Organic Farming System - An Integrated Approach for Adoption under National Horticulture Mission

Introduction

Organic agriculture has grown out of the conscious efforts by inspired people to create the best possible relationship between the earth and men. Since its beginning the sphere surrounding organic agriculture has become considerably more complex. A major challenge today is certainly its entry into the policy making arena, its entry into anonymous global market and the transformation of organic products into commodities. During the last two decades, there has also been a significant sensitization of the global community towards environmental preservation and assuring of food quality. Ardent promoters of organic farming consider that it can meet both these demands and become the means for complete development of rural areas. After almost a century of neglect, organic agriculture is now finding place in the mainstream of development 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 and productivity at its core, in addition to the founders concerns for healthy soil, healthy food and healthy people.

Concept of organic farming

Organic farming is very much native to India. 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.
- The entire system is based on intimate understanding of nature's ways of replenishment. The system does not believe in mining of the soil of its nutrients and do not degrade it in any way.
- The soil in this system is considered as a living entity
- 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.
- The total environment of the soil, from soil structure to soil cover is more important and must be preserved.

Definition, Organic farming is a method of farming system, which primarily aims at cultivating the land and raising crops in such a way, so as to keep the soil alive and in good health.

It is the use of organic wastes (crop, animal and farm wastes, aquatic wastes) and other biological materials, mostly produced insitu ----- along with beneficial microbes (biofertilizers) to release nutrients to crops, which connotes the 'organic' nature of organic farming. It is also termed as organic agriculture. In the Indian context it is also termed as 'Javik Krishi'.

As per FAO's definition "*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*".

Organic agriculture perspective under Indian conditions

Organic farming denotes a holistic system of farming which optimizes productivity in a sustainable manner through creation of interdependent agri-eco systems where annual crop plants (e.g. wheat), perennial trees (e.g. horticulture) and animals (including fishes where relevant) are integrated on a given field or property. It is often confused with certified organic farming or labeled organic produce, which is a commercial quality control and marketing mechanism entailing third party certification or any other form of independent certification for individual commodities and the process of their cultivation. It is important to separate the two.

The first - organic farming (OF) is essentially an agricultural activity employing the knowledge/understanding of naturally occurring processes while the second – a certified organic farming (COF) is essentially the same as OF but there is an addition of checks and balances to maintain soil fertility and control insect-pests and diseases. It is done by involving record keeping on various aspects and is dictated by market forces.

About 74% farmers in India are small and marginal farmers. Organic farming is most relevant to them because they are resource poor to provide costly inputs for enhancing yield. Their only resource viz. land, need to be prevented from degradations. In the organic farming system approach, a piece of land is used optimally and to its fullest potential to produce a range of nutritious and healthy food as well as other required commodities in a manner which can healthily feed a small family, and maintain soil health and productivity by agricultural practices based on principles of nature. Pests (both insects and diseases) are also controlled and managed by the selection of crop mixes and using biological control measures.

Emergence of organic farming in India

Organic farming has made a credible advancements during the past decade. It is a combined effect of farmers' efforts, NGOs work, Governmental

interventions and market forces that organic farming in India has reached a stage where it can swiftly move to occupy prominent space in Indian agriculture.

Certified organic farming, which was 42,000 ha during 2003-04, has now grown almost by 20 fold during the last 4 years. As on March 2009, the total cultivated area under organic certification process has crossed one million ha mark. Besides this, there is another 2.5 million ha under certified wild forest harvest collection area. National Project on Organic Farming (NPOF) and National Horticulture Mission (NHM) scheme of Department of Agriculture and Cooperation has significantly contributed to this growth. For quality assurance the country has internationally acclaimed certification process in place for export, import and domestic markets. The National Programme on Organic Production (NPOP) provides necessary policy support. Presently,16 accredited certification agencies are looking after the requirement of certification process and the products certified by them are accepted in many countries including European Union and USA. The list of the accredited certifying agencies is given in **Annexure-I.**

Growing Crops under Organic Management

Philosophy - Organic farming package is an integrated approach, where all aspects of farming systems are interlinked with each other and work for each other. A healthy biologically active soil is the source of crop nutrition, on-farm biodiversity controls pests, crop rotation and multiple cropping maintains the system's health and on-farm resource management with integration of cattle ensure productivity and sustainability. Organic management stresses on optimization of resource use and productivity, rather than maximization of productivity and over exploitation of resources at the cost of resources meant for future generations.

Management Principals - A living soil is the basis of organic farming. A live, healthy soil with proper cropping pattern, crop residue management and effective crop rotation can sustain optimum productivity over the years, without any loss in soil fertility. Organic farming envisages a comprehensive management approach to improve soil health, the ecosystem of the region and the quality of produce. It includes all agricultural systems that promote environmentally sound production of food and fibres. These systems take local soil fertility as a key to successful production, by respecting the natural capacity of plants, animals and the landscape; they aim to optimize quality in all aspects of agriculture and environment. A living soil can be maintained by continuous incorporation of crop and weed biomass, use of animal dung, urine-based manures (FYM, NADEP, vermicompost), biofertilisers and bioenhancers, special liquid formulations (like vermiwash, compost tea etc) during a crop's duration.

As a thumb rule, crop residues should be returned to the plot, directly or indirectly. Cattle droppings may be returned to the field as compost. As a strategy, the quantity of biomass removed for human food and fiber, cattle feed or firewood from an organic farm should be replaced with any other bio-waste on the farm. But it is important to account for it for preparing the balance sheet of nutrients for each crop being cultivated on the farm. In phosphorous-deficient and acidic soils, some quantity of mineral grade rock phosphate and lime can also be added either by direct application to the field or through addition to compost. The compost can be further enriched by incorporation of biofertilisers, microbial inoculants, etc. Special composts like biodynamic compost, cowpat pit compost, biodynamic preparations such as BD-500 and BD-501, special formulations like Panchgavya, Dashgavya, Biosol etc are also useful and ensure optimum productivity. Use of EM formulation has also been found effective in soil enrichment and compost making. For high nutrient demanding crops and for intermittent soil enrichment use of oilcakes, poultry manure, concentrated manures (mixture of oil cakes, poultry manure and rock phosphate) can also be an ideal low-cost option of manuring.

Important steps

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 parts 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:

- Enrichment of soil
- Management of temperature
- Conservation of rain water
- Maximum harvesting of sun energy
- Self reliance in inputs
- Maintenance of natural cycles and life forms
- Integration of animals
- Maximum reliance on renewable energy sources, such as solar power and animal power

How to achieve

1. **Enrichment of soil** –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. Do not use any chemicals.

2. **Management of temperature** - Keep soil covered, Plant trees and bushes on bunds.
3. **Conservation of soil and rain water** – Dig percolation tanks, maintain contour bunds, farm ponds in sloppy lands and adopt contour row cultivation, maintain low height plantation on bunds.
4. **Harvesting of sun energy** – Maintain green stand throughout the year through combination of different crops and plantation schedules.
5. **Self reliance in inputs** – develop your own seed, on-farm production of compost, vermicompost, vermiwash, liquid manures and botanical extracts.
6. **Maintenance of life forms** – Develop habitat for sustenance of life forms, never use pesticides, create enough diversity.
7. **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.
8. **Use of renewable energy** – Use solar energy, bio-gas and bullock driven pumps, generator and other machine.

Developing organic farm

As organic management is an integrated approach, manipulation and adoption of one or few steps may not yield significant results. 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 a 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.

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).

Major and minor plots should be separated by bunds about 1.5m wide and should be planted with Glyricidia, perennial Sesbania (jayanti), Leucaena leucocephala, cassia siamea, etc. The internal hedgerow should consist of perennial pigeon pea, Crotalaria , seasonal Sesbania, etc. Lops from these trees will provide enough quantity of biologically fixed nitrogen.

In between *Glyricidia/Sesbania* rows insert few plants of pesticidal value such as *Adathoda vesica, Vitax nigundo, Calotropis, Datura alba, Ipomea* (Besharam) etc. Surrounding the farm or garden, there should be hedgerows or a live fence of coppiced or pollarded, multipurpose, deep-rooted trees and shrubs and medicinal herbs such as Adathoda vasica, Vitex negundo, Jatropha curcas, etc. Ecological diversity is an essential component of any successful organic farming system.

Trees on utility space can be allowed to grow fully. Trees and bushes on farm bunds should be placed randomly at sufficient distance and pruned at repeated intervals. Glyricidia plants should be planted at close spacing on all major bunds and all around the farm. They will act not only as biological fence but also provide biologically fixed nitrogen to soil.

A 400 mt long Glyricidia strip can provide 22.5 kg N/ha per year from the year 3 and up to 77 Kg N/ha from year 7 under rainfed conditions. This can be 75-100% higher under irrigated conditions. Three to four harvests can be made under

irrigated conditions and two harvests under unirrigated conditions. Never allow them to grow above 5.5 ft to avoid shading effect. Lopping is used as green leaf manure. Simply harvest them and incorporate in soil before sowing or use as mulch.

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. N_2 fixation are generally inhibited by adding Nitrogen fertilizer. Soil scientists generally caution against non-judicious 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. Seedlings will emerge from this layer. If soil is poor in phosphorus then apply 300 kg of low grade mineral rock-phosphate along with the compost. Apply second dose of Jivamrut after 25-30 days of sowing with irrigation water or during rains.

To add to diversity 100 plants/ acre of marigold or Hibiscus subdarifa may be planted randomly through out the field. Few seedlings of vegetables such as chillies, tomato, brinjal, etc and rhizomes of turmeric, ginger etc can be planted randomly for home consumption.

Harvest the pods/ fruits and use remaining biomass for mulch. Collect the crop biomass at the end of strips in the form of heaps and drench with Jivamrut. Sow short duration leafy vegetables (such as fenugreek or spinach) in the space vacated by the first and second crop and mulch the surface with treated biomass. Harvest leafy vegetable and grains and incorporate remaining biomass in the soil at appropriate time.

In next season apply compost-vermicompost mixture @ 2.5 ton/ha and sow cereal crop with legume as inter or companion crop. After harvest use entire legume and remaining part of cereal crop as mulch. If irrigation facilities are there, take summer legume with some vegetable crop. Recycle entire residue as mulch. Use 3-4 application of liquid manure (such as Jivamruta) during each cropping season for soil application. Now the soil is ready for high value horticultural crops.

High input alternative – Incorporate 2.5-3.0 ton compost/ vermicompost or 1.5 ton of biodynamic compost, 500 kg crushed oil cakes, 500 kg rock phosphate, 100 kg neem cake, 5 kg Azotobacter and 5kg PSB biofertilizer or 4 kg consortia of customized cultures in soil through broadcasting or by drilling in furrows below the seeds. Sow 3-4 types of different crops in strips. 40% crop stand should be of legumes. Randomly plant 100-150 marigold and vegetable seedlings for increased diversity. After harvest incorporate entire residue in soil or use as mulch after sowing of the next crop. For second crop also use similar quantities of manures. Use liquid manure (Jivamruta) @ 200lit/acre 3-4 times during cropping season along with irrigation water. For increased productivity 2-3 sprays of vermiwash or vermiwash+cow urine or Panchgavya can also be provided.

In fruit orchards cultivate 3-4 types of legume mixtures as mixed or intercrop in inter spaces along with adequate quantity of manures (as specified above). After pod/ grain harvest mulch the entire soil surface with the left over biomass and drench the biomass with 2 applications of Jivamruta.

After about 12-18 months the soil will be ready for organic cultivation of any crop combination. For next two-three years, along with any crop incorporate legumes as inter or companion crops. Ensure that crop residue always have at least 30% residue from legumes. Also treat crop residue with liquid manure before incorporating into soil or using as mulch.

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. Deep rooted plants drew nutrient from deeper layer of soil and bring them to the surface of soil through their leaf fall. So the nutrients leached down to lower strata are further brought back to upper layer by these deep rooted plants. Also help in protecting soil from soil erosion. Farmers should select the crops combination according to their needs and season.

In selecting crop combinations, only compatible crops should be planted, for 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. High nutrient demanding crops should always be followed by legume crops and returned back to soil. Some important benefits of crop rotations are:

a. Not all plants have same nutritive needs
b. Soil structure is improved through different types of roots
c. Pest build up is avoided and
d. Rotations help against the build up of weeds.

Under Network Project on Organic Farming (NPOF of ICAR) important cropping systems, which were found economically better or at par with conventional system at different experimental stations in the country have been identified, which are as follows:

- Tomato/ Cabbage – cauliflower – pea and maize – garlic at Bajaura, Himachal Pradesh
- Rice – wheat/ potato/ mustard/ lentil at Ranchi, Jharkhand
- Groundnut – rabi Sorghum, soybean – durum wheat, potato – chick pea, chillil+ Cotton and maize – chick pea at Dharwad, Karnataka
- Soybean – durum wheat/ mustard/ chick pea/ isabgol at Bhopal, M.P.
- Rice – durum wheat/ berseem, rice – potato – Okra and rice – garlic, sorghum – berseem, maize – berseem – maize + coepea and sorghum + cluster bean – oats-cowpea at Ludhiana, Punjab
- Maize – cotton, chillies – onion and brinjal – sunflower at Coimbatore
- Sorghum – pea – okra at Modipuram, Uttar Pradesh
- Carrot/ rice (pre kharif) – rice (kharif), potato/rice (pre kharif) – rice (kharif), tomato/ rice (pre kharif) – rice (kharif), French bean/ rice (pre kharif) – rice (kharif) at Umiam, Meghalaya

Status of rich and live organic soil

A fertile and live organic soil ideally should have Organic Carbon (C) between 0.8-1.5%. At any point of time it should have adequate quantity of dry, semi decomposed and fully decomposed organic matter for the use of micro-flora and fauna. Total microbial load (bacteria, fungi and actinomycetes) should be above

1 x 10^8 /gm of soil. There should be at least 3-5 earth worms/cubic ft of soil. There should be enough quantity of small life forms and insects such as ants etc.

Seed/ Planting material Treatment

In organic management, protection measures are used only in the case of problematic situations. Use of disease free seed stock and resistant varieties is the best option. There is no standard formulation or treatment methodology, available as on today, but farmers use different methods. Few of such innovative seed treating formulations are as follows:

- Hot water treatment at 53^0C for 20-30 min.
- Cow urine or cow urine-termite mound soil paste
- Beejamrut
- Asphoetida 250gm in one lit. of water for 10 kg seed
- Turmeric rhizome powder mixed with cow urine
- Panchgavya extract
- Dashparni extract
- *Trichoderma viride* (4gm/kg seed) or *Pseudomonas fluorscens* (10gm/kg seed)
- Biofertilizers (Rhizobium/ Azotobacter +PSB)

Preparation of Beejamruta – Put 5 kg of fresh cow dung in a cloth bag and suspend in a container filled with water to extract the soluble ingredients of dung. Suspend 50 g lime in 1 lit water separately. After 12 – 16 hours squeeze the bag to collect extract and add 5 lit cow urine, 50 gm virgin forest soil, lime water and 20 lit water. Incubate for 8-12 hours. Filter the contents. The filtrate is used for seed treatment.

Manuring and soil enrichment

During conversion period, soil fertility can be improved and maintained initially through use of organic inputs like well decomposed organic manure/ vermicompost, green manure and biofertilizers in appropriate quantity. These organic inputs are used for feeding the soil. Well fed healthy soil rich in microflora and microfauna takes care of the crop nutrient requirement. Plant biomass, FYM, Cattle dung manure, enriched compost, biodynamic compost, Cow-pat-pit compost and vermicompost are key sources of on-farm inputs. Among off-farm inputs, important components are non-edible oil cakes, poultry manure, biofertilizers, mineral grade rock phosphate and lime etc.

Lopping from Glyricidia and other plants grown on bunds, on-farm produced compost and vermicompost, animal dung and urine and crop residue should form the major source of nutrient and concentrated manures such as crushed oil cakes, poultry manure, vegetable market waste compost and other novel preparations such as biodynamic formulations etc can be used in appropriate quantity. Use of high quantities of manures should be avoided. Changing crop rotations and multiple crops ensure better utilization of resources. Depending

upon the type of crop and requirement of nutrients for different crops, the quantity of externally produced inputs is determined.

Application of liquid manure (for soil enrichment) is essential to maintain the activity of microorganisms and other life forms in the soil. 3-4 applications of liquid manure is essential for all types of crops. Vermiwash, compost tea, cow urine, Pachgavya and Biosol etc are excellent growth promoters when used as foliar spray. 3-5 sprays after 25-30 days of sowing ensure good productivity. Use of Biodynamic preparations, such as BD-500 and BD-501 as foliar spray has also been found to be effective in growth promotion.

Use of Biofertilizers and microbial cultures

Biofertilizers viz: Rhizobium, Azotobacter, Azospirillum, PSB and Pseudomonas etc have been found to be very effective tools of fertility management and biological nutrient mobilization. Recently customized consortia of such biofertilizer organisms, better adapted to local climatic conditions have also been developed and are available commercially. Efficiency of such microbial formulations is much higher under no-chemical use situations, therefore application of such inputs need to be ensured under all cropping situations.

Some important formulations for soil enrichment

Preparation of liquid manures

Many variants of liquid manures are being used by farmers of different states. Few important and widely used formulations are given below:

Sanjivak – Mix 100 kg cow dung, 100 lit cow urine and 500 gm jaggary in 300 lit of water in a 500-lit closed drum. Ferment for 10 days. Dilute with 20 times water and sprinkle in one acre either as soil spray or along with irrigation water.

Jivamrut – Mix cow dung 10 kg, cow urine 10 lit, Jaggary 2 kg, any pulse grain flour 2 kg and Live forest soil 1 kg in 200 lit water. Ferment for 5 to 7 days. Stir the solution regularly three times a day. Use in one acre with irrigation water.

Amritpani - Mix 10 kg cow dung with 500 gm honey and mix thoroughly to form a creamy paste. Add 250 gm of cow desi ghee and mix at high speed. Dilute with 200 lit water. Sprinkle this suspension in one acre over soil or with irrigation water. After 30 days apply second dose in between the row of plants or through irrigation water.

Panchgavya – Mix fresh cow dung 5 kg, cow urine 3 lit, cow milk 2 lit, curd 2 lit, cow butter oil 1 kg and ferment for 7 days with twice stirring per day. Dilute 3 lit of Panchgavya in 100 lit water and spray over soil. 20 lit panchgavya is needed per acre for soil application along with irrigation water.

Enriched Panchgavya (or Dashagavya) – Ingredients - cow dung 5 kg, cow urine 3 lit, cow milk 2 lit, curd 2 lit, cow deshi ghee 1 kg, sugarcane juice 3 lit, tender coconut water 3 lit, banana paste of 12 fruits and toddy or grape juice 2 lit. Mix cow dung and ghee in a container and ferment for 3 days with intermittent stirring. Add rest of the ingredients on the fourth day and ferment for 15 days with stirring twice daily. The formulation will be ready in 18 days. Sugarcane juice can be replaced wit 500 g jaggery in 3 lits water. In case of non-availability of toddy or grape juice 100g yeast powder mixed with 100 g jaggery and 2 lit of warm awter can also be used. For foliar spray 3-4 lit panchgavya is diluted with 100lit water. For soil application 50 lit panchagavya is sufficient for one ha. It can also be used for seed treatment.

Management of Temperature

Temperature in summer season is quite high and need to be managed. It can be achieved by keeping soil covered with biological mulch. Surface mulch has been reported to conserve soil moisture and improve water use efficiency. In the long term experiment at ICRISAT, it has been reported that mulch applied in this manner on the hottest day of summer (April 30) in 2002 the soil temperature at 5 and 10 cm depth in the mulch applied plots was 6.5 to 7.3^{o} C lower than in control plot (Rupela et al 2005). Temperature control can also be achieved by planting different types of trees like neem, amla, tamarind, gular, zizipus bushes, gliricidia on bunds.

Protection to all life forms

Practice of maintaining enough biomass and mulching with crop and weed residue will ensure the protection to all life forms in soil. Another important practice of banning the chemical fertilizers and pesticides in farming definitely helps in protecting the life forms in soil. For the survivability of different life forms the field must have dry organic matter as a food for small insects and small animals in soil, semi decomposed organic matter as food for earthworms and fully decomposed organic matter for micro organisms in the soil at all times. These insects ,small animals ,earthworms and microorganisms are the tireless natural employees of the soil, wherein small animals and insects feed on the larvae of pests and thus controlling the pest ,earthworms makes the soil porous thus creating the more aerobic conditions in soil and also decompose the half digested organic residue and release locked nutrients into soil. Soil rich in organic carbon contain ample quantity of beneficial micro flora which plays an important role in recycling of nutrients and nitrogen fixation, phosphate solubilization and photosynthesis activity, cellulolytic activity. Therefore protection to all life forms in soil should be ensured at all time.

Pest management

As in organic farming management use of synthetic chemicals are prohibited, the pest management is done by: (i) cultural or agronomic (ii) mechanical (iii) biological or by (iv) organically acceptable botanical extract or some chemicals such as copper sulphate and soft soap etc.

Cultural alternative - Use of disease free seed or stock and resistant varieties are best preventive practice in organic pest management. Maintenance of biodiversity, effective crop rotation, multiple cropping, habitat manipulation and use of trap crops are also effective practices which can keep the population of pests below economical threshold limit (ETL).

Mechanical alternative - Removal of affected plants and plant parts, collection & destruction of egg masses and larvae, installation of bird perches, light traps, sticky colored plates and pheromone traps are most effective mechanical methods of pest control.

Biological alternative - Use of pest predators and pathogens has also proved to be effective method of keeping pest problem below ETL. Inundative release of *Trichogramma sp*. @ 40,000 to 50,000 eggs per hectare, *Chelonus blackburni* @15,000 to 20, 000 per hectare, *Apanteles* sp.@15,000 to 20,000 per ha and *Chrysoperla sp*.@ 5,000 per ha., after 15 days & others parasites & predators after 30 days of sowing, can also effectively control pest problem in organic farming .

Use of Biopesticides - *Trichoderma viride* or *T. harazianum* or *Pseudomonas fluorescence* formulation @ 4gm/kg seed either alone or in combination, manage most of the seed borne & soil borne diseases. There are other formulations viz. *Beauvaria bassiana*, *Metarizium anisopliae*, *Numeria rileyi*, *Verticillium* sp, which are available in the market and can manage their specific host pest. *Bacillus thurengensis stenebrionis and B.thurengensis sandigo* are effective against coleopterans as well as some other insect species. Bt. has been used in the management of diamond back moth on crucifers and vegetables @ 0.5-1.0 kg. formulation per ha.

Viral biopesticides of baculovirus group viz. granulosis viruses (GV) and nuclear polyhedrosis viruses provided a great scope in plant protection field. Spray of nuclear polyhedrosis viruses (NPV) of *Helicoverpa armigera* (H) or *Spodoptera litura* (S) @ 250 larval equivalents are very effective tools to manage the *Helicoverpa* sp. or *Spodoptera* sp. respectively.

Botanical pesticides

Many plants are known to have pesticidal properties and the extract of such plants or its refined forms can be used in the management of pests. Among various plants identified for the purpose, neem has been found to be most effective.

Neem (*Azadirachta indica*) – Neem has been found to be effective in the management of approximately 200 insects, pests and nematodes. Neem is very effective against grasshoppers, leaf hoppers, plant hoppers, aphids, jassids, and

moth caterpillars. Neem extracts, are also very effective against beetle larvae, butterfly, moth and caterpillars such as Mexican bean beetle, Colorado potato beetle and diamondback moth. Neem is very effective against grasshoppers, leaf minor and leaf hoppers such as variegated grasshoppers, green rice leaf hopper and cotton jassids. Neem is fairly good in managing beetles, aphids and white flies, mealy bug, scale insects, adult bugs, fruit maggots and spider mites.

Some other pest control formulations

Many organic farmers and NGOs have developed large number of innovative formulations which are effectively used for control of various pests. Although none of these formulations have been subjected to scientific validation but their wide acceptance by farmers speak of their usefulness. Farmers can try these formulations, as they can be prepared on their own farm without the need of any purchases. Some of the popular formulations are listed below:

Cow urine – Cow urine diluted with water in ratio of 1: 20 and used as foliar spray is not only effective in the management of pathogens & insects, but also acts as effective growth promoter for the crop.

Fermented curd water – In some parts of central India fermented curd water (butter milk or *Chaach*) is also being used for the management of white fly, jassids aphids etc.

Dashparni extract – Crush neem leaves 5 kg, Vitex negundo leaves 2 kg, Aristolochia leaves 2 kg, papaya (Carica Papaya) 2 kg, Tinospora cordifolia leaves 2 kg, Annona squamosa (Custard apple) leaves 2 kg, Pongamia pinnata (Karanja) leaves 2 kg, Ricinus communis (Castor) leaves 2 kg, Nerium indicum 2 kg, Calotropis procera leaves 2 kg, Green chilly paste 2 kg, Garlic paste 250 gm, Cow dung 3 kg and Cow Urine 5 lit in 200 lit water ferment for one month. Shake regularly three times a day. Extract after crushing and filtering. The extract can be stored up to 6 months and is sufficient for one acre.

Neem-Cow urine extract - Crush 5 kg neem leaves in water, add 5lit cow urine and 2 kg cow dung, ferment for 24 hrs with intermittent stirring, filter squeeze the extract and dilute to 100 lit, use as foliar spray over one acre. Useful against sucking pests and mealy bugs.

Mixed leaves extract - Crush 3 kg neem leaves in 10 lit cow urine. Crush 2 kg custard apple leaf, 2 kg papaya leaf, 2kg pomegranate leaves, 2 kg guava leaves in water. Mix the two and boil 5 times at some interval till it becomes half. Keep for 24 hrs, then filter squeeze the extract. This can be stored in bottles for 6 months. Dilute 2-2.5 lit of this extract to 100 lit for 1 acre. Useful against sucking pests, pod/fruit borers.

Chilli-garlic extract - Crush 1 kg Ipomea (besharam) leaves, 500 gm hot chilli, 500 gm garlic and 5 kg neem leaves in 10 lit cow urine. Boil the suspension 5

times till it becomes half. Filter squeeze the extract. Store in glass or plastic bottles. 2-3 lit extract diluted to 100 lit is used for one acre. Useful against leaf roller, stem/fruit/pod borer

Broad spectrum formulation - 1 - In a copper container mix 3 kg fresh crushed neem leaves and 1 kg neem seed kernel powder with 10 lit of cow urine. Seal the container and allow the suspension to ferment for 10 days. After 10 days boil the suspension, till the volume is reduced to half. Ground 500 gm green chillies in 1 lit of water and keep overnight. In another container crush 250gm of garlic in water and keep overnight. Next day mix the boiled extract, chilli extract and garlic extract. Mix thoroughly and filter. This is a broad spectrum pesticide and can be used on all crops against wide variety of insects. Use 250 ml of this concentrate in 15 lit of water for spray.

Broad spectrum formulation - 2 Suspend 5 kg neem seed kernel powder, 1kg Karanj seed powder, 5 kg chopped leaves of besharam (*Ipomea* sp.) and 5kg chopped neem leaves in a 20lit drum. Add 10-12 lit of cow urine and fill the drum with water to make 150 lit. Seal the drum and allow it to ferment for 8-10 days. After 8 days mix the contents and distil in a distiller. Distillate will act as a good pesticide and growth promoter. Distillate obtained from 150lit liquid will be sufficient for one acre. Dilute in appropriate proportion and use as foliar spray. Distillate can be kept for few months without any loss in characteristics.

Some Other forms of Organic Management

1. **Biodynamic Agriculture**
   Biodynamic agriculture is a method of farming that aims to treat the farm as a living system which interacts the environment, to build healthy, living soil and to produce food that nourishes and vitalizes and helps to develop man kind. The underlying principle of biodynamics is making life-giving compost out of dead material. The methods are derived from the teachings of Rudolf Stainer and subsequent practitioners.

   The important components of biodynamic farming are as follows:

   a. Turning in plant materials such as green crops and straw
   b. Not using chemical fertilizers and pesticides
   c. Avoiding soil compaction by machinery or animals, particularly in wet weather
   d. Keeping soil covered by pasture, crops or mulch not destroying the soil structure by poor farming practices such as excessive use of rotary hoe or cultivation in unsuitable weather (too wet or too dry)
   e. Fallowing the land by planting deep-rooting permanent pasture species or using green crops
   f. Use of preparations BD-500 and BD-501

g. Compost made with preparations BD-502 – BD-507
h. Liquid manure made with preparations BD-502 – BD-507
i. Cowpat pit manure made with preparations BD-502 – BD-507

These biodynamic preparations named BD-500 to BD-507 are not food for the plants, but they facilitate the effective functioning of etheric forces. They are also not the usual compost starters, but can stimulate compost organisms in various ways. In short they are biologically active dynamic preparations which help in harvesting the potential of astral and etheral powers for the benefit of the soil and various biological cycles in the soil.

So far 9 biodynamic preparations have been developed, named as formulation 500 to 508. Out of these, formulation-500 (cow horn compost) and formulation-501 (horn-silica) are very popular and are being used by large number of organic farmers. Formulations-502 to 507 are compost enrichers and promoters, while formulation 508 is of prophylactic in nature and helps in control of fungal diseases.

Biodynamic formulation-500 (BD-500)
As per the established norms of biodynamic process while cow-dung is full of astral and etheral powers; the cow-horn shell has the potential to absorb astral powers. In this formulation the inherent potential of these two components is harvested in making a biologically active formulation.

a. **Method of preparation** - Whip fresh cow dung to prepare a thick smooth paste. Fill the empty cow horn shells with this paste. Now place these horns in the pit in upright position with the pointed closed end of horns facing upwards. Fill the pit with good fertile soil and compost mixture (25 : 1) till ground level. The soil of the pit is to be kept moist for all the time. If required sprinkle water at repeated intervals. As per the Indian moon calendar "*Kwar Navratra*" (October-November) is the most ideal period for placing the dung filled horns in pits. The horns are kept buried for approximately six months and are taken out during "*Chaitra Navratra*" (March-April). Dig out the horns at appropriate time and take out the BD-500 compost. The compost should be moist and should have a pleasing smell. Store the compost in earthen pots till its use. BD-500 can be used in any crop twice, first dose is to be applied a day before sowing and second dose after 20 days of seedling emergence. For best results it should be applied close to full moon days. BD-500 applied during low-moon or no-moon days will not be that effective.
b. **Method of application** – Mix 30 gm of BD-500 in about 13 lit of rain or fresh tube-well water. Stir the solution with hand for one hour. Apply this suspension with the help of Knapsac sprayer on soil surface or as foliar spray. The best time of application is close to sunset. BD-500 application encourage the growth of beneficial microorganisms and earthworms,

promote rooting process and harvest terrestrial forces for better crop growth and increased biological activity in the soil.

Biodynamic formulation 501 (BD-501)

In this formulation fine powder of quartz silica is filled in empty cow-horn shells and kept buried in soil for six months during hot summer season. Opposed to BD-500, the silica filled horns are buried during March-April (*Chaitra Navratra*) and taken out during Oct.-Nov. (*Kwar Navratra*). BD-501 is used as foliar spray and is known to be promoting photosynthetic activity of the plants, resulting into better growth of the plants and better quality of grains and fruits. 1gm BD-501 is sufficient for one acre. Mix 1gm BD-501 in 13 lit of water and mix by whirling for one hour. Apply this suspension in the field as fine mist spray. BD-501 should be applied in early morning hours when there is mild breeze. BD-501 is to be applied first at 3-4 leaf stage followed by two more application at an interval of 30 days. BD-501 also acts as prophylactic agent and helps in prevention of many fungal diseases such mildews and blights.

Other biodynamic preparation

Besides 500 and 501 there are seven other biodynamic preparations having numbers from 502 to 508, but as their method of preparations are difficult, they are not very popular in India and are not being used in large scale. Their methods of preparation in brief are as follows:

BD-502 – Moistened *yarrow* (*Achillea millefolium*) blossom gathered in spring, are packed into the bladder of deer stag or hart. The bladder is hung into the sun over the summer and buried into good soil over the winter. The contents, dug up in the spring, will aid the compost to regulate potassium and sulphur processes.

BD-503 – Chamomile blossoms (*Matricria chamomilla*) gathered in the summer are moistened with chamomile tea and stuffed into the small intestine of a freshly butchered cow, made into little links of sausages and buried into good humus soil in the fall. The burial place should be close to melt water flow of snow after the winter. This preparation helps regulate the calcium processes of compost.

BD-504 – Stinging nettle (*Urtica dioica*) is buried in the soil for one full year, enclosed in a mantle of peat moss. It aids in humification of the compost.

BD-505 – Scrapings of the outer rind of Oak bark (*Quercus robur*) are placed in the skull cavity of a domestic animal such as sheep or goat and buried in fall in ground that has water percolations through it (such as below leaking drain pipe). The contents are used in the spring. This preparation works on calcium processes and contributes to making plants disease resistant.

BD-506 – Dried flowers of Dandelion (*Taraxacum officinale*) gathered in spring are moistened and folded into the mesentery (membrane that holds

intestines) of a cow. This is buried in soil until the spring. It helps to regulate the silica processes in relation to the potassium processes.
BD-507 – Extract the juice of Valerian (*Valeriana officinalis*) flowers by squeezing. The juice is diluted in rain water and sprayed on the compost pile. This preparation regulates the phosphorus processes in the compost.

Although, the method of preparation of these compost BD formulations are difficult, but they are required in very small quantities and can be stored in glass containers for long periods. Once prepared can be used over large number of compost piles. A tea spoonful of each (502-507) will suffice for a normal garden compost pile of 3 m^3. On a compost pile poke 5 holes of about 30-40cm deep and stuff each with tea spoonful of formulation 502 to 506. Formulation 507 is stirred in a bucket of water and uniformly spread over the entire compost pile.

BD-508 – Fresh tissue of horse tail plant (*Equisetum arvense*) is made into a tea by boiling with water for 20 min. Filtered tea can be stored in glass bottles and diluted at the time of use. This formulation is used as prophylactic agent against mildews, blights and other fungal disorders.

2. Natural farming

Natural farming emphasizes on efficient use of on-farm biological resources and enrichment of soil with the use of Jivamruta to ensure high soil biological activity. Use of Bijamruta for seed/ planting material treatment and Jivamruta for soil treatment and foliar spray are important components. The use of both these ingredients have been incorporated in the package described above.

Jivamruta has been found to be rich in various beneficial microorganisms. As per the studies conducted by Bio Centre Bangalore the Jivamruta contains following microorganisms:

- Azospirillum 2×10^6
- PSM 2×10^6
- Pseudomonas 2×10^2
- Trichoderma 2×10^6
- Yeasts and moulds 2×10^7

200 lits of jivamruta is needed for one application in one acre. It can be applied through irrigation water by flow, by drip or sprinkler or even by drenching of mulches spread over the field or under the tree basin.

3. Natueco Farming

The Natueco farming system follows the principles of eco-system networking of nature. It is beyond the broader concepts of organic or natural farming in both philosophy and practice. It offers an alternative to the commercial and heavily chemical techniques of modern farming. Instead, the emphasis is on

the simple harvest of sunlight through the critical application of scientific examination, experiments, and methods that are rooted in the neighborhood resources. It depends on developing a thorough understanding of plant physiology, geometry of growth, fertility, and biochemistry. This can be simply achieved through:

Understanding Natueco Farming Science

- Natueco Farming methods go beyond natural farming and organic farming.
- In natural farming, farming is done trusting nature through the empirical wisdom of ages. However, Natueco methods emphasize farming by knowing nature more and more through critical scientific inquiries and experiments. It is an ever growing, novel, unique, participatory tryst between man and nature. Moreover, Natueco Farming in no way related to the present commercial techniques of farming.
- It has a new vision of infinite resource potentials in Nature and sunlight and promises ***plenty for all*** through harvesting all available resources by increasing the human activity.
- This depends on critical understanding of greening and recycling of biomass within the neighborhood to enrich the structure and fertility of soil in a calculated way.
- It promises record assured yields in a mathematic precision by understanding plant's geometry, cycles of growth and canopy (leaf area) management with little or no external inputs and ensuring optimum harvesting of sunlight.
- It visualizes that in the near future, the present money market system will have to give way to a new eco-economic system of Nature, i.e. energy market system.

Natueco Farming Step by Step

Natueco Farming emphasizes `Neighborhood Resource Enrichment' by `Additive Regeneration' rather than through dependence on external, commercial inputs. The three relevant aspects of Natueco Farming are:

1. **Soil -** Enrichment of soil by recycling of the biomass by establishing a proper energy chain.
2. **Roots -** Development and maintenance of white feeder root zones for efficient absorption of nutrients.
3. **Canopy -** Harvesting the sun through proper canopy management for efficient photosynthesis.

Basic Principals of Natueco farming

Harvesting the sun

In all biological processes, energy input is required and solar energy is the only available resource. No time and no square foot of sun energy should be lost by not harvesting it biologically. Lost sun energy is lost opportunity. Photosynthesis is the main process by which Solar Energy is absorbed. It is

of course the objective to obtain a higher degree of photosynthesis. Although genetically photosynthesis efficiency is around 1.5% to 2.5%, we can increase leaf index [area of leaf for every square meter of land] by caring for healthy canopies, use of multiple canopy utilizing direct and filtered sunrays.

Five Stages in plant life

Every plant goes through five stages in its life: [1] Childhood [2] Puberty [3] Youth [4] Maturity and [5] Old age. These stages are of roughly equal duration and external interventions at specific stages are most important. (e.g. There is no use giving fertilizer dose when the plant has become old and is dying) Generally, plants can be classified as having a seasonal, short duration life span [90 to 130 days], medium life span of 4 – 5 years, or perennial long life span. For short duration life span, all 5 stages become very critical. For example, if sumptuous roots are not developed in the first 15-20 days [20% of lifespan] no amount of external inputs, thereafter will be useful or effective. Leaves and Branches also show these stages in their life cycles. Yellow, old leaves can only fall and cannot be rejuvenated. Old branches eventually become deadwood.

Medium for root zone

Generally, this is soil. However, one can do without it as in the case of hydroponics.

The main purpose of the medium is

- To give support to the plant and anchoring it by means of shoot root and feeder roots.
- To supply nutrients to the feeder roots.
- To provide moisture to the plant roots.
- To provide good air circulation to the roots.

It is always possible to prepare an ideal soil by human intervention. The soil also supports a whole range of life starting from microorganisms up to earthworms. The presence of these life forms provide essential benefits to the plant roots, in that they convert minerals found in nature into root-absorbable forms.

Plants manufacture their own food

Unlike animals, plants manufacture their own food. By means of photosynthesis, water and carbon dioxide, is converted into sugar: glucose, which is then converted to other forms of sugar, lignin, fats, etc. Plants produce 3 – 4g of dry mass/ square foot of photosynthesis area / per one sun-day of 8 – 10 hrs. From this: (i) 1g is used in plant metabolism (ii) 1g is used to build plant body, roots, stem, leaves, etc and (iii)1g is either stored or used for producing fruits.

It is very useful and instructive to know, especially about the timings and places of storage of food/ energy and how to tap them at appropriate time. Without the knowledge of this the enzymes and hormones [Gibberilic acid,

Indol acetic acid] may lead to a stage, where plants grow with luxurious growth but scarce fruiting.

Plant Biochemistry
Hormones are the messengers and enzymes are the catalysts of plant metabolism, hence their study is very useful for general understanding of plant physiology.

A family's requirement can be met in just 1000 m^2
It is possible to create a microclimate within 10 Guntha (1 guntha = 1000sq.ft), which can meet one family's entire requirement, needed for respectable living**.**

Limited water supply
Assured supply of 1000 liters of water per day is a right of every family. With this as the only external input, prosperity can be built from within the neighborhood using the Prayog Pariwar methodology

Implementing Natueco Principle with Prayog Parivar Methodology

a) **Soil Management -** The first step of Natueco Farming is to develop the Nursery Soil using neighborhood resources. Nursery Soil consists of 50% biomass and 50% activated mineral topsoil by volume. The Biomass forms the organic part and the topsoil forms the inorganic part of the Nursery Soil. The Nursery soil provides support and delivers water and nutrients to the plant in the most efficient manner. To obtain high quality nursery soil, it is most important to build its organic part through biomass addition. The well composted organic part of the nursery soil is called HUMUS which contains ligno proteins. It is a black, light, and easily friable material that can be broken into small fragments or crumbs. It has very good water holding capacity, twice its own weight. Generally, the weight of such material per liter of its volume in fine crumb form is about 400 grams. It has a peculiar black luster & we can see layers of dead colonies of the micro flora especially in well composted (humified) animal dung.

b) **Harvesting the Sun** - It is well known that the entire food chain is directly or indirectly depend upon sun energy, harvested by green plants through a process known as photosynthesis. Although one square meter of land surface usually receive 14,400 K. cal energy per day during bright sunny days, but only a small fraction of direct, total solar insolation is harvested by plants. The philosophy of Natueco culture emphasize on increasing the sun energy harvesting potential of plants, first by understanding the requirement of canopy index establishment, secondly by understanding the principal, that only the mature leaves of the plant are capable of doing optimum harvesting of sun and third by understanding the requirement of matching storage organs.

What is canopy index number – Canopy index number is calculated by accommodating overlapping leaves in multiple of 3 in one sq.ft. area. For example a plant, whose up to 3 overlapping leaves covers an area of 1 sq.ft., assigned Index No.1, with six overlapping leaves in 1 sq.ft., assigned Index No.2, with 9 overlapping leaves in 1 sq.ft. assigned Index No.3, with 12 overlapping leaves in 1 sq.ft., assigned Index No.4 and so on. Different plants have different leaf indices, generally between 5 and 10. Even the same plant can have different leaf indices as per its vigour.

Maximize Sun Harvesting - Critical studies by Prayog Parivar revealed many new findings, summerised below:

i. To harvest optimum sunlight, the plant must build a canopy as per the index number of the crop, which is generally between 5 to 10. Thus if a plant's index number of leaves is 5, it means that, to harvest maximum sunlight from one sq.ft of area, this plant must have a canopy of 5 sq.ft. area.
ii. Each plant needs specific area for its maximum growth. By multiplying this area required by the plant, by the index number of leaves, we can calculate the requirement of canopy area e.g. if a plant needs about one half sq.ft. area for its full spread and its leaf index is 5, then for optimum sun harvesting the plant must have a canopy of 2.5 sq.ft. (0.5 x 5).
iii. Each plant must establish its optimum canopy spread at the earliest of its life cycle.
iv. As only mature leaves are capable of doing optimum harvesting of the sun, the young emerging leaves and old dying leaves should be excluded from the point of view of calculation.
v. There should be matching storage organ growth in plants at the time when optimum photosynthesis is taking place in the matured leaves.

c) Recycling Process

For optimum and continued growth of crops in the fields year after year, it is very much essential that recycling process caries on effectively. Three major components of this recycling process are (a) aerial component such as carbon dioxide, oxygen and nitrogen (b) mineral elements from soil and (c) water. For optimum availability of all the essential nutrients, the fertility of the soil is very important. A good fertile soil maintains its fertility structure, only when the mineral part and the composted part of the soil are equal by volume. In Prayog Parivar's term such soils are called nursery soils. Thus in one cubic foot of nursery soil one half cubic foot soil will be of mineral part and the other one half of the well composted part of dead organic matter. Decomposition of dead organic matter first into compost and then finally into mineral matter and gases is the last part of the food chain of our ecosystem.

(a) Among the aerial components, although one need not worry about carbon dioxide and oxygen, supply of nitrogen is partly ensured by good

population of nitrogen fixing bacterial in fertile soil and partly is obtained from decomposition of degrading organic matter.

(b) Entire quantity of mineral elements, need to come from soil reserve. Due care is needed to keep a balance in demand and supply of these nutrients by recycling partly the same crop residue and if needed from neighourhood resources. Most of the nutrients absorbed by the plants are conserved in their leaves and twigs and only a small fraction goes in fruits and grains. To maintain the balance, the entire quantity of leaf and twigs etc. need to be recycled back and to compensate the loss of a small fraction of nutrients taken away in fruits and grains need to be compensated by small biomass /compost from other sources such as animal dung etc.

(c) The water cycle is the cycle run by the nature, bringing water from the oceans to the lands and the mineral contents from the lands to the oceans. The evaporation of one litre of sea water requires 600 K cal of sun energy. The clouds so generated are transported to the lands by strong winds which eventually come down as rain. All life cycle on land depends on the supply of rain water and the life cycles in the oceans depend on the supply of nutrients carried through the water returning back to the seas or oceans. The Natueco culture cautions that in bringing one litre of rain water about 600 – 800 K cal of sun energy is involved, therefore we should not allow this precious water to be wasted as run-off, before it is fully utilized to optimize biomass production at every place. As per Prayog Parivar's estimate, the water required for producing one Kg biomass (on dry wt basis) is about 6000 gms. Only this much water is used in the production of 1 Kg carbohydrates. The remaining quantity of water supplied to the plant is used only temporarily and released in the environment, creating micro-climate of moisture conditions, favourable for its growth, as well as for the growth of the ecosystem.

d) Energy Pool and Energy Chain

The Nature's food chain starts with synthesis of carbohydrates in green plants, runs through various macro and micro consumers and ultimately ends into brown mass of decomposed organic matter, before releasing its mineral elements in air and soil. Although, this process is a natural process and runs without the involvement of human but man has accelerated the process to his advantage by bringing more land under cultivation, by using tools and the energy of drought animals. The use of animals in this sun harvesting is very important and must be exploited to its best, otherwise, it will be just wasted. The use of man-made energy tools might have accelerated the process, but has rendered the animal energy useless which is going waste. In Prayog Parivar's vision all natural aspects, which can be incorporated in accelerating the biomass production need to be exploited to its optimum to harvest maximum richness of the nature.

Natuco summary

Prayog Parivar members conceived, practiced and mastered this new concept of Natueco culture. In their words while natural farming is done by trusting the nature, Natueco culture is done through understanding nature more & more. In this understanding harvesting of sun energy was given the prime importance, coupled with nursery soil build up through whole plant use. In this culture, if appropriate planning is done, then one family of five members can meet its entire requirements from just 10 gunthas of land (1000 m^2). But for this one need to understand the Prayog Parivar's vision, his own initiatives, continuous innovations with latest scientific knowledge and once it is accomplished, this cultures promises "**Plenty for All**.

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Annexure-I

Accredited Certification Agencies for Organic Products

1	M/S BUREAU VARITAS CERTIFICATION INDIA PVT. LTD.
2	M/S APOF ORGANIC CERTIFICATION AGENCY (AOCA)
3	M/S LACON QUALITY CERTIFICATION PVT. LTD. (LACON), THIRUVALLA, KERALA
4	M/S NATURAL ORGANIC CERTIFICAION ASSOCIATION (NOCA), PUNE
5	M/S ONECERT ASIA AGRI CERTIFICATION PVT. LIMITED
6	M/S SGS INDIA PVT LTD, GURGAON
7	M/S CONTROL UNION CERTIFICATION
8	M/S IMO CONTROL PRIVATE LIMITED
9	M/S UTTARANCHAL STATE ORGANIC CERTIFICATION AGENCY, DEHRADUN
10	M/S ECOCERT INDIA PVT. LTD. AURANGABAD, MAHARSHTRA
11	M/S INDOCERT, COCHIN
12	M/S ISCOP
13	M/S FOODCERT INDIA PVT. LTD.
14	VEDIC ORGANIC CERTIFICATION AGENCY, HYDERABAD.
15	RAJASTHAN ORGANIC CERTIFICATION AGENCY (ROCA)
16	ADITI ORGANIC CERTIFICATIONS PVT. LTD., BANGALORE

Source: APEDA. Details available on APEDA web site.

Technical Brochure

on

Organic Farming System - An Integrated Approach for Adoption under National Horticulture Mission

National Horticulture Mission
Department of Agriculture and Cooperation
Ministry of Agriculture, New Delhis