Organic Farming: Scope and strategy for Andaman & Nicobar Islands

N. Ravisankar[1] and B. Gangaiah[2]

Indian Institute of Farming Systems Research, Modipuram, Meerut-250 110, Uttar Pradesh

Backed by continued science led technological innovations in the agriculture sector, India's food grain production has more than doubled over the decades to a record 264 m t in 2014. The country has 11.3% of world arable land and 25% of the population depending on agriculture is living in India. Ranks second in rice, wheat, groundnut, vegetables and fruits production with larger share of livestock especially buffaloes (57.3%). Productivity of major crops in India against the world is given in Table 1. Inspite of technological advancements, the lower productivity prevails in paddy, maize, pulses and soybean to the extent of 18 to 53 % compared to world average productivity which is mainly attributed to large dependency on rainfall and other climatic conditions for good yield.

The irrigated area produces about 56% of total food requirement of India. The remaining 44% of the total food production is supported by rainfed agriculture. Most of the essential commodities such as coarse cereals (90%), pulses (87%), and oil seeds (74%) are produced from the rainfed agriculture. These statistics emphasise that rainfed regions play a major role in ensuring food for the ever-growing population. The rainfed regions are predominantly marked by low cropping intensity, relatively low organic matter status, poor soil physical health and low fertility. Further, moisture stress accompanied by other soil related constraints also results in low productivity of crops (Sharma *et al.,* 1997).

As per FAO definition, food security is not only the ability to produce but also to access food. According to the data put out by international agencies, 70% of world's food is produced by small holders and 30 % by the agri-business sector. A report by United Nations Conference on Trade and Development (UNCTAD) and United Nations Environment Programme (UNEP), found that organic agriculture is more conducive to food security and is more sustainable in the long term. There are two significant areas where organic systems have higher yields than conventional systems. These are under conditions of climate extremes and in small holder systems. Both these areas are critical to achieving safe food security for future in India. Organic farmers grow a variety of crops and livestock in order to optimize competition for nutrients. This results in less chance of low production, improved availability and positively impact local food security. Studies by national and international agencies have proved that organic systems may decrease yields depending on intensity of inorganic inputs used before conversion. In irrigated lands, conversion to organic agriculture may lead to almost identical yields over a period of time. In low- input, traditional / rainfed agriculture, conversion to organic agriculture has potential to increase yields. Hence, having 53.6% area under rainfed and rainfall extremes in various parts of the country, promotion of organic agriculture in niche areas and crops is essential for having safe food security in future.

Concept and strategic importance of organic farming

Organic farming is very much native to this land. India and China have the long history of organic farming. The farmers of these two countries are farmers of 40 centuries and it is organic farming that sustained them (Yadav, 2008). This

Table 1. Productivity (kg/ha) of major crops in India and World (2011)

Crops	India	World	% difference
Paddy	3591	4429	18.9
Wheat	2989	3175	5.8
Maize	2496	5154	51.5
Total cereals	2864	3661	21.8
Total pulses	616	859	28.2
Potato	22724	19455	-
Soybean	1200	2529	52.50

(Source: Agricultural data book, 2014)

[1] Principal Scientist & National PI, NPOF, ICAR-Indian Institute of Farming Systems Research, Modipuram, Meerut-250 110, Uttar Pradesh
[2] Head, Division of Natural Resource Management, ICAR-Central Island Agricultural Research Institute, Port Blair, Andaman & Nicobar Islands

concept of organic farming is based on principles of: i) nature is the best role model for farming, since it does not use any inputs nor demand unreasonable quantities of water (ii) the entire system is based on intimate understanding of nature's ways and the system does not believe in mining of the soil of its nutrients and do not degrade it in any way for today's needs iii) the soil in this system is a living entity and 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, and iv) the total environment of the soil, from soil structure to soil cover is more important.

In today's terminology it is a method of farming system which primarily aims at cultivating the land and raising crops in such a way, as to keep the soil alive and in good health by use of organic wastes (crop, animal and farm wastes, aquatic wastes) and other biological materials along with beneficial microbes (bio-fertilizers) to release nutrients to crops for increased sustainable production in an eco-friendly pollution free environment. Organic farming system relies on crop rotations, crop residues, animal manures, legumes, green manures, safe off-farm organic wastes and aspects of biological pest control to maintain soil productivity and tilth, to supply plant nutrients and to control insects, weeds and other pests. In its simplistic form, organic agriculture may be defined as "a kind of diversified agriculture wherein crops and livestock are managed through use of integrated technologies with preference to depend on resources available either at farm or locally". According to Scialabba (2007), the strongest benefits of organic agriculture are its reliance on fossil fuel independent, locally available resources that incur minimal agro-ecological stresses and are cost-effective. She describes organic agriculture as 'neo-traditional food system', which combines modern science as well as indigenous knowledge.

Organic area, production and export

From a meagre 42,000 ha of certified organic farming in 2003-04 in the country, it has grown many folds to reach 4.71 m ha area as on March 2014. Out of this, cultivated area accounts for 0.72 m ha (15.2 %) while the remaining (84.8%) is wild forest harvest collection area. Currently, India ranks 10th among the top ten countries having the cultivable land under organic certification. In terms of wild collection, India ranks 3rd next to Finland and Zambia. Around 0.65 m producers are engaged in the country in various forms. Presently only 0.51 % of area (including wild collection) is under the process of certification. Sikkim has the highest % of net sown area (79) under organic certification while Madhya Pradesh has the largest area (2, 32,887 ha) under organic production system (Table 2). As per the statistics, 99.5% of area is still under conventional system. However, it is important to note that the data of organic farming area is collected from certification agencies, producers and processors. The actual area under organic production system must be and should be higher as many of the hilly states and rainfed districts are having very low use of external inputs for managing the soil fertility and pests.

Organic farming is considered incomplete without livestock as livestock alone contributes 37.5% of total organic manures in the country. Crop + dairy is the pre-dominant farming system practiced traditionally by Indian farmers over the centuries. Analysis of benchmark data of 732 marginal households across the 30 NARP zones indicates existence of 38 types of farming systems. Out of this, 47% of households have the integration of crop + dairy, 11% have crop + dairy + goat, 9% households have crop + dairy + poultry systems and 6% households have only crop component. Hence, natural strength exists in the country for promotion of organic farming.

Table 2. Top 10 states of India in terms of actual area (ha) and % of net sown area (NSA) under organic farming

State	Actual area		State	% of net sown area		
	NSA ('000 ha)	Certified organic area (ha) in 2013-14		NSA ('000 ha)	Certified organic area (ha) in 2013-14	% of NSA
MP	15119	232887	Sikkim	77	60843	79.0
Maharashtra	17406	85536	Goa	131	12853	9.8
Rajasthan	18349	66020	Uttarakhand	723	24739	3.4
Sikkim	77	60843	A&N Islands	15	321	2.1
Odisha	4682	49813	MP	15119	232887	1.5
Gujarat	10302	46863	Nagaland	362	5168	1.4
Uttar Pradesh	16593	44670	J & K	732	10035	1.3
Karnataka	10523	30716	Odisha	4682	49813	1.0
Uttarakhand	723	24739	HP	539	4686	0.8
Kerala	2072	15020	Kerala	2072	15020	0.7
All India*	141515	723039	All India*	141515	723039	0.5

*All India includes other states data also (Source: Anonymous, 2015)

Further, over 85% of the farmers hold less than 2 ha land and about 53% of the area under agriculture is dependent on rainfall, whereby return on investment is not assured due to failure of rains and other calamities. Small and marginal farmers who spend most part of their income on food alone have no opportunity to make any savings. In the absence of cash reserves, the poor farmers are unable to procure necessary inputs for crop production. As against the world average of 172 kg/ha chemical fertilisers, Indian agriculture consumes only ~128 kg/ha. The average fertiliser consumption is even lower, if fertilisers applied for paddy, wheat and sugarcane are not considered in the average. In fact, hilly and rainfed regions are more suitable for growing wide variety of crops under organic farming.

Components of organic farming

Essential components of organic farming are keeping the soil alive through effective management natural resources. They are : 1) **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, 2) **Management of temperature**: Keep soil covered, plant trees and bushes on bund, 3) **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, 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 and 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 and 8) **Use of renewable energy**: Use solar energy, bio-gas and other eco-friendly machines.

Various forms of organic agriculture

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: i) turning in plant materials such as green crops and straw, ii) not using chemical fertilizers and pesticides, iii) avoiding soil compaction by machinery or animals, particularly in wet weather, iv) 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, v) fallowing the land by planting deep-rooting permanent pasture species or using green crops, vi) use of preparations Biodynamic (BD)-500 and BD-501, vii) compost made with preparations BD-502 – BD-507, viii) liquid manure made with preparations BD-502 – BD-507 and ix) 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 nine (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.

Rishi Krishi

Drawn from Vedas, the Rishi Krishi method of natural farming has been mastered by farmers of Maharashtra and Madhya Pradesh. In this method, all on-farm sources of nutrients including composts, cattle dung manure, green leaf manure and crop biomass for mulching are exploited to their best potential with continuous soil enrichment through the use of Rishi Krishi formulation known as "*Amritpani*" and virgin soil. 15 kg of virgin rhizosperic soil collected from beneath of Banyan tree (*Ficus bengalensis*) is spread over one acre and the soil is enriched with 200 lit Amritpani. It is prepared by mixing 250 g ghee into 10 kg of cow dung followed by 500 g honey and diluted with 200 lit of water. This formulation is utilized for seed treatment (*beej sanskar*), enrichment of soil (*bhumi sanskar*) and foliar spray on plants (*padap sanskar*). For soil treatment it needs to be applied through irrigation water as fertigation. The system has been demonstrated on a wide range of crops i.e. fruits, vegetables, cereals, pulses, oilseeds, sugarcane and cotton.

Panchgavya Krishi

Panchgavya is a special bioenhancer prepared from five products obtained from cow; dung, urine, milk, curd and ghee. Dr. Natrajan, a Medical practitioner and scientist from Tamil Nadu Agricultural University, has further refined the formulation suiting to the requirement of various horticultural and agricultural crops. Ingredients and methods of preparation of Panchgavya and enriched. Panchgavya (Dashgavya) has

already been described in preceding pages. The cost of production of panchgavya is about Rs. 25-35/liter. Panchgavya contains many useful microorganisms such as fungi, bacteria, actinomycetes and various micronutrients. The formulation act as tonic to enrich the soil, induce plant vigour with quality production.

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 has been incorporated in the package described above. Jivamruta has been found to be rich in various beneficial microorganisms. 200 liters 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.

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.

Natueco farming emphasizes 'Neighborhood Resource Enrichment' by 'Additive Regeneration' rather than through dependence on external, commercial inputs. The three (3) 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 and 3) *canopy* **-** harvesting the sun through proper canopy management for efficient photosynthesis.

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.

Homa farming

Homa farming has its origin from vedas and is based on the principle that "*you heal the atmosphere and the healed atmosphere will heal you*" The practitioners and propagators of homa farming call it a "revealed science". It is an entirely spiritual practice that dates from the Vedic period. The basic aspect of homa farming is the chanting of Sanskrit mantras (Agnihotra puja) at specific times in the day before a holy fire. The timing is extremely important. While there is no specific agricultural practice associated with homa farming, the farm and household it is practiced in, is energized and "awakened". The ash that results from the puja is used to energise composts, plants, animals, etc. Homa organic farming is holistic healing for agriculture and can be used in conjunction with any good organic farming system. It is obviously extremely inexpensive and simple to undertake but requires discipline and regularity. Agnihotra is the basic Homa fire technique, based on the bio-rhythm of sunrise and sunset, and can be found in the ancient sciences of the Vedas. Agnihotra has been simplified and adapted to modern times, so anybody can perform it. During Agnihotra, dried cow dung, ghee (clarified butter) and brown rice are burned in an inverted, pyramid-shaped copper vessel, along with which a special mantra (word-tone combination) is sung. It is widely believed that through burning organic substances in a pyramid-formed copper vessel, valuable purifying and harmonizing energies arise. These are directed into the atmosphere and are also contained in the remaining ash. This highly energized ash can successfully is used as organic fertilizer in organic farming.

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.

Soil and crop management

The natural resources (soil, rainfall, dust) provide several nutrients for crop plants. Soil organic carbon (SOC) is central to soil health due to its influence on soil structure, water retention, microbial activities, soil aeration, and nutrient retention. It is the organic forms of C and not the source of nutrient which is important for soil-plant continuum. Hence, Bio-organic fertilizer merits consideration. Indian soils are, in general, poor in organic C, which is further going down with every intensification of agriculture. Promotion of green manuring is essential and quick way to increase Farmers should take at least one green manuring crop once in every two years. In all rice fields, cultivation of green manuring plants as an intercrop is highly recommended (like one row of *Sesbania* after every 10-15 rows of rice which can be incorporated into field after 30-35 days) to achieve the best productivity. Use

of crop straw and weed biomass as mulch-wheat and rice straw can also be used with dung and cattle urine to increase organic carbon.

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 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 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.

Green manuring

Green manuring (GM) can be defined as a practice of ploughing or turning into the soil un decomposed green plant tissues for improving physical structure as well as soil fertility. GM, wherever feasible, is the principal supplementary means of adding organic matter to the soil. The GM crop supplies organic matter as well as additional nitrogen, particularly if it is a legume crop, due to its ability to fix nitrogen from the air with the help of its root nodule bacteria. The green-manure crops also exercise a protective action against erosion and leaching. Green manure to be incorporated in soil before flowering stage because they are grown for their green leafy material, which is high in nutrients and protects the soil. Green manures will not break down in to the soil so quickly, but gradually, add some nutrients to the soil for the next crop.

Natural safe products for control of pest, disease, weeds, diseases and growth management

Under organic systems, use of synthetic/chemical pesticides, fungicides and weedicides is prohibited. Natural enemies shall be encouraged and protected (for ex. 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 (eg. Neem Seed Kernel Extract (NSKE), 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 i.e. bordeaux mixture, plant & animal preparations e.g. cow urine spray, garlic extract, chilli extract and 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, pseudo scorpians, crypto stigmatids 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 (Table 3) and weed management (Table 4) packages for various cropping systems through network project indicates the pest and diseases of crops can be managed through cropping systems approach along with suitable natural pesticides. Further the weeds can be managed through live

Table 3. 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	Soil borne pests and diseases	Summer ploughing + green manure incorporation
Calicut (Kerala)	Ginger-fallow	Shoot borer	Ginger Endophytic Bacteria 17 & 18, Ginger Rhizobacteria 57
Bajaura (Himachal Pradesh)	Cauliflower-peas-tomato	Fruit borer & fruit rot	Karvi (*Roylea cinerea*) @ 10% aqueous leaf extract + cow urine (3%) + tween-80 (0.05%) as emulsifier
Umiam (Meghalaya)	Maize + Soybean	Monolapta Mylloceros Ephilechma Leaf folder Rust	Derisom (3 ml/l) + Panchagavyya @ 10% and cow urine 3% Anomin 3 ml/litre or Panchagavyya @ 3%. Panchagavyya @ 3% + lantana @ 10% + vermiwash @ 10%

Table 4. Identified weed management packages for various locations and cropping systems

Centre	Cropping System	Recommended practice
Raipur (Chhatisgarh)	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 *Prospis 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 (green cob)-mustard	Mulching with fresh *Eupatorium/Ambrosia* @ 10 t/ha (after earthing up)

and organic mulches.

Preparation of bio-pesticide inputs recommended for organic farming

Availability of bio-pesticides, microbial pesticide for pest control, intercropping approach and indigenous technical knowledge (Table 5 & 6) increases the scope of preventive and post pest and disease incidence management for organic farming.

ITKS for termite 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 are followed Pudukottai district of Tamil Nadu.

ITKs for 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 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

Table 5. Preparation methods of natural bio-pesticides and its time of application

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 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	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.
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°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 1500 ppm is used as a general insecticide, fungicide	It is a bio-based pest controller containing 0.5% Azadirachtin and other vital bio-energizers. Application of pestoneem 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.	This liquid manure is applied as foliar spray (10% solution) to the plants for better growth and insect-pest and disease management

(Source: ICARNEH, 2014)

Table 6. ITKs practiced by farmers for managing the pest and disease under organic management

Crop	Pest/disease/rodent	Materials	Method
Rice	Brown planthopper & green leafhopper	Garlic	Grind one kg of garlic and mix in one litre of kerosene. Keep it overnight and filter. Mix in 200 litres of water and spray
	Stem borer and leaf folder	Neem leaves, Citronella grass, rhizome of *Alpinia galangal*	4 kg each are chopped and ground in mortar. Mix in 40 litres of water. After 1 day, dilute with water @ 1:60 ratio
Vegetables	*Shoot and fruit borer in Brinjal*	*Tagetes*	Border cropping
	brinjal shoot and fruit borer, ribbed gourd stem borer, hairy caterpillar of drumstick and armyworms	Syrianangai *Andrographis paniculata*	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 spray
	pumpkin beetle, Epilachna beetle and pod bugs	Cowdung	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 and spray
	Pests in Mango	Coriander, mint, ginger and turmeric	Intercropping *Ocimum sanctum* in mango orchard acts as a trap crop for fruit flies
	Insect pests in grapevines	cow urine or tobacco decoction	Spray
Turmeric	*Insect pests*	*Garlic, ginger, chillies, tobacco, pepper, neem oil,*	1kg garlic + 500g of ginger, + 500g of green chillies + 500g of tobacco + 200g of pepper + 200 ml of Neem oil + 30g of khadi soap checks the most of the insect pests infecting turmeric crop. 700 ml of the mixture is to be diluted in 10 lit of water and sprayed

(*Source:* TNAU, 2014)

practice is followed in Thanjavur district of Tamil Nadu.

ITKs on 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 urine and keep the mixture in plastic or earthen ware. Allow the content 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.

Mixed farming

Integrated farming system (IFS) mode of promotion of organic farming in A&N islands is essential. Animal husbandry, poultry, fisheries, etc. should be practised in addition to agricultural farming. 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 7).

Strategy for promotion of organic farming in A&N Islands

Andaman and Nicobar (A&N) Islands is known for its natural resources and biodiversity. Paddy, coconut, areca nut, clove, black pepper, cinnamon, nutmeg and vegetables are the major agricultural crops in these islands. Agriculture has always been a challenge for the people of the islands, both due to limited cultivable area and low productivity. It is further constrained due to reduction of paddy land due to tsunami 2004. Initially, agriculture in these islands was promoted to attain self-sufficiency and thus intensive farming technologies, use of chemical fertilizers and pesticides were promoted in

Table 7. Performance of integrated organic farming system models

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) + vermicompost + 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

the past few decades. Subsequently, these islands have been seen as potential area for organic farming. Considering the limited area under crops, these islands can be brought under organic farming with available plant residues, animal wastes and forest litters from buffer zone. Since both area and productivity are constrained, farmers income can be enhanced through branded organic farming based agricultural products that fetch higher prices. Agriculture challenges the people of islands. The area under cultivation is shrinking much faster. The cultivated land available before Tsunami 2004 was 50,000 ha which came down to 43,339 ha. The area under paddy has drastically came down from 12,000 ha to 8005 ha (2013-14) due to submergence of low lying areas or seawater intrusion. The major area is under plantations with 21,900 and 4,290 ha under coconut and areca nut. Given the limited area under crops, the islands can be brought under organic cultivation of crops with the available plant residues, animal wastes and rest through collection of forest litters. The island has the livestock species of cattle (45,608), buffalo (7,850), goat (64,602) and Poultry (10,80,106) (Table 9), producing annual excreta of 429,841 t / annum.

Nutrient demand and sources of supply

The nutrient requirement of major crops are presented in the Table 8 which indicates annual requirement of 2187, 170780 & 3933 t of NPK / annum for the major crops *viz.,* paddy, pulses, vegetables, black pepper, ginger, coconut and fruits. The requirements of nutrients are worked out on the basis of actual area of crops under cultivation. According to statistics from an fertilizer dealer of Andaman and Nicobar Islands, the islands imports annually 600 t urea, 750 t DAP, 200 t rock phosphate and 300 t of MOP worth Rs. 89,50,000 which can be reduced considerably if proper planning is made on utilization of plant and animal residues.

Residues / excreta availability

The annual production of residues from six major crops (rice, pulses, coconut, areca nut, vegetables and fruits) alone accounts to 2,15,690 t (Table 10) which can be very well composted using the standard techniques and recycled back in to the system. Among the crops, coconut and areca nut produces maximum residues of 6.40 and 8.50 t /ha annually. The annual production of wastes from 4 species of livestock namely cattle, goat, buffalo and poultry accounts to 4,29,841 t which can be recycled using the standard techniques. Thus, the total availability of organic wastes in Andaman and Nicobar islands accounts to 6,45,531 t/annum. According to the

Table 8. Requirements of nutrients for cultivated crops (based 2013-14 crop acreage)

Crop	Area (ha)	Recommended dose (kg/ha)			Nutrient requirement /annum (t)		
		N	P	K	N	P	K
Paddy	8005	90	60	40	720	480	320
Pulses	578	30	60	30	17	35	17
Vegetables	5693	30	60	60	171	342	342
Black Pepper	698	56	22	67	32	13	38
Ginger	200	40	100	80	7	19	15
Coconut	20927	53	35	142	1160	767	3110
Fruits	3621	22	14	25	80	51	91
Total	39722	-	-	-	2187	1707	3933

estimates, the entire lot of residues and animal wastes will not be available for recycling. After composting and enrichment, the weight of materials are reduced to the extent of 60% means 60% loss in weight.

Balance sheet of nutrients

Balance sheet of nutrients is presented in the Table 10. Nutrient availability from plant residues and animal wastes are calculated based on the assumption that 60% weight loss and on an average of 0.75: 0.15:0.40% NPK in the final product of compost. On this assumption, 1937, 387 & 1033 t of NPK requirement can be met from the composted plant residues and animal wastes. Hence, out of 7827 t of nutrient requirement / annum, 3356 t of nutrients is made available from the plant and animal wastes. The balance of 4471 t needs to be met from the other source.

Forest litter for meeting the balance nutrient requirement

Andaman and Nicobar Islands are having 86.9% area under forest. Andaman and Nicobar islands are having twelve types of forests in 7,17, 069 ha. The rate of litter production and erosion rate is presented in Table 11. The maximum litter production is from Andaman moist deciduous forests (5.5 t/ ha/annum) followed by Mangrove (Tidal swamp forests) (5.0 t /ha/annum). The mean litter production of all species works to 3.13 t/ha/annum. The erosion rate is in the range of 3.8 to 6.7 t/ha/annum, which is quite high in the high rainfall areas. Total litter availability from reserved and protected forests in bay islands works out to 22,44,426 t /annum. Inventory of the forest litter indicates the availability of 29, 7 and 6 kg of N, P, and K /ha (Table 12) from forest litter. One tonne of forest litter contains around 0.0093, 0.0022 & 0.0019 t of NPK nutrients. Reports indicates the critical C: N ratio of forest litter as 15:1 to 55:1 which makes that, nutrient can be made available to the crops from forest litter. It is estimated from the available data that, forest litter is required to meet the balance N requirement of 305 t. Similarly, 5,35,455 t and 14,28,421 t of litter is required to meet the P & K nutrient requirement (Table 13). As Andaman and Nicobar island soils are medium in available N, low in P & K, it is suggested that, 24% of forest litters from periphery may be collected for meeting the balance requirement of N and P. In respect, it is suggested that, from the 23% of litters, 1,017 kg K requirement can be met and the balance of 1,697 t needs to met through

Table 9. Availability of organic manures through plant / animal residues in A & N Isalnds

Crop / Animal	Residue/ excreta production per unit area	Area/Population	Total residue/ excreta availability/ annum
Crop residues	*t /ha*	*ha*	*tonne*
Rice	3.00	8005	24015
Pulses	5.00	578	2890
Coconut	6.40	21900	140160
Areca nut	8.50	4290	36465
Vegetables	1.50	5693	8539
Fruits	1.00	3621	3621
Sub total	-	44087	215690
Livestock wastes	*Kg*	*no's*	*Tonne*
Cattle	7000 kg / animal /year	45608	319256
Goat	185 kg /goat / annum	64602	11951
Buffalo	9125 kg /animal /year	7850	71631
Poultry	25 kg / bird / annum	1080106	27003
Subtotal		1198166	429841
Total			**645531**

Table 10. Balance sheet of nutrients

Nutrients	Requirements (t)	Availability from plant residues / animal wastes (t)*	Balance requirement (t)
N	2187	1937	150
P	1707	387	1320
K	3933	1033	2400
Total	7827	3356	4471

*Minimum: 0.75: 0.15: 0.4 % NPK with recovery rate of 40 % after composting residues

enrichment techniques. Among the crops, coconut requires high quantity of potassium.

Method of recycling wastes

Organic manure in the form of vermicompost obtained from the earthworms is one way to overcome the problems of low productivity. The production of compost from any organic waste (agriculture and homestead) using earthworms is called vermicomposting. Earthworms feeds the organic waste materials and passes it through their digestive system (digested by microbes present in the guts of worms) and gives out in a granular form which is known as vermicompost. It also includes cocoons and young stages of earthworms. The earthworms enhance the decomposition rate of organic waste and improve the biological activities in the soil. It prevents nutrient losses and soil erosion. Its utilization in agriculture is one of the most economic ways in keeping the soils alive for sustainable productivity. Vermicompost made from mix of dung, crop residues and kitchen wastes along with earthworms are rich in terms of nutrient availability compared to farm yard manure which is from mere decomposition of dung. Vermiwash is the byproduct of the vermicompost which can also be utilized for improving the land productivity. The relative nutrient availability in farm yard manure, vermicompost and vermiwash is given in Table 14.

Advantages of Vermicompost and Vermiwash over FYM

- Rich in all essential plant nutrients (N, P, K, Ca, Mg, Fe, Mn, Zn, Cu etc.)
- Improves structure, texture, aeration and water holding capacity of the soil
- Enhances the decomposition of organic matter in soil and prevents soil erosion
- Provides better plant growth and improves quality

Table 11. Type, area, litter fall and erosion rate of different forests in A&N Islands

Forest type	Area (ha)	Litter fall (t/ha/year)	Erosion rate (t/ha/year)
Giant evergreen forests (1A/C1)		2.8 –3.3 (3.1)	3.8-4.4
Andaman tropical evergreen forests		3.1-3.9 (3.5)	4.7-6.6
Southern hill top evergreen forests		3.8 – 4.2 (4.0)	5.6-7.8
Andaman semi ever green forests		3.4 –3.8 (3.6)	6.4-8.2
Andaman moist deciduous forests		4.9-6.2 (5.5)	5.3-5.9
Andaman secondary moist deciduous forests	717069	3.3-3.6 (3.5)	6.1-6.7
Littoral forests		0.8-1.4 (1.1)	4.1-5.3
Mangrove (Tidal Swamp) forests		4.6-5.4 (5.0)	5.4-6.6
Brackish water mixed forests		1.2-1.7 (1.5)	4.7-5.6
Sub mountain hill valley swamp forests		-	-
Cane brakes		-	4.3-5.5
Wet bamboo brakes		0.4-0.6 (0.5)	4.2-5.1
Mean		3.13	

(Figure in parenthesis is mean values)

Table 12. Composition of nutrients from forest litter

Type	Litter fall (t/ha/year)	Total litter availability (t/ annum)	Nutrient content of litter (kg /ha)			Nutrient content (kg / t of litter)		
			N	P	K	N	P	K
Litter	3.13	2244426	29	7	6	9.3	2.2	1.9

Table 13. Litter requirement for meeting the balance nutrient (Estimates for 2008)

Nutrient	Nutrient content (t /t)	Balance requirement (t)	Litter requirement (t)	Total litter availability (t/ annum)	% requirement of litter to meet the demand
N	0.0093	305	32796	2244426	1.46
P	0.0022	1178	535455		23.86
K	0.0019	2714	1428421		63.64

Table 14. Nutrient profile of farm yard manure, vermicompost and vermiwash

Nutrient	Farm yard manure	Vermicompost	Vermiwash
N (%)	0.5	1.6	0.01
P (%)	0.2	0.7	1.69
K (%)	0.5	0.8	0.01
Ca (%)	0.9	0.5	0.01
Mg (%)	0.2	0.2	0.02
Fe (ppm)	146.5	175.0	0.06
Mn (ppm)	69.0	96.5	0.58
Zn (ppm)	14.5	24.5	0.02
Cu (ppm)	2.8	5.0	0.01
C:N ratio	31.3	15.5	-

and shelf life of the produce
- Rich in beneficial micro-flora (P- solubilizers, cellulose decomposing flora etc.)
- It is free from pathogens, toxic elements, weed seeds etc.
- Minimizes the incidence of pest and diseases
- Contains valuable vitamins, enzymes and hormones like auxins, gibberellins etc.
- It helps in production of marketable organic fertilizer
- Vermiwash being rich in nutrients, enzymes and hormones was found to be an excellent spray material for improving growth and yield of crops
- Vermiwash complex is efficient in raising nursery, lawns and orchids

Requirements for Vermicomposting

Vermicomposting has four major requirements: suitable organic wastes; multiplication of earth worms; structure for composting and suitable method of composting.

Suitable organic wastes: Crop residues, plant litters, weeds, farm yard manure and kitchen wastes are the common organic wastes available in a typical farm. The availability of organic wastes from different sources are given in Table 15.

Multiplication of Earthworms: About 2-3 kg of earthworms is required for 1000 kg of biomass, whereas about 1100 number earth worms are required for 1 m^2 area. Non burrowing species are mostly used for compost making. Red earthworm species like *Eisenia foetida* and *Eudrillus enginae* are most efficient in compost making. Following steps should be taken for small scale multiplication of worms:

- Use flower pots or abandoned bucket for small scale earth worms multiplication
- Make small holes on the side of pot or buckets
- Put 3-4 big size gravels on the bottom of bucket /pot to enable aerobic condition
- Fill pot with well chopped (4-5 cm length) organic wastes of about 2 cm thickness
- Spread 2 cm thick layer of fresh cowdung (2-3 days old) over the organic wastes
- Fill organic wastes and cowdung alternatively till the pot is filled
- Introduce red earthworms (10 to 20 numbers) and cover the pot with gunny bag
- Sprinkle water once in a day on the gunny bag to keep it sufficiently moist
- Once decomposing process starts, space will be available on the top. Fill it with organic wastes and cowdung alternatively to give sufficient feed to earthworms
- Within 2 months, 4-5 kg of worms can be produced from 10 to 20 numbers which can be utilized for farm scale vermicompost production

Structure for composting: For production of farm scale vermicomposting in island conditions, different structures i.e. plastic tubs, earthen pits, cement concrete tank and RCC rings can be used.

RCC ring: RCC rings of 1, 1.5, 2 and 2.5 m diameter are commonly available in the islands. The number of rings required will vary depending upon the availability of ring diameter and quantity of organic wastes available.

- 2 m diameter rings will be the optimum size for production of vermicompost
- 6 RCC rings are required to produce vermicompost from one ha of each lowlying paddy areas and hilly plantations. Two units of 3 RCC rings each should be made in case of paddy land alone or hilly lands alone so that height (0.9 m) of structure is manageable for mixing and collection activities
- 8 rings are sufficient for producing vermicompost from 2 ha land having 1 ha each of paddy-vegetable and coconut/Arecanut+ Black pepper. Make two units of 4 RCC rings each, so that the height is 1.2 m only
- Make a thatched shed over the RCC ring at a height of 2.5 m using coconut leaves, so that structure can be protected from heavy rain
- In the bottom of the ring, put either gunny bag or boulders to protect earthworm moving inside the soil

- Approximate cost of a 2 m diameter RCC ring will be Rs. 1500/-

Hollow block tank: Tanks can be constructed with hollow blocks of cement concrete. However, the size of the structure will vary depending on the quantity of organic wastes.

- For 1 ha of lowlying valley or hilly plantation area, construct two units of hollow blocks cement concrete tanks (Length - 5 m, Width - 3 m, Depth - 1 m)
- For 2 ha area (1 ha lowlying and 1 ha plantations), construct two units of hollow blocks cement concrete tanks (Length - 5 m, Width - 4 m, Depth - 1 m)
- Structure should be constructed in a levelled area
- 2 m diameter rings will be the optimum size for production of vermicompost

Water source should be available near to structure

- Make a thatched shed over the structure at a height of 2.5 m using coconut leaves, so that structure can be protected from heavy rain
- Approximate cost of construction will be Rs 15000/-

Earthern Pits: Structured pits can also be used for making compost at farm level. However, due care should be taken to cover the walls and bottom of soil surface with stones to avoid moving of earthworms outside the compost unit.

- For 1 ha area of lowlying valley or hilly plantations, dugout two pits (Length - 5 m, Width - 3 m, Depth - 1 m)
- For 2 ha area (1 ha lowlying and 1 ha plantations), dugout two pits (Length - 5 m, Width - 4 m, Depth - 1 m)
- Lay the stones and boulders around the pits so that soil surface is not exposed.
- Pits should be made in a levelled area.
- Water source should be available near to structure
- Make a thatched shed over the structure at a height of 2.5 m using coconut leaves, so that structure can be protected from heavy rain.

Plastic tubs: Ready made plastic tubs available in the market can also be used for making of compost.

- Procure two rectangle plastic tubs of 5 m length × 3 m width × 1 m depth or tub which can hold 15,000 litres of water for one ha area of lowlying valley or hilly plantations are present
- Procure two rectangle plastic tubs of 5 m length × 4 m width × 1 m depth or tub which can hold 20,000 litres of water for 2 ha area having lowlying and hilly plantations in each ha.
- Make small holes on the side of walls of tubs to facilitate aeration
- Tubs should be kept in a levelled area.
- Water source should be available near to tubs
- Make a thatched shed over the structure at a height of 2.5 m using coconut leaves, so that structure can be protected from heavy rain.

Method of preparation: Vermicompost can be prepared in any one of the above mentioned structures by adopting the following steps:

- Collect the available organic wastes from crops and *Gliricidia*
- Chop the wastes in to small pieces of 5 cm using knife for hastening the decomposition process
- Heap the chopped materials under sun for about 7-10 days
- Sprinkle cow dung slurry (5 kg of dung in 5 litres of water) on the heap
- Place a thin layer of half decomposed cow dung (3-5 cm) at the bottom
- Place the chopped weed biomass and partially decomposed cow dung layer wise (10-20 cm thickness) in the rings up to the depth of 75 cm
- Organic waste and cow dung ratio should be mixed at 60: 40 on dry weight basis
- Release about 2-3 kg of red earthworms per 1000 kg of biomass

Table 15. Availability of organic waste from different sources

Source	Type of wastes	Residue production (kg/ha/year)
Paddy	Straw, weed biomass	3000-4000
Vegetables	Leaves, stalks, infected fruits, plants	2500-3250
Homesteads	Kitchen wastes, dried leaves, weeds	500
Coconut	Coconut husk, coir pith, leaf litter	8100
Arecanut, blackpepper	Leaf litter, weed biomass	6900
Gliricidia in fence	Green leaves	1250
Livestock	Cowdung	5500 kg/cow/year
	Poultry	65 kg /bird/year
	Pig	750 kg/pig/year
	Goat	290 kg/goat/year

- Place wire net / bamboo net over the tank to protect earthworm from birds.
- Sprinkling of water should be done to maintain 70-80 % moisture content.
- Provide a shed over the compost to prevent entry of rainwater and exposure to direct sunshine.
- Sprinkling of water should be stopped when 90 % bio-wastes are decomposed.
- Maturity could be judged visually by observing the formation of granular structure of the compost at the surface of the tank. Normally after 60 days, compost will be ready for collection.
- Harvest the vermicompost by scrapping layer wise from the top of the tank and heap under shed. This will help in separation of earthworms from the compost. Sieving may also be done to separate the earthworms and cocoons.
- Biogas slurry aged aerobically for 15 days enhances vermicomposting process
- Mix *Trichoderma* or *Pseudomonas* with the compost which will increase the value of compost in controlling pathogens of crops
- The compost is very dark in colour and it is very similar to farmyard manure in uses and appearance
- Compost should be dark brown in colour and has a fine smell and should have 15-20 % moisture in it

Production of vermicompost

Production of vermicompost both at farm scale and large scale is essential for converting the agricultural lands in to organic production units.

At farm scale: In A&N Islands, two major type of farming situations are present. They are lowlying valley areas and hilly areas. In lowlying valley areas, paddy followed by vegetables is grown mostly. In hilly areas, coconut, arecanut plantations are present apart from some mixed crops like clove, black pepper, cinnamon etc. Hence, proper planning is essential for farm scale production of vermicompost by taking in to consideration of requirement of compost in one year and availability of resources namely organic wastes, number of cows etc. The design considerations for vermicompost unit at farm scale are: (i) structure for vermicompost (ii) waste availability, (iii) requirement of compost per year and (iv) availability of livestock components in farm.

Tips for production

- 15000 kg of organic wastes like crop residues (7750 kg), *Gliricidia* (1250 kg) and cow dung (6000 kg) are required to produce 7500 kg of vermicompost.
- In the islands, only upper portion of the paddy straw having panicles is harvested and most of the straw remains in the field allowing cattle to graze in the field.
- Harvest the paddy leaving only 5 cm stubble in the field. 4000 kg of paddy straw can be made available for composting leaving remaining 2000 kg of straw as fodder for animals from one ha area.
- Organic waste produced from vegetable crop grown after paddy, homestead wastes and kitchen wastes will amount to 3750 kg approximately.
- Plant one row of *Glriciidia* in the border of 1 ha land at a spacing of 50 cm which can give 1250 kg of green pruning. Addition of *Glricidia* will enrich the compost in terms of nutrient availability.
- One livestock (Cow/buffalo), 4 goats and 10 poultry bird which is commonly available in the farm household can supplement the requirement of 6000 kg of cowdung for composting.
- Six RCC rings of 2 m diameter and 0.3 m height will be sufficient to make 7500 kg of vermicompost in a year.
- Make two units of RCC rings (3 rings in each unit) in the field where in shade is available and also it should be near to water source.
- Temporary shed using coconut /Arecanut leaves thatching can be made over the composting unit to protect from heavy rain which is common feature in Islands.
- Earth worm of 7.5 kg is required at initial stage which can be collected from the near by farmers who is practicing vermicomposting or from the field of fertile soil.

2. Hilly area

Area	1 ha (7.5 bigha)
Crops	Coconut / Arecanut + Black pepper
Vermicompost requirement	2500 kg /year

Tips for production

- 5000 kg of organic wastes are sufficient to produce 2500 kg of vermicompost/year
- Collect all the residues from plantations, heap it near the unit after chopping for 7 to 10 days
- Mid rib of coconut leaves, inflorescence are to be avoided otherwise, decomposition process will be slow.
- Plant one row of *Glriciidia* in the border of 1 ha land at a spacing of 50 cm which can give 1250 kg of green pruning. Pruning can be done once in two months which can be added for composting. Addition of *Glricidia* will enrich the compost in terms of nutrient availability

1. Low lying area

Area	1 ha (7.5 bigha)
Cropping sequence	Rice-vegetable (Okra, Brinjal, Cowpea)
Vermicompost requirement	7500 kg/year (2500 kg for rice and 5000 kg for vegetables)

- One livestock (Cow/buffalo) which is commonly available in the farm household can supplement the requirement of 5500 kg of cowdung for composting
- Two RCC rings of 2 m diameter and 0.3 m height will be sufficient to make 5000 kg of vermicompost in a year
- Make one unit of RCC rings (2 rings in a unit) in the field where in shade is available and also it should be near to water source
- Temporary shed using coconut /arecanut leaves thatching can be made over the composting unit to protect from heavy rain which is common feature in Islands
- Earth worm of 2.5 kg is required at initial stage which can be collected from the near by farmers who is practicing vermicomposting or from institutions or from the field of fertile soil

3. Low lying + hilly area

Area	2 ha (15 bigha)
Crops	Rice-vegetable (okra, brinjal, cowpea) : 1 ha Coconut / arecanut +black pepper : 1 ha
Vermicompost requirement	10000 kg /year (2500 kg for rice, 5000 kg for vegetables and 2500 kg for plantation crops)

Tips for production

- 20000 kg of organic wastes like crop residues (9500 kg), *Gliricidia* (2500 kg) and cow dung (8000 kg) are required to produce 10000 kg of vermicompost/ year.
- Out of 9500 kg of crop residues, 3000 kg of residues produced from rice-vegetable in one ha area and 6500 kg of coconut / arecanut + black pepper plantations in one ha area can be used for composting.
- Plant one row of *Glriciidia* in the border of 2 ha land at a spacing of 50 cm which can give 2500 kg of green pruning. Pruning can be done once in two months which can be added for composting which will enrich nutrient availability.
- Two livestock (cow/buffalo) which is commonly available in the farm household of 1 ha lowlying and 1 ha plantation can supplement the requirement of 8000 kg of cowdung for composting.
- Eight RCC rings of 2 m diameter and 0.3 m height will be sufficient to make 7500 kg of vermicompost in a year.
- Make two units of RCC rings (4 rings in each unit) in the field where in shade is available and also it should be near to water source.
- Temporary shed using coconut /arecanut leaves thatching can be made over the composting unit to protect from heavy rain which is common feature in Islands.
- Earth worm of 10 kg is required at initial stage which can be collected from the near by farmers who is practicing vermicomposting or from the field of fertile soil.

Depending upon the availability of wastes in different farming situations, the requirements for production of vermicompost are summarized in Table 16.

Hence, on an average, 7500 kg of wastes will be available per year for composting. If all the available wastes are utilized for production, the requirement of cowdung will be 5500 kg/ year which can be met from one cow. Including *Gliricidia*, the total waste availability will be 15000 kg/year which requires 7.5 kg of earth worms and 2 units comprising 3 rings + 3 rings for composting. The total production will be 7500 kg of vermicompost/year. The additional quantity of 5000 kg/ year available can be sold.

Existing programmes/ approaches to promote organic agriculture

Department of Agriculture & Cooperation (DAC) under the Ministry of Agriculture promotes various components of organic farming through various programmes *viz.* National Mission on Sustainable Agriculture (NMSA), Mission for Integrated Development of Horticulture (MIDH), Rasthtriya Krishi Vikas Yojana (RKVY) and 'Network Project on Organic Farming under ICAR'. National Project on Organic Farming (NPOF) which was started in the year 2004 has been concluded in March 2014. The existing components of organic farming have been put together under a programme called 'Paramparagat Krishi Vikas Yojana (PKVY)' to be implemented in a cluster mode from 2015-16, wherein it is proposed to increase certified area by 2 lakhs ha under organic farming within a period of 3 years. Government has also made a budget announcement to develop commercial organic farming in the North Eastern States. This scheme is being implemented through Department of North Eastern Region.

Further, easy certification through GGC and PGS are also considered. There are three components of organic farming under MIDH *viz*. adoption of organic farming, organic certification and establishment of vermi-compost units/organic input units.

CONCLUSION

Presence of vast area under forest increases the scope to collect forest litter from periphery of the area and utilize for crop production. Increased use of chemical fertilizers leads to reduced productivity over the years reduced microbial activity in soil and residues of in organics reaches to human being through direct or indirect ways. Since island is located in isolation, it is very easy to bring all the crops of islands in to organic cultivation. The availability of organic sources alone (plant and animal residues alone) is not sufficient to meet the entire requirement of nutrients for all crops. The balance requirement can be met from the forest litter. Collection of entire litter or > 30 % litter would lead higher erosion. Hence, there needs to be control. After considering the many facts, it is suggested about 24 % of forest litter is required to meet the demand of N & P requirements. The balance K requirement may be met through enriching organic plant and animal wastes. Hence, it can be concluded that, Andaman and Nicobar islands, can be brought to organic islands in a phased manner by utilizing its natural resources.

Organic farming systems are very much native to India especially A&N Islands as traditionally crops and livestock are reared together and as of today also, present in more than 85 % of the farm households. Since, integrated approach of crop management including inter/mixed cropping (is also considered as **"towards organic"**) is found to increase the use efficiency of all costly inputs especially fertilizers and water, it would be appropriate to adopt the integrated crop management in the states contributing major share to the food basket. Organic production of niche crops (crops which yield higher under organic condition and have market demand) can be considered in the hilly and rainfed areas. It will also add to the increase in overall food production of the country. However, organic farming technologies need to be fine-tuned and updated to further enhance the yields. Farmer friendly certification policies and supply-demand chain management is essential for the growth of organic farming in the country. It can be concluded that **"towards organic"** (integrated crop management) approach for intensive agricultural areas (food hubs) and **"certified organic farming"** with combination of tradition, innovation and science in the de-facto organic areas (hills) and rainfed/dryland regions will contribute for safe food security in future besides increasing the income of farm households and climate resilience. This approach will also positively contribute to the cause of human, livestock and eco-system health.

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