Study site and design:
A Batch reactor (20L capacity each) will be constructed (with concrete, mortar & bricks) at a local animal farm in a rural community in Egypt. Three ports (one at the surface and two at the sides) will be drilled on each of the digesters. The surface port will be used for measuring biogas production and samples for the analysis of biogas quality will be collected through the same port. From one of the side ports, samples will be withdrawn for the analysis of chemical parameters and microbial determination while the pH meter will be set up at the other port. The samples will be stored at - 4°C in a freezer before analysis.

Experimental set-up

The animal wastes will be pre-treated by separation of substrates from foreign materials like stones, woods, metals and other inorganic materials. A slurry will be prepared with water and the ratio of mixing will be dependent on the moisture content of the animal manure. The slurry formed will be fed into three-quarters of the batch reactor allocating space for biogas generated. The contents of the digester will be adequately mixed once daily for 2-3 min to create homogeneous substrate preventing stratification (i.e. creating the formation of temperature gradient within the digester) and formation of a surface crust and distributing microorganisms and substrate constituents throughout the digester. The experiment will be batch operated until the bacterial count is at a level recommended for safe handling, under atmospheric pressure and ambient temperature conditions

EGYPTIAN PARTNER
At any local Farm in Eqypt, a biodigester will be implemented, installed and charged with a slurry of animal wastes made available. The waste will be anaerobically digested under batch mode for a duration determined by the level of the measured microbial count. At different time interval, samples will be withdrawn from the digester to analyze the physicochemical and microbial parameters. More elaborately, total solids, total volatile solids, ash content, energy content, ammonium concentration will be determined by standards methods. A data acquisition system will be built incorporating four temperature sensors embedded at different levels in the slurry and then connected externally to a data logger for recording the temperature at 30 minutes interval. The pH and biogas will be measured daily using a pH meter and a gas analyzer. Samples to be employed in the determination of microbial and physicochemical parameters will be withdrawn and stored at -4C^{o} until analysis. Standard plate count method will be employed to determine the bacterial counts at different time interval through different microbiological media in order to relate the reduction in the bacterial count to decontamination over time. Also, specific bacteriological media for the isolation of bacteria of environmental and public health importance such as *Campylobacter, Shigella*, *Salmonella, E. coli* etc. will be used in order to view the potential environmental/health risk of these wastes. In addition, staining technique will be used to determined the type of protozoa present.

Objectives
i. To determine the physicochemical parameters of the manure
ii. To determine the microbial composition in both the influent and effluent
iii. To determine the relationship between slurry age and daily/total biogas yield
iv. To determine the bacterial population at different slurry age to detect changes in bacteria population over time (retention time)
v. To analyze the volume and composition/quality of biogas produced.
vi. To correlate the efficiency (quality & quantity of biogas generated) of the process to the diversity of microbial population and total viable count

vii. To determine the antimicrobial resistance profile of bacterial isolates
viii. To employ anaerobic digestion as an approach for waste management and decontamination (i.e. checking on the survival rate of bacteria of public health importance).
ix. To develop a mathematical model incorporating all the necessary parameters for biogas production and using this model to forecast future biogas yield
x. The input parameters will be screened using the relief F algorithm in the MATLAB software to determine their contribution whether it is primary or secondary
xi. To simulate the system using the developed mathematical model
xii. To optimize the anaerobic digestion process for improved biogas yield

Anticipated outputs

At the end of this study, it is anticipated that;

i. The microbial structure of the animal waste will be ascertained in relation to the chemical and operational parameters e.g. temperature and as such could lead to better understanding on optimization of the anaerobic digestion technology in a bid to increase process efficiency.
ii. Data obtained will be assembled into manuscripts that will be published in international peer-reviewed journals and also presented at conferences.
iii. The biogas production potential of the animal waste will be elucidated contributing in the field of environmental technology for sustainable energy production.
iv. Antimicrobial resistance profile of the isolated bacterial strains will be delineated giving information on health risk involve during handling of these wastes as well as the information will aid in public health strategy to minimize the spread of antimicrobial resistance.
v. Skills will be developed in anaerobic digestion phenomenon which is an eminent process employed in the decontamination and treatment of animal wastes/waste water especially since wastes disposal is a serious problem in most third world countries thus contributing to nation building.
vi. A cordial and long lasting relationship between Egypt and Spain will be guaranteed for future purposes in the line of research because the objectives of this study will be met.

Possible socioeconomic benefits.

The execution of this study is linked to the following socioeconomic benefits:

I. It will salvage the problem of water, land and air pollution
II. A more complete treatment/recycle system will be made available to local farms
III. An alternative source of energy will be identified that can be used for cooking, heating and other purposes at the farm thus resulting in the conservation of energy
IV. The readily available waste produced in huge quantities at the Farms will now be looked upon as a good source of energy i.e. waste to energy.
V. Farmers can also raise money from the selling of biogas and can use the money for other purposes.
VI. Individuals practicing animal husbandry can install biodigester at their homes for domestic purpose thus reducing the load on national grid.
VII. The Biogas can be purified and fed into the national grid thus help in reducing dependence on conventional sources of energy which are the fossil fuels.
VIII There shall be an improvement in environmental and public health conditions since the waste will be properly treated before release into the environment to be used as soil conditioner /fertilizer