

12m³producing 2.6m³ of biogas per day. Suggested biogas storage option was having two 500m³ plastic bladder type storage units for the 949m³ of gas produced per year. The amount of gas required to cure 2.8 tonnes was calculated to be 1475.8m³ thus the deficit can be clearly seen therefore for the average farmer the gas produced was less than the gas required for curing the tobacco. The most important biomass resource was cattle as they were responsible for most of the gas produced per household. Cost of implementing a biogas tobacco curing system on an existing tobacco barn was calculated as \$144.54 /m³ of biogas digester designed. From the financial analysis all tests performed had positive results in terms of feasibility and profitability of the project. Financial benefits of curing tobacco using biogas included lessening the cost of buying coal and firewood for curing. It should be noted that the most important benefit of curing tobacco with biogas which is to save the environment does not have much direct financial benefit that could be calculated using the capital budgeting techniques applied in the financial analysis.

References

1. Den Liangwei, L. y. (2016). *Application and development of biogas technology of waste in China*. Renewable and sustainable Energy reviews.
2. Kulcu, R. (2007). *Determination of optimum environmental conditions for composting agricultural waste*. Akdeniz, Turkey: Master of Science Thesis, Department of Agriculture and machinery Akdeniz University.
3. Miyamoto, K. (1997). *Renewable biological systems for alternative sustainable energy production*. Rome.
4. Moyo, T. (2015). The potential for electricity generation from dairy manure. *University of Zimbabwe*, 14-15.
5. Oppenorth, W. a. (2014). *Bioslurry: a supreme fertiliser*. Deltahedge.
6. REA. (2017). *Rural Electrification fund*. Retrieved November 13, 2017, from <http://www.rea.co.zw/index.php/achievements>
7. TIMB. (2016). *Annual Statistical report*. Harare: Tobacco Industry and Marketing Board.
8. TRB. (2018). *Barns*. Harare: Kutsagha field division.
9. Y. Abubakar, J. H. (2000). CHANGES IN MOISTURE AND CHEMICAL COMPOSITION OF FLUE-CURED TOBACCO DURING CURING. *Tobacco Science*, 51-58.
10. Abbasi, T., Tauseef, S. M. and Abbasi, S. A. (2012) 'Biogas energy', *Biogas Energy*, pp. 1–169. doi: 10.1007/978-1-4614-1040-9.
11. Davis, C. H. and Preston, T. R. (1883) 'A combined digester and gasholder PVC plastic tube biogas unit', *ADAB News*, (February), pp. 35–41.
12. Dobre Paul, Nicolae, F. and Matei, F. (2014) 'Main factors affecting biogas production - an overview', *Romanian Biotechnological Letters*, 19(3), pp. 9283–9296. Available at: https://www.google.co.in/url?sa=t&rc=t=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=0ahUKEWjr4OWLnsrJAhWKGpQKHd9zBREQFggqMAE&url=http://www.rombio.eu/vol19nr3/lucr_1_Dobre_Paul_Main_factors_affecting_biogas_production_re.
13. Ekinci, K. *et al.* (2010) 'The prospective of potential biogas plants that can utilize animal manure in Turkey', *Energy, Exploration & Exploitation*, 28(3), pp. 187–206. doi: 10.1260/0144-5987.28.3.187.
14. Ekinci, K. *et al.* (2018) 'The prospective of potential biogas plants that can utilize animal manure in Turkey' Author (s): Kamil Ekinci, Recep Kulcu, Durmus Kaya, Osman Yaldiz, Can Ertekin and H. Huseyin Ozturk Published by: Sage Publications, Ltd. Stable URL: <http://www>, 28(3), pp. 187–205.

Biography

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