BIO-SLURRY – IS IT A FERTILIZER IN THE MAKING?

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CHALLENGE

Agriculture for more than 50 % of Ethiopia's GDP, 90 % of foreign exchange earnings, 70 % of raw material for domestic industries, and 85 % of employment for the population. Although agriculture has a substantial contribution to the national economy, its impact to bring meaningful development to the country and feed the ever-increasing population is still unimpressive. The country still has a sizeable number of households that are food insecure. The situation is also further aggravated by a number of environmental challenges resulting directly or indirectly from human activities due to unsustainable agricultural practices, rapid population growth, and the consequent increase in the exploitation of natural resources.

In an effort to increase the agricultural production, Ethiopian farmers were first introduced to the use of chemical fertiliser in the late 1960s, when FAO's Freedom from Hunger Campaign started to advance the use fertiliser within the then existing extension system. After half a century, the chemical fertilizer consumption is still a mere 35 kg/ha (World Bank, 2006) which is the lowest in Sub-Saharan Africa. It is also still imported with hard currency, thus expensive, keeping it out of the reach of most farmers.

Under these circumstances, putting emphasis on locally available low cost organic manure becomes an attractive option. Traditionally, the smallholder mixed farms in Ethiopia value dairy cows for manure besides milk. However, this manure is used as commercial and domestic fuel and this has restricted its use as fertilizer to increase agricultural production. The use of manure as fuel has also caused many health related problems that come mainly through indoor air pollution. Proper use of bio-slurry can reduce the dependency of many farmers on increasingly expensive chemical fertilizer. Hence developing the knowledge base of bio-slurry as fertilizer can immensely contribute to the promotion of the uptake of biogas technology. In this connection, the benefits of bio-slurry need to be substantiated with scientific evidence to demonstrate to the agricultural experts and farmers, amongst others, on its impact to increased yield.

CLIENTS

Organisation	Function
MoWE – Ministry of Water and Energy, National Biogas Program Ethiopia	National Implementing Agency responsible for the regulatory and coordination of activities at national level
OBoWME – Oromiya Bureau of Water, Mines and Energy Resources AMERDA – Amhara Mines and Energy Resources Development Agency MEA-SNNPRS – Mines and Energy Agency in SNNPRS TMERDA – Tigray Mines and Energy Resources Development Agency	Government institutions responsible for the regulatory and coordination activities in their respective regions

METHOD / SNV INTERVENTION

Realizing the immense benefits, all biogas programmes supported by SNV in Asia and Africa, have included a bio-slurry extension component. The component aims at maximizing the revenues for a farmer on his investment by making optimal use of the bio-slurry as organic fertilizer to enhance agricultural productivity and trigger the market for biogas technology especially among the poor farmers. In line with this objective, SNV Ethiopia engaged LCB /Institute for Sustainable Development (ISD)/ to help in the documentation of knowledge on the use of bio-slurry from farmers' practices and from on farm research trials by using experts and MSc students from universities. The LCB also conducted training of trainers who later trained farmers on proper use of bio-slurry. Accordingly, this case is a documentation generated from data collected in Tigray and Oromiya regional states using the following methods.

Household survey
Two surveys were conducted in December 2009 and August 2010. Interviews and direct observation were used to collect data. In 2009, 35 households were visited. Similarly in 2010 another 71 households were visited in which some were included from the previous visits. Most of the households visited during the survey were the ones that installed biogas in 2008, so at the time when the survey was carried out these users had more than two years of experience.

Trial on farmers' fields
The research was carried out on volunteer farmer fields with a follow up made by the local development agents and experts that are trained with the crop sampling procedure developed by Institute for Sustainable Development (ISD). The local development agents and experts in Tigray received guidance from the ISD Project Officer stationed in the region, while in Oromiya, the good contact with the local experts enabled crop yield data to be recorded from few farmers using bio-slurry compost.

OUTCOME & IMPACT

Household survey results
Use of bio-slurry has opened up an opportunity for farmers to produce more fruit trees and vegetables in their homesteads since the bio-slurry, in its liquid form, can be used as a fertilizer. Moreover, it has increased the availability of appropriate and quality material for composting throughout the year, provided that other composting materials such as agricultural residues, biodegradable kitchen wastes, etc. are found in adequate quantity.

However, the utilization of bio-slurry varies from region to region. The variation is also visible between urban and rural areas even in a given region. Except in a few households, bio-slurry in urban areas is not mostly utilized but rather discarded to waste lands especially in Debre-zeit and Butajira towns. However, in recent months according to the information we got from the local energy expert in Meskan, his office in collaboration with Butajira municipality has started to collect bio-slurry from these households for the greening project of Butajira town. The bio-slurry is collected from each urban household using a plastic tanker purchased and distributed by the municipality. In addition, there is an ongoing negotiation with one Israeli company working around Butajira to sell the biogas bio-slurry for its horticulture nursery.

Table 1. Bio-slurry Management and Utilization in 8 woredas of program intervention areas (Field survey August 2010)

Regions	Form of utilization of Natural Fertilizer				Performance of compost and / or bio-slurry utilization			No. of compost pits			Shading of compost pit		Protection of compost pit	
	compost	bio-slurry	both	none	poor	good	v.good	1	2	3	yes	no	yes	no
Oromiya (21)	12	1	8	-	4	9	8	3	15	3	15	6	18	3
SNNP (22)	3	11	4	4	4	8	10	5	17	0	20	2	18	4
Amhara (13)	1	1	10	1	3	5	5	2	10	1	9	4	11	2
Tigray (15)	5	4	5	1	4	10	1	5	9	1	7	8	11	4
Total (71)	21	17	27	6	15	32	24	15	51	5	51	20	58	13
%age	**29.6**	**24**	**38**	**8.4**	**21.2**	**45**	**33.8**	**21.2**	**78.9**	**7**	**71.8**	**28.2**	**81.7**	**18**

Since the intervention in 2008, in all regions the bio-slurry coming out of the biogas digesters is being utilized as organic fertilizer in one or both forms indicated in the table. According to the results of the survey (see table 1), from the total sampled 71 households that installed biogas in 2008, 91.6 % use bio-slurry as fertilizer. Of those 38 % use both bio-slurry and compost, 29.6 % only in compost form and 24 % as liquid bio-slurry. Although there are still some farmers who need serious follow up most of the farmers prepare and utilize the bio-slurry according to the guidelines.

Preliminary trial results

Figure 1 clearly shows the positive impact of bio-slurry compost combined with row planting on the yields of the major crops in Oromiya (Adda'a and Hetossa):

teff increased by 60 %, maize by 91 % and wheat by 56 % over the control which was broadcast and using chemical fertilizer for teff, and row planted with chemical fertilizer for maize and bread wheat.

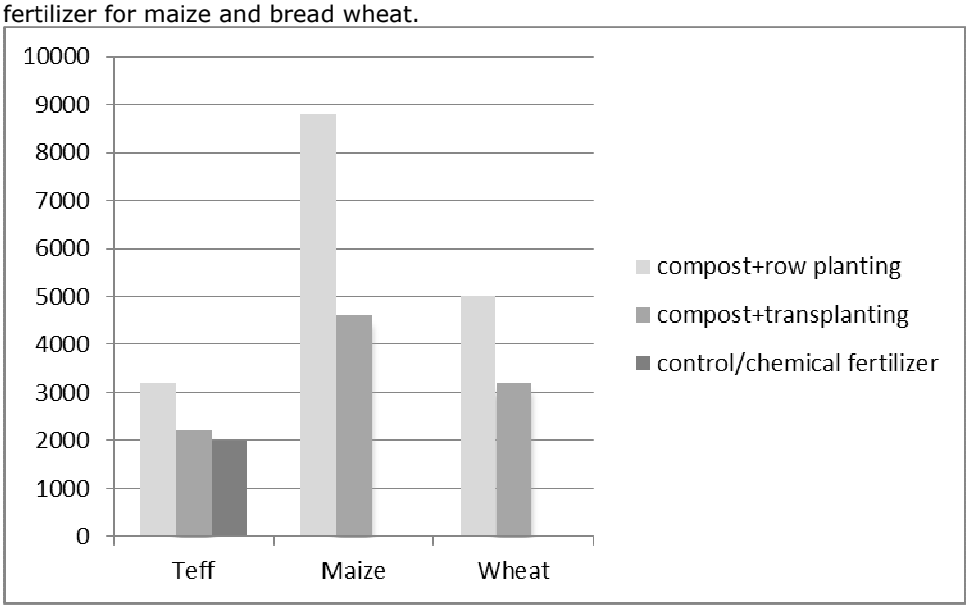

Figure 1: Grain yields of 3 crops (kg/ha) where farmers used bio-slurry compost in Oromiya, 2010 (Source: ISD report June 2011)

In both Adda'a and Hetossa, the farmers are using improved, potentially high yielding varieties that have been bred and selected mostly using chemical fertilizer, Urea and Di Ammonium Phosphate. It is, therefore, especially interesting to note that these varieties responded very well to the application of bio-slurry compost to the soil. Concerning Tigray farmers (Hintalo Wejirat and Ofla), the bio-slurry development agents recorded grain and straw yields from farmers that had used bio-slurry compost on their fields, as well as from farmers that had not used any fertility input (check) and in most cases also farmers that had used chemical fertilizer. The data were taken from fields growing either wheat or barley, as these are the dominant crops in these villages. In Hintalo Wejirat, none of the farmers had used chemical fertilizer and the response from applying bio-slurry compost to their fields was large: average wheat grain yield increased by 64% and that for barley increased by 72 % over the check (Table 2.). Even the farmers with poorer fields benefitted from the use of bio-slurry compost. For wheat the average yield for a poor field fertilized with bio-slurry compost was more than double from 1170 kg/ha (117 g/plot) to 2450 kg/ha, while that for barley increased from 1150 to 2270 kg/ha.

The data from Ofla show that applying bio-slurry compost and using chemical fertilizer resulted in increased yields for the farmers but the difference from the yield of the check was not as high as that found in the crop yields from the farmers in Hintalo Wejerat. The yields of grain and straw are comparable. One possible explanation is that, in a separate study, ISD has learnt that farmers in some parts of Ofla have been adopting a form of conservation tillage called stubble ploughing. This involves the farmers ploughing under the stubble soon after harvest in order for it to improve the organic content of the soil. Farmers also tend to leave a long stubble in their fields so that their domestic animals can graze on the stubble while dropping their urine and dung on the field. Such factors need to be recorded from the farmers alongside the taking of sample plots for recording yields of grain and straw.

Table 2: Grain and straw yield of major crops in Tigray, 2010

Woreda	Crop type	Treatment	Average grain yield kg/ha	Average straw yield kg/ha	Grain increase over check (%)
Hintalo Wejirat	Wheat	Compost	2800	3911	164
		Ch. Fertilizer	-	-	
		Check	1711		
		Compost	2628	4056	

	Barley	Ch. Fertilizer	-	-	172
		Check	1528	2417	
Ofla	Wheat	Compost	4505	4623	125
		Ch. Fertilizer	4607	4707	128
		Check	3607	3732	

Source: ISD report June 2011

Stories told by farmers

In rural areas of Meskan and Arbaminch districts, bio-slurry is used in liquid form predominantly for production of fruit trees such as banana, mango, chat, orange, and other vegetables. Terefe Mekuriya, the resident of Lentae kebele in Arbaminch district informed us that he tried to conduct trial to compare the effect of bio-slurry and compost fertilizer on his banana plot. According to the results he observed, bio-slurry was very effective in making the banana plant green within a short period of time as compared to compost. Worku Sima from Yetebon kebele in Meskan woreda, Southern Nationas and Nationalities and Peoples Regional State (SNNPRS) expressed bio-slurry as 'glucose' for his chat (Chata edulis) plot. He told us that before he was the beneficiary of biogas (bio-slurry), he was able to collect and sell chat once in a year. But after he used the bio-slurry for his chat production, he managed to collect and sell twice a year. In Oromiya region, the majority of farmers use bio-slurry for crop production after composting. However, some model farmers like Beyene Tadesse in Hitosa and Delelegn Girma in Lode Hitosa districts use bio-slurry not only for crop production but also for horticulture, forage, and pasture. In crop production, Beyene was able to produce 4700 kg of wheat per hectare as compared to 3200 kg he produced on average using chemical fertilizer. Furthermore, the harvesting time on Beyene's wheat farm fertilized with bio-slurry was also delayed by 15 days as compared to the one cultivated with chemical fertilizer and helped the wheat seed to mature properly. He sold his wheat grain as organic product with 15 % higher price than the average wheat price. His farm was also covered with the healthiest wheat crop when other farms including his farm that was fertilized by chemical fertilizer were attacked by bread wheat stripe leaf rust. This has ignited the visit of the farm by higher officials from the MoA and drawn attention of the research institutions to design research projects to investigate further. For example, the National Wheat Research Institute at Kulumsa located in Asela town has already started collecting information from Beyene's farm to investigate the cause of this resistance to stripe bread wheat leaf rust due to bio-slurry application.

Figure 2: Bread wheat with stripe leaf rust observed on bread wheat fertilized with chemical fertilizer (Left) compared to the one fertilized with bio-slurry compost (Right)

Beyene further informed us that he was able to sell his compost made mainly from bio-slurry. For example, in 2010, he sold 3500 kg of compost at a unit price of ETB 40. But now he has increased the price of one quintal of organic fertilizer to ETB 100. He also produced alfalfa crop for his livestock using compost and sold alfalfa seed for ETB 7000 which is an additional income he never got before. According to local agriculture experts, the creativity and effectiveness of Beyene has triggered other farmers from his district and other areas to invest in biogas.

Shume Deyas is another innovative farmer living in Denkaka kebele in Ada woreda. In 2009 he cultivated teff crop with organic and chemical fertilizer. He realized that there was a big difference between using chemical fertilizer and organic fertilizer in terms of quality and quantity of products. In terms of quality he stated that the taste and smell of food produced from organic fertilizer is very pleasant. Moreover, he compared the weight of the same amount of teff produced by bio-slurry and chemical fertilizer by putting in same sized sack. According to him, teff produced by bio-slurry weighed 58 kg where as the one produced by chemical fertilizer weighed 52 kg.

LESSONS LEARNED

The construction of 14 000 family-size anaerobic bio-digesters in the coming three years is expected to contribute to the farm economy of many rural households in Ethiopia. The general conclusion from this case is that investing on biogas technology by households reduces expenditure on fuels, fertilizers, and pesticides freeing up income that can be spent otherwise. Although there are a number of promising stories told by farmers as indicated above there is still lack of enough empirical data to substantiate the stories and preliminary results from few trials. From the survey we were able to observe considerable variation in the degree of awareness among farmers. Hence, this calls for our strengthened effort in the training of farmers and agricultural experts on bio-slurry application and handling in order to raise the awareness of the rural households about the multiple benefits of biogas and improve the depth and outreach (upscaling) of the program to its targeted beneficiaries. Furthermore, the monitoring of crop yields from farmers' fields where bio-slurry has been applied needs to be continued for a number of years to identify the overall trend.

STANDARD DATA

The contract for knowledge development on utilization and mangement of bio-slurry started in 2010 and is renewed every year based on the recommendation made in the report on the outcome of the engagement. The current contract ends in December 2012. The team consists of 2 SNV advisors and three experts from ISD. A total of 110 PP-days were invested by ISD with a financial input of ETB 263, 644 (~ EURO 10000) and 76 PPD by SNV. This includes also other activities related to the capacity development services invested for training woreda staff in data collection and in the development of manual for training extension agents. The research results were obtained from farmers' fields that were followed up by the staff of the MoA.