"Water, Food & Energy in the 21st Century"

Potential impacts of biogas technology integration in crop-livestock mixed farming: A case study of some biogas projects in some rural farming cooperatives in the Limpopo Province

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Presentation layout

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Introduction: Some Fact about Limpopo

Poverty level	78.9% of its population
Population	10.4% of national
Agricultural households	33 % of its households
Households with 11-100 cattle	23.7%
households in Limpopo using solid fuels for cooking, compared to 10,9% nationally.	41,5%

Source: StatsSA 2012,

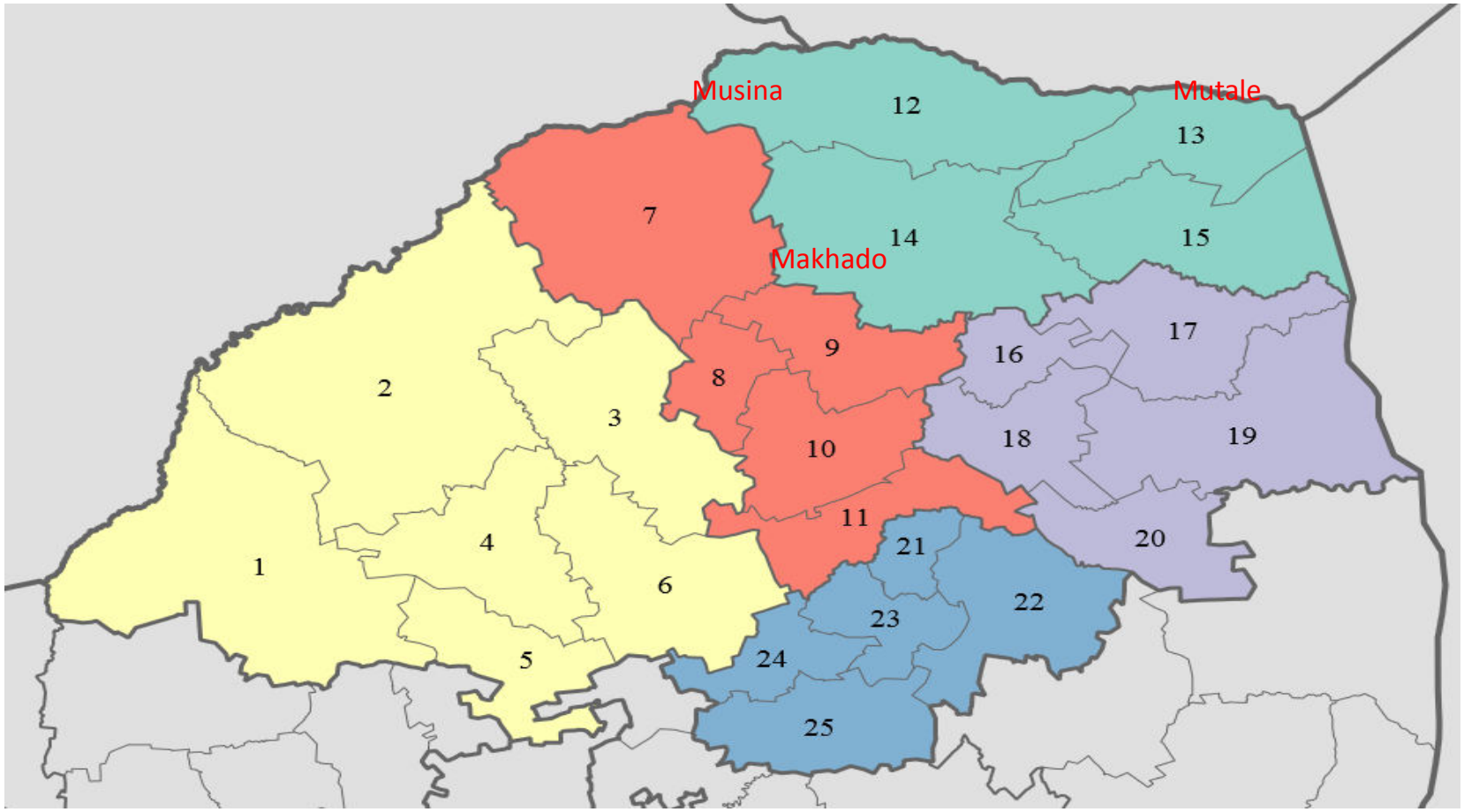
Objectives and motivation of the research work

- Limpopo Province is the poorest province in the country,
- But most places in Limpopo and Makhado in particular are endowed with renewable energy sources.
- The province has relatively good agricultural climatic conditions,
- The province thus presents very good conditions for the exploitation of the cheap and multi-beneficial biogas technology to replace the dirty, time consuming and in some instances also expensive firewood.

The study has the following objectives:

- To carry out an energy use baseline study for selected villages of Makhado Municipality
- To assess the biogas resource availability in the studied communities
- To assess the need for biogas through the comparison of the cost of the present options and biogas option
- To assess the potential impact of biogas technology in livestock-crop farming through presentation of **the initial results of an implemented** integrated rural agricultural bioenergy systems that includes a bio-digester, egg layer dip litter run, and open land to which digested effluent and/or sludge, (as organic fertilizer) is applied, (Tian, et al., 2004).
- To demonstrate the potential this has in rural development in general. It is hoped that this will serve as a living demonstration example of a working community cooperative that uses the real appropriate technology through multi-stakeholder involvement and proper co-design.

Area of study : Farming could be a pillar to combating rural poverty



Baseline Survey

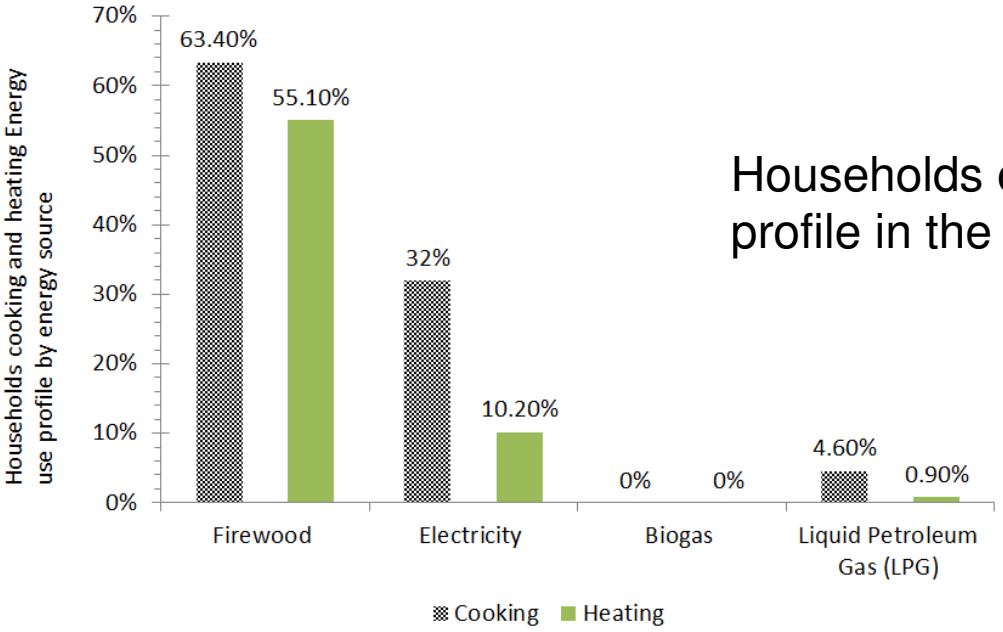
Objectives:

1.to determine the level of awareness in the community of biogas as a source of energy for domestic purposes and,

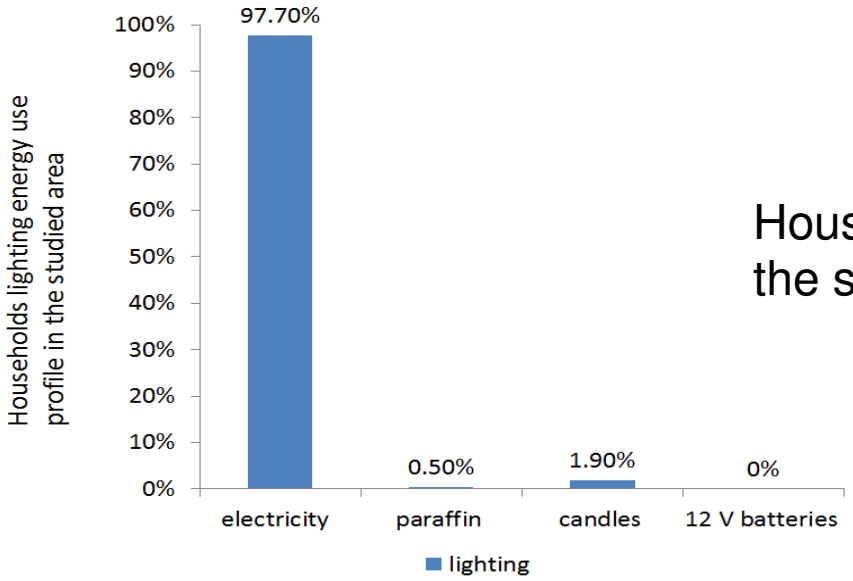
2.assess the financial and economic feasibility of biogas production for rural households in seven communities of ward 19 in Makhado

Name of Village	Number of households	10.3% sample
Mabogo	167	17
Sedza ufhire	83	8
Ntavhanyeni	137	14
Munzhedzi A	28	3
Tshifhefhe	64	6
Munzhedzi	1800	180
Maila	1900	190
Total	4179	434

Random selection of the households to be interviewed



Households cooking and heat energy use profile in the studied area



Households lighting energy use profile in the studied area

Baseline Conclusions

From the survey it has been established that although suitable conditions exist for the implementation of biogas technology, there are some challenges especially in the more urban households. The livestock population is low in these places. However for those areas in the outer periphery of the communities where people are still living with their livestock and practise some farming at the backyard, the technology can be a real solution. As for the need of the biogas, no doubt the surveyed communities need a substitute to the dirty firewood energy and as they claim the ever increasing price electricity.

Project sites description

Nthabalala Agricultural Primary Co-Operative Limited

- co-operative has 10 members
- Broiler production (up to 1500 birds at a time in batches of 500)
- also grows vegetables
- Have borehole and 1 x 10 m^3 plastic tank
- Prepare lunch at the project site and used firewood
- One digester was installed and is fed with cow dung

No longer use firewood for cooking

Maila: Marubini Multi-Purpose Women's Primary Co-Operative Limited

- co-operative has a membership of 12 (permanent cooperative
- members) and 10 volunteers
- The co-operative is in early childhood development with number of children varying from 100 to 250 in a year
- the co-operative is also in egg production keeping up to 3200 egg layers a time throughout the year.
- Cook for both children and workers and use LPG, fire and biogas for cooking
- Two digesters were installed on 9 May 2013, one fed with chicken manure and the other with cow dung
- The bio slurry is used for vegetable production and fodder

Approach used to implement the project in the community

Stage One

The University of Venda and University of Kwa Zulu Natal are collaborating in research project of piloting **on** integrated rural agricultural bioenergy systems coupled with rainwater harvesting. By the nature of bioenergy, its introduction requires profound engagement with the end users especially when they are new to it. So a quick baseline survey to familiarize with the communities was initiated: a series of missions visits were undertaken and always observing the local protocols – this way initiating the process of energy system co-designing with the community.

Stage Two

Awareness raising: here different strategies were used, that include meetings and discussions with the communities, organized workshops to train, share and engage with the different imported stakeholders .

Stage Three

Development of the selection criteria: A number of candidate cooperatives were visited for initial data collection exercise and two were selected mainly due to their high success and impact potential. Factors looked at were energy source type used, amount of time and or money spent on the energy, production of waste (quantity and type), type of farming activities and the general organization of the cooperative. Here Maila Village women cooperative was selected

Stage Four:

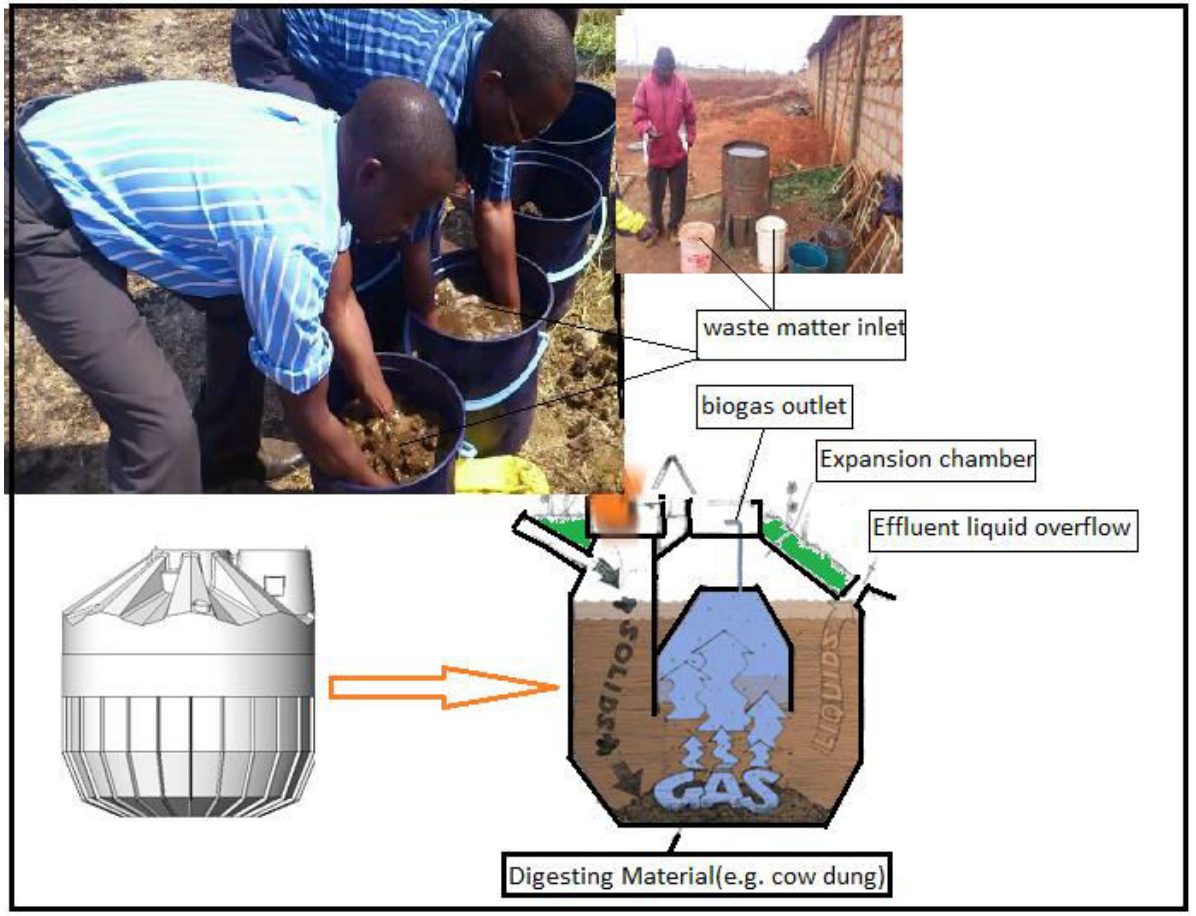
Concept design, detailed design and implementation:

Due limited budget from the project only a total of 18 cum digesters could be installed and thus the system sizing was based not on demand by capital. Installation date - 09th of May 2013, System size - 2 x 6 cum fixed dome prefabricated Agama bio-digesters were installed and coupled to supply one burner

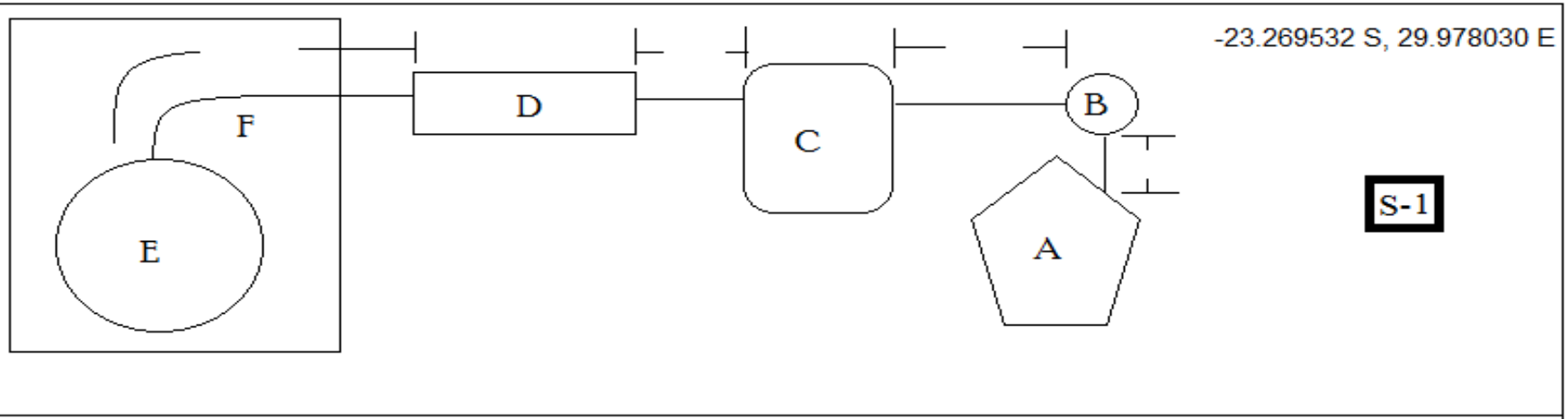
Digester feeding

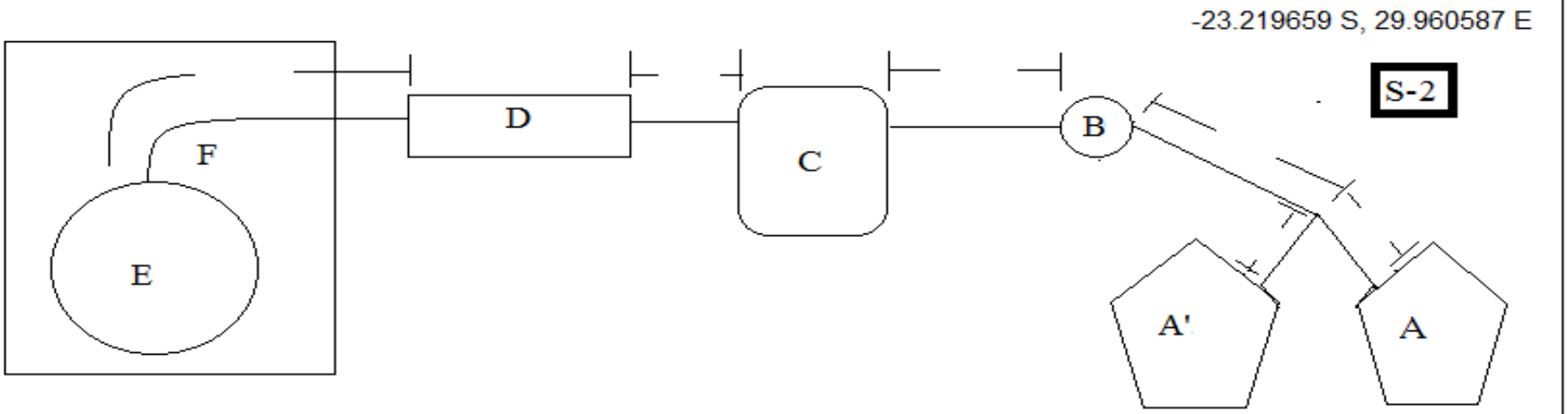
Each of the six cubic metre digesters is every day fed with 20 litre bucket of waste (chicken or cow dung) mixed with another 20 litres of water as shown in the picture. The mixture is poured into the digester inlet and stirred in the digester.

Biogas production and monitoring: Description of the operation of the installed biogas digesters



Layout of the biogas systems at Maila and Nthabalala





A= Biogas digester
B= Pressure Gauge
C= Desulfurizer Unit Box

D= Volume meter reader
E= Gas Stove
F= biogas Gas pipe

Monitored parameters (Riken Keiki GX-2012 Gas Monitor)

16-July -31 July(Maila)

Monitoring date	Gas Preassure /kPa	Biogas usage volume reading / m^3	vol % CH4
16-Jul-13	2.4	4.87	56
17-Jul-13	4.8	5.109	55
18-Jul-13	4.18	5.463	53
19-Jul-13	4.8	6.468	52
20-Jul-13			
21-Jul-13			
22-Jul-13	6.5	7.205	
23-Jul-13	2.8	7.241	54
24-Jul-13	2	7.498	53
25-Jul-13	2	7.853	53
26-Jul-13	2.5	8.066	51
27-Jul-13			

16-July -31 July(Nthabalala)

Monitoring date	Gas Preassure /kPa	Biogas usage volume reading / m^3	vol % CH4
16-Jul-13	2.5	1.061	63
17-Jul-13	2.04	1.158	63
18-Jul-13	4.04	1.158	62
19-Jul-13	2.06	1.367	63
20-Jul-13			
21-Jul-13		1.367	
22-Jul-13	5.09	1.367	
23-Jul-13	3.4	1.813	62
24-Jul-13	4.2	1.832	62
25-Jul-13	2.2	2.257	
26-Jul-13	2.02	2.438	62
27-Jul-13			

Monitored biogas usage

Site	Monitoring period	Cumulative consumption of gas /m^3
Maila	22-June 2013 – 13 July 2014	129.810
Nthabalala	22-June 2013 – 13 July 2014	92.350

Cor

•M

and fire wood)

•Nthabalala system is not used to the maximum. The cooking is not every day.

•The biogas methane content of 53 % on average for all digesters

•Amount of gas produced per day not easy to determine with the present set up

Operational problems

•Two of the three digesters have developed leaks and sealing requires special skills not easily got from the users

Community engagement: regular stakeholder consultation and feedback through information days and / or workshops

Extension officer at Nthabalala broilers project

Maila vegetable garden

Visitors from DA and Eskom to the Maila biogas system

Researchers from HSRC visit Maila biogas system

Limpopo Project Sites fields visit and workshop

Biogas technology dissemination workshop at Maila

Biogas meeting at Vele Secondary School

Results and Discussion

The cooperative is very satisfied with the benefits demonstrated by incorporating the bioenergy system in their farming activities. Although still too early to make definite conclusions on all benefit associated, already a saving of R925 (has been realised from cooking energy only. On the agricultural part the yields have improved significantly in both quantity and in quality as a result of the use of bio-slurry for irrigation. The unpleasant odour has significantly reduced and making the place more comfortable to stay during their working time. After realising the great potential of production of energy from gas, with more waste use the cooperative already working towards expanding the egg layers quantity, increase the crop farming sector now that fertiliser is available.

This cooperative is now used by the university project team to disseminate information to other stakeholders and to be users. Field days are regular at the project site with day long workshops carried out on site giving other great opportunities of catering services to participants. The place has turned to be a centre of attraction, receiving all kinds and levels of visitors with even local and provincial government leadership visiting to see a working self sustain integrated agricultural bioenergy system.


Food leftover also feed digester
Fodder feed digester
By bio-slurry fertilised Fodder to feed animals
Cooking energy
By bio-slurry fertilised vegetable food for people
Chicken droppings to digester

Initial benefits of the bioenergy system

SOCIO-ECONOMIC IMPACT		
Parameter description	Parameter indicator	comment
Digester system size	2 x 6 cum	
Date digester installed	9 May 2013	
Date gas started burning	21-06-13 (44 day after commission	With 4.2 kPa and 30% by vol. methane
Amount of gas used as of 29 May 2014	126.261 cum	$\approx \frac{0.522m^3}{day} \approx 3.132\ kWh$ Of calorific energy
Total cost avoided	126.261 cum x 6 kWh/cum=757.566 kWh	R925.82

Conclusions

Conditions existing at Maila are typical not only in the district but the whole province if not country. Each school prepares food for the learners through the government sponsored nutrition programme and thus creating high demand of energy and production of waste. From the presented project and results it is clear that biogas technology is the most effective way to achieve social and economic development. The benefits of this system extends to even almost all the millennium development goals. The use of biogas from the conversion otherwise environmental dirt waste like animal and human waste is a clean way of waste management, the improved yields from crops improve diet, thus good health, increase income – poverty reduction, avoid environmental pollution and so on. This technology if well approached may really be a solution to many of the developmental challenges in the rural communities. Many governments are realising the great potential in bioenergy and it is essential that all stakeholders participate active to the development of this technology so that all it potential benefits are realised.

THANK YOU FOR YOUR ATTENTION

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