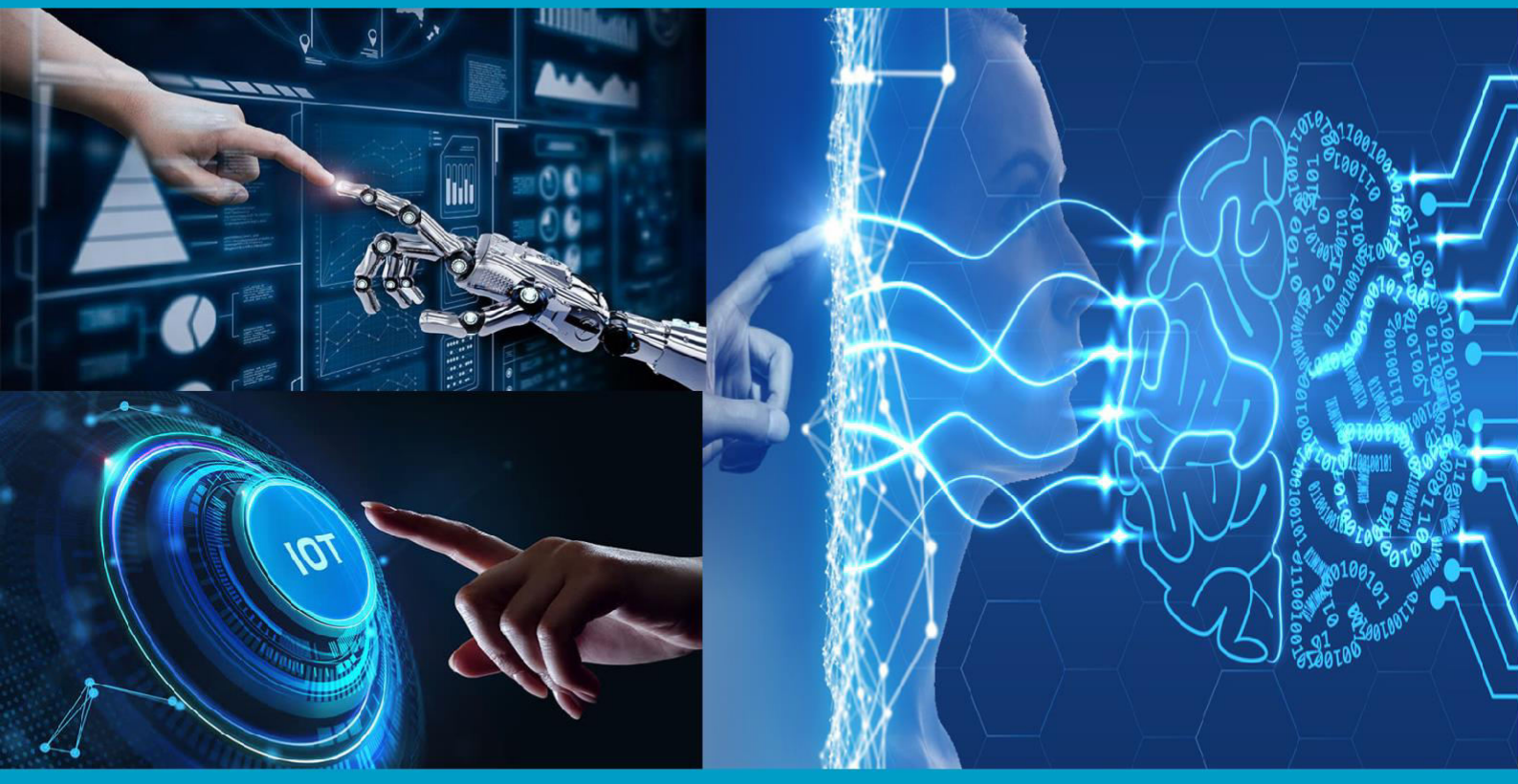
IJMRSETM

e-ISSN: 2395 - 7639



INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH

IN SCIENCE, ENGINEERING, TECHNOLOGY AND MANAGEMENT

Volume 11, Issue 3, March 2024

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.580

International Journal of Multidisciplinary Research in Science, Engineering, Technology & Management (IJMRSETM)

| ISSN: 2395-7639 | www.ijmrsetm.com | Impact Factor: 7.580| A Monthly Double-Blind Peer Reviewed Journal |

| Volume 11, Issue 3, March 2024 |

Role of Organic Manures in Sustainable Agriculture: A Review

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ABSTRACT: Green manure crops as organic manure also act as natural weed suppressants, reducing the competition for resources. They also help prevent soil erosion by improving ground cove is an agricultural practice that involves cultivating certain plants with the purpose of improving soil fertility.

KEYWORDS-organic, manures, sustainable, agriculture, soil, fertility

I. INTRODUCTION

Agriculture is the most basic kind of human activity, encompassing both crop production and animal domestication. Agricultural land is thus the most basic of the world's vast and varied resources, and it is from it that the world's population is fed and sheltered. Although Agriculture's exact beginning is unknown, as the human population developed, fishing and hunting became more important as a means of supplementing what was lacking in the field, and a never-ending search for food ensued. It was apparent that food production was required if human beings were to live a long and secure life. Thereby it is obvious that the importance of agriculture arose from this argument. Agriculture provides a significant proportion of the household economy worldwide. People rely on agriculture to feed their families, earn a living, and start a business, no matter how small (Dorosh and Thurlow, 2016; Abhilash et al., 2021) In affluent countries, agriculture is a less popular source of income, but agriculture benefits everyone in the world, regardless of direct or indirect. As a result of the growing need for agricultural products on a global basis, a variety of job opportunities have arisen. (Mathlouthiet al., 2022). Agriculture is an important part of many people's jobs. The agriculture industry has been a source of income for many individuals in developing and developed countries, with construction programs, drainage systems, suppliers, and more (Bennett et al., 2013). Agriculture has brought a plethora of benefits, and its significance should not be overlooked. It has basic, economical, and developmental benefits. It enriches every country in the world in some form while functioning a critical role in both developed and developing countries when it comes to the way of life (Christiaensenet al., 2011; Dubey et al., 2022).

Modern agriculture is an evolving approach to agricultural innovations and farming practices based on the use of high-yielding varieties of seeds, chemical fertilizers, irrigation water, pesticides, etc (Gamage et al., 2022a). Applications of plastics in agriculture are mainly related to crop production and micro-irrigation, forestry, livestock production, and aquaculture and fishery (Gamage et al., 2022b b) (Fig. 1). During the earning process of food safety, people have to face various kinds of natural and manmade hazards. The growing demand for food is not only to fulfill the issues of food security but also to earn foreign exchange. The food manufacturing process has been evaluated from cultivation to distribution for consumers. However, the rapid increase in the requirement for food couldn't be provided by using traditional methods and people have invented more ways over the natural process. But now it has exceeded the natural boundaries of the environment and occurred so many adverse effects due to not following sustainable ways. The cost of environmental quality cannot be sustainable in the future because of the adverse changes being caused to the environment and ecosystem. Resources are limited, but the requirements and ambitions of human beings are limitless and also recovery or regeneration may take thousands/millions of years.

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Protected cultivation	Nets	Packaging	Piping, irrigation / drainage	Other
Greenhouse and tunnel (high and low tunnels)	Covering vineyards and orchards	Seeds and planting packaging	Channel lining	Silage films
Mulching	Wind breaking	Agrochemicals cans	Irrigation tapes and pipes	Fumigation films
Nursery covering films	Shading	Containers for harvesting and storage	Drainage pipes	Grafting and layering tapes
	Nets for harvesting	Tanks of liquid storage	Micro irrigation	Bale wraps
		Crates	Drip irrigation tubes	Nursery pots
				Strings and ropes






Thus, widespread environmental degradation including soil, water, and air pollution, poverty, and concerns about good quality of life were the principal factors for taking interest in future generations' equity, regarding access to natural resources (Table 1). As the best agricultural land has already been farmed and has exceeded the safe limit, the natural resources available for further farming expansion are practically exhausted. The necessity of having an alternative agriculture method that can be functioned in a friendly Ecosystem while sustaining and increasing productivity. Organic farming is recognized as the best-known alternative. It is economically feasible to practice when the farmers can get a premium price for their product. The widespread challenges organic growers face includes lower yields, difficulty maintaining soil fertility levels, gaining proper certifications, and market access. A combination of organic farming and new technologies is of utmost importance to reduce the limitations and challenges of organic farming. The innovative and sustainable approach of organic farming enhances the agricultural productivity, and quality of life of many farmers in an environmentally friendly way. In this review, agricultural pollutants and their impacts, sustainable development and organic farming, challenges and limitations of organic farming are mainly considered and will give information about new innovation technologies improve the application efficiency of organic fertilizers as well as use efficiency of organic farming.[1,2,3]

Table 1. Types of Agricultural pollutants and their impacts.

Types of Pollutant	Source	Effect	References
Soil			
Salts	Irrigation water	Inhibiting seed germination; reduced growth rate; foliage discoloration and disfiguration; growth of halophytic plants; waterlogging	Mohanavelu et al. (2021); Thaker et al. (2021)
Heavy metals and nutrients	Pesticides and chemical fertilizers	Human health: can cause skin cancer, liver and kidney damage	Singh et al. (2017); Briffa et al. (2020); Gavrilescu (2021); Sharma et al. (2021); AL-Huqail et al., 2022; de Carvalho et al. (2022); Gamage et al. (2022a); Xu et al. (2022)
Nondegradable plastics	Crop production and micro-irrigation, forestry,	Combustion of agricultural plastic wastes −1.volatile	Solomon-Wisdom and Ndana (2012); Dwivedi et al.

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Types of Pollutant	Source	Effect	References
	livestock production, and aquaculture and fishery.	toxic emissions effects on human health, −2. ash-change the composition and pH of the soil.	(2019); Szajner et al. (2021); Gamage et al. (2022b)
Manure	Animal and domestic wastes	Plant diseases	Maria, 2021; Gamage et al. (2022b)
Water			
Biological or infectious agents	Animal and domestic wastes- Pathogenic bacteria, yeasts, and protozoa; parasitic worms; viruses; fungi, algae, some crustaceans, and insects, etc.	Infectious diseases	Maria, 2021
Biodegradable organic compounds and oxygen-demanding wastes	Organic wastes-biodegraded by aerobic microorganisms	Effect on the water quality by microorganisms; can cause color, taste, and odor problems	Bala et al. (2022); Policastro and Cesaro, 2023
Nonbiodegradable organic compounds	Industrial effluents, runoff from farms and yards; pesticides, organic solvents, oil with its refining and processing products, tannins and lignins, cellulose and phenolic compounds	Effect on Human health fish and wildlife	Xuqing et al. (2016)
Inorganic chemicals	Industrial effluents, surface runoff, pesticides; water-soluble acids, heavy metals; increase salinization	Effects on drinking and irrigation water; human health,(fish and wildlife; reduces crop yields; metals corrosion exposed to contaminated water	Singh et al., 2017; Briffa et al., 2020; Gavrilescu, 2021; Sharma et al., 2021; AL-Huqail et al., 2022; de Carvalho et al., 2022; de Xu et al., 2022; Gamage et al., 2022a; Rad et al., 2022;
Plant nutrients	Chemical fertilizers and organic wastes (manure, biosolids),	Eutrophication -effects on the aquatic life	Fageria, 2007; Atwell and Bouldin, 2022; El-Ramady et al., 2022
Sediments	Erosion, runoff soil, silt, and other solid matters.	Reduce photosynthesis (due to water clouding); disrupt aquatic food webs; transport pesticides, bacteria, and other harmful substances; destroy feeding and spawning grounds of fish; clog lakes, reservoirs, channels, harbors	Maria, 2021; Atwell and Bouldin, 2022;
Air			
Carbon dioxide	Food processing plants; burning of agricultural wastes; agricultural	Climate change- Global warming;	Szajner et al., 2021

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Types of Pollutant	Source	Effect	References
	machinery		
Methane	Crop production and livestock; animal feed production; food processing; agricultural residues	Climate change-global warming	Szajner et al., 2021; Xu et al., 2022
Nitrous Oxide	N fertilization; management of manure, burning of agricultural residues.	Climate change-global warming	Szajner et al., 2021; de Carvalho et al., 2022; Xu et al., 2022

II. DISCUSSION

Worldwide, most agricultural soils are less fertile because of low organic matter content. In addition, increased dependency on chemical fertilizers for improving crop yield leads to disturbance of soil health and its natural environment, as well as human health, and becomes the reason for high expenses for crop production in the world. In such environments, use of organic supplements or fertilizers for crop production may produce an environmentally friendly approach for ideal crop production. Maintaining the soil organic matter content results in enhancement of organic carbon level, improved biotic activities performed in the soil and increased nutrient availability in the soil, which ultimately maintains the physical, biological and chemical properties of the soil. Use of organic amendments is also a useful method for improving soil water-holding capacity, and its structure also ensures the minimum leaching. A range of organic amendments are available for improving soil environments to meet different requirements, which are obtained through a variety of sources of plants and animals such as cattle manure, chicken manure and compost. The organic matter raw material is nutritious but can be less effective when compared to the processed form (i.e., compost). When the organic matter has attained its maximum maturity and stability, it becomes a highly valuable compost in agricultural fields. Different organic wastes which vary in quality and stability are used from different sources for the preparation of compost. Under the current situation of soil organic content, it is necessary to maintain the regular incorporation and recycling of organic wastes into the soil for the maintenance of the optimum level of organic matter and other essential nutrients. This chapter aims to review the current knowledge on agronomical uses of organic manures and their important roles in better crop production and agricultural development.[4,5,6]

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

1. Cattle shed wastes-dung, urine and slurry from biogas plants
2. Human habitation wastes-night soil, human urine, town refuse, sewage, sludge and sullage
3. Poultry Jitter, droppings of sheep and goat
4. Slaughterhouse wastes-bone meal, meat meal, blood meal, horn and hoof meal, Fish wastes
5. Byproducts of agro industries-oil cakes, bagasse and press mud, fruit and vegetable processing wastes etc
6. Crop wastes-sugarcane trash, stubbles and other related material
7. Water hyacinth, weeds and tank silt, and
8. Green manure crops and green leaf manuring material

Manures can also be grouped, into bulky organic manures and concentrated organic manures based on concentration of the nutrients.

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Bulky organic manures

Bulky organic manures contain small percentage of nutrients and they are applied in large quantities. Farmyard manure (FYM), compost and green-manure are the most important and widely used bulky organic manures. Use of bulky organic manures has several advantages:

- They supply plant nutrients including micronutrients
- They improve soil physical properties like structure, water holding capacity etc.,
- They increase the availability of nutrients
- Carbon dioxide released during decomposition acts as a CO2 fertilizer and
- Plant parasitic nematodes and fungi are controlled to some extent by altering the balance of microorganisms in the soil.

Farmyard manure

Farmyard manure refers to the decomposed mixture of dung and urine of farm animals along with litter and left over material from roughages or fodder fed to the cattle. On an average well decomposed farmyard manure contains 0.5 per cent N, 0.2 per cent P2O5and .0.5 per cent K2O.The present method of preparing farmyard manure by the farmers is defective. Urine, which is wasted, contains one per cent nitrogen and 1.35 per cent potassium. Nitrogen present in urine is mostly in the form of urea which is subjected to volatilization losses. Even during storage, nutrients are lost due to leaching and volatilization. However, it is practically impossible to avoid losses altogether, but can be reduced by following improved method of preparation of farmyard manure. Trenches of size 6 m to 7.5 m length, 1.5 m to 2.0 m width and 1.0 m deep are dug.

All available litter and refuse is mixed with soil and spread in the shed so as to absorb urine. The next morning, urine soaked refuse along with dung is collected and placed in the trench. A section of the trench from one end should be taken up for filling with daily collection. When the section is filled up to a height of 45 cm to 60 cm above the ground level, the top of the heap is made into a dome and plastered with cow dung earth slurry. The process is continued and when the first trench is completely filled, second trench is prepared.

The manure becomes ready for use in about four to five months after plastering. If urine is not collected in the bedding, it can be collected along with washings of the cattle shed in a cemented pit from which it is later added to the farmyard manure pit. Chemical preservatives can also be used to reduce losses and enrich farmyard manure. The commonly used chemicals are gypsum and superphosphate. Gypsum is spread in the cattle shed which absorbs urine and prevents volatilization loss of urea present in the urine and also adds calcium and sulphur. Superphosphate also acts similarly in reducing losses and also increases phosphorus content.

Partially rotten farmyard manure has to be applied three to four weeks before sowing while well rotten manure can be applied immediately before sowing. Generally 10 to 20 t/ha is applied, but more than 20 t/ha is applied to fodder grasses and vegetables. In such cases farmyard manure should be applied at least 15 days in advance to avoid immobilization of nitrogen. The existing practice of leaving manure in small heaps scattered in the field for a very long period leads toloss of nutrients. These losses can be reduced by spreading the manure and incorporating by ploughing immediately after application.

Vegetable crops like potato, tomato, sweet-potato, carrot, raddish, onion etc., respond well to the farmyard manure. The other responsive crops are sugarcane, rice, napier grass and orchard crops like oranges, banana, mango and plantation crop like coconut.

The entire amount of nutrients present in farmyard manure is not available immediately. About 30 per cent of nitrogen, 60 to 70 per cent of phosphorus and 70 per cent of potassium are available to the first crop.

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Farm yard manure

Sheep and Goat Manure

The droppings of sheep and goats contain higher nutrients than farmyard manure and compost. On an average, the manure contains 3 per cent N, 1 per cent P2O5 and 2 per cent K2O.It is applied to the field in two ways. The sweeping of sheep or goat sheds are placed in pits for decomposition and it is applied later to the field. The nutrients present in the urine are wasted in this method. The second method is sheep penning, wherein sheep and goats are kept overnight in the field and urine and fecal matter added to the soil is incorporated to a shallow depth by working blade harrow or cultivator or cultivator.

Poultry Manure

The excreta of birds ferment very quickly. If left exposed, 50 percent of its nitrogen is lost within 30 days. Poultry manure contains higher nitrogen and phosphorus compared to other bulky organic manures. The average nutrient content is 3.03 per cent N; 2.63 per cent P2O5 and 1.4 per cent K2O.

Concentrated organic manures

Concentrated organic manures have higher nutrient content than bulky organic manure. The important concentrated organic manures are oilcakes, blood meal, fish manure etc. These are also known as organic nitrogen fertilizer. Before their organic nitrogen is used by the crops, it is converted through bacterial action into readily usable ammoniacal nitrogen and nitrate nitrogen. These organic fertilizers are, therefore, relatively slow acting, but they supply available nitrogen for a longer period.

Oil cakes

After oil is extracted from oilseeds, the remaining solid portion is dried as cake which can, be used as manure. The oil cakes are of two types:

- Edible oil cakes which can be safely fed to livestock; e.g.: Groundnut cake, Coconut cake etc., and
- Non edible oil cakes which are not fit for feeding livestock; e.g.: Castor cake, Neem cake, Mahua cake etc.,

Both edible and non-edible oil cakes can be used as manures. However, edible oil cakes are fed to cattle and non-edible oil cakes are used as manures especially for horticultural crops. Nutrients present in oil cakes, after mineralization, are made available to crops 7 to 10 days after application. Oilcakes need to be well powdered before application for even distribution and quicker decomposition.

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Jatropha oil cakes

Pongamia oil cakes

Cotton seed oil cakes

The average nutrient content of different oil-cakes is presented in the following table.

Average nutrient content of oil cakes

Oil-cakes	Nutrient content (%)		
	N	P2O5	K2O
Non edible oil-cakes			
Castor cake	4.3	1.8	1.3
Cotton seed cake (undecorticated)	3.9	1.8	1.6
Karanj cake	3.9	0.9	1.2
Mahua cake	2.5	0.8	1.2
Safflower cake (undecorticated)	4.9	1.4	1.2
Edible oil-cakes			
Coconut cake	3.0	1.9	1.8
Cotton seed cake (decorticated)	6.4	2.9	2.2
Groundnut cake	7.3	1.5	1.3
Linseed cake	4.9	1.4	1.3
Niger cake	4.7	1.8	1.3
Rape seed cake	5.2	1.8	1.2
Safflower cake (decorticated)	7.9	2.2	1.9
Sesamum cake	6.2	2.0	1.2

Other Concentrated Organic Manures

Blood meal when dried and powdered can be used as manure. The meat of dead animals is dried and converted into meat meal which is a good source of nitrogen. Average nutrient content of animal based concentrated organic manures is given as follows.

Animal based concentrated organic manures

Horn and hoof meal

Raw bone meal

Crushed bone meal

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Average nutrient content of animal based concentrated organic manures

Organic manures	Nutrient content (%)		
	N	P2O5	K2O
Blood meal	10 - 12	1 - 2	1.0
Meat meal	10.5	2.5	0.5
Fish meal	4 - 10	3 - 9	0.3 - 1.5
Horn and Hoof meal	13	-	-
Raw bone meal	3 - 4	20 - 25	-
Steamed bone meal	1 - 2	25 - 30	-

III. RESULTS

Organic fertilizers have been tested scientifically in Indian Council of Agriculture Research (ICAR), institutions and State Agricultural Universities (SAUs) on various crops and soil types and found suitable for improving soil health and crop productivity. The organic fertilizers presently available may supplement (N,P) by nearly 20-25%. Biofertilizers when applied along with compost @ 5t/ha or vermicompost @ 2t/ha, fertilizer saving is almost 50%. The advantages of these organic fertilizers are that they are eco-friendly and not only provide nutrients for maintaining soil fertility but also improve soil physical & biological health. Government is promoting judicious use of chemical fertilizers in conjunction with organic manures and biofertilizers to maintain soil health and productivity.[7,8]

Organic fertilizers largely are produced on-farm by the farmers. When on-farm organic inputs are used, cost of production per unit area is less than 13% under organic agriculture than inorganic management. However, if organic inputs from outside the farm are purchased and utilized, the cost of production increases by about 15-20% depending on the nature of inputs used. Integrated Organic Farming System (IOFS) models being developed under National Project on Organic farming (NPOF) promises to meet 70-80% of organic inputs within the farm thus reducing the market input cost considerably.

Government is promoting the use of Organic manures under the scheme Paramparagat Krishi Vikas Yojana (PKVY) of National Mission for Sustainable Agriculture (NMSA). The Government is promoting the use of organic inputs in the country, through assistance as under:

(i) Financial assistance is provided under the component Integrated Manure Management of Paramparagat Krishi Vikas Yojana (PKVY) for Phosphate Rich Organic Manure (PROM) as per specification given in FCO, 1985 @Rs.1000/acre for procuring and application of PROM to soil to meet phosphorus/Zinc deficiency in soil.

(ii) Financial Assistance is provided for vermi-compost (size 7'x3'x1') @Rs.5,000/- unit for procurement of earth worms, preparation of pits, construction of brick wall etc.

(iii) Promotion of Organic Inputs under Organic & INM Components of Soil Health Management, assistance is provided for Vermi-compost, Bio-fertilizers (Liquid / solid), Waste compost, Herbal extracts etc. including PROM @ 50 % of cost subject to a limit of Rs. 5000/- per ha and maximum Rs.10,000 per beneficiary.

(iv) Government is also promoting the production of organic manures by providing 100% financial assistance to State Governments/ Government Agencies upto a maximum limit of Rs.190.00 lakh per unit and 33% of project cost maximum limited to Rs.63 lakh per unit for individuals/private agencies through NABARD as capital investment for establishment of agro/vegetable waste compost production units of 3000 Total Per Annum (TPA) production capacity.

(v) Under the Rain fed Area Development (RAD) component of NMSA, 50% of cost subject to limit of Rs 125/- per cubic ft. and maximum permissible assistance of Rs.50,000/- per unit for permanent structure and Rs 8,000/- per unit for High Density Polyethylene (HDPE) vermi bed is provided for construction of compost unit and, organic input production unit.

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(vi) The Government of India is providing a Market Development Assistance @ Rs.1500/-per metric ton (MT) to Fertilizer Companies for sale of City Compost.

State-wise details of different organic manures produced / available in during 2015-16

(lakh MT)

State	Rural Compost	Farm Yard Manure (FYM)	City Compost	organic manure	Vermi Compost	other manure	Total Manure	Green manure (Ha.)
Andhra Pradesh	62	0.35	22.1	0	1.52	0	85.97	8.39
Arunachal Pradesh	0.7	0.21	0	0.01	0.62	0.062	1.602	0.1
Assam	0	841	0	0	93.1	1.56	935.66	123
Bihar	10.32	8.5	0.32	5.01	9.12	0	33.27	1.8
Chhattisgarh	11.04917	42.51	11.23	0	3.02	53.0884	97.88217	18.68472
Delhi	0.04	0	0.5	0.04	0.03	0.21	0.82	0.097
Goa	0	375	0	0	0.78	4.9	380.68	62
Gujarat	10.2	8.6	0	2.175985	0.2	0.0106015	2.3886365	0.012
Haryana	0	0	0	15	25.1	14	29	2.92
Himachal Pradesh	1.9	0	0.23	0	0	0	2.13	1.11
Jammu & Kashmir	0	0	0	0	396	0	700	72.1
Jharkhand	5.9	6.3	6.5529578	2.723575	19.13513	0.1587	28.570628	1.22
Karnataka	0.72	0	0.68	0	3.2515	0.005	4.6565	0.45
Kerala	26.38297	15.165	1.026	0.909	10.096	1.26194	19.84091	0.9
Madhya Pradesh	10.36	6.58	7.5	0	2.5	4	14	1.05
Maharashtra	0	0.72	0	0	0.09	0	0.81	0.08
Manipur	0	19	0	0	9	0	28	2.1
Mizoram	0	1.12	0	0	1.06	0	2.18	0.013
Meghalaya	0.42	1.3	0	0	1.21	0	2.93	0.01
Nagaland	10.6	0	8.42102	0.2154	6.1665	0	25.40292	3.21
Odisha	0	0	0.19229	0.8346	0.34	7.531	8.70198	0.45
Punjab	0.04	0	0.5	0.04	0.03	0.21	0.82	0.097
Pondicherry	0	0	3.1162	0	0	1.434895	4.551095	0.45
Rajasthan	21.92	12.2	0	0.012	0	0.0113	34.1433	0.004
Sikkim	0.34	0	0	0	0.05	0	0.39	0.05
Tamilnadu	0.05	0	9.28915	0	5.784556	1.29863	18.422336	2.21
Tripura	2.6	0	0	0	0.91	0	0.91	0
Uttar Pradesh	10.6	14.6	0	0	0.5	0	25.7	3.31
Uttarakhand	25.3	19.5	0	0	0.23	0	0.23	0.03
West Bengal	8.5	29.99	8.3	4.2	1.95	4.986	57.926	22
Grand Total	219.9421	1402.645	79.95762	31.17056	591.7937	94.72847	2547.588	327.8477

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IV. CONCLUSION

The modernization of agriculture along with the "Green Revolution" transforms the agriculture practices in a new dimension where the traditional knowledge and techniques were replaced by the new technology to increase the productivity to feed the growing population. This Green Revolution changed the country status from importer to self-sufficient. Traditional source of nutrients was replaced by the synthetic and chemical fertilizers. Undoubtedly the inorganic fertilizers are keys behind the increasing productivity to a greater scale. However, inappropriate use of these chemical/synthetic fertilizers, unscientific management, over-utilization, etc. lead to soil and environmental pollution as well as deterioration of the soil quality. Moreover, continuous use of these fertilizers leads to toxicity as well as deficiency of some major and minor nutrients. In the scenario of global climate change, the unscientific use of these chemical inputs are major threats to environment. To reduce or minimize these ill effects, it is high time to shift the agriculture system from inorganic to organic mode to sustain the soil and environments for a longer period. Side by side, the use of chemical fertilizers should be minimized or avoided depending upon the cropping condition and demand of the system. Organic farming system and combined system (organic and inorganic or INM) both can promote agriculture toward the reducing use of chemical fertilizers, and that system must be popularized. Organic as well as INM have several advantages over the convention (chemical-based) system in terms of soil quality, environmental pollution, crop productivity, as well as the quality of produce. This aims to focus on the use of organic fertilizers (alone or in combination) for better soil and environmental management. However, the organic system also has the several limitations that must be addressed, and proper management must be evaluated to promote the organic production system. The popularization of the technology and techniques is governed by different factors, so the organic farming practices will be adopted by the farmers only when the technology will reach to the farmers with the clear message. Organic farming or organic nutrient management not only reduces the input cost but also provides an opportunity to recycle the waste unused materials, crop and plant residues to reduce the soil, water, and environment pollution. The use of organic fertilizers will improve the soil carbon status and soil quality which help in improving, carbon sequestration. With the several advantages associated with organic nutrient management, still proper demonstration, awareness, and training are required to popularize among the farmers and to get the best benefit out of it.[8]

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