

Turning Garbage into Gold – Sharing experience from Gujarat, India

Varsha Parikh, Lecturer, Mousami Phukon, ex PG student,
Faculty of Family and Community Sciences, M S University of Baroda,
Vadodara, Gujarat

ABSTRACT

Today, environment degradation has become a matter of concern because of the systematic approach of viewing the earth and man as one of its many subsystems. There is a growing realization of the constant interaction between the subsystems and with the environment. These issues revolve around the central concept of quality of life with reference to environmental quality, depletion of natural resources and growing pressures of population. The environment requires ecological balance and sustainability. A major cause of agricultural environment degradation is the use of chemicals in farming. This gave birth to organic farming, based on specific standards precisely formulated for food production. It aims at achieving an agro eco system, which is socially and ecologically sustainable. Vermicompost is an eco-friendly natural manure prepared from biodegradable organic wastes and is free from chemical inputs. A project to promote vermicomposting for small and marginal farmers was taken up in the Gohilpura and Kotna villages of Vadodara district, Gujarat. The visualized effect and progress achieved in this community-centered project of vermicomposting was measured with the three main goals of capacity building namely; (a) Replicability which was visualized and measured by checking project worker, participants and collaborative organization's ability to expand the project. (b) Effective use keeping in mind the optimal use of manure for domestic and commercial purposes as well as its consistent use by project participants and (c) Sustainability which was achieved by strengthening individual project participants as well as through management of resources. The success of the project provided high credibility to the villagers within and outside the village as well as the collaborative organization.

Introduction

Environmental Status in India

The word 'environment' is very broad in itself. It consists of a number of natural

resources in terms of air, water and trees etc. The population 'is increasing day by

day as is the demand for food, clothing and shelter. Issues related to the environment revolve around the central concept of quality of life with reference to the environment quality, depletion of natural resources and growing pressures of population. There is no easy way out whereby the coming generation may find pure air, ample living space, and safe climates. Protection of the environment requires an individual, community and society to work together.

Exploitative land use practices in rural India

Human communities are an integral part of the eco system. They are born out of the ecosystem and live on it. In farming, by far the largest human activity, people make use of natural resources like soil, water and bio diversity in a given climatic situation to make a living and make money. Some resources are renewable, within limits; others are not. The manner in which these natural resources are utilized may amount to 'exploitation' or 'conservation'. Our resource use pattern in farming must be more conservational than exploitative. Indian farming patterns have been witnessing severe exploitation. An alternative agricultural system is needed which integrates traditional practices with a modern understanding of life science. It is essential that the extension system builds the sensitivity and capacity of farming communities with regard to eco friendly farming alternatives as opposed to exploitative systems.

Organic Recycling through Composting: The environmentally and economically sustainable solution

Nowadays organic farming is gaining wide attention among farmers, entrepreneurs, policy makers and agricultural scientists because it minimizes dependence on chemical inputs like fertilizers, pesticides and other agro chemicals and safeguards and improves the quality of resources and the environment. It is labour intensive and

provides an opportunity to increase rural employment and achieve a long-term improvement in the quality of resources by using organic manure.

Vermicomposting

The term "vermi-composting" means the use of earthworms for composting organic residues. Earthworms can consume practically all kinds of organic matter. Compost is produced by using clean, environment-friendly, pathogen-free raw materials, making the plants healthy. It is organic manure produced as the vermicast by earthworms feeding on biological waste material and plant residues. Vermicompost is an eco-friendly natural manure prepared from biodegradable organic wastes, free from chemical inputs and does not have any adverse effect on soil, plant or environment. It improves the physical structure of the soil and attracts deep-burrowing earthworms already present in the soil. It improves water-holding capacity, enhances germination, plant growth and crop yield, improves the nutrient status of soil, both macro and micro nutrients and promotes better root growth and nutrient absorption.

Rationale behind the project

Mother earth is already on the slippery slope to ecological disaster. With the depletion of vital nutrients in our soil and the over production of crops, the ability of the soil to regenerate and heal itself lessens each year. Unless the substances taken out are put back into the earth, the soil will degrade more each year and the food supply will become less nutritious. We need to get back to basics and help to rebuild the soil. Successful experiments of vermicomposting by several private and government organization have been conducted at household and farm level in India viz by Kheti Virasat Mission (KVM) (2007), Bharatiya Agro Industries Foundation (BAIF) (2005) and Lila Agrotech (2000). Consequently, the project to promote vermicomposting among farm men and women from the selected villages of Vadodara district was taken up by the project worker in the Department of Extension and Communication, Faculty of Family and Community Sciences, The Maharaja Sayajirao University of Baroda, thinking it may be beneficial to village farmers in the following ways:

Objectives of the project

1. To develop understanding among farm men and women of selected villages of Vadodara district regarding segregating garbage into degradable and non-degradable waste
2. To develop skills among farm men and women to implement vermicomposting as a technique of waste management
3. To guide farm men and women to utilize vermicompost in their farms/gardens or for sale
4. To promote vermicomposting among farm men and women from selected villages

Methodology

Stage 1 Planning the project

Planning is required to carry out the work systematically and within a calculated period of time. The plan of activities provides a framework within which the predetermined activity has to be completed. Planning answers questions like what, where, when and how a particular activity needs to be carried out.

The project was planned to make it successful. Planning was based on Training and Visits concept of Extension. The following steps were taken in Phase-I.

i) Identification of environment action plans by various agencies

To explore possible areas for planning an action project relating to environment prevention, the project worker visited many agencies and voluntary organizations in Vadodara district which worked in the area of organic farming viz Naturopathy Centre (Gotri), Nature Conservation and Renewable Energies (Nature CARE), Society of Village Development in Petrochemicals Areas (SVADES), Deepak Charitable Trust (DCT), to understand their action plans in the areas of waste management.

Meetings, visits and observations helped the project worker to know that there are various types of waste in rural areas namely community waste, waste from agricultural and agro based industries, animal wastes and oil bearing seeds. Lots of unutilized agricultural waste is available in villages - leaves, farm litter, animal and bio waste.

Hence, the project worker thought to make rural people realize the quantity of biodegradable waste in their villages and

farms and the potential of unused biodegradable waste when used for vermicomposting.

ii) Collection of information on Vermicomposting

The project worker met experts from various agencies and voluntary organizations (Nature CARE organisation, Vadodara, Naturopathy centre at Gotri and Nimeta) and gained information and literature about vermicomposting as a manure production and waste management technique and about developing vermicomposting in small and large units.

iii) Collaboration with existing organizations

Surveying and studying environment action plans of various organizations/agencies and collection as well as reviewing of information on vermicomposting helped the project worker to visualize and design different dimensions of the project. For instance, co-operative participation, decision making ability of individuals, effective utilization of human and non-human resources, sustainability and replicability. Hence, the project worker decided to seek the collaboration of existing working organizations and approached SVADES, Vadodara, discussed the project with its chief executive and was asked to submit a proposal.

iv) Selection of villages

Before finalizing project sites, visits to different adopted villages of SVADES namely Koyal, Angadh, Dhanora, Kotna, Gohilpura and Ranoli were made. Gohilpura, 18 km from Vadodara, with a 75% farm population, had more agro and animal waste than other villages. Villagers used to dispose of the waste on the outskirts or put it on fields/farms. The villagers were unaware of any useful purpose for waste. So Gohilpura was selected for project activities.

Kotna, 22 km from Vadodara city, with 80% farm population was also visited. Agriculture is the main occupation of this village. SVADES had already tried to develop Kotna as a model village and had showed keen interest in starting a vermicompost project. During the project worker's visit, leaders and some active farmers showed their willingness to participate in the project so this village was also taken up.

v) Training of the Project worker

Before planning and executing the project the project worker adopted vermicomposting first at her home during May-June, 2007.

vi) Learning materials under the project

The most effective learning is a combination of seeing, hearing and doing. Audio-visual materials facilitate, make experiences concrete and meaningful, which provide quicker and greater understanding to the learners.

The project worker prepared a set of charts in Gujarati covering topics like the process of preparing the vermicomposting unit, points to be kept in mind while adding waste in the unit, care to be taken during the process and the benefits of adopting vermicomposting.

Stage II Execution of the project

a) Approaching and attracting people for vermicomposting

With the help of SVADES project officers and field workers, the project worker started approaching farm men and farm women in Gohilpura and Kotna in June 2007 using learning materials she had prepared. She explained the benefits of vermicomposting as a feasible method of waste management, the deterioration of land quality due to increasing use of chemical manure and the contribution of farm men and women in the use and adoption of vermicompost manure.

b) Arousing interest, convincing people and promoting awareness

In initial meetings, the project worker convinced people by talking to them personally and showing the benefits of adopting this technique with the help of learning materials.

Thirty-seven household/farm people were approached from which twenty were convinced to start the project in the first round.

c) Leading to action and guiding to manure production

The project was carried out in two phases.

- a) Phase I – Execution of action plan with first group of participants.
- b) Phase II – Execution of action plan with second group of participants.

PHASE I - Execution of action plan with first group of participants

The following steps were carried out by the project worker with the first group of twenty participants:

- a) Demonstration of vermicomposting
- b) Guiding and leading participants to adopt the necessary steps for the vermicomposting process

Demonstration of vermicomposting

After convincing people, the project worker inspired participants to implement the project systematically. Demonstrations can illustrate and explain a new production method, new tool or can show results in a convincing manner. Hence, the project worker organized demonstrations in both villages separately at key leaders' places at a time convenient to all participants.

b) Guiding and leading participants to adopt vermicomposting process

1) Collection and segregation of garbage and preparation of vermicompost units

The session of practical work was held to actualize operations shown in the demonstration. Participants were instructed to select either a container for a small unit or a site/open place to start a large unit.

In Gohilpura, the farm women initiated the project on smaller scale by using containers. A kit containing a bamboo basket (2ft high, 2ft area), hand gloves (1 pair), litmus paper (1 strip), along with an informative pamphlet in Gujarati, was provided from SVADES to each of the ten participants. They collected other materials on their own like wastes (garden waste, agro waste, kitchen waste), animal waste (10 – 15 days old), gunny bags (to cover the basket, to prepare the base) and bricks (2 for one unit). In Kotna, the participants had their own farms, where large amounts of agro and garden waste were regularly produced. The farm men had large open spaces at the backs of their homes. Hence, the bedding technique was used to obtain vermicompost manure in their unused plot. A kit containing 110 bricks, a thick plastic sheet (12ft x 4ft), hand gloves (1 pair), litmus paper (1 strip) and informative reading in Gujarati was provided from SVADES to each of the ten participants to develop bedding for large units. They were instructed to collect other required materials like wastes (garden waste, agro waste, kitchen waste), animal waste (10 –

15 days old) and gunny bags (to cover the unit).

Next, participants collected and segregated the quantity of organic kitchen, agro, garden and animal waste required as per size of unit. Family members helped with waste collection. The harmful effects of adding non-biodegradable wastes on earthworms were explained. They were instructed to separate the following types of waste before collecting garbage for the units:- plastic bags and wrappers, metal / stones / rubber, oily and spicy food waste , wrappers of medicine and aluminum foil /glass

2) Preparation of waste layers in vermicompost units

The participants collected degradable waste like dry leaves, peels of vegetable and fruits, left over foods from the kitchen/farms and animal waste and laid these in their selected containers/beddings. In small units a layer of 2 inches was prepared at the base of the basket with materials like coconut coir and dry leaves. A second layer of 4-5 inches was prepared with the collected degradable wastes under the guidance of the project worker. For large units two layers were prepared of about 4 inches thickness of bedding materials like coconut fibers, sugarcane trash, grasses or dry banana leaves by cutting them into smaller sizes under the guidance of the project worker. This layer served as a home for the earthworms during compost preparation. Then the project worker guided participants to prepare the second layer of 6-8 inches thickness on the bedding, of old dry cow dung and dried sludge from the biogas plant. This second layer being partially digested waste serves as food for earthworms. These two layers of 1ft thickness from the ground were prepared within one month by participants of large units to help the earthworms settle under temporary adverse conditions like excessive heat in the afternoon or temporary water shortage occurring for short periods. The project worker also took expert help in checking the thickness of layers in the first phase of large units.

3) Checking of pH level and introduction of earthworms in the units

After preparing base layers in small and large units, animal waste and red earthworms (*Eudrilus Eugeniae*) were added. Before introducing earthworms, the

pH (Hydrogenic Concentration) levels in the bedding waste mixtures were measured. *Eudrilus Eugeniae* earthworms were then introduced in the required amounts. Each small unit of ten members received 250gms of earthworms worth about Rs.75, whereas each large unit of ten members received 5kg of earthworms worth about Rs.1500 from SVADES. The project worker demonstrated the introduction of earthworms in the units to the participants. They were lightly placed on the second layer in a uniformly distributed manner on the surface. Inoculation of the earthworms was carried out carefully so as not to crush or harm them. Initially, some of the women were very reluctant to touch the earthworms, but the project worker again motivated and interacted with them which helped them to get over their aversion to handling earthworms.

4) Maintenance of humidity in vermicompost units

The participants were told that the second layer should be sprinkled with water mixed with cow urine, keeping the surface slightly moist. The project worker visited every unit on alternate days and provided necessary instructions. The process of garbage conversion into manure was faster in the small units than the large units because there was a smaller quantity of waste.

5) Taking care of vermicompost units

The project worker instructed the participants to cover their baskets/bedding with jute sack and sprinkle water regularly to maintain a humid atmosphere. The temperature was measured and pH levels checked after one week.

Other villagers were influenced by what the participants were doing and a second group took shape in both villages. The project worker decided to develop a trainer's group from both villages to carry out the action plan of phase II with the second group.

Phase II – Execution of action plan with second group of participants.

This phase included selection of trainers, imparting training to trainers on vermicomposting, approaching second group of participants and execution of

vermicomposting process with second group of participants by trainers.

a) Selection of trainers

To strengthen replication of project activities within and outside the villages, the project worker prepared trainers from the first group who had already successfully completed the vermicomposting process. She selected four leaders from each of the two villages on the basis of their abilities in terms of clarity of the content, communicating skills and successful results of their projects.

b) Imparting training to trainers

These key leaders were charged with the responsibility of conducting training with new groups and given in-depth information and IEC materials used in the project. In interactive sessions, participants were taught to discuss vermicomposting at length, answer questions and guide the practical work for new participants. This boosted their confidence and ability.

c) Approaching the second group

The project worker approached motivated groups, which emerged as a result of Phase-I in both villages. There were fourteen participants from Gohilpura and ten from Kotna. Trainers and the project worker discussed the options of unit selection. Fourteen participants from Gohilpura selected small units while ten from Kotna selected large units. SVADES was asked to provide kits but not earthworms which are earthworms costly. The project worker developed a strategy of "pay an interest" by providing at least fifty percent of earthworms to the new recipients of the project, after the first round of manure production.

d) Execution of vermicomposting process with second group

Trainers in respective villages were guided to follow the steps of Phase-I, gave demonstrations and explained the vermicomposting process to the second group of participants. The project worker summarized the whole session and directed trainers to adopt practical work.

PROJECT OVERVIEW

In all, there were forty-four participants who adopted vermicomposting in the first and second phase of the project as described in the following diagram:

Figure 2: Diagrammatic representation for execution of the project.

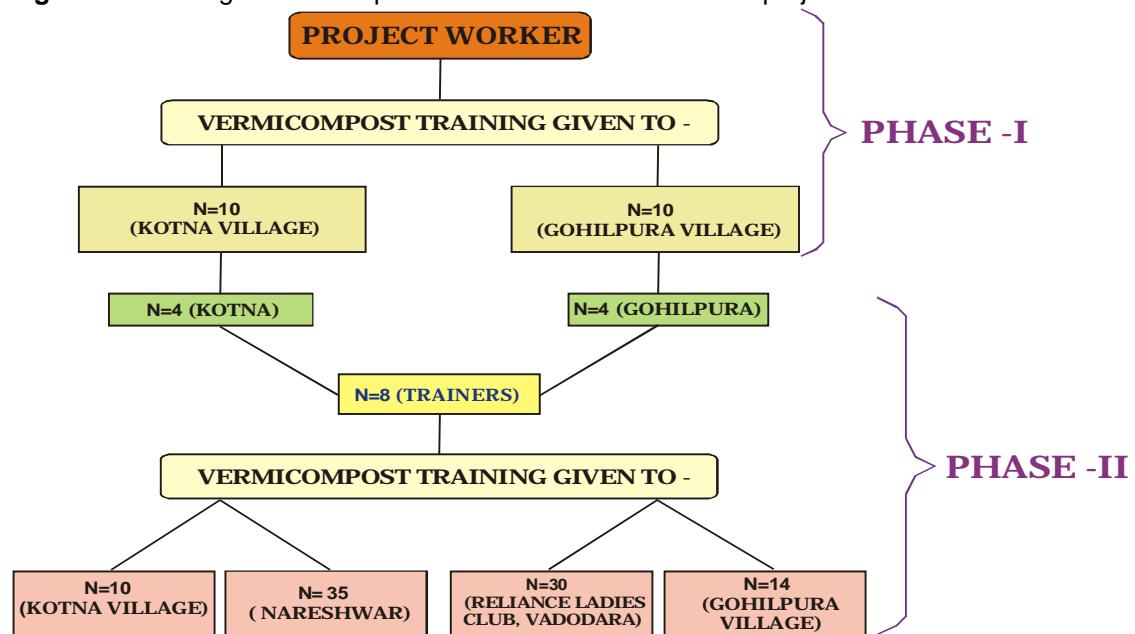


Table 1: Types of units adopted by farm men and women from Gohilpura and Kotna

Sr. No.	PROJECT UNITS	PROJECT PARTICIPANTS	
		GOHILPURA	KOTNA
1	Small (using bamboo basket)	20	-
2	Large (preparing bedding)	4	20
	<i>TOTAL</i>		44

Stage III Monitoring and Evaluation of the project

The project worker monitored each phase of the project execution namely waste segregation, collection of garbage and maintenance of soil humidity for the first group participants, by personal visits. The monitoring was done to check for Collection of required amount of garbage, Growth of the earthworms, Maintenance of the humidity in the vermicompost unit, Production of manure and Problems faced

in a project execution. Every week visit to both the villages were made by the project worker to check and understand progress of first and second group of participants and also to interact with the trainers regarding vermicomposting process. Total production of vermicompost manure in small and large units by project participants within the project duration of September 2007- April 2008 was as follows:

Table 2: Total production of manure under the project

Sr.No.	Production unit	No. of units	Production of manure (in Kg.)
1	Small	20	1132
2	Large	24	6162
	TOTAL	44	7294

Testing the nutritive value

To test the nutritive value of the manure, the project worker and SAVDES approached the agriculture department of Gujarat State Fertilizer and Chemical Limited (GSFC), Vadodara to test samples and match them with the ideal requirement of nutrients in fertile soil. All the samples were rich in nutrients.

RESULTS AND DISCUSSION :

The project worker constructed a reaction scale to evaluate the project after its completion. The results after administration of the reaction scale are reported under four categories:

- 1) Background Information
- 2) Opinions of the project participants regarding vermicomposting project
- 3) Trainer's opinion
- 4) Benefits of the project

BACKGROUND INFORMATION

Background information revealed that 81.81% of the participants were in the age group 15 – 40 years, living in joint families. 50% were male and 50% female and 40.9% were educated to higher secondary level. 54.54% were also doing business like running shops and driving cars and 45.45% were occupied in service as *aanganwadi* workers, nursery assistants or labourers. 70.45% had a monthly family income ranging between Rs.1001 and Rs.2000. All the participants possessed their own farms, were using animal waste as natural manure and 97.72% were using chemical manure in their farm. 88.37% spent Rs.100 to Rs.500 monthly to buy manure whereas 11.62 percent of the participants spent between Rs.501 to Rs.1000.

OPINIONS OF PROJECT PARTICIPANTS REGARDING VERMICOMPOSTING PROJECT

- Ø Regarding content and teaching learning materials all the participants felt that it was complete and easy to understand. Regarding instruction and procedures of teaching methods used by project worker, (demonstration and discussion) both the methods were found suitable, and easy to understand by all participants. 90.90% found field visits an effective method while the rest had not gone on these visits for personal reasons.
- Ø All the participants felt that vermicomposting was useful as a waste management technique and

showed an interest in continuing the vermicomposting project.

Ø With regard to reasons for participation in the project, 95.45% participated in the project to develop cheaper manure, followed by management of biodegradable waste (90.90%). More than three fourths (77.27%) participated to generate a source of income, as well as to learn something new thing (72.72%).

Ø With regard to assistance in the project activities, all the participants took help for execution of the project. 77.27% took help from family members followed by neighbours and friends (72.72%). A very few percent of the participants took help from labour (18.18%).

Ø With regard to types of help sought during project activities, participants reported that 56.81% took help for introducing earthworms into the unit and taking care of the units, whereas 50% took help for using manure in farms/kitchen gardens. 40.90% took help for collecting waste, putting waste into the unit and selling the manure.

Ø With regard to problems faced by the participants in the project, 86.36% did not face any problems. 13.63% faced problems of flies, mosquitoes, ants, snails and other insects.

Ø With regard to the participants' opinions regarding promotion of vermicomposting to others, all the participants said that they would like to promote vermicomposting to others. 81.81% would like to promote this technique to their relatives and neighbours. 77.27% reported promoting this technique to their friends followed by family members.

3) TRAINER'S OPINION

All the trainers provided training to other groups within and outside the villages. With regard to the problems faced while imparting training to others on vermicomposting by trainers prepared under the project, 62.5% of the trainers didn't face any problems whereas 37.5% faced problems giving instructions to others.

4) BENEFITS OF THE PROJECT

With regard to the reasons for adoption of vermicompost by others in their villages, all the participants felt that other people

should adopt vermicomposting. 54.54% felt that other people should adopt vermicomposting, as it is a technique for producing cheaper manure. 31.81% reported that this technique could be adopted to generate income for the family. With regard to vermicomposting as a useful technique, findings revealed that all the participants felt vermicomposting was an economically, ecologically and socially helpful technique. Furthermore:

- In terms of economic benefits, 95.45% felt that this technique was useful to obtain cheaper manure. 90.90% reported that this technique is helpful to promote family incomes. 72.72% felt that this technique could reduce the use of chemical fertilizer.
- Regarding ecological benefits 93.18% felt that it saves land degradation and provides long life to the products. Participants also felt that vermicomposting is helpful by getting nutrient rich manure (90.90%) followed by management of biodegradable waste (81.8%) and rehabilitation of soil (79.5%) respectively. 63.63 felt that vermicomposting leads to a sustainable environment.
- In terms of social benefits 90.90% felt that this type of project helped them to raise their status as organic farmers, followed by feelings of making social bonds stronger, by bringing like-minded people of the community closer as well as becoming responsible citizens by keeping the environment clean (88.63% and 86.36% respectively).

Achievement of the project at a glance

The visualized effect and progress achieved in the community-centered project of vermicomposting was also checked, measuring three main goals of capacity building namely; A) Replicability B) Effective use C) Sustainability

A) Replicability

This goal was visualized and measured by checking project worker, participants and collaborative organization's ability to communicate to expand the project.

i) Efforts of project participants

One-third women of Gohilpura expanded their vermicomposting units from small to

large without seeking any assistance from the collaborative organization.

ii) Efforts of project worker

- The efforts of the project worker were published by local print media namely The Times of India, Gujarat Samachar, Sandesh and Loksatta-Jansatta. As a result, seven different individuals/organizations contacted her and asked her to demonstrate this technique for adoption.
- New groups of participants in both villages are ready and trainers will follow the same steps.

iii) Efforts of collaborative organization

To expand the project, collaborative organizations offered a trainer's visit package for newly interested groups. Through this, trainers will develop their potentials and will be given the chance to replicate project work.

B) Effectiveness

This goal was visualized and measured, keeping in mind optimal use of manure for domestic and commercial purpose as well as its consistent use by project participants. In all, 7294 kg manure was produced in the project, by forty-four participants. Out of that, 7107 kg worth Rs.35,535.00 (1 kg = Rs.5) was regularly used by participants for their own farms and the rest was sold to earn a profit. Commercialization of the vermicompost manure was done as per participant's demand. SVADES provided a platform, where with the help of the project worker participants sold their manure at two major outlets, an exhibition of Reliance Ladies Club and in United Way Mela, 2008 in Vadodara. Few participants explored their own avenues to sell manure. In all, through different outlets, 187 kg vermicompost manure was sold and earned Rs.1445.00. The profits were distributed among participants according to their share of manure.

C) SUSTAINABILITY

This goal was achieved by strengthening individual project participants as well as through management of resources.

a) Strengthening individuals' capacity

- Ø During project execution at the end of phase-I, the second group of participants in both villages was ready to adopt project activities, and later on trained.

- Ø Eight leaders were selected and trained to sustain future project activities.
- Ø Trainers conducted four training programmes, two within Gohilpura and Kotna and two in outside communities like Reliance ladies club of Vadodara and farmers of Moti Koral village, Nareshwar, Vadodara.
- Ø Two more new groups are ready within two selected villages to adopt vermicomposting.

b) Management of resources

To make availability of earthworms easy within the villages, sustainable management of resources was visualized. The project worker emphasized the importance of earthworms and asked participants to "pay an interest" by providing at least 50% of earthworms to new recipients of the project after the first round of manure production.

Conclusion

The project results were quite encouraging. Vermicompost manure was used by participants regularly to achieve better results in their plants and farms. It indicates that adoption of such practice needs to be promoted to large numbers of people in society. It solves the problem of garbage management and also develops sustainability of soil nutrients and provides better natural manure. However, adoption by handfuls of people will not serve much purpose. Everyone must unite in promoting and adopting vermicompost manure to ensure a better environment in.

References:

ANNADURAI, K. and PALANIAPPAN, S.P., Organic Farming – Theory and Practice, Scientific Publishers India, Jaipur, 1999, pp. 74- 92.

BRITHA, M., Methods for Development Work and Research, Sage Publication, New Delhi, 2005, pp. 169-190.

CHARY, S.N. and VYASULU, V., Environment Management, Dariyagunj, New Delhi, 2001, pp. 1-10. DAVE, S., An Action Project on Waste Management Through Vermicomposting at Household and Industrial level, Baroda 1996. Dissertation (M. Sc.).....The M. S. University, 1997.

DHAMA, O. P., Education and Communication for Development, Oxford Publication, New Delhi, 1985.

GUPTA, M., Organic Agriculture Development in India, ABD Publishers, Jaipur India, 2004, pp. 73-79.

GALA, K., Vermi composting Manual, Nature CARE (OASIS), Vadodara, 2004, pp. 12-31.

KOHIL, A., KOTHARI, S. and CHOUDHARY, A. P., Management of Environment Pollution, Encouave publication, 2003, pp. 108-118.

Krikhi Darkhon. (T. V. Programme), Dibrugarh Doordarshan, Assam, Oct 2007. 30 min.

MODI, N. L., Compost manure, a viable alternative, *Yojana*, Vol.33, No.11, June 1986, pp. 25-33.

OZA, G.M., Calcutta: Waste Recycling Capital of the World, *Environment Awareness*, Vol.14, No.3, July-Sept 1991, pp. 115-120.

PANDYA, P., Vermicomposting – Manual, Shaktikunj Haridwar Publication, Uttarakhand, 2002.

REDDY, K. and REDDY, N., Environment education, Neelkamal publications Pvt. Ltd., New Delhi, 2003.

SUPE, S.V., An Introduction to Extension Education, Mohan Primali for Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2002, pp. 35-42.

SAXENA, H., Environmental Management, Rawat publication, Jaipur, 2002, pp. 64-67.

SOCIETY FOR CLEAN ENVIRONMENT (SOCLEEN). Grow Chemical free Fruits and Vegetables with Vermiculture Biotechnology. Baroda, 2006.

TRIPATHI, G., Vermi resources Technology, Discovery publication, 2002, pp.81-101.

WEBLIOGRAPHY

- <http://info.lut.ac.uk/departments/cv/wedc/papers/1ain.html>
- http://en.wikipedia.org/wiki/Vermicompost#Vermicompost_properties
- http://agri.and.nic.in/vermi_culture.htm
- <http://www.arushigramudyog.com/vermicompost.htm>
- <http://www.manuremaiden.com/blog/2007/12/what-is-manure-vermicomposting.php>
- <http://en.wikipedia.org/wiki/Vermicompost>
- http://journeytoforever.org/compost_worm.html
- <http://www.wormdigest.org/content/view/441/2/>
- http://www.karmayog.org/library/html/libraryofarticles_613.htm
- <http://en.wikipedia.org/wiki/bigha>