Feasibility of Biomass Recycling of Arecanut based Cropping System

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Introduction

Plantation crops have sufficient potential to benefit from natural farming and sustain their yield with low external input as they produce considerable quantities of biomass for recycling. One hectare of arecanut plantation gives about 8000kg of available biomass for recycling in a year and if utilized fully, it can meet the requirement of a major portion of the nitrogen requirement and a part of other nutrients (Nampoothiri, 2001). Under conditions in Assam, it is estimated that on an average six to seven tonnes of dry arecanut leaves are available from one hectare of a well maintained garden. The nutrient requirement of these crops can be met to a considerable extent if they are composted or recycled in the field. However, decomposition of dry leaves of arecanut is rather slow because of their high lignin and poly phenol content. Earthworms can mediate decomposition of lignin as well as poly phenol and thus accelerate the humification process. Vermicomposting is the method of composting the organic matter by earthworms under favourable soil moisture and temperature conditions. Central Plantation Crops Research Institute (CPCRI) at Kasaragod, Kerala has identified a local strain of earthworm (*Eudrilus* sp.), similar to African Night Crawler, which is quite efficient in composting coconut and arecanut leaves into granular vermicompost (Prabhu et *al.* 1998).

It is observed in the villages of Assam that each and every household is having arecanut based cropping system in their homestead garden with very poor scientific management resulting in poor yield. It is also found that huge amounts of biomass are available from the arecanut based cropping system, which can be recycled through vermicompost technology for better nutritional management of the existing crop. Though fertilizers are instrumental in

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increasing farm output, at the same time they are affecting the environment in a negative way. Now attempts are being made to maintain soil fertility through organic manure, which is rich in NPK and other vitamins, minerals, growth hormones etc. Though there are full fledged technology transfer programmes, the adoption level of vermicompost technology is very low in the farmers' field. The method of vermicomposting of biomass of arecanut based cropping system has been standardized at CPCRI, RC, Kahikuchi, Guwahati.

With the above background, an attempt was undertaken in the farmers' field through a comprehensive extension programme in the form of technology training cum demonstration with an objective to study the feasibility of recycling the biomass of arecanut based cropping system.

Materials and Methods

A survey was undertaken to understand the feasibility of vermicompost technology in the farmers homestead garden. The survey was conducted in two villages under Rani Development Block of Kamrup district, Assam, during the months of February-March, 2004. A team consisting of Scientists, Technical personnel, Research Associates of CPCRI, Kahikuchi and local farmers were involved during the survey for accomplishing the task. Techno-social aspects of the farmers such as size of operational land holding, homestead garden area, crops grown in the homestead garden, biomass available from arecanut based cropping system were collected and are given in Table 1. A total of 20 farmers' homestead gardens were selected in which 20 vermicompost pits were laid out. To estimate the available biomass, an area of 20 Sq.m. of 5m. length and 2 m. width was randomly chosen on two different sites in each garden. The biomass was then collected from specified area 20 sq. m. and subsequent study was undertaken. Details regarding awareness, knowledge, skill and adoption level regarding the vermicompost and general compost were collected before the initiation of the training cum demonstration and after the training cum demonstration period. After analyzing the survey data and sharing the experiences of the farmers, a comprehensive extension programme cum technology demonstration was undertaken for recycling the available biomass in arecanut based cropping system in the farmers' field. The programme including informal meetings, group discussion, training programme and technology demonstration was conducted in the farmers field and critical input such as earthworm (*Eudrilus* sp.) @ 100 numbers were supplied free of cost to each individual farmer.

Table 1. General information regarding the status of the homestead garden

1.	Average area of homestead garden	0.42 ha
2.	Average number of crops available in homestead garden: Arecanut Betelvine Banana Black pepper Coconut Fruit crops (Citrus, Mango, Guava, Papaya) Ginger and Turmeric Vegetables	108 42 22 11 4 14 m^2 area 60 m^2 area
3.	Available average estimated biomass per homestead garden	4 - 5 tonnes
4.	Available average estimated biomass per homestead garden per hectare	8 - 10 tones

Technology for Recycling the Arecanut Based Biomass Waste

Biomass collected in the system was allowed to decompose for 30 days and release of earthworm (*Eudrilus* sp.) @ 100 numbers per 100 kg of bio mass was carried out in each farmer's garden.

Composting Procedure

The collected biomass of different crops was chopped into pieces, weighed and put into pits by spreading the biomass in a thin layer and sprinkled with fresh cowdung @10% of the fresh weight of biomass. Then, earthworms were released in the pit. When the pit was filled to a height of 45-60 cm above ground level, the surface was plastered with 45-60 cm layer of mixture of cowdung. During non-rainy periods pits were sprinkled with water to maintain the moisture and were allowed to undergo decomposition and compost became ready in about 95 to 100 days.

Technology demonstration was started during June-July 2004 and continued up to June-July, 2005. Observations on recovery of vermicompost were recorded periodically.

Results and Discussion

Farmers' Homestead Garden

Based on the field survey, information gathered regarding farmers homestead garden status, available biomass etc is summarized in Table 1. The techno-social aspects of the farmers were collected and it is found that majority of farmers were in marginal to small farmer category. It is observed that arecanut is the most dominant plantation crop in their homestead garden (commonly called as *Bari*). It is most commonly observed in the farmers field that by and large each and every household was having homestead crops like arecanut, betel vine, Black pepper, banana, coconut, mango, jackfruit, citrus, ginger, turmeric, and vegetables etc. which were grown under rainfed condition and without any scientific management practices. It is found that on an average each farmer has 0.42 ha of area in their homestead garden. It is also found that quantities of biomass (8 to 10 tonnes/ha) are generated from homestead garden depending upon crops grown.

Impact of Technology Demonstration

Vermicompost Production

The amount of vermicompost produced, after the process, was recorded in all the farmers' gardens. It is revealed (Table 2) that 71.2 kg maximum and 46.2 kg minimum vermicompost could be produced from 100 kg of arecanut based biomass with mean 59.3 kg and standard deviation 6.95. The difference in recovery of vermicompost was mainly due to variation in maintenance of vermicompost pits by different farmers.

Economic Indicators

Economics of producing vermicompost is presented in Table 3. It is evident from the table that the return per rupee spent is Rs 2.40. This indicates profitability of the technology when adopted at the farmers' level.

Table 2. Vermicompost production characteristics in the farmers' field

Sl No.	Characteristics	
1	Total no. of Farmers actively associated	20
2	Total no. of Homestead gardens considered	20
3	Total no. of vermicompost units	20
4	Pit size of vermicompost unit	2.5m x 1m x 0.5m
5	Total biomass deposited	100kg
6	Total earthworms released	100
7	Maximum vermicompost production / Unit	71.25 kg
8	Minimum vermicompost production / Unit	46.25 kg
9	Mean/ Average vermicompost production	59.33 kg
10	Standard Deviation	6.95

Table 3.Economics of vermicomposting in farmers' field for one pit (2.5mx 1m x0.5m)

Sl No.	Economic indicator	Cost (Rs)
1	Cost of pit making (Labour cost)	Rs 75.00
2	Cost of earthworm (Eudrilus sp)	Rs 50.00
3	Total cost	Rs 125
4	Value of vermicompost produced (60kg @ Rs 5.00/ kg)	Rs 300.00
5	Gross returns	Rs 300.00
6	Net Returns	Rs 175.00
7	Returns per rupee spent	Rs 2.40

Impact of Training cum Demonstration on Techno-Social Characteristics of the Farmers

Impact of the training cum demonstration with regard to techno-social aspects of the farmers is presented in Table 4. It is evident from the data that, there was a drastic change in the awareness, knowledge, skill level and adoption

Table 4. Techno-social characteristics regarding vermicompost technology before and after technology training cum demonstration.

N = 20

Characteristics	Not at all		Poor		Medium		High	
	Before	After	Before	After	Before	After	Before	After
Awareness	18 (90%)	-	2 (10%)	-	-	3 (15%)	-	17 (85%)
Knowledge	20 (100%)	-	-	2 (10%)	-	5 (25%)	-	13 (65%)
Skill	20 (100%)	-	-	1 (5%)	-	3 (15%)	-	16 (80%)
Adoption	20 (100%)	-	-	4 (20%)	-	3 (15%)	-	13 (65%)

behaviour of the farmers after imposition of the technology intervention in their field.

Awareness: About 80% of the farmers were not at all aware of the vermicompost technology, and only 20% of the total farmers had poor level of awareness about the recycling of biomass through earthworms before the training. Awareness about the recycling of biomass through earthworms has increased remarkably after the training in the farmers' field. It was observed that, 85 % respondents had high level of awareness followed by medium (15%) level of awareness about the vermicompost technology.

Knowledge: Knowledge level about the vermicompost technology increased remarkably after the training in the farmers' field. All the farmers had no knowledge at all about the vermicompost technology before training. After the training, about 13 (65%) respondent farmers had high level of knowledge regarding vermicomposting followed by medium (25%) and poor (10%) level of knowledge.

Skill: Skill for vermicomposting the biomass increased remarkably after technology demonstration in the farmers' garden. None of the respondent

farmers had the skill for vermicomposting the biomass before initiation of the technology demonstration. After technology demonstration, about 16 (80%) respondent farmers had high level of skill regarding vermicomposting the biomass followed by medium (15%) and poor (5%) level of skill.

Adoption: Adoption level of respondent farmers was nil before the training cum demonstration. The data revealed that after the training cum demonstration in the farmers' garden, 13 (65%) respondent farmers had high adoption level followed by medium, 3 (15%) and poor, 3 (15%) adoption level.

Matrix Scoring of Technology/Feed back

The matrix scoring regarding advantages of vermicomposting compared with natural composting revealed that, the earliness in the effect of compost when applied to plants and easiness in application to the plants had higher matrix score (Table 5). Farmers had indicated their difficulty in getting the earthworms required for the vermicomposting. The farmers are satisfied with the performance of vermicomposting under homestead arecanut plantation. The farmers are under risk of heavy monsoon rainfall that may cause inundation of the natural vermicompost pit. Fellow farmers and neighbor farmers are requesting for the specific earthworm sp. as well as training programmes observing the verification trial plot of CPCRI, RC, Kahikuchi.

Table 5. Matrix Scoring (10 point scale) for vermicomposting and natural composting

Sl. No.	Characters/ items	Vermicompost	Natural composting
1	Higher cost of adoption technology	8	5
2	More Labour involved	8	5
3	Availability of material for composting	5	8
4	Earliness in the effect of compost when applied to plants	10	5
5	Ease in application	10	6

Conclusion

In arecanut based cropping system enormous amount of biomass is available for recycling through vermicomposting. An attempt was undertaken in the farmers' field by a comprehensive extension programme in the form of technology training cum demonstration to study the feasibility of recycling the biomass of arecanut based cropping system. On an average, it was observed that 60 kg of vermicompost could be produced from 100 kg of arecanut based biomass. Economics of producing vermicomposting indicated that the return per rupee spent is Rs.2.40. This indicates profitability of the technology when adopted at the farmers' level. The techno-social aspects like awareness, knowledge, skill and adoption level with regard to the technology for recycling the arecanut biomass have positively changed among the farmers during the study. Apart from this kind of specific earthworm, our local earth worm species should be screened out or identified for recycling the available biomass.

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