source and Preparation	Time, rate and purpose of application
Panchagavya	It is a cow excreta based indigenous nutrient solution. Panchagavya consists of products viz. cow dung, cow urine, milk, curd, jaggery, ghee, banana, Tender coconut and water. When suitably mixed and used, these have miraculous effects. The preparation steps of panchagavya is as follows; 1. 7 kg. cow dung and 1 kg. cow ghee is mixed thoroughly and kept for 3 days. 2. After 3 days, 10 lt. cow urine and 10 lt. water is added, mixed and kept for 15 days with regular	3% solution was found to be most effective compared to the higher and lower concentrations investigated. 3 litres of Panchagavya to every 100 litres of water is ideal for all crops.

	mixing both in morning and evening hours. 3. After 15 days the following ingredients are added and mixed • Cow milk - 3 liters • Cow curd - 2 liters • Tender coconut water - 3 liters • Jaggery - 3 kg • Well ripened banana – 12 nos. Panchagavya is ready after 30 days	
Lantana leaf extract 10%	Leaves of *Lantana camara* were collected from the nearby area of the farm and 10% aqueous leaf extract is prepared firstly by grinding the leaves and then soaking 100g of grinded leaves in 200 ml. distilled water for 24 hours at a room temperature of 30^{o}C. The aqueous extract was obtained by filtering the mixture (leaf and water) through a Whatman No .42 filter paper and diluted with distilled water to prepare 10% concentration.	The extract is diluted with water @ 10% before spraying. This foliar spray act as insect-pest repellent. It can be sprayed 3-4 times during the crop duration according to pest infestation.
Derisom	It is a bio-pesticide based on botanical extract of *Derris indica*.	It is applied as foliar spray @ 0.2% or 2 ml/lt. of water. It can be sprayed 2-3 times during the crop duration according to pest infestation. Derisom has Karanjin as active principle and acts as antifeedant and also acts on central nervous system of the Mites and Insect pests. Derisom works as Acaricide (Miticide) and Insecticide.
Pestoneem	Neem biopesticide is made from cold pressed neem kernels and its active azadirachtin 1500ppm is used as a general insecticide,	It is a bio-based pest controller containing 0.5% Azadirachtin and other vital bio-energizers. Application of pestoneem

	fungicide and for coating urea for slow release	increase resistance to infestation of pest and disease.
Vermiwash	It is a liquid that is collected after the passage of water through a column of worm action in vermicomposting. It is prepared in the vermicompost unit of Agronomy experimental farm, ICAR RC for NEH Region, Barapani	This liquid manure is applied as foliar spray (10% solution) to the plants for better growth and insect-pest and disease management
Botanicals	These are aqueous or alcohol extracts of different herbs, shrubs or tree. These are prepared in the Botanicals laboratory , Division of Crop Production, Agronomy Section, ICAR RC for NEH Region, Barapani	These extracts are applied as seed treatment before sowing which stimulates plant growth and productivity and act as bio-pesticide too. Foliar spray and soil drenching were also done in some cases.
Anonine	Purchased from the market	Organic pesticide used as foliar spray @ 3 ml/lit.

ITKs practiced by farmers for managing the pest and disease under organic management

Rice

- Grind one kg of garlic and mix in one litre of kerosene. Keep it overnight and filter. Mix in 200 lit of water and spray to control brown planthopper, green leafhopper. This practice is widely practiced in Tirunelveli district of Tamil Nadu.
- 4 kg of neem leaves + 4 kg of citronella grass + 4 kg of rhizome of *Alpinia galanga* are chopped and ground in a mortar. Mix the materials in 40 lit of water and leave it for a day. Filter the mixture and dilute with water at 1:60 ratio to control stem borer and leaf-folder.
- Ducks are allowed inside the fields after the harvest of rice crop. The ducks feed on snails and insects found on the boundary. This is common in Trichirapalli and Thanjavur districts of Tamil Nadu.

Millets

- Lab lab or cowpea intercropping in sorghum controls sorghum stem borer incidence.
- Application of ash during flowering phase controls earhead bugs in sorghum.
- Application of onion bulb extract (2-3 kg) control grasshoppers incidence in maize crop.
- Planting of napier grass (2-3 rows) along the maize field border controls maize stem borer attack.
- Intercropping of lucerne in maize crop controls maize stem borer effectively.

Pulses

- Mixture of 3-5 lit of Cow urine and equal quantity of cow dung, kept for four days and filtered. To this 200 g of lime is added and made up to 80 litre and sprayed to control red gram pod borers.
- Spray application of butter milk in cow pea controls yellow vein mosaic virus (YMV) disease where in the buttermilk act as a good barrier of vectors of the YMV.
- Spreading castor oil coated polythene sheet in cowpea field traps sucking pests.
- Coriander intercropping in bengalgram controls gram pod borer.
- Application of tobacco decoction mixed with soap emulsion controls aphids.

Oil seeds

- Digging trench around groundnut field and spreading *Calatropis* leaves in trenches kills red hairy caterpillars trapped in trenches.
- Spreading one kg of popped sorghum grains around castor field attracts birds which pick up semiloopers attacking castor leaves.
- Application of sand and salt crystals in leaf axils controls rhinoceros beetle in coconut.
- Spray application of diluted cow urine controls leaf webber in gingelly.
- *Helicoverpa armigera* in groundnut is controlled by spraying leaf extract of *Prosopis juliflora* in which 200 ml of *Prosopis* leaf extract is mixed with 10 litres water and sprayed. This practice is common in Thummanayakkanpatty village of Madurai district in Tamil Nadu.
- Roasted seeds of maize or sorghum (5 kg/ac) are broadcasted in groundnut field. This attracts birds which pick up the leaf eating caterpillars.
- Cooked rice mixed with turmeric powder is placed in castor field during morning and late in the evening for 2 to 3 days continuously attract birds which devour the semilooper larvae.

Vegetables

- Border cropping of *Tagetes* in brinjal controls shoot and fruit borer pests.
- Syrianangai *Andrographis paniculata* (3-5%) decoction spray controls brinjal shoot and fruit borer, ribbed gourd stem borer, hairy caterpillar of drumstick and armyworms. For that one kilo gram of plant is cut into small pieces and mixed with 4 lit of water and placed in a mud pot, boiled and reduced to 1 lit and 500 ml of this extract is mixed with 100 ml of soap solution and 9.4 lit of water and and used for spraying.
- One kg of cow dung is mixed with 10 lit of water. Filter the extract with a gunny cloth and add 5 litres of water to the filtrate and again filter. Spray the clear filtrate on plants to control pumpkin beetle, **Epilachna** beetle and pod bugs.
- Planting of coriander, mint, ginger and turmeric in mango orchards deters mango pests.
- Application of cow urine or tobacco decoction controls insect pests in grapevines.
- Basin (*Ocimum sanctum*) in mango orchard acts as a trap crop for fruit flies.

Cotton

- 15 lit of curd is mixed with 15 lit of water. Neem leaf extract prepared from 5 kg of neem leaves is added to the curd and allowed for 15 days with stirring at least once in a day. The mixture was filtered used for the management of bollworm in cotton.

- Deep summer ploughing, bonfires and light traps were used for red harry caterpillars. Nipping of the terminal buds and destruction is practiced to destroy eggs and larvae of spotted bollworm.
- Papers coated with castor oil/grease are hung at 5-6 places in the cotton field to manage white flies. For that air is blown using a sprayer over the crop which disturbed the adult flies and stick to the oily paper. This practice if commonly followed in Puducherry union territory.
- The extracts of neem seeds/leaves possess insecticidal properties, which is sprayed on the aphid-infested crops.
- Herbal pesticide formulation prepared by grounding 500g of neem seeds, 1000g of tobacco, 100g of *Acorus calamus*, 250g of *Asafoetida* and 50g of *Sapindus emarginata* seeds and the extract is sprayed for one acre cotton to control pests.
- *Citrullus grandiflora* (periya kumuttikai), *Cissus quadrangularis* (perandai kodi), *Tecoma stans* (yellow arali seeds) and *Azadirachta indica* (neem) eaves / seeds are ground and the paste is allowed to ferment as such for 10 days and used for the management of cutworms.

Turmeric

- Herbal pesticide developed by Mr. K.M. Chellamuthu 1kg garlic + 500g of ginger, + 500g of green chillies + 500g of tobacco + 200g of pepper + 200ml of Neem oil + 30g of khadi soap ckecks the most of the insect pests infecting turmeric crop. The method of preparation is garlic was soaked in 100 ml of kerosene and kept for overnight and then ground with green chillies and pepper the next day (A). Tobacco is to be soaked in water for a day and then filtered and mixed with 200 ml of neem oil (B). Then the A and B is mixed together and finally khadi soap was added and stirred well. 700 ml of the mixture is to be diluted in 10 lit of water and sprayed. This was developed by Mr. K.M. Chellamuthu from Kodumudi village in Erode District of Tamil Nadu.

T**ermite management**

- The dye prepared from Noni (*Morinda citrifolia*) is mixed with garlic extract which completely checked the termite ravages in trees.
- Paint prepared from 1 part of gum of *Gardenia gummifera*, 2 parts of *Asafoetida*, 2 parts of Aloe and 2 parts of castor oil cake controlled termite menace in trees.
- Application of tank silt in sandy wetlands is practiced for termite control.
- *Calotropis* plant material (8-10 kg) soaked in sufficient quantity of water for 24 hr and filtered and poured on termite infested soil.
- Application of sheared human hair obtained from barber's shop, applied on live mounds and along the infested pathways has good control termites which is followed Pudukottai district of Tamil Nadu.

Rat management

- Pieces of cotton or thermocole, dipped in jaggery solution, made into small packets and spread in field / orchard. Rats which consume these will suffer from gastric bloating disorders due to the swelling of cotton or thermocole in stomach.
- Partly cooked sorghum grains are coated with urea or cement or white cement and packed into small packets and spread in the field. Rats that consume this mixture will die due to gastric disorders.
- Mix powder of fused electric bulb with coconut flakes and used in coconut gardens to manage rodents. This practice is followed in Thanjavur district of Tamil Nadu.

Herbal insect repellent

- A popular natural pest repellent paste mixture prepared by Tamil Nadu farmers containing each 1kg of *Vitex nigunda* leaf, *Agave cantala* leaf , *Datura methal* leaves, *Calotropis* leaves and neem seeds. The paste mixture is dissolved in 5 lit. of cow uring and keep the mixture in plastic or earthen ware. Allow ht econtent to ferment for 15 days and then filter. Add 100 lit of water to the filtrate and spray in the field. Most of the insect pests are repelled from the treated area.

vii) Soil and water conservation: Measures like stone pitching/contour wall construction are to be taken up to prevent soil erosion. In case of saline soils, saline resistant varieties may be grown. Judicious irrigation is to be practised. Mulching is required. Pollution of surface and ground water shall be prevented. Clearing of primary forest is prohibited. Cleaning of land through straw burning should be restricted to minimum.

viii) Contamination control: It is necessary to take the following measures to minimise the contamination from outside and within farm.

If neighbouring fields are non-organic, a buffer zone should be maintained. The height of buffer crop shall be twice the height of organic crop and the width of the buffer shall be 25-50 feet. (When chilli is grown as the main organic crop, castor or Agathi (Sesbania) can be grown as buffer crop. The crops from the buffer zone should be sold as non-organic).

If the farm is under conversion, equipment's used for conventional areas shall be well cleaned before using for organic areas.

Products based on polythene, polypropylene and other polycarbonates are allowed to cover protected structure, insect netting, nursery, drying, etc. subject to the condition that these materials shall be removed from the field after use and they shall not be burnt or put in the soil. Use of polychloride based products like PVC pipe is prohibited.

ix) Processing: Processing technologies like solar drying, freeze drying, hot air chambers are permitted. Irradiation of agricultural produce is not permitted. No synthetic additives/days are to be added during processing.

x) Labelling: The label should convey clear accurate information on the organic status of the product. (i.e. conversion in progress or organic). The labels for organic and conversion in progress products should be distinguishable by different coloured labels. The details like name of the product, quantity of the product, name and address of the producer, name of certification agency, certification, lot number etc. are to be given in the label. Lot number is helpful in tracing back the product particularly the field no. in which it is grown in case of contamination. Lot no. should include the crop, country, field no, date of harvest and production year.

xi) Packaging: For packing, recycling and reusable materials like clean jute bags, shall be used. Use of bio-degradable materials shall also be used. Unnecessary packaging material should

be avoided. Organic and non-organic products shall not be stored and transported together except when labelled

Xii) Documentation: Documentation of farm activities is must for acquiring certification especially when both conventional and organic crops are raised. The documents/records such as field map, field history sheet, activity register, input record, output record, harvest record, storage, sales record, pest control records, movement records, equipment cleaning and labelling records are to be maintained

XII) Certification Process: Certification of organic farms is required to satisfy the consumers that the produce is totally organic. Certification agency conducts the inspection that minimum requirements prescribed for organic agriculture is fully met and issues certificate. The producer makes contact with certifying agency. Certification agency provides information on standards, fees, application, inspection, certification and appeal procedures. The producer then submits application along with field history, form map, record keeping system etc. Then the contract indicating scope, obligation, inspection and certification, sanction and appeals, duration, fee structure is executed. Then the Inspector of agency comes and carries out inspection. The Inspector gives inspection report with his recommendation to the agency, then the agency issues approval or denial of certificate. Certificate is given for current year's harvest only and hence annual certification is required.

3. Economics of Organic Farming

The studies conducted under Network project on Organic Farming revealed that across the locations, net return was 17 % higher (at 20-25 % premium price) under organic production system compared to inorganic production system. The cost of cultivation was found to be 13 % higher under organic production system mainly due to handing of bulky nature of organic manures. Benefit: Cost ratio of important cropping systems experimented under NPOF is given below.

Cropping System (s)	**B:C ratio***	**Cropping System (s)**	**B:C ratio***
Babycorn -Potato-Greengram	2.38	Rice -Lentil-Sesbania (GM)	0.97
Brinjal-Sunflower	1.41	Rice -Mustard-Sesbania (GM)	1.19
Cabbage-Radish-Capsicum	0.81	Rice -Pea (veg.)-Sesbania(GM)	2.16
Cauliflower-Radish-Tomato	1.42	Rice-Dolichos bean	0.94
French bean-Cauliflower-French bean	0.86	Rice-G.Nut	1.35
Ginger	1.97	Rice-Maize	1.12
Groundnut -Sorghum	3.52	Rice-Mustard	0.75
Maize-Cotton	2.60	Rice-Pea-Sorghum F	2.99
Maize-Garlic	1.83	Rice-Potato-Radish	1.91
Maize-Mustard-Radish-G. gram	1.87	Rice-Wheat-Sesbania (GM)	1.35
Maize-Potato-Okra	1.73	Sorghum (F)-Pea-Okra	2.69

Potato-Chickpea	3.06	Soybean- Wheat	3.00
Rice – Berseem	3.46	Soybean-Berseem	1.58
Rice - Carrot	4.34	Soybean-Chickpea	2.11
Rice – French bean	3.18	Soybean-Isabgol	2.44
Rice -Mustard	1.04	Soybean-Mustard	1.94
Rice - Potato	2.06	Turmeric	1.91
Rice – potato -Okra	3.34	Turmeric+ Onion	1.26
Rice –Barley+mustard-Green gram	1.90		

* Benefit cost ratio worked out by taking 20 to 25 % premium price for organic products & it is mean of over the years and across the locations

The cost of organic source of nutrients under organic cultivation varied between 28 to 85 % of the operational cost across different crops, whereas, under non-organic cultivation, the cost of nutrient sources predominantly constituted by inorganic sources ranged between 16 to 68 %.

Charyulu and Biswas (2010) examined the economic viability and efficiency of organic farming in India. The study is based on farm production data from the four states *viz.,* Punjab, Uttar Pradesh, Gujarat and Maharashtra. A field survey was conducted in 2009-10 among 120 farmer households, 15 organic and 15 inorganic farmers in each province. The crops covered are paddy, wheat, cotton and sugarcane. The authors also conducted a Data Envelope Analysis (DEA) analysis using per acre figures of gross value of output and four input costs (seeds, fertilizers, pesticides and inter-culture to measure the efficiency of organic and conventional farming for the sample. The findings reveal that for paddy cultivation, the organic method is less profitable than the conventional paddy farming. The net returns per acre were less for organic paddy by 15 per cent in Punjab and 33 per cent in Uttar Pradesh than that for conventional input-intensive paddy cultivation. In Punjab, the cost of cultivation for organic farming was higher than its conventional counterpart though it was compensated to some extent by premium prices for organic paddy. In contrast, the organic paddy cultivation in Uttar Pradesh had a lower unit cost of cultivation but the lack of premium prices rendered it less attractive than conventional cultivation. In contrast, wheat cultivation is more remunerative when done organically than using conventional methods. In both Punjab and Uttar Pradesh, the net returns per acre were higher for organic farming, mainly due to the much higher output prices that organic wheat fetched in the markets.

Srikrishna sudheer (2012) compared the economics of organic farmers (N=350) and chemical farmers (N=200) for three crops, paddy, redgram, and groundnuts, in the state of Andhra Pradesh during 2010-11. It was found that organic farmers are earning a gross income of 5%, 10% and 7% more compared to the chemical farmers of paddy, redgram and groundnut, respectively, and with lower input costs, the profits earned by the organic farmers are higher by 37%, 33% and 59% for the selected crops respectively. Organic farming is generally more profitable in terms of financial costs and returns than chemical farming, irrespective of the crop or the size of farm (the exceptions being small redgram farms and large goundnut farms). An analysis of the farmers' perception of organic farming reveals that electronic media (television) is the prime motivator for farmers to adopt organic practices.

4. Scientific Constraints of Organic Farming

- Very high volume of organic materials required to meet the nutrient demand. [Eg. Average application of 234 kg N/ha/year for a system, this requires either 46 t of raw FYM (0.5 % N) or 15.5 t vermicompost (1.5 % N)]. **Finding the right combination of sources are essential to meet the demand?**
- Efficiency of organic manures is higher than inorganic? Hence, **standardization of frequency and quantity of application of manures are essential to develop package of practices in a system mode.**
- Mismatch between time of nutrient release from organic materials and crop nutrient demand (Mineralization of N from VC is high in first 30 days) in most of the cases affects the yield. **Hence, split application of enriched manures for various crops and systems needs to be standardized.**
- Higher incidence of weeds under organic conditions is reported by organic growers. There is a need to identify crop specific non-chemical weed management strategies.
- Estimation of heavy metals and other residues are essential when the different kind of organic inputs (including municipal waste) are used
- Development of climate friendly smart farms and carbon farming techniques are essential to promote organic farming.
- While a great deal of research has been conducted on the impact of non-organic farming systems on the environment, there are very little data available on the positive impacts of organic farming.
- Great need for research on the human health benefits of consuming organic foods compared to non-organic food diets. The conversation needs to be expanded beyond the argument over "is organic more nutritious or not" and encompass full analysis of different agriculture and food systems, their environmental impacts, and their impacts on public health.

Constraints expressed by organic growers in Madhya Pradesh (Bhopal, Sehore and Raisen districts, total number of organic farmers surveyed: 98)

- Lack of marketing facilities (43.7 %),
- Non availability of premium prices (39.5 %),
- Difficulty in control of weed, pest and diseases (35.4 %),
- Limited availability of organic manures (31.3 %)

5. Practical and Adaptation Measures

Developing organic farm

For optimization of productivity all the essential components need to be developed in a systematic manner. These steps include: (i) Habitat development, (ii) on-farm facilities for input production (iii) cropping sequence and combination planning, (iv) 3-4 year rotation plan and (vi) growing of crops suiting to the region, soil and climate.

Development of farm facilities and habitat

Infrastructure – Reserve 3-5% of farm space for utilities, such as space for cattle, vermicompost bed, compost tank, Vermiwash/ compost tea unit etc. 5-7 trees should be planted only on this space, as all utility infrastructure need shade. Irrigation well, water pumping infrastructure etc can also be in this utility area. Dig some percolation tanks (7x3x3mt or of any other size depending upon the rainfall and run-off pattern) for rain water conservation (1 pit per ha) at appropriate places depending upon slope and water flow. If possible develop a farm pond of preferably 20x10 mt size. Keep few 200 lit tanks (1 per acre) for liquid manure preparation and few containers for botanicals. For 5 acre farm, develop 1-2 vermicompost beds, 1 NADEP tank, 2 biodynamic compost beds, 2-3 compost tea/ vermiwash units, 5 liquid manure tanks, five cowpat pits and one underground cattle-urine collection tank. Efforts should also be made to produce sufficient quantities of BD-500 (cow horn manure) and BD-501(cow horn silica). 10-12 horn products are sufficient for 5 acre farm. Use of biodynamic compost prepared with the use of BD-502-507 has also been found to be very effective.

Habitat and biodiversity- Management of an appropriate habitat for sustenance of different life forms is an essential component of organic farming. This can be achieved by ensuring crop diversity and by maintaining a wide variety of trees and bushes as per climatic suitability. These trees and bushes will not only ensure the nutrients from air and deep soil layers to surface layer but also attract the birds and predators, friendly insects and also provide the food and shelter. There may be some loss of productivity due to shading effect but that loss can be compensated with reduced pest problems and natural biological pest control system. In the plains, for a 10-acre farm, plant at least five to six neem trees (*Azadirachta indica*), one to two tamarind (*Tamarindus indica*), two gular (*Ficus glumerata*), eight to ten ber (*Zizyphus* Sp) bushes, one to two aonla (*Emblica officinalis*), one to two drumstick and 10–15 wild bushes. More specifically, if we classify areas into wet and dry farms, then on the wet farms there should be five to six neem trees, one to two wood apples, one to two star fruit, eight to ten guava or sour soap, three to four drumstick, one to two fig and 10–15 bushes of mulberry, star gooseberry, curry leaf etc, and on the dry farms there must be at least five to six neem, one to two bael fruit, eight to ten ber or custard apple, one to two aonla , one to two drumstick and 10–15 bushes of sasaka , nirgundi (*Vitex negundo*), *Cassia auriculata*, *C. tora*, etc. In hilly areas, *Alnus nepalensis* is considered to be a wonder tree as it fixes good amount of nitrogen. It is being promoted in a cropping system mode particularly in northeastern India. Bushes of Prunus, oak (*Quercus glauca*), Pinus species along the farm boundary and yarrow (*Achillea millifolium*), buck wheat (*Fagopyrum esculentum*), lupin (*Lupinus sativus*), Himalayan stinging nettle (*Urtica parviflora*), marigold, etc., in between the plots invite a lot of predators and also attract a large number of pests. Fruit orchards also need to maintain adequate diversity with at least 3-5 types of fruit plants and few non-fruit trees (as listed above).

Conversion of soil to organic

***Banning of chemicals*-** It is widely known fact that some biological processes of plants involved in acquiring nutrients such as nitrogen e.g. N2 fixation are generally inhibited by adding Nitrogen fertilizer. Soil scientists generally caution against nonjudicious fertilizer use and encourage use of organic compost otherwise it may lead to deficiency of micronutrients. Therefore in organic farming systems there is no place for chemicals.

Low input alternative - In first year simultaneously sow three different types of legumes in strips, first of 60 days (like moong), second of 90-120 days (Cow pea or soybean) and third of more than 120 days (red gram) in strips. Apply mixture of Compost and vermicompost (2:1) @ 2.5 ton per acre enriched with 4 kg Azotobacter and 4 kg PSB biofertilizers or 4 kg consortia of customized cultures as basal dose at the time of sowing preferably in furrows below the seeds. Seeds of legumes should be treated with crop specific strains of Rhizobium biofertilizer. Mulch the entire surface with a thick layer of biological mulch and drench the biomass with Jivamrut @ 200 lit per acre.

Multiple cropping and crop rotation

Mix cropping is the outstanding feature of organic farming in which variety of crops are grown simultaneously or at different time on the same land. In every season care should be taken to maintain legume cropping at least 40%. Mix cropping promotes photosynthesis and avoids the competition for nutrients because different plants draw their nutrients from different depth of soil. The legume fixes atmospheric nitrogen and make available for companion or succeeding crops. In selecting crop combinations, it is also to be kept in mind that plants also have their feelings, likes and dislike e.g. maize gets along well with beans and cucumber, tomatoes go well with onions and marigold. On the other hand beans and onions do not go well with each other. Entire farm should have at least 8-10 types of crops at all the times. Each field/ plot should have at least 2-4 types of crops out of which one should be legume. In case if only one crop is taken in one plot then adjacent plots should have different crops. For maintenance of diversity and pest control randomly plant 50-150/acre vegetable seedlings for home consumption and 100 plants/acre of marigold (Genda) in all crop fields. Even high nutrient demanding crops such as sugarcane can also be grown with suitable combination of various legume and vegetable crops with optimum productivity.

Crop rotation

Crop rotation is the back bone of organic farming practices. To keep the soil healthy and to allow the natural microbial systems working, crop rotation is must. Crop rotation is the succession of different crops cultivated on same land. Follow 3-4 years rotation plan. All high nutrient demanding crops should precede and follow legume dominated crop combination. Rotation of pest host and non pest host crops helps in controlling soil borne diseases and pest. It also helps in controlling weeds. It is better for improving productivity and fertility of soil. Crop rotations help in improving soil structure through different types of root system. Legumes should be used frequently in rotation with cereal and vegetable crops. Green manure crops should also find place in planning rotations.

While turning towards organic it is essential that the basic requirements of the system and the area are properly understood and long term strategies are addressed first. In most part of the country poor soil health due to loss of organic matter and soil microbial load is a major problem. Reducing water availability and increasing temperature is further adding to the problems. Too much dependence on market for supply of inputs and energy has made the agriculture a cost intensive high input enterprise with diminishing returns. We need to address all these concerns and develop a system which is not only productive and low cost but also resource conserving and sustainable for centuries to come. To start with, following parameters need to be addressed in first stage.

Enrichment of soil – Abandon use of chemicals, use crop residue as mulch, use organic and biological fertilizers, adopt crop rotation and multiple cropping, avoid excessive tilling and keep soil covered with green cover or biological mulch.
Management of temperature - Keep soil covered, Plant trees and bushes on bund
Conservation of soil and rain water – Dig percolation tanks, maintain contour bunds in sloppy land & adopt contour row cultivation, dig farm ponds, maintain low height plantation on bunds.
Harvesting of sun energy – Maintain green stand throughout the year through combination of different crops and plantation schedules.
Self-reliance in inputs – develop your own seed, on-farm production of compost, vermicompost, vermiwash, liquid manures and botanical extracts.
Maintenance of life forms – Develop habitat for sustenance of life forms, never use pesticides and create enough diversity.
Integration of animals – Animals are important components of organic management and not only provide animal products but also provide enough dung and urine for use in soil.
Use of renewable energy – Use solar energy, bio-gas and bullock driven pumps, generator and other machine.

Effective microorganisms (EM) technology: Effective Microorganisms is a consortium culture of different effective microbes commonly occurring in nature. Most important among them are : N_2-fixers, P-solubilizers, photosynthetic microorganisms, lactic acid bacteria, yeasts, plant growth promoting rhizobacteria and various fungi and actinomycetes. In this consortium, each microorganism has its own beneficial role in nutrient cycling, plant protection and soil health and fertility enrichment.

Success stories

Strong belief can innovate: Mr. Sundara Raman of M/s Thayalu Ammal farms lives in Sathyamangalam near Erode district in Tamil Nadu. Mr. Sundara Raman tried a few of the new options but stood out as the only 'organic farmer' in the zone. "Everyone thought I was impractical," he adds. "I tried farming with my own methodology but I knew there was a better way." By cutting his inputs and chemical costs, he kept the farm alive and profitable. He also formulated many forms of plant and microbial consortia to put into various uses as growth promoters and pest management. To address soil fertility and other natural resource concerns on the farm, Raman developed and implemented a Conservation Plan. A number of practices like micro irrigation with microbial consortia, bird perches, livestock waste management system, multiple cropping and an agro-forestry unit. Organic crops grown on Raman's farm included a variety of marketable organic grains like corn, hybrid seed corn, vegetables, redgram, turmeric and organic lime. Over the years, the Tamil Nadu Agricultural University recognized his hard efforts and offered a number of farmer to farmer collaborations. Mr. Sundara Raman took the plunge and got involved with these programmes and with those of other conservation-oriented farmers as much as he could. He worked and collaborated with other organic farmers within and from other states, sharing his own knowledge and successes as well.

Organic farming system in cluster approach: A village in Ri-Bhoi district of Meghalaya namely Mynsain have been adopted for disseminating organic production technology developed in the ICAR Research Complex for NEH Region, Umiam through a model village concept under Network Project on Organic Farming-Tribal Sub Plan (NPOF-TSP) with financial assistance from ICAR-Indian Institute of Farming System Research, Modipuram. The village is having 130 households with an approximate area of 60 ha. Under the program, seeds of improved verities of crops and vegetables, planting materials, lime, rock phosphate, neem cake and other organic inputs were provided to the adopted farmers. For effective soil fertility management application of weed, decomposed farm yard manure, pig manure, green leaf manure, composts, liming, rock phosphate etc. were promoted. For pest and disease management use of neem oil, trichoderma, derisom, indigenous technical knowledge was emphasized. Crop rotation with legumes such as groundnut, soybean, French bean etc. were introduced. To promote small scale mechanization, implements and tools like paddy thresher, cono-weeder, sprayer, rose cans, maize sheller and electric pump has been provided to the village. The farmers were given training in various aspects of organic farming along with conservation of natural resources and residue recycling. Successful cultivation of pea, rapeseed and lentil were followed in rice fallow under no-till. Three new ponds were constructed and seven existed ponds were renovated in farmer's field of Mynsain village for multiple uses like irrigation and composite fish culture. A total of 17 small rain water harvesting structure - jalkund having 30,000 liters capacity each were developed for growing vegetables such as French bean, cabbage, broccoli, tomato, lettuce, cucurbits and for rearing of animals such as pig and poultry specially during dry season. A community vermicomposting unit (size 6m x 8m x 2.6m) consisting of eight tanks (size 2m x 1.5m x 0.75m) has been constructed in the village with an objective to produce vermicompost by recycling farm biomass. Raised and sunken beds with 1:1 dimension were developed in 10509 m2 area after rice harvest in lowland for cultivation of vegetables like tomato (var. Avinash, Rocky), French bean (var. Naga local), potato (var. Kufri Megha), carrot (var. New Kuroda), lettuce, etc. Six hundred numbers of improved varieties of Guava seedlings were planted in farmer's field covering an area of about 4500 m2. Multipurpose trees along with fodder were also grown for rehabilitation of degraded land and supply of fodder to cattle in lean period. Farmers were provided with improved breeds of pig (75% Hampshire and 25% mixed local) and poultry (Vanaraja) for higher productivity, nutritional security and income. Mostly the farmers were doing mixed cropping of ginger-colocasia –chili for higher income. Mrs Hynniew Rynghang, an adopted farmer of the village narrated that 'The integrated organic farming system given very good returns with using very less quantity of external inputs'.

Integrated organic farming system

As the villagers were not using any synthetic fertilizers or pesticides earlier, the chance of reduction in yield due to adoption of organic farming does not arise. Rather due to adoption of improved organic production technology, the yield of rice, maize, French bean, ginger, tomato, carrot and chilly had been enhanced by about 15, 22, 40, 33, 45, 37 and 27 %, respectively over conventional practice. Villagers are currently selling their produce in local

market and along the highway side as uncertified organic produce with 10-15% higher market price as compared to conventional produce.

Manar Vanadesa Farmers Group: Fifty tribal farmers including 20 women were trained under ICAR-Network Project on Organic Farming for modern organic Farming methods and techniques in 5 villages of Karamadai block in Coimbatore district of Tamil Nadu. Special lectures on mushroom cultivation, apiculture, bio-fertilizer production were given. Inputs such as 10,000 number of Jasmine seedlings, 16.4 kg vegetable seeds, 200 kg of Azospirillum, Phosphobacteria, VAM and 100 kg of bio-control agents such as Pseudomonas fluroscens and trichoderma viridie were also given for practicing the organic farming in the form of Participatory Guarantee System (PGS). From the trained group, **Manar Vanadesa Farmers Group** was formed for organic certification and registered at Joint Registrar Office, Coimbatore.