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Manual on Vermiculture Biotechnology for Eco-friendly Agriculture

Compilation

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PREFACE

Indiscriminate use of chemical fertilizers and pesticides leads to environmental hazards has imposed a serious threat globally, which results in low productivity in all crops. The environmental degradation is evidenced by changes in rainfall pattern and raise in day and night temperature. Greatest natural resource soil and water are still polluting due to continuous use of chemical fertilizers and pesticides. Besides pollution in natural resources, the food consumption by human beings is also intoxicated due to this excess use of chemicals. Therefore, it is a time to think over on Eco-friendly, Sustainable food production in nature's cycle through Vermicomposting for safe environment.

Being an era of mechanizations bullocks are being replaced by tractor, thus the population of dung producing animal is regularly decreasing. Therefore, dung that formed the major component of farmyard manure is not available to meet out the demand of production system. Hence, Vermicomposting is the only viable method to restore the problem. Vermicomposting is cost effective means of safe guarding environment as well as its turn biodegradable waste into useful manure. Vermicompost is a term, which denotes to prepare compost with the help of earthworm, which has been recognized as a friend of agriculture from the time immemorial. Vermicompost can be prepared in rural as well as urban areas in a wooden model or plastic model or in a pit. According to an estimate by application of only 6 tonnes of Vermicompost instead of 25 tonnes farmyard manure or recommended dose of N, P, K for cereal crop production, one can reduce the cost on fertilizer up to Rs. 4000/- per hector and 40% reduction on the cost of pesticides in subsequent 3-4 years. Vermicomposting can be boon for kitchen garden,ornamental plants, crops, farmers, and farmwomen. It is easy to transport and helpful in sustainable agriculture production without any pollution hazards to soil, water and environment. Therefore, awareness generation on Vermicomposting is essential at this juncture and present bulletin certainly disseminate the knowledge of Vermiculture Biotechnology for Eco-friendly agriculture.

Authors

The vigor and health of a society is underpinned by its food production, processing and distribution system. For more than thirty years, governments all over the world promoted as external input chemical dependent agriculture. Today, we realize our food system is no longer safe or sustainable. With globalization and trade liberalization, we are moving towards a global food market economy with powerful economic institutions namely transnational companies, emerging as influential players.

Fortunately, there were farmers and consumers who did not simply follow their government's advice of the day. These visionaries pressed on to develop other modalities for agriculture production including Vermiculture. Indian agriculture has come a long way since independence. The humiliating image of 'the begging bowl' is long erased as India, riding on the crest of the Green Revolution of the 1960s, is now practicing agriculture with modern means from famine-hit, food-importing nation, it has become the largest exporter of Food grains. Yet, Indian agriculture is confronted with several challenges. Reports and experiences of farmers have revealed adverse effect of conventional chemical farming on crop yields and quality. The degenerative effects of such farming practices on soil fertility and ecological balance are also surfacing. All these, together with ever increasing prices of chemicals used in conventional farming are forcing the farming community to think of alternative farming methods. Since we have no further scope of bringing more land under cultivation, the existing, land should be made to produce more in an eco friendly, cost effective and sustainable manner in order to fulfill the total food grain requirement for 10.5 billion populations by the year 2110.

From the time of Darwin (1881) earthworms, one of the major fauna of the soil have been considered as the farmer's friend but Vermiculture biotechnology is just taking roots in India. It deals with utilizing working strength of earthworms on a large scale to draw multifarious benefits for agriculture as well as elsewhere. It has the potential to counter the above outlined problems arising out of the use of chemicals in agriculture.

What is Vermiculture Biotechnology?

The word biotechnology means theoretical approaches based on knowledge through which living organisms may be utilized commercially and the word Vermiculture means the scientific method of breeding and multiplications of earthworms in controlled conditions. It aims at creating improved conditions artificially so that the earthworms can multiply in shortest period of time and space.

What is the use of Vermiculture Biotechnology?

Vermiculture biotechnology will be useful in field for -

1. City garbage recycling deodorization and to keep environment clean.
2. Management of effluents from intensively housed livestock.
3. Management of sewage sludge.
4. Decomposition of organic, industrial waste matters specially paper mill waste.

Benefit of Vermiculture:

The major economic benefits that can be accrued from Vermiculture are as follows:

1.	Soil turnover.
2.	Improvement of soil aeration.
3.	Increased rate of humification.
4.	Agri waste resource cycling.
5.	Once the soils are inoculated with earthworms, it need not be repeated as the multiplication of worm goes on every year.
6.	Stimulation of respiratory and enzymatic activity of soil.
7.	Reducing soil erosion. Worm action increases water infiltration capacity of soil and thus less run off.
8.	Enrichment of soil fertility.
9.	Helping in reclamation of waste land.
10.	Increase in yield.
11.	Irrigation requirement of crop plants reduces because:
i)	Water is stored to a greater depth in the soil.
ii)	Water holding capacity of soil increases due to vermicastings, which

	also absorb moisture from the air particularly during night.
iii)	Mulch layer on ground reduces moisture loss from soil .
12.	Significant increase in N- fixing bacteria.
13.	Conversion of organic N and P in plant assimilable form.
14.	Destruction of phytopathogenic fungi.
15.	Assimilation of nematodes.
16.	Bactericidal and bacteriostatic properties of coelemic fluids of earthworm.
17.	Earthworm ability to eliminate offensive odor.
18.	Conservation of water. Protecting ground water from getting polluted.
19.	As protein source for poultry, fishery, pigs, pets etc. Earthworm body contains 70% crude protein , higher than fish meal (65%), meat and bone meal (50%), and soyabean meal (45%).
20.	Extraction of enzymes, medicinal compounds and high value amino acids.
21.	Production of Vermicompost which may be developed as an enterprise for the source of income.

What Earthworms do?

Earthworms live in the soil and perform following role -

1. Earthworms eat plant biomass, which fall on the form of mulch.
2. Earthworms are effective tool for speedy development of wastelands.
3. Earthworms recharge ground water.
4. Earthworms maintain soil aeration.
5. Earthworms produce 10 mm soil per year, which is produced by nature in 200 years.
6. Earthworms maintain soil temperature and moisture.
7. Earthworms increase root volume and bacterial activity about 10 fold.
8. Earthworms feed on soil and soil organic matter and convert it to compost, making the soil rich in nutrients.
9. Earthworms are natural tillers of soil.
10. Earthworms aerate and pulverize soil.

11. Earthworms make soil porous, improving drainage.
12. Earthworms increase water-holding capacity of soil.
13. Earthworms encourage growth of useful microorganisms, which also make soil rich.
14. Earthworms produce enzymes, hormones, vitamins and antibiotics, thereby increasing immunity of plants against some pests.

Taxonomic position of the Earthworm:

Earthworms are segmented animals, hermaphrodite (bi-sexual), invertebrate creatures belong to Phylum – Annelida (Bilaterally symmetrical, metamerically segmented, true coelomates), Class – Oligochaeta (Setae embedded in the integument, parapodia absent) and Order- Terricolae or Neooligochaeta (Clitellum in 14^{th}, 15th and 16^{th} segments, and eye spots absent). Earthworms found burrowing in moist soil, sand or mud all over the world. Their body is elongated, cylindrical and pointed at both ends, It is adapted for burrowing. Body is metamerically segmented, consisting of about 120 metameres (segments).Prostomium reduced, forms upper lip and hangs in front of mouth. A ring of setae present in each segment except the first and last segments. Female genital aperture unpaired and present in 14^{th} segment but male genital apertures are paired and present in 18^{th} segment. Two pairs of genital papillae present on the ventral surface, one pair in each of the segments 17^{th} and 19^{th}. Anus situated in the last segments and they reproduced usually sexual. Earthworms have no eye but photo sensitive i.e. respond to light, have no ear extremely sensitive to touch and vibrations, have no teeth but feeds organic materials,have no nose but take oxygen through skin. A matured red earthworm lay cocoons (eggs) every 7-10 days. Cocoons incubate with in 14-21 days in moist bed at $20\ ^{0}$ C – $30\ ^{0}$ C . After hatching immatures develop to reproductive stage within 60-90 days with 4-8 inch length. One earthworm produces with in a period of 12 months about 100-200 worms.

Type of Earthworms:

Charles Darwin (1881) carried out first systemic study on earthworms. Later on George Oliver and Barret taken the clue from Darwin's work and demonstrated that earthworms could be utilized to draw excellent benefits in agriculture. Barret(1947) was

the first commercial worm grower and operated on a tonnage scale. Barret's success encouraged many others but it was only in the late sixties that some scientists felt the need to merge ecology with the concept of utilizing earthworms commercially to draw multifarious benefits.

There are about 386 varieties of earthworm. Earthworms can be classified into three types viz; Epigeic, Endogeic and Anisic (Diageic) according to their feeding habits, distribution in soil strata, defecation activities, and response to soil constraints. Worm can multiply 20 to 25 times with in 65 to 70 days in favourable conditions.

Epigeic: This species live on surface of the soil and have activity for limited period. They have high reproductive rate, but a short life span. High organic content is their dietary requirement. They are also known as surface feeders convert waste matter into humus, exhibit high metabolic activity and so are very useful for vermicomposting. Certain species introduced from Africa are very efficient humus producers. They can be brought from companies, which produce Vermicompost. Some important species are: *Eisenia foetida*, *Eudrilus euginae*, *Perionyx excavatus*,*Lumbricus rubellus and P. arborjcola* .

Endogeic: This species reside beneath the topsoil surface where mineralized iron oxide, aluminum oxide and clay generally occur. They feet on humified organic matter, which is at different levels of degradation. They make extensive tunnels oriented obliquely and horizontally to soil surface. They enhance soil aeration. By mixing any of leached microbial or organic matter with clay, silt and sand particles. They also improve texture and structure of the soil.

Diageic : These worms are deep dwelling. They make extensive and permanent burrows. They line the burrows with their excrements and collect litter from the surface and store thin in their burrows for feeding. Therefore, they are useful in loosening the soil, mixing of surface organic matter into sub-terranian soil strata.

Vermicomposting :

As regards the usefulness of earthworms in alternative agriculture, it is suffice to consider Vermicomposting and increasing earthworm population of all the species of worms in the fields.

Vermicomposting is the bioconversion of organic waste materials into nutritious compost by earthworm activity. Vermicomposting is an easy and effective way to recycle agricultural waste, city garbage and kitchen waste. In this process worms help in transforming waste into high quality fertilizer. There are reports that, in general, Vermicompost helps to boost productivity of crops by 40% even at 20 to 60% lower nutrient input. The Vermicast is valuable soil amendment and may replace the chemical fertilizer. Therefore, many countries have adopted Vermicomposting for sound waste management and recycling strategies. In Vermicomposting process, earthworms are used to produce Vermicompost from variety of organic waste mixes. In this process the technology employed is very simple and can be easily handled even by an uneducated, unskilled farmwoman after a brief training.

What is Vermicast?

After passing through the earthworm gut, ingested soil is expelled as globular soil aggregates called Vermicast. Earthworm casts are the excreta of earthworm. These casts contain five times the nitrogen of ordinary soil, seven times the phosphorus, eleven times the potash, two times the calcium and magnesium, and eight times the Actinomycetes (useful bacteria). During the passage through the earthworm's gut, organic materials are thoroughly shredded and mixed with mineral soil materials. Probably because of enhanced bacterial activity earthworm casts are usually high in polysaccharides, which are credited with stabilizing the granular structure. The earthworm castings are known to be a rich source of plant growth promoting substances such as Auxins and Cytokinins. The casting behavior of earthworms, therefore generally enhances the aggregate stability, exchangeable calcium and potassium of the soil.

What is Vermicompost?

Vermicompost is a result of a method of making compost with the use of earthworms, which generally live in soil. They eat biomass and excrete it in digested form. This compost is generally called Vermicompost . It is the dropping of earthworms after the intestinal digestion of organic matter. These dropping are high in nutritive value. Even of

the Vermicompost dries there is no harm to the microorganisms. Research has revealed that Vermicompost contains many micronutrients like Manganese, Iron, Molybdnum, Boron, Copper and Zink as well as some of the growth regulators. Vermicompost is a stable fine granular organic matter, when added to clay soil loosens the soil and provides the passage for the entry of air. The mucus associated with the cast being hygroscopic absorbs water and prevents water logging and improves water-holding capacity. Thus in the sandy soil where there is problem of water retention the strong mucus coated aggregates of Vermicompost hold water for longer time.

In the Vermicompost some of the secretion of worms and the associated microbes act as growth promoters along with other nutrient. It improves physical chemical and biological properties of soil in the long run on repeated application. The organic carbon in Vermicompost releases the nutrient slowly and steadily into the system and enables the plant to absorb these nutrients. The nutrient level of the Vermicompost varies with the inputs. To get high nitrogen content residues of leguminous species should be added to the pit. Addition of blood meal will result in increased nitrogen and potassium content and bone meal will enhance the potash and phosphorus content of the Vermicompost. Vermicompost is richer than other types of compost. A comparative statement of Farmyard manure and Vermicompost is given in Table 1.

Table1: Comparative Statement of Farmyard Manure and Vermicompost

Sl.No	**Particulars**	**Farm Yard Manure**	**Vermicompost**
1.	Nitrogen %	0.40 – 0.75	1.00 – 1.60
2.	Phosphorus %	0.17 – 0.30	0.50 – 5.04
3.	Potash %	0.20 – 0. 55	0.80 – 1.50
4.	Calcium %	0.91	0.44
5.	Magnesium %	0.19	0.15
6.	Iron (ppm)	146.50	175.20

7.	Manganese (ppm)	69.00	96.51
8.	Zink (ppm)	14.50	24.43
9.	Copper (ppm)	2.80	4.89
10.	Carbon: Nitrogen Ratio	31.28	15.50
11.	Duration required for the preparation	One year	Less then ¼ th year
12.	Immunity against insect pest and diseases	Not developed	Developed

How to collect the Earthworm?

About 500 gm jaggery and equal quantity of fresh cow dung should be mixed in 15 to 20 liters of water, and this diluted slurry-should be sprinkled over the area. Wet pats of cow dung is scattered over the area and a layer of moistened rice straw should be laid over it. The whole area is then covered with a jute sack. Regular watering should continue for a period of 20 to 25 days and care should be taken to avoid waters stagnation. When the cover is removed a large worms can be seen. Farmers can collect these earthworms and utilize for Vermicomposting. A solution of formaline @ 0.55 % has been also found effective for the collection of Earthworms. Taking worms out of their natural environment and placing them in containers creates a human responsibility. They are living creatures with their own unique needs, so it is important to create and maintain a healthy habitat for them to do their work.

Materials required for Vermicomposting for a 10 sq.m. Plot:

1.	Stone chips of 1 cm size	For the filling of pit 3”
2.	Sand or Morang	For the filling of pit 3”
3.	Wet Soil	For the filling of pit 6”
4.	Dry organic matter	200-300 kg
5.	Decomposed Farmyard Manure	300-400 kg
6.	Organic waste including kitchen Waste	700-800 kg

7.	Earthworms	10,000
8.	Water	ready supply

Estimated cost to start Vermicompost:

Pit:

Length = 1.5m, Width=1.0m, Height =0.75m,

Stone slab area	=	5.25 sq.m.
Stone slabs Rs. 86/m^2	=	Rs. 450.00
Earth work	=	Rs. 30.00
Laying filling of joints with cements	=	Rs. 100.00

		Rs. 580.00

Roof:

Length = 3. 0 m, Width= 3. 0 m, Height =1.0m

Thatch leaves	=	Rs. 60.00
Poles	=	Rs.200.00
Construction (Labour)	=	Rs. 40.00

		Rs 300.00

Production:

Charge of Earthworm (Per kg)	=	Rs. 500.00
Wire mesh cover	=	Rs .200.00

		Rs. 700.00

Total cost for one unit	**=**	**Rs.1580.00**

Method of Preparation of Vermicompost:

Vermicomposting can be done indoors and outdoors, thus allowing year round composting. Wooden plastic containers either build or buy, or something like an old dresser drawer, trunk or discarded barrel may be used for Vermicomposting. Wooden containers preferably should be used because it is more absorbent and a better insulator for the worms. In plastic containers compost tends to get quite wet. Containers should not be very large and heavy for easier lifting and moving. Depending on the size of the container drill 8 to 12 semicircular holes of ½ inches in the bottom for aeration and drainage. A plastic bin needs more drainage holes. Raise the container on bricks or wooden blocks and place a tray underneath to capture excess liquid, which can be used as liquid plant fertilizer.

The container needs a cover to conserve moisture and provide darkness for the worms. If the container is indoors, a sheet of dark plastic placed loosely on top of the bedding is sufficient as a cover. For outdoor containers, a solid lid should be preferred, to keep away-unwanted scavengers and rain. Worms need air to live, so be sure to have bin sufficiently ventilated.

It is necessary to provide damp bedding for the worms to live in, and to burry food waste in. Suitable bedding materials are cow dung slurry, shredded newspaper and cardboard, shredded fall leaves, chopped up straw and other dead plants, seaweed, sawdust, compost and aged manure. It is very important to moisten the dry bedding materials before putting them in the container. Do not use large size worms found in soil and compost, as they are not likely to survive. It is advisable not to compost meats, dairy products, oily foods and grains because of problems with smells, flies and rodents. No glass, plastic or tin foil should be present in the composting materials. Containers should be kept out of hot sun and heavy rain. If temperature drops below 40 degree F, containers should be replaced indoors or well insulated outdoors. It is estimated that 1000 tonnes of sludge organic waste could be converted in to 400 tonnes of organic fertilizer through

vermicomposting.The production cost of vermicompost works out of Rs. 750 – 1000/- per tonne. A flow chart for the preparation of Vermicompost is given herewith.

Flow chart for the preparation of Vermicompost

Prepare the pit 1.5m x 1.0m x 0.75m without flooring and make Proper arrangement of shade

↓

Fill up the pit 3” from concrete (small stone)

↓

Fill up the pit 3” from sand/morang

↓

Fill up the pit 6” from moist soil

↓

Release earthworm @ 20 number or 20 gm / kg; or 1 kg / 1000 sq mt or / 50 kg or 20000 earthworm / MT organic waste

↓

Placement of cow dung heap

↓

Fill up the pit 4” from agro waste

↓

Cover with gunny bag or coconut leaf

↓

Provide water up to 30 days daily and wait

↓

Remove cover of gunny bag or coconut leaf

↓

Fill up pit 3” with cow dung and agro waste twice in a week followed by covering and watering

↓

Turning of compost once in a week

Contd..

Continue the process of filling covering, watering and turning up to the completion of pit

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After complete filling of pit continue watering up to 45 days and turning once in a week

↓

Stop watering for 2 days

↓

Remove the compost from the pit

↓

Make a heap in shady place for 3 days

↓

Collect the worm from the lower level of heap and again release them in the pit

↓

Sieving and packing of Vermicompost

How to know that Vermicompost is ready?

1. The colour of compost turns black.
2. Compost will be light in weight.
3. Compost does not emit any foul smell.
4. pH value of the compost will be around seven.
5. The worms start crawling over the top cover and the bed boundaries.

Maintenance of Vermicomposting:

Take care to maintain an optimum number of Earthworms in the pit/fields. Their population is adversely affected by-

1. Use of chemical fertilizers.
2. Use of certain pesticides against soil borne pests.
3. Inappropriate cultivation techniques, like use of rotary cultivators.
4. Acidification of soil.
5. Insufficient organic matter in the soil.
6. Always maintain moisture 60 to 65 %.
7. Make the heap in shady and comparatively higher site.
8. Worms have been known to crawl out of the bedding and on to the sides and lid if conditions are wrong for them. If the moisture level seems all right, the bedding may be too acidic. This can happen if you add a lot of citrus peels and other acidic foods. Adjust by adding a little garden lime and cutting down on acidic wastes.
9. Worms require protection from excessive sunlight, heat, down pouring rain etc. They grow well under shades.
10. Protect the earthworms in the pit from their enemies like birds, rats, mice, toads, lizards, centipedes, ants and cockroaches etc.

Quantity of Vermicompost to be applied:

Sl.No	Type of crop	Quantity
1.	Rice, Wheat, Jowar, Bajra, Maize	2.50 tonnes /ha
2.	Cotton	3.75 tonnes/ha
3.	Groundnut, Mustard and Pulses	2.50 tonnes/ha
4.	Sugarcane	5.00 tonnes/ha
5.	Potato, Tomato, Brinjal, Carrot, Cauliflower, Cabbage and Garlic	1.00 – 2.00 tonnes/ha.
6.	Coconut and Mango	4-5 kg/plant (below 5 years)

		8-10 kg/plant (above 5 years)
7.	Lime and Pomegranate	3-4 kg/plant (below 5 years) 6-8 kg/plant (above 5 years)
8.	Pumpkin, Papaya, Orange, Pear and Peach etc.	6-8 kg /plant
9.	Rose, Jasmine, Marigold etc.	3.75 tonnes /ha or 2-3 kg/plant
10.	Chilly, Turmeric, Ginger	3.75 tonnes /ha
11.	Grapes, Pineapple, Banana	3.75-5.00 tonnes/ha
12.	Plants in pots	250 gm/pot

Advantage of Vermicompost:

1.	Vermicompost boosts growth of plants making them strong and healthy and free from pest attack. It helps microorganisms produce polysaccharides, improving soil health.
2.	Vermicompost absorbs 10 times more water than the soil, so it increases water retention capacity, thus avoiding erosion. Earthworm plough through 7-8 times a day, making the soil loamy, thereby enhancing drainage. They also take in 10 times their body weight in water and release it to the soil when needed.
3.	Vermicompost organic elements decompose so finely into 0.2-micron size in the earthworm's stomach enabling roots of plants to easily absorb these food elements.
4.	Vermicompost contains abundant food elements; micro bacteria and humus, making it complete manure. Using Vermicompost thus not only saves money, but also increases yield by 40% to 80% per hectare.
5.	Vermicompost increases the shape, colour, taste and luster of crops. It increases shelf life and nutritions of fruits, vegetables, cereals and flowers.
6.	Vermicompost is about 50% cheaper than chemical fertilizers, saving

	expensive imports. This will give support to export of chemical and pollution free produce to foreign countries there by earning valuable foreign exchange to the country.
7.	Vermicompost increase immunity to crops. Therefore, no money is spent on unaffordable chemical fertilizers, pesticides and insecticides. Consuming fruits, vegetables, and grains, grown thus is safe and everyone is free from health hazards.
8.	Vermicompost is suitable for all type of soil, crops and can be used in any season.
9.	Vermicompost is rich in several micro floras like *Azospirillium, Actinomycetes, and Phosphobacillus,* which multiply faster through digestive system of earthworms.
10.	Several enzymes, auxins and complex growth regulators like *Gibberellines,* which are not formed in different soils and environmental conditions, are present in the earthworm castings.
11.	Buffering action neutralize soil pH.
12.	Vermicompost helps multiplication of earthworms, which reduce the incidence of nematodes.
13.	Due to buffering action, minerals and trace elements become available more easily to crops.
14.	Leaching of nutrients from chemical fertilizers in the soil is reduced considerably specially of Nitrogenous fertilizers.
15.	Reduce soil toxicity by buffering action.
16.	Vermicompost influences the physiochemical and biological properties of soil where in turn improves soil fertility.
17.	Low cost to produce in comparison of fertilizers.
18.	Easy to use in comparison fertilizers.
19.	Harmless to useful soil organisms
20.	Converts organic matter to useful plant food.
21.	The fresh Vermicompost will have maximum microbial load beneficial to

	increase soil microflora.

Advantage of Vermicomposting :

1. Productive utlization of waste materials available in or around the house on farm.
2. Assured supply of Vermicompost which is excellent in manurial qualities and as soil conditioners.
3. The waste biomass remaining after harvesting the crop can be recycled into the same field thus assuring maintenance of soil fertility.
4. Transportation cost of manure can be avoided.
5. Vermicompost prepared at site will avoid loss of neonates (newly born earthworms) and cocoons.
6. Viability of earthworm cocoons and their number is guaranteed when made at site.
7. This operation will stimulate population growth of local communities of earthworms, imparting a multiplier effect, which in turn, will help in maintaining soil fertility and ecology.
8. By manipulating composition of wastes, desired quality of Vermicompost can be obtained.
9. Vermicomposting process generates an internal heat. The heat kills the pests and pathogens. It also destroys the seeds of weeds that may be found in the organic wastes.
10. Nitrogen oxides from chemical fertilizers might deplete the Ozone layer which may consequently cause- more skin cancer, more eye cataracts, loss of immunity, harm of the phytoplankton and crop damage affecting entire food chain but Vermicomposting will help for the minimization of these cosequences.

Around the world, there is growing interest in finding alternatives to the industrial farming methods that have emerged during the 20th century. Almost five decades of pesticides and fertilizers use have left us a tragic legacy; severe contamination of our soils and water system, increased cancers, birth defects and other ailments in humans and the emergence of powerful pests which are resistant to chemical pesticides. According to the World Health Organization (WHO) approximately one to two million persons are affected every year because of pesticides. The present level of use of chemical fertilizers and pesticides is harmful to ecological balance and sustainable use of natural resources. Vermiculture biotechnology can provide effective alternative to these costlier agricultural inputs while preserving the environment. During the formulation of development programme all developmental agencies are required to pay attention that there should be no any adverse effect on the environment by the implementation of development programme. Promotion of Eco-friendly agriculture is certainly saving the earth itself as well as saving of own self. It is important to conserve environment for regular development and welfare of humanity on our unique planet earth.

Success story No 1

To increase the production and productivity of rice cultivation in Kerala the major thrust area in front of scientists and policy makers was to reduce the cost of labour and expensive inputs to the maximum extents. Taking this in view CARD-KVK Pathanamthitta (Kerala) took up a demonstration in Vermicompost with an innovative farmer Sri Rajan Varghese. In his field of 1.5 acres of rice crop he applied two tonnes of Vermicompost produced by him instead of sterameal and cow dung as basal application. By this he could save Rs. 4000.00 being the cost of stera meal and Rs. 2500.00 for cow dung. He also reduced the application of Urea as basal dose from 40 kg to 30 kg. According to him the most important advantages of using Vermicompost is that transportation is made easy when compared to cow dung. Additional payment has to be made or cleaning, loading and unloading of cow dung. Thus he could save good amount of

money. He effectively utilized family labour for spreading of Vermicompost, because it was free off foul smell and also it was in dried powdered form.

Mr. Rajan also concluded that he used to spray 2 or 3 rounds of insecticides, when he applied chemical fertilizer as basal dose. After applying Vermicompost he sprayed only once while other neighboring farmers had sprayed 2-3 rounds in the same season itself for controlling severe leaf roller and stem borer attack. The reason for severe attack in other fields is because of high succulent growth due to application of urea and other chemical fertilizers. Incidence of rice blast and sheath rot was also not seen in Sri Rajan's field. In addition to rice, he applied Vermicompost to his mulberry field also. He positively concluded that quality of leaves has been improved and he was able to reduce the number of irrigation when compared to chemical fertilizer. Thus Vermicompost has enabled this rice farmer to continue with this rice crop by directly reducing to inputs and indirectly increasing out puts. (Source :ICAR News, April-June-2002).

Success story No 2

A villager Sri Karni Beniwal, retired Army man, Jhunjhunu district of Rajasthan experienced that Earthworms may not turn you into Ambanis, Birlas or Tatas over night but they can assure you a successful business venture, promising nearly 100 percent annual returns-with a guarantee that your "Stocks" automatically multiply every 45 days. Sri Karni Beniwal decided to become an "agri-preneur" and invested a big part of his lifetime saving into a Vermicompost plant.

With a short training, free supply of earthworms and technical support for a year from the Morarka Foundation and NGO run by Former Rajya Sabha member Kamal Morarka, Beniwal set up a Vermicompost unit on his 700 Sq yard plot with a one-time investment of Rs. 1.25 lakh. One year later his account books balanced out: Cost of setting up a unit: Rs 1,25,000.00; Net returns in first year: Rs. 1,20,000.00; Remaining stocks worth: Rs. 80,000.00 and multiplying. Each kg of compost Beniwal harvests at the cost of about Rs. 7.00 is sold at Rs. 40 per kg in cities like Delhi, where people have started waking up to the importance of organically grown food. Beniwal utilized *Eisenia foetida*

variety of earthworms for making Vermicompost and explained that this enterprise can generate indirect full time employment for at least 2-3 persons. The sale of earthworms at any point of time will always be an “added bonus”.

(Source: Times of India, 6.11.02)

The National Research Centre for Women in Agriculture (NRCWA), established in 1996 under the aegis of Indian Council of Agricultural Research (ICAR) with its headquarters at Bhubaneswar, Orissa and sub-centre at Bhopal, Madhya Pradesh, in India. The present mandate of the center is “To identify gender issues and test appropriateness of

available farm-technologies/ programmes / policies with women perspective for promoting gender mainstreaming in research and extension for empowerment of farmwomen and capacity building of scientists, planners and policy makers to respond to the needs of the farm women."

For any information please write to:

The Director, National Research Centre for Women in Agriculture (NRCWA), Indian Council of Agricultural Research, Baramunda, Bhubaneswar, Orissa-751003, Phone: 0674-2600947, 2601012, 2600276 (O).