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Socio Economic and Environmental Benefits of Biogas Slurry

Yalemtsehay Debebe [1] Dr.Teshome Soromessa[2]
1. Jimma Agricultural Research Center, P.O. Box 192, Jimma, Ethiopia
2. Addis Ababa University, P.O. Box 1176, Adiss Abeba, Ethiopia

Abstract
This study was conducted in Sebeta Hawas Woreda with the objective of assessing socio-economic feasibility and environmental contribution of bio-slurry. The questionnaire survey was conducted to obtain information on the family size, number of cattle, type of fertilizer used, the amount of money saved by biogas using households when replacing chemical fertilizer with bio-slurry, bio-slurry storage and management, household yield increment and perception of soil fertility improvement by using bio-slurry as organic fertilizer. Bio-slurry is environment friendly as mentioned by 92 % respondents and 80.8 percent of the bio-slurry users save 1000-2000 ETB per year and 19.2% save 2000-3000 ETB per year.
Keywords: bio-slurry, fertilizer, environment

1. INTRODUCTION

Bio-slurry is an anaerobic digested organic material released as byproduct from the biogas plant after production of combustible methane gas for cooking, lighting and running machinery (SNV/Ethiopia, 2005). It is almost pathogen-free stabilized manure that can be used to maintain soil fertility and enhance crop production, reduces the probability of diseases transmitted by water, air, dust and insects because slurry does not attract flies or other vermin, the vectors for contagious diseases for humans and animals (Al Seadi *et al.*, 2008).

By substituting synthetic fertilizer and changing traditional manure management systems, biogas installation reduces the emission of green house gases into the atmosphere as well as in less diffuse pollution from surface run off and leaching. These direct benefits will help governments meet targets for reducing GHGs. Other major environmental benefits associated with using bio-slurry as organic fertilizer in place of untreated manures include: reduced odours and the reduction of weed seeds.

According to Devkota (2001), the economic value of the bio-slurry shows that the investment can be gained back in three to four years. It is estimated that the use of bio-slurry annually saves 39 kg of nitrogen, 19 kg phosphorus and 39 kg potash per household (East Consult, 2004).

2. MATERIALS AND METHODS

The study area is found in Sebeta-Hawas woreda, which is found in South-West Shoa Zone. It is found 25 km South-West of Addis Ababa.

of forty two Kebeles found in Sebeta Hawas woreda 3 Kebeles which adopted the biogas technology and already started the biogas production were selected purposively and semi-structured questionnaire was administered to 26 respondents belonging to 3 Kebeles in Sebeta Hawas woreda; 9 respondents from Dima (05 Kebele), 6 from Alemgena (02 Kebele) and 11 respondents from Sebeta (01 Kebele).

A pre- prepared interview questions with biogas owners house hold head were used during data collection. In addition, direct observations were also carried out to support the information generated from the households .

Some of the interviews and questions arose during the time of conversation to collect data were information about family size, number of cattle, the amount of money saved from biogas slurry using households and bio-slurry management and utilization status.

3. RESULTS AND DISCUSSION

3.1. Demographic Analysis of Respondents

Of 26 respondents questioned during this study, 84.6 % (22 persons) of the persons from biogas using households were males and 15.4 % (4 persons) were females. The average age of the respondents is above 45 years old with the average family size of 8 and minimum and maximum family sizes were 4 and 10. Regarding the educational statuses of the respondents, 3.85 % not educated 84.6% grades 1 to 8, 7.7% grades 9 to 12 and 3.85% above grade 12.Demographic characteristic has a key role in research study to understand an implication of development effort and plan for future. From the results obtained it can be concluded that educated people are more likely to be an owner of a biogas plant. Average household size was found to be 8 members per household which is higher than the national average household size 4.8. In respect to gender, the respondents indicated that it is not a matter of being male or female to be owners of a biogas plants but it is a matter of having enough family labor force, interest and financial capacity. Therefore, owning of the biogas technology was not affected by sex difference.

3.2. Land hold size of biogas users

The majority of biogas plant owners 15 (57.7%) have 1.5-2 ha land . The remaining 1 (3.8%), 8 (30.8%) and 2 (7.7%) own less than 0.5 ha, 0.5-1 ha and greater than 2 ha, respectively. According to the results obtained, owning farm size of less than 2 ha was advantageous with regard to applying the bio-slurry to their piece of land. Because, the biogas owners have better probability of maintaining their land using the organic fertilizer since applying is tedious work and the bio-slurry collected from 6, 8 and 10 cubic meter biogas plant is not enough to accommodate a large area of land.

3.3. Fertilizer types used by respondents

The fertilizer types used by the respondents revealed that, 15.4% used chemical fertilizer only, 11.5% used animal dung, compost and chemical fertilizer, while the remaining 7.7% used bio-slurry, compost and chemical fertilizer. The majority of the respondents used bio-slurry in combination with chemical fertilizer which is 65.4 %. From the results obtained we can understand that the owners of the biogas plant have started using bio-slurry.

3.4. Form of bio-slurry utilization

The bio-slurry can be applied in the field in different forms. Around 69.2 % of the households utilize it in compost form, only 30.8% utilize in liquid form.

The data from most of the biogas user households indicates that the form of bio slurry they used for soil fertility improvement and vegetable production was in compost form because users of the composted slurry mentioned that preparing this type of organic fertilizer reduces the challenge of transportation especially for farm lands which are sometimes far from the place where it is prepared and also liquid slurry was not always available at the time of field application.

3.5. Bio-slurry storage and management

Crop production is seasonal while the slurry production is continuous. Hence the need for storage of slurry arises. Present bio-slurry handling at the plant premises is highly unsatisfactory. None of the biogas plants have the proper system of bio slurry collection, drying, processing and bagging. The study revealed that majority of the biogas users (65.4%) stored composted slurry in heap without cover, 4% spread and dry on ground, only about 4% and 3% stored composted slurry cover on heap and under a shade respectively.

3.5.1. Training on management and use of bio-Slurry

Training is very much effective for proper use of bio slurry. Not all users have a clear understanding of the proper management of bio slurry. As it is shown in table 4.4, only 26.9 % respondents received training on use and management of bio slurry and remaining 73.1% did not receive training.

3.6. Comparing farmers' perception on soil fertility increment by bio-slurry or inorganic fertilizer

Assessment was made on what farmers believe in the effect of inorganic fertilizer and bio-slurry on the fertility of the soil. Most of the interviewed farmers (69.2%) believed that application of bio-slurry on soil increased the fertility of the soil. It is only (19.2%) of the respondent farmers who believed that use of inorganic fertilizer increases the fertility of the soil, while (7.7 %) replied both have similar effect on the fertility of the soil and 3.8% have no idea .

3.7. Socio- economic and environmental benefits that resulted from bio-slurry

3.7.1. Social benefits

Farmers face health problems from the use of chemical fertilizers that it causes poisoning if it is not kept properly and straw which is obtained from chemical fertilizer applied crops makes animals to be thin (Berihu Araya, 2012). According to the respondents, biogas had greatly benefited bio-slurry users by contributing to a significant reduction in skin problems, itching, death of cattle in case of grazed fertilizer together with grass etc. This is mainly because biogas slurry reduces the probability of diseases transmitted by water, air, dust and insects because slurry does not attract flies or other vermin, the vectors for contagious diseases, for humans and animals.

3.7.2. Economic benefits

3.7.2.1. Benefit from reduced use of chemical fertilizer

The respondents mentioned that chemical fertilizer is very expensive as compared to the organic fertilizer produced from biogas, 80.8 percent of the bio-slurry users save 1000-2000 ETB per year and 19.2% save 2000-3000 ETB per year. This result differs from the result of Claudia and Yitayal Addis (2011) who reported that the maximum money saved from reduced use of inorganic fertilizer is 682 ETB.

3.7.2.2. Income benefits from vegetable production

Majority of the biogas users (69.2%) reported that application of bio-slurry for vegetable farm increases their

income and only (30.8%) can not specify income benefits. Those respondents who sell bio slurry and those who apply the slurry to the crop field, both are economically benefited. Because by selling of bio slurry they earn extra money, and biogas digested manure improves crop yield with reduced cash outflow increasing their net economic benefits.

3.7.3. Environmental benefits

3.7.3.1. Environmental benefits of bio-slurry over inorganic fertilizer

Bio-slurry is environment friendly as mentioned by 92 % respondents. Using of bio-slurry for agriculture has significantly improved the household environment, kitchen environment, homestead surrounding environment, and social environmental condition. It was observed during field trips that biogas plant brings an aesthetic change within household.

4. CONCLUSION

Biogas slurry is an effective fertilizer as compared to chemical fertilizer because, biogas slurry has been found to be beneficial in decreasing the use of chemical fertilizers. This directly saves money for both farmer and government.

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Table 1. Demographic characteristics of the study population

Name	**Sample Areas**				
	Dimma (Kebele 05)	**Sebeta (Kebele 01)**	**Alemgena (Kebele 02)**	Total	Percent (%)
Number of Respondents	**9**	**6**	**11**	**26**	**100**
Sex	**9**	**6**	**11**	**26**	**100**
Male	8	4	10	22	84.6
Female	1	2	1	4	15.4
Age	**9**	**6**	**11**	**26**	**100**
31-45	6	1	4	11	42.3
Above 45	3	5	7	15	57.7
Educational level	**9**	**6**	**11**	**26**	**100**
Not educated		1		1	3.85
Primary(1-8)	8	3	11	22	84.6
Secondary (9-12)	1	1		2	7.7
Higher(12+)		1		1	3.85
Family Size	**9**	**6**	**11**	**26**	**100**
1-3			2	2	7.7
4-10	7	6	7	20	76.9
11 and above	2		2	4	15.4

Table 2. Total land holding size of the respondents

Land holding in ha	Frequency	Percent	Valid Percent	Cumulative Percent
Less than 0.5	1	3.8	3.8	3.8
0.5-1	8	30.8	30.8	34.6
1.5-2	15	57.7	57.7	92.3
Above 2	2	7.7	7.7	100
Total	26	100	100	

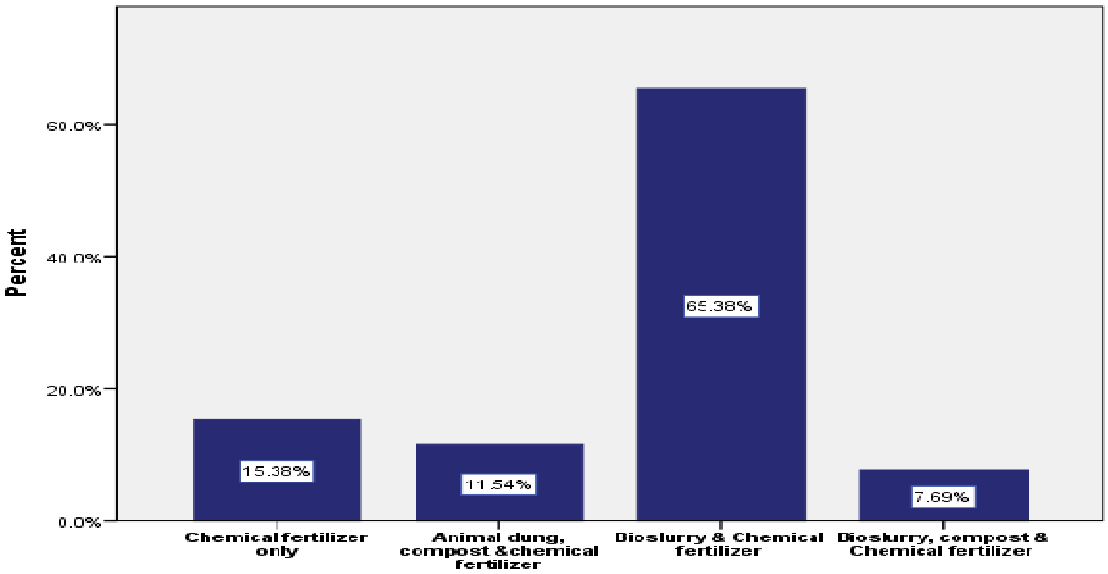

Figure 1.Types of fertilizer used by the respondents

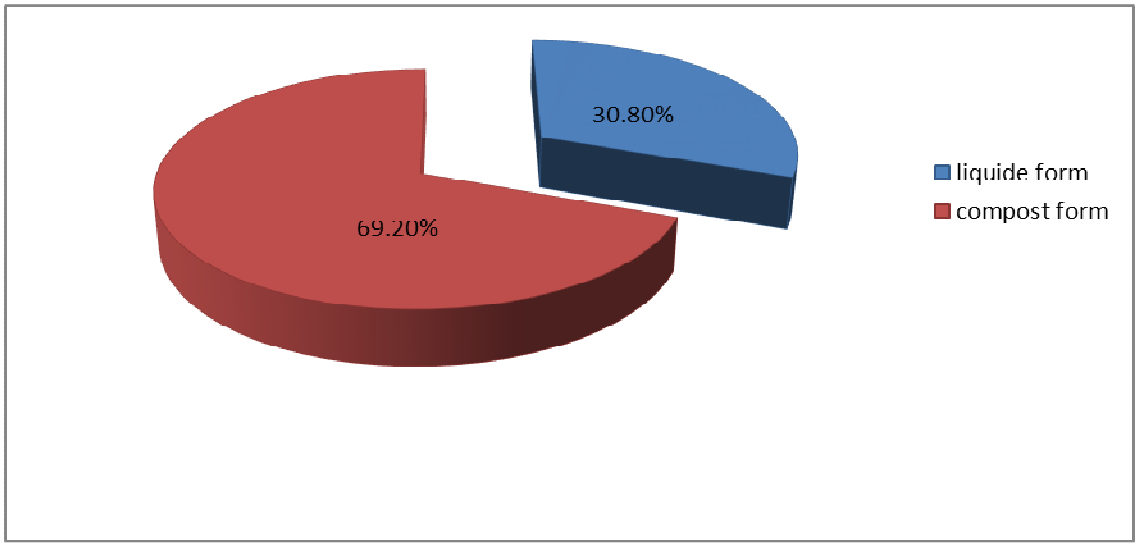

Figure 2. Form of bio-slurry used by the respondents

Table 3. Bio-slurry storage and management

Storage and management	Frequency	Percent	Valid Percent	Cumulative Percent
Spread and dried in ground	2	7.7	7.7	7.7
Keep in heap uncovered	17	65.4	65.4	73.1
Keep cover on heap	3	11.5	11.5	84.6
Pile under a shed	4	15.4	15.4	100.0
Total	26	100.0	100.0	

Table 4. Bio-slurry use and management training

Training	Frequency	Percent	Valid Percent	Cumulative Percent
Receive training	7	26.9	26.9	26.9
Not receive training	19	73.1	73.1	100.0
Total	26	100.0	100.0	

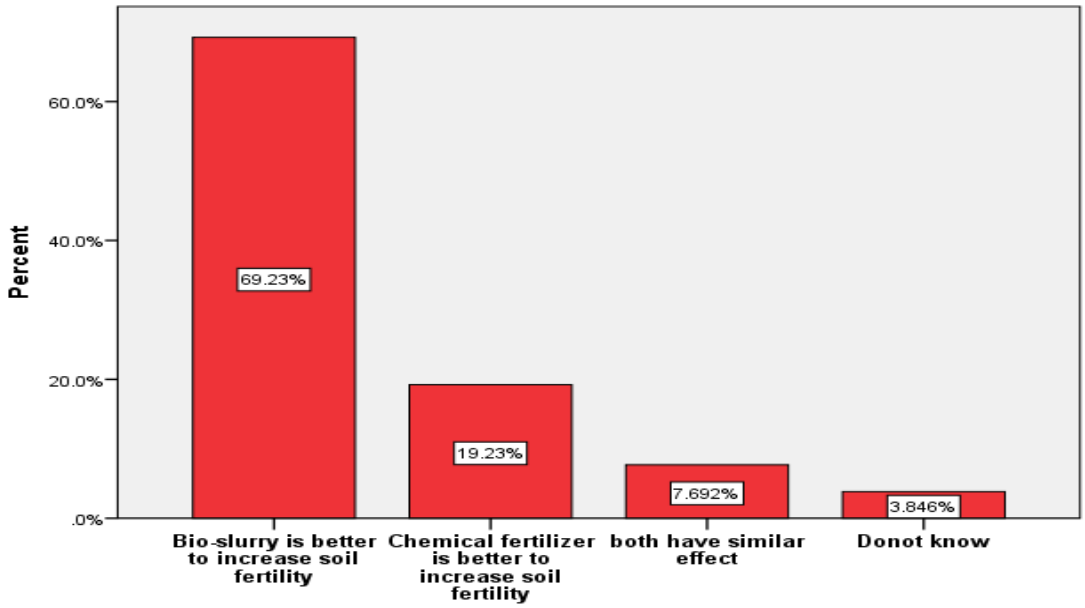

Figure 3. Comparison of farmers' perception on soil fertility increment by bio-slurry or inorganic fertilizer

Table 5. Comparison of health benefits of bio-slurry over inorganic fertilizer

Major problems	**Due to the use of chemical fertilizer**		**Due to the use of bio-slurry as fertilizer**		**Total # of respondents**
	Frequency	**Percent**	**Frequency**	**Percent**	
Skin problems	18	69.2%	0	0%	26
Itching	9	34.6%	0	0%	26
Death of cattle in case of grazed fertilizer together with grass	21	80.8	0	0%	26
Poisoning	16	61.5%	0	0%	26
Other problems	2	7.7	0	0%	26

Table 6. Money saved by using bio-slurry as organic fertilizer

Money saved by bio-slurry	Frequency	Percent	Valid Percent	Cumulative Percent
1000-2000	21	80.8	80.8	80.8
2000-3000	5	19.2	19.2	100.0
Total	26	100.0	100.0	

Table 7. Income benefits after bio-slurry usage for vegetable production

Income benefits	Frequency	Percent	Valid Percent	Cumulative Percent
Increase	18	69.2	69.2	69.2
Can not specified	8	30.8	30.8	100.0
Total	26	100.0	100.0	