International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 07 July 2024, pp: 345-381 www.ijaem.net ISSN: 2395-5252

Review of Biogas Plant Proposals for Different villages with different Population sizes within Obafemi Owode Local Government, Ogun State, Nigeria

Abatan O.A, Adewale A.O Oseni K.Jand Sodunke M.A
[1]*Department of Science Laboratory Technology,Moshood Abiola Polytechnic, P.M.B 2210, Abeokuta, Ogun State, Nigeria*

Date of Submission: 10-07-2024 Date of Acceptance: 20-07-2024

ABSTRACT
This proposal suggests installing biogas plants in villages to provide sustainable energy and improve sanitation. The biogas plants would use animal and human waste as feedstock to produce methane gas for fuel. Calculations estimate the plants could produce enough gas to meet the villages' energy needs. Benefits include reducing disease, generating renewable energy without external inputs, creating local jobs, and helping alleviate poverty in the communities.

INTRODUCTION

Abatan{Abata} is a populated place-a village, city, town, or other agglomeration of buildings where people live and work in ObafemiOwode, Ogun State, South West Nigeria, West Africa. It is on latitude 7° 4' 59" N, longitude 3° 40' 59" E, lat/long (dec) 7.08333,3.68333 with tropical savanna climate type (source : Mindat.org) and is situated nearby to the villages Isagolu and Owojo.

. The village has a populationof716people with 172householdsspread acrossthevillage and atleast 142live belowthepovertyline.Themajorityofthepopulationis agriculturalworkersand every householdownslivestock.

NEED

Ithasbeenreported thatonly70households haveaccesstoa decent toilet each resulting into widespread practiceof opendefecation behindhomesasanorm.Thissystem brings about ahealthrisk scenario. Sources of water are contaminated when deposits arewashedin likely causing diseasespreading in the village. Most of the villagers living below the poverty line are involved in everyday practice of using firewood orkerosenefuelledstovesindoors bringing detrimental health effects.

SOLUTION

Installationof abiogassettlerwitha toilet facilityfeedhasbeenproposed in order to reduce or terminate someofthisunsustainableanddangerouspractice.
The proposed systemcollects and converts waste frombothhumanandanimalfaecestoenergyandfertiliser.

USESANDIMPLEMENTATION

This studyaims toprovideasolutiontothecurrentwasteprobleminAbatan villagewhere wasteisbeingleftintheopenincreasingthechanceofdisease.Currentlyhumanfaecesare depositedbehindthehousesalongwithlivestockmanurewheretheyareleftun-buriedand untreated.Theseunsanitaryconditionscanleadtothe build-upbacteriaseeing the communitysusceptibletodisease.Theproperimplementationof abiogasdigesterwould solvethisproblemwhilealsotakingtheloadofthelocalpowerproblemby providingthe communitywithanotherenergysourcein theformofbiogas.Theywouldbeabletousethe biogasforanumber ofthingsbutprimarilyinbiogasstovesforcookingwhich arequite efficient.Theother product made fromthe bio-digestersisfertigationwater. Thiswater whenimplementedintothelocalirrigationsystemsand farmingareaswouldbenefitthe cropsandagriculturalyield thattheareaproduces.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 07 July 2024, pp: 345-381 www.ijaem.net ISSN: 2395-5252

ThePositionofBio-digesterinrelationtothetownisdependent onthesizeandhowthe waste is beingcollected.Ourproposalalsoincludesthe constructionofcentralvillage latrinesandanimalmanurecollectionpoints. Theactualimplementationintothe communityofthe bio-digesterswouldrequirethe educationof howallprocessesoratleastprimaryfunctionsof theunitwouldentail,the precautions neededwith theuseof thebiogasandpossibilitiesofinfectionwiththemisuse andstorageofthefertigation water.Thewaythiswatercanbeincorporatedintothevillage isbyaddingittotheexistingirrigationsystemwhich wouldenrichthetowns.

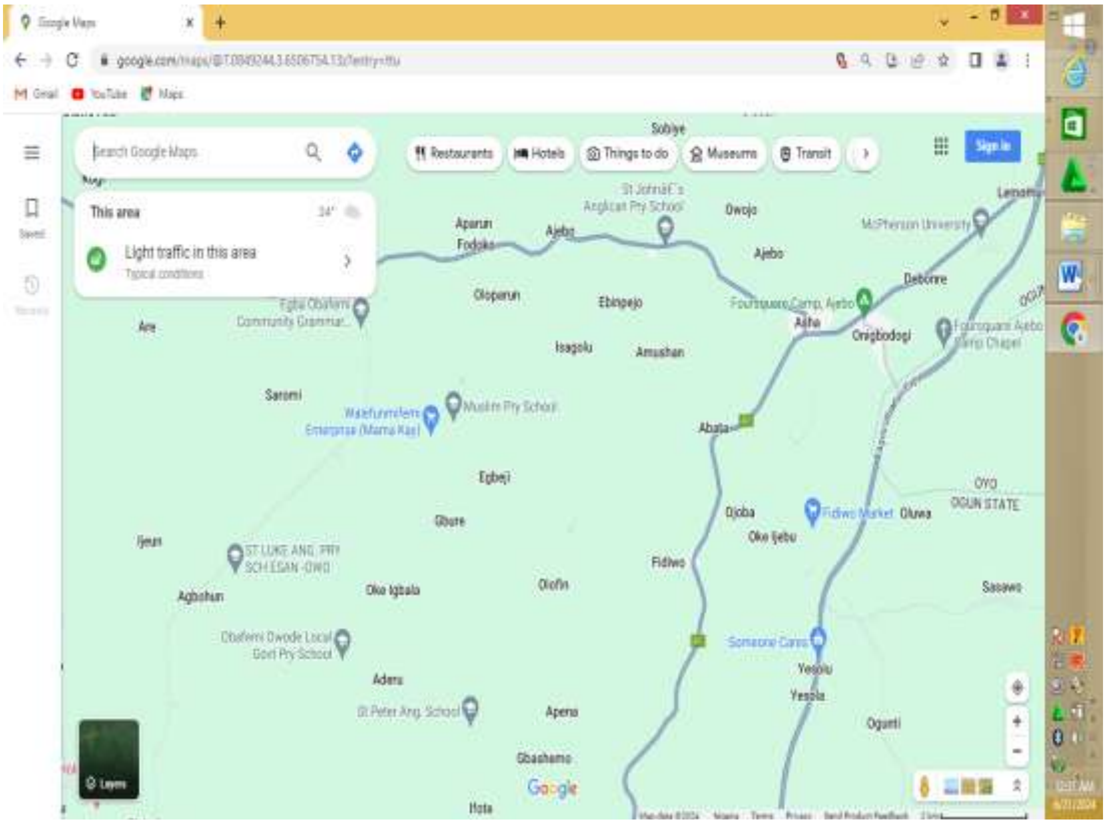


Figure1–MapofAbatan (Abata)villagewithpositionofdigesterandlatrinesindicated

Biogasdigestersetup awayfromthe mainvillageroughlyonehundred metresminimum withafertigationwater storage tankwhichlinkstothe villager'sirrigationandwatering systemsonceimplementedproperly.

CONCEPT

Theconceptofabiogassettleristotreatthewasteproductsenteringittocreateausable gasandasafeproducttobeusedforfertilisation.Thedesign of abiogassettlerissimilarto thatofaseptic tank,howeverthedesignincorporatestheabilityofbiogas tobeharnessed andstored.

The by-products of the fertilisationand biogas are possible through a process called anaerobicdigestion.Theairtightchamberdevelopssludge atitsbottomandwiththelackof oxygeninthechamberachemicalreactiontakesplacethatcreatesamethane richbiogas thatisabletobeusedinhouseholdgasappliancessuchas stovesandlamps.Withthelack ofoxygeninthe chamber, andasthe influentmaytake60-80daystopassthrough the system,mostharmfulpathogensaredestroyedandtheeffluentliquidandslurryareableto beusedforfertilisationofthesurrounding farmland,reducing thewasteandincreasingthe sanitationofthearea.

Theuseofabiogassettlerisidealinthissituationastheinitialcostof theunitisrelatively low,itrequires littlemaintenance, hasnoenergyconsumptionasopposedtomanysimilar designthatmaybeaffectedbyflood,thebiogassettlerwillnotbeaffectedbyitslocationin suchawetarea. Theadvantages ofthe settlerfaroutweighits negatives,oneofwhich beingtheremovalofthesludge;approximatelyevery5 yearsthesludgewillaccumulateto alevelatwhichitwillneedtoberemovedandwhilstmany of theharmful pathogenshave beenremovedby thisstage,itisrequiredtobedoneby skilledpersonnel.Thissludgewill usuallythenisplacedinadrying bedbeforeitis usedforfertilisation.

Largeretentiontimesontheinfluentandwarmertemperaturesof thechamberareidealin the treatmentofthe effluentto increasethe effectivenessofthe removalofharmful products, resulting in by-products higher nutrients and more suitable for uses as fertilisation.Ideallythe hydraulicretentiontime(HRT) wouldbe closeto 100daysand chambertemperaturewouldbecloseto55°Ctoensurepathogensaredestroyed.Byplacing thechamberbelow ground,thetemperaturecanberegulatedmuchmoreeasilywiththe chemicalreactionsinsidecreatingitsownheatwithinthechamber.Anexpertdesignisthen requiredtoensuretheHRTisaslargeaspossiblewhilststillproducingaconsistentamount ofbiogasforthecolony'sdemands.

Oncebiogasisinitiated,thepressure levelwithinthemainchamberisincreased,forthis reason acompensationtankisneeded. Connectedtothelowerofthemainchamber,as pressure increases, the sludge is then forced through a pipe into the compensation chamber, thus reducing the absolute pressure in the main chamber and preventing fracturesintheframe.Thiscompensationtankisthenopentoatmosphereasthesludge stored withinitispractically harmlessand can be placedwithinthe dryingbeds. The benefitsofabiogasplantseemendless-lowconstructioncosts,lowrunningcostsanda cleansourceofenergy.However thesystemcanhavesomedownsides,suchasgaslossifchambersuffersafractureandthedependenceonthecommunitytoparticipateintheuse andproductionofthebiogasplant.

DESIGN

Biogassettlersinvolvetheconstructionofcarefullycalculatedchambersinorderforthemtoproducethebiogasefficiently.Thefollowingdiagramshowsagoodrepresentationofthe systemandhowitishopedtobeimplemented.

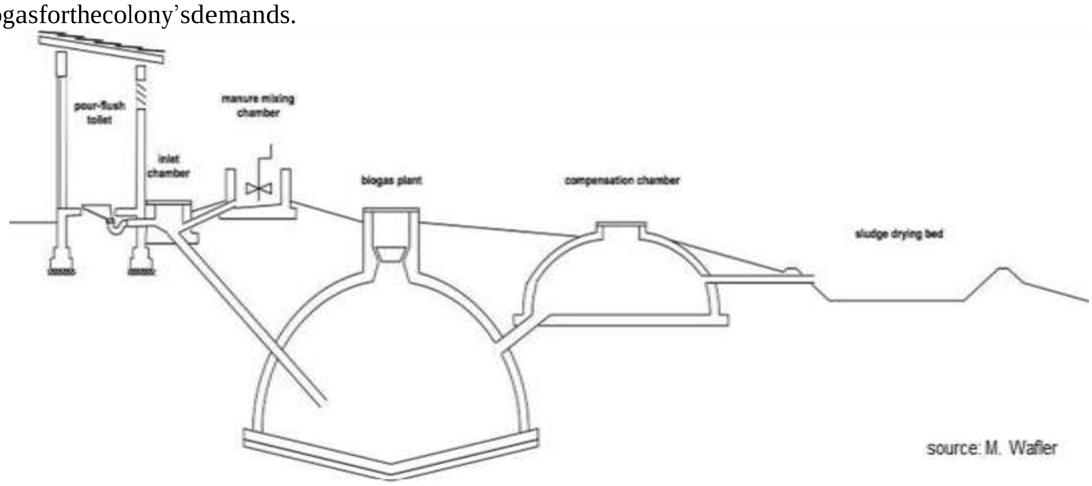


Figure2-Theinitialdesignofabiogasplant,includingallaspects-latrines,animalwaste entryandchambers

Thetoiletswillbeplacedinlatrines nearthevillagesforwhichpeoplecanusetocontribute tothe productionofthe biogasandthe manure mixingchamber allowsforfarmersand villagerstodisposeoftheirlivestockwaste intothe biogasplant.Oncegasbeginstobe producedthesludgecanthenflowintothecompensationchamberandeventually intothe dryingbed,wherenowalmost pathogenfreeisharmlesstohumans.Once leftinthedrying bedforapproximatelya month,itisthenabletobeusedasanutrientrichfertiliser. Manyareas areinvolvedinthe calculationsthat makeforaneffectivesystem,including usageandproduction ofthebiogasitself,aswellasthetime thewastewillspendinthe chamber. Thefollowingtableoutlinesthe valuesofwhich Iwill be usingto developa suitablechamber.

Animal species/ feed material	Dailymanureyield		Fresh-manure solids			LiveweightC/N		Gasyield	
	manureurine		DM	ODM				rangeaverage	
	[kg/d]	[%lw]	[%lw]	[%]	[%]	[kg]	[-]	[l/kgODM]	
cow manure	16	8	4- 5	18	13	110-300	10-25	100-250	175
buffalo manure	12	6	4- 5	15	12	140-320	20		
pigmanure	3	3	3	18	12	20-65	9- 13	140-360	250
sheep/goat droppings	2	4	1- 2	33	20	30-100	30	125-175150	
chicken manure	0.08	6.5	-	27	17	1.5-2	5- 8	300-560430	
human excreta	0.75	2	2.5	25	15	30-60	10	10-50	30
cornstraw	0.02	-	-	7870	-		30-55	350-480	410
water hyacinths	0.5	-	-	6	4	-	25-35	250 -300	275
vegetable residues	0.5	-	-	11	9-		25	350-450	400
freshgrass	-0.2	-	-	22	24-		18	480-620	550

Table1–GasYield

Table1–GasYield

InordertofulfilltheneedoftheAbatancommunitybyreducingharmfulpathogens in theair,increasingsanitationandprovidingacleanersourceofenergy,theproductionofthe biogasintheplantmustbegreater (butonlyslightly)tothat beingconsumed,toavoida potentialbuild-upofgas. Luckilythough,duetothecurrentnatureoftheAbatancommunity,wecanexpectsome villagers mayrefusetoaltertheircurrentways.Inthisway,thefollowingcalculationshave takenintoaccountthelikelihoodofonly85%ofthecommunityembracingthenewbiogas productionplant.Thisalsoallowsforflexibilityinthebiogasplant'sproduction-shouldgas usagebehigherthanfirstanticipated,villagerswillstillbeabletousepreviousmethodsfor cookingetc.toallowthebiogaslevelstoincreaseagain.Theplantmustalsobeabletocater fordemandwhengasisnotbeingproducedandwillconsequentlyneedstorageroomfor thegas.

CALCULATIONS
FromtheinformationgivenbytheEWBchallenge,thefollowingpopulationstatistics canbe estimated-

- 716People
- 172householdsin village,54in bottomcolonyand46in topcolony

- 3goatsperhouseholdintopandbottomcolonies(85% ofhouseholds)
- 3cowsperhouseholdintopandbottomcolonies(85% ofhouseholds)
- 1goatperhouseholdinvillage(15%ofhouseholds)
- 1cowperhouseholdinvillage(15%ofhouseholds)

Thesevalueswillform thebasisofallfollowingcalculations

Gasproduction

Σgoats=#colonyhouseholdsx85%x3goats+#villagehouseholdsx15%x1goat
= (54+46)*0.85*3+172*0.15*1
= 513goats
Σcows=#colonyhouseholdsx85%x3cows+#villagehouseholdsx15%x1cow
=(54+46)*0.85*3+172*0.15*1
=513 cows
Cowsyield175Lperheadperdayofgas.(Fig1)
Yield(cows)=Σcowsx 175
=513*175
= 89,775L/d
Goats yield 150Lperheadperdayofgas.(Fig1)
Yield(goats) =Σgoatsx150
= 513* 150
= 76,950L/d
Humansyield 30Lperheadperday ofgas.(Fig1)
Yield(humans)=Σhumansx30
= 513*30
=15,390L/d
Yield(total)=89,775+76,950+15,390
= 182115L/d
≈7588L/hr

GasUsage

(Duetotheunpredictablenature oftheenergyusageofthevillage(notknowingcooking habitsetc.),acasestudyhasbeenadaptedforthepurposes)
Acommunityconsistingof30peoplesimilartotheA b a t a n community conditionsuseda total of 3000L/dof gasintheirdailydutiesincludingcooking,makingteaan dusinggaslamps [NETSSAF].
Bydividing thisby30 wecangettheaverageusageperperson,butmultiplyingt hisby716willprovide adecentestimation totheenergyconsumption of theentire village community.
Usage(perperson)=3000÷30=100L/d
Usage(total)=716 *100
= 71600L/d
≈ 2983L/hr

This proposal is effective since the estimatedgasproductionis greater than estimatedgasusage.

GasStorageCapacity

Usingtheabovecasestudy,themaximumgasconsumptionforthesmallcommunitywas 500L/h,byadaptingthisvaluefortheconsumptionoftheAbatancommunityusingthe sametechniqueasabove:
Consumption(max) =500÷30x 716 =11933L/h
However,biogas isstillbeingproduced asthisis beingused, therefore the maximum decreasein gasisthemaximumusageminusproduction
Consumption-Yield=11933-7588= 4345L/h
Asthecasestudycommunityconsumedthegasatthisratefor5hoursthetotalstorage requiredwillbetherateatwhichitsbeingconsumedmultipliedbythetime
Volume(gasstorage)= 4345x 5= 21725L
Andinordertoaccountforfluctuationsinthis,itisthen multipliedbyasafetyfactorof 1.35,toensureadequategasshouldconsumptionincreaseby35%.
Volume(gas)=21725x1.35 = 29328.75L

SludgeStorageCapacity

Inordertocopewiththeamount ofwastecomingintothechamberandtheamount of timeitstaysthere beforeitleavestothecompensationtankandfinallythedryingbed,it hastobeofsufficientsize.Inordertocalculatethis,thevolumeofwastegoinginneedsto beestimatedandthehydraulicretentiontime(HRT)needstobedecided. Thehigherthe HRT, the greater efficiency ofthe biogassettler,however the volumeisthen increased resultinginalargerarearequiredandincreased costs.Ideally,theHRTwouldbeover100 days,butanythingover50daysisacceptable,forthiscaseaHRTof70dayswillbeused.
Thequantityofmanure(slurry) willbemeasuredasfollows:
Cowsproduce16kgperheadperday ofmanure.(Table1)
Quantity(cows)=Σcowsx16kg
= 513* 16
=8208L/d
Goatsproduce 2 kgperheadperday ofmanure.(Table1)
Quantity(goats) =Σgoatsx2kg
= 513*2
=1026L/d
Humansproduce0.75kgperheadperdayofmanure(Table1)
Quantity(humans)=Σ humansx0.75kg

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 07 July 2024, pp: 345-381 www.ijaem.net ISSN: 2395-5252

= 716 *0.75
=537L/d
Quantity(total)=8208+1026 +537
= 9771L/d
NowasthiswillbestoredinthetankfortheHRTof70days, thiswillneedtobemultiplied by80togetthefinalvolumeofsludgeinthetank.
Volume(sludge)=9771x70
=683970L

VolumeofTank
Nowthatthevolumerequiredforgasandthatforsludge areknown,thesecansimplybe addedtogethertodeterminethevolumeofthechamber
Volume(total)=Volume(gas)+Volume(sludge)
=65,000+136,000
≈200,000L
AswedonotexpectthewholeoftheAbatancommunityt oembracethenewsystem, wewillthenneedtomultiplythisnumberby 0.6,forthe60%ofvillagersthatwillendup usingthissystem
Volume(adjusted)=200,000x0.6
=120,000L
Byusingtheformulaforthe volumeofahemisphere,itcanthen becalculatedthat theradiusofthechamberwillbeinthevicinityof 3.85m
120,000=120 m^3
$120=(2*R^3*\pi)/3$
$R^3= 57.27m^3$
$R \approx 3.8545$ m
VolumeofCompensationTank(CT)
Thevolumeof thecompensationtankisequaltothatof thevolumeofthegasinthemain chamber,inordertoallowforanexcessofgasbeingprod ucedwithoutexcessivepressure in thechamber.
Volume(gas)=65,000L=Volume(CT)
∴Volume(CT)=65,000Lx60%
∴Volume(CT)≈39,000L=39m^3
$39=(2*R^3*\pi)/3$
R≈2.65m

FINALDESIGN
MainChamberCompensationTank

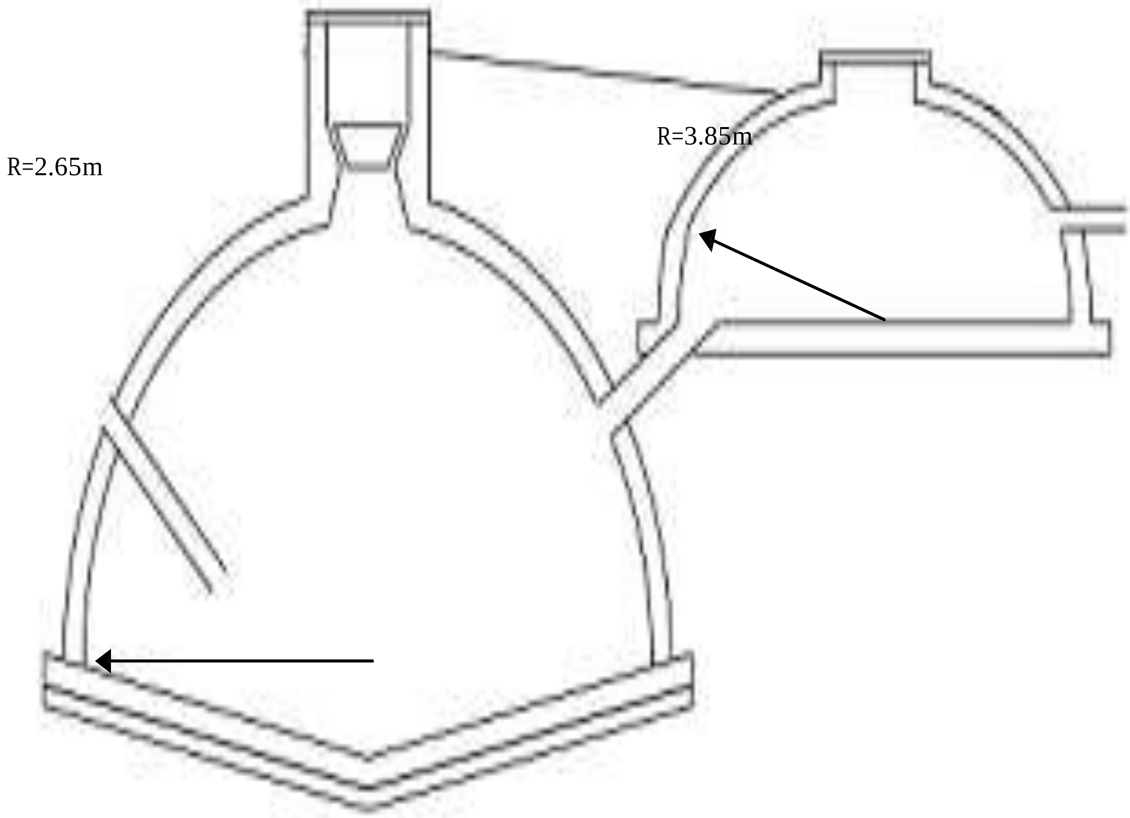
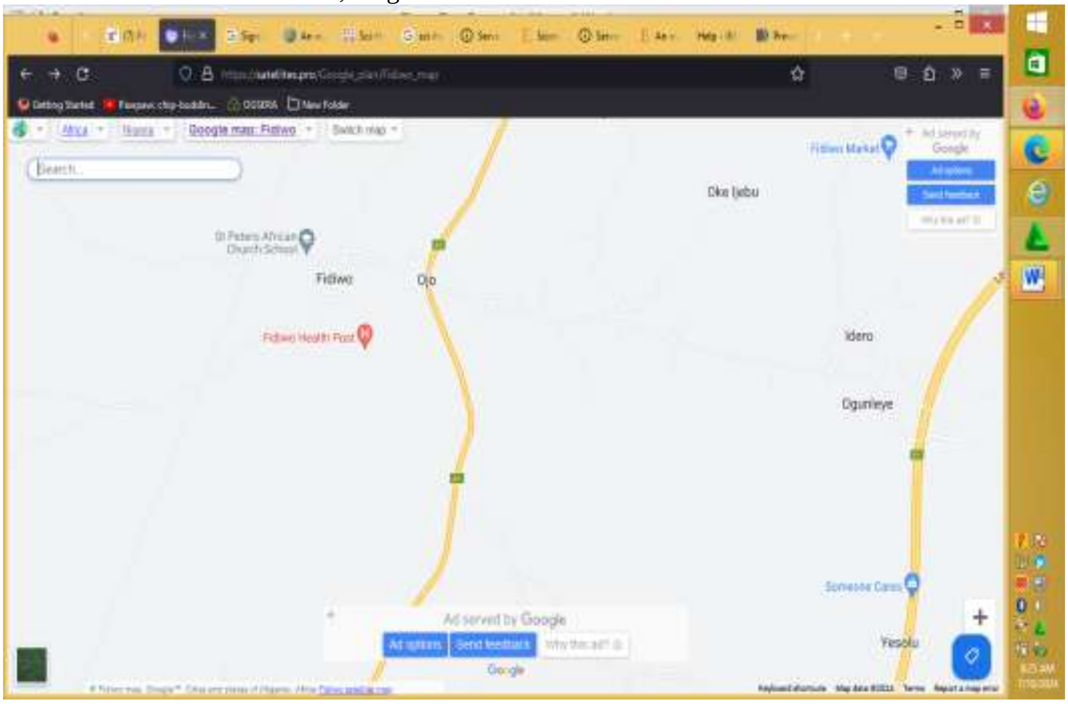


Figure3-Finaldesignofthebiogaschambersincludingtheradiusinorderforittobe effective

INTRODUCTION

Fidiwo is a populated place-a village, city, town, or other agglomeration of buildings where people live and work in ObafemiOwode, Ogun State, South West Nigeria, West Africa. It is on latitude 7° 4' 00" N, longitude 3° 40' 59" E, lat/long (dec) 7.08333,3.68333 with tropical savanna climate type (source : Mindat.org) and is situated nearby to the villages Isagolu and Owojo.



The village has a populationof1680people with 228householdsspread acrossthevillage and atleast 187live belowthepovertyline.Themajorityofthepopulationis agriculturalworkersand every householdownslivestock.

NEED

Ithasbeenreported thatonly108households haveaccesstoa decent toilet each resulting into widespread practiceof opendefecation behindhomesasanorm.Thissystem brings about ahealthrisk scenario. Sources of water are contaminated when deposits arewashedin likely causing diseasespreading in the village. Most of the villagers living below the poverty line are involved in everyday practice of using firewood orkerosenefuelledstovesindoors bringing detrimental health effects.

CALCULATIONS

FromtheinformationgivenbytheEWBchallenge,thefollowingpopulationstatistics canbe estimated-

- 1680People
- 228householdsin village,30in bottomcolonyand25in topcolony
- 2goatsperhouseholdintopandbottomcolonies(75% ofhouseholds)
- 2cowsperhouseholdintopandbottomcolonies(75% ofhouseholds)
- 1goatperhouseholdinvillage(25%ofhouseholds)
- 1cowperhouseholdinvillage(25%ofhouseholds)

Thesevalueswillform thebasisofallfollowingcalculations

<u>Gasproduction</u>

Σgoats=#colonyhouseholdsx75%x2goats+#villagehouseholdsx25%x1goat

= (30+25)*0.75*2+228*0.25*1

=139.5goats

Σcows=#colonyhouseholdsx75%x2cows+#villagehouseholdsx25%x1cow

=((30+25)*0.75*2+228*0.25*1

=139.5cows

Cowsyield175Lperheadperdayofgas.(Fig1)

Yield(cows)=Σcowsx 175

=139.5*175

=24412.5L/d

Goats yield 150Lperheadperdayofgas.(Fig1)
Yield(goats) =Σgoatsx150
=139.5* 150
=20925L/d
Humansyield 30Lperheadperday ofgas.(Fig1)
Yield(humans)=Σhumansx30
=139.5*30
=4185L/d
Yield(total)=24412.5L/d+20925L/d +4185L/d
=49522.5L/d
≈2063.4L/hr

GasUsage

(Duetotheunpredictablenature oftheenergyusageofthevillage(notknowingcooking habitsetc.),acasestudyhasbeenadaptedforthepurposes)
Acommunityconsistingof30peoplesimilartotheF i d i w o community conditionsuseda total of 3000L/dof gasintheirdailydutiesincludingcooking,makingteaandusinggaslamps [NETSSAF].
Bydividing thisby30 wecangettheaverageusageperperson,butmultiplyingthisby1680willprovide adecentestimation totheenergyconsumption of theentire villagecommunity.
Usage(perperson)=3000÷30=100L/d
Usage(total)=1680 x100
=168000L/d
≈ 7000L/hr
This proposal is not effective since the estimatedgasproductionis lesser than estimatedgasusage.

GasStorageCapacity

Usingtheabovecasestudy,themaximumgasconsumptionforthesmallcommunitywas 500L/h,byadaptingthisvaluefortheconsumptionoftheF i d i w o communityusingthe sametechniqueasabove:
Consumption(max) =500÷30x1680=28000L/h
However,biogas isstillbeingproduced asthisis beingused, therefore the maximum decreasein gasisthemaximumusageminusproduction
Consumption-Yield=28000–49522.5= -21522.5L/h
Asthecasestudycommunityconsumedthegasatthisratefor5hoursthetotalstorage requiredwillbetherateatwhichitsbeingconsumedmultipliedbythetime
Volume(gasstorage)=21522.5x 5=107612.5L
Andinordertoaccountforfluctuationsinthis,itisthen multipliedbyasafetyfactorof 1.25,toensureadequategasshouldconsumptionincreaseby25%.
Volume(gas)=107612.5Lx1.25=134515.625L

SludgeStorageCapacity

Inordertocopewiththeamount ofwastecomingintothechamberandtheamount of timeitstaysthere beforeitleavestothecompensationtankandfinallythedryingbed,it hastobeofsufficientsize.Inordertocalculatethis,thevolumeofwastegoinginneedsto beestimatedandthehydraulicretentiontime(HRT)needstobedecided. Thehigherthe HRT, the greater efficiency ofthe biogassettler,however the volumeisthen increased resultinginalargerarearequiredandincreased costs.Ideally,theHRTwouldbeover100 days,butanythingover50daysisacceptable,forthiscaseaHRTof70dayswillbeused.
Thequantityofmanure(slurry) willbemeasuredasfollows:
Cowsproduce16kgperheadperday ofmanure.(Table1)
Quantity(cows)=Σcowsx16kg
=139.5* 16
=2232L/d
Goatsproduce 2 kgperheadperday ofmanure.(Table1)
Quantity(goats) =Σgoatsx2kg
=139.5*2
=279L/d
Humansproduce0.75kgperheadperdayofmanure(Table1)
Quantity(humans)=Σ humansx0.75kg
=1680 *0.75
=1260L/d
Quantity(total)=2232L/d+279L/d+1260L/d
=23863L/d
NowasthiswillbestoredinthetankfortheHRTof70days, thiswillneedtobemultiplied by80togetthefinalvolumeofsludgeinthetank.
Volume(sludge)=23863x70
=1670410L

VolumeofTank

Nowthatthevolumerequiredforgasandthatforsludge areknown,thesecansimplybe addedtogethertodeterminethevolumeofthechamber
Volume(total)=Volume(gas)+Volume(sludge)
=65,000+136,000
≈200,000L
AswedonotexpectthewholeoftheF i d i w o communitytoembracethenewsystem, wewillthenneedtomultiplythisnumberby 0.6,forthe60%ofvillagersthatwillendup usingthissystem

Volume(adjusted)=200,000x0.6
=120,000L
Byusingtheformulaforthe volumeofahemisphere,itcanthen becalculatedthat theradiusofthechamberwillbeinthevicinityof 3.85m
120,000=120 m^3
120=(2*R^3*π)/3
R^3= 57.27m^3
R ≈3.8545 m

VolumeofCompensationTank(CT)
Thevolumeof thecompensationtankisequaltothatof thevolumeofthegasinthemain chamber,inordertoallowforanexcessofgasbeingproducedwithoutexcessivepressure in thechamber.
Volume(gas)=65,000L=Volume(CT)
∴Volume(CT)=65,000Lx60%
∴Volume(CT)≈39,000L=39m^3
39=(2*R^3*π)/3
R≈2.65m

BiogasPlantProposal
For
Gbure, a village in ObafemiOwode, Ogun State, Nigeria

Abatan O.A, Adewale A.O Oseni K.Jand Sodunke M.A
[1]Department of Science Laboratory Technology, MoshoodAbiola Polytechnic, P.M.B 2210, Abeokuta, Ogun State, Nigeria
E-mail: abatanadio4xrist@yahoo.co.uk

Abstract
This proposal suggests installing biogas plants in villages to provide sustainable energy and improve sanitation. The biogas plants would use animal and human waste as feedstock to produce methane gas for fuel. Calculations estimate the plants could produce enough gas to meet the villages' energy needs. Benefits include reducing disease, generating renewable energy without external inputs, creating local jobs, and helping alleviate poverty in the communities.

INTRODUCTION

Gbure is a populated place-a village, city, town, or other agglomeration of buildings where people live and work in ObafemiOwode, Ogun State, South West Nigeria, West Africa. It is on latitude 7° 4' 59" N, longitude 3° 37' 59" E, lat/long (dec) 7.08333,3.68333 with tropical savanna climate type (source : Mindat.org) and is situated nearby to the villages Isagolu and Owojo.
.

The village has a populationof839people with 85householdsspread acrossthevillage and atleast 480live belowthepovertyline.Themajorityofthepopulationis agriculturalworkersand every householdownslivestock.

NEED

Ithasbeenreported thatonly15households haveaccesstoa decent toilet each resulting into widespread practiceof opendefecation behindhomesasanorm.Thissystem brings about ahealthrisk scenario. Sources of water are contaminated when deposits arewashedin likely causing diseasespreading in the village. Most of the villagers living below the poverty line are involved in everyday practice of using firewood orkerosenefuelledstovesindoors bringing detrimental health effects.

CALCULATIONS

FromtheinformationgivenbytheEWBchallenge,thefollowingpopulationstatistics canbe estimated-

- 893People
- 85householdsin village,15in bottomcolonyand10in topcolony
- 2goatsperhouseholdintopandbottomcolonies(85% ofhouseholds)
- 2cowsperhouseholdintopandbottomcolonies(85% ofhouseholds)
- 2goatsperhouseholdinvillage(15%ofhouseholds)
- 2cowsperhouseholdinvillage(15%ofhouseholds)

Thesevalueswillform thebasisofallfollowingcalculations

Gasproduction
Σgoats=#colonyhouseholdsx85%x2goats+#villagehouseholdsx15%x2goats
= (15+10)*0.85*2+85*0.15*2
= 68goats
Σcows=#colonyhouseholdsx85%x2cows+#villagehouseholdsx15%x2cows
=(15+10)*0.85*2+85*0.15*2
=68cows
Cowsyield175Lperheadperdayofgas.(Fig1)
Yield(cows)=Σcowsx 175
=68*175
= 11900L/d
Goats yield 150Lperheadperdayofgas.(Fig1)
Yield(goats) =Σgoatsx150
= 68* 150
=10200L/d

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 07 July 2024, pp: 345-381 www.ijaem.net ISSN: 2395-5252

Humansyield 30Lperheadperday ofgas.(Fig1)
Yield(humans)=Σhumansx30
= 68*30
=2040L/d
Yield(total)=11900+10200+2040
=24140L/d
≈1005.83L/hr

GasUsage

(Duetotheunpredictablenature oftheenergyusageofthevillage(notknowingcooking habitsetc.),acasestudyhasbeenadaptedforthepurposes)
Acommunityconsistingof30peoplesimilartotheG b u r e community conditionsuseda total of 3000L/dof gasintheirdailydutiesincludingcooking,makingteaandusinggaslamps [NETSSAF].
Bydividing thisby30 wecangettheaverageusageperperson,butmultiplyingthisby839 willprovide adecentestimation totheenergyconsumption of theentire village community.
Usage(perperson)=3000÷30=100L/d
Usage(total)=839 *100
=83900L/d
≈3496L/hr
This proposal is not effective since the estimatedgasproductionis lesser than estimatedgasusage.

GasStorageCapacity

Usingtheabovecasestudy,themaximumgasconsumptionforthesmallcommunitywas 500L/h,byadaptingthisvaluefortheconsumptionoftheG b u r e communityusingthe sametechniqueasabove:
Consumption(max) =500÷30x 839 =13983L/h
However,biogas isstillbeingproduced asthisis beingused, therefore the maximum decreasein gasisthemaximumusageminusproduction
Consumption-Yield=13983-24140=-10157L/h
Asthecasestudycommunityconsumedthegasatthisratefor5hoursthetotalstorage requiredwillbetherateatwhichitsbeingconsumedmultipliedbythetime
Volume(gasstorage)= 10157x 5= 50785L
Andinordertoaccountforfluctuationsinthis,itisthen multipliedbyasafetyfactorof 1.25,toensureadequategasshouldconsumptionincreaseby25%.
Volume(gas)=50785Lx1.35= 263481.25L

SludgeStorageCapacity

Inordertocopewiththeamount ofwastecomingintothechamberandtheamount of timeitstaysthere beforeitleavestothecompensationtankandfinallythedryingbed,it hastobeofsufficientsize.Inordertocalculatethis,thevolumeofwastegoinginneedsto beestimatedandthehydraulicretentiontime(HRT)needstobedecided. Thehigherthe HRT, the greater efficiency ofthe biogassettler,however the volumeisthen increased resultinginalargerarearequiredandincreased costs.Ideally,theHRTwouldbeover100 days,butanythingover50daysisacceptable,forthiscaseaHRTof70dayswillbeused.
Thequantityofmanure(slurry) willbemeasuredasfollows:
Cowsproduce16kgperheadperday ofmanure.(Table1)
Quantity(cows)=Σcowsx16kg
= 68* 16
=1088L/d
Goatsproduce 2 kgperheadperday ofmanure.(Table1)
Quantity(goats) =Σgoatsx2kg
= 68*2
=136L/d
Humansproduce0.75kgperheadperdayofmanure(Table1)
Quantity(humans)=Σ humansx0.75kg
= 839 *0.75
=629.25L/d
Quantity(total)=1088L/d+136L/d +629.25L/d
=1853.25L/d
Nowasthiswillbestoredinthetankforthe HRTof70days, thiswillneedtobemultiplied by80togetthefinalvolumeofsludgeinthetank.
Volume(sludge)=1853.2L/dx70
=129727.5L

VolumeofTank

Nowthatthevolumerequiredforgasandthatforsludge areknown,thesecansimplybe addedtogethertodeterminethevolumeofthechamber
Volume(total)=Volume(gas)+Volume(sludge)
=65,000+136,000
≈200,000L
AswedonotexpectthewholeoftheGburecommunitytoembracethenewsystem, wewillthenneedtomultiplythisnumberby 0.6,forthe60%ofvillagersthatwillendup usingthissystemVolume(adjusted)=200,000x0.6
=120,000L
Byusingtheformulaforthe volumeofahemisphere,itcanthen becalculatedthat theradiusofthechamberwillbeinthevicinityof 3.85m

120,000=120 m³
120=(2*R³*π)/3
R³= 57.27m³
R ≈3.8545 m

VolumeofCompensationTank(CT)

Thevolumeof thecompensationtankisequaltothatof thevolumeofthegasinthemain chamber,inordertoallowforanexcessofgasbeingproducedwithoutexcessivepressure in thechamber.
Volume(gas)=65,000L=Volume(CT)

∴Volume(CT)=65,000Lx60%

,∴Volume(CT)≈39,000L=39m³

39=(2*R³*π)/3 ,R≈2.65m

BiogasPlantProposal
For
Ebinpejo, a village in ObafemiOwode, Ogun State, Nigeria

Abatan O.A, Adewale A.O Oseni K.Jand Sodunke M.A
[1]Department of Science Laboratory Technology, MoshoodAbiola Polytechnic, P.M.B 2210, Abeokuta, Ogun State, Nigeria
E-mail: abatanadio4xrist@yahoo.co.uk

Abstract
This proposal suggests installing biogas plants in villages to provide sustainable energy and improve sanitation. The biogas plants would use animal and human waste as feedstock to produce methane gas for fuel. Calculations estimate the plants could produce enough gas to meet the villages' energy needs. Benefits include reducing disease, generating renewable energy without external inputs, creating local jobs, and helping alleviate poverty in the communities.

INTRODUCTION

Ebinpejo is a populated place-a village, city, town, or other agglomeration of buildings where people live and work in ObafemiOwode, Ogun State, South West Nigeria, West Africa. It is on latitude 7° 4' 59" N, longitude 3° 40' 59" E, lat/long (dec) 7.08333,3.68333 with tropical savanna climate type (source : Mindat.org) and is situated nearby to the villages Isagolu and Owojo.
. The village has a populationof500people with 45householdsspread acrossthevillage and atleast 350live belowthepovertyline.Themajorityofthepopulationis agriculturalworkersand every householdownslivestock.

NEED

Ithasbeenreported thatonly5households haveaccesstoa decent toilet each resulting into widespread practiceof opendefecation behindhomesasanorm.Thissystem brings about ahealthrisk scenario. Sources of water are contaminated when deposits arewashedin likely causing diseasespreading in the village. Most of the villagers living below the poverty line are involved in everyday practice of using firewood orkerosenefuelledstovesindoors bringing detrimental health effects.

CALCULATIONS

FromtheinformationgivenbytheEWBchallenge,thefollowingpopulationstatistics canbe estimated-

- 500People
- 45householdsin village,10in bottomcolonyand5in topcolony
- 2goatsperhouseholdintopandbottomcolonies(85% ofhouseholds)
- 2cowsperhouseholdintopandbottomcolonies(85% ofhouseholds)
- 1goatperhouseholdinvillage(15%ofhouseholds)
- 1cowperhouseholdinvillage(15%ofhouseholds)

Thesevalueswillform thebasisofallfollowingcalculations

Gasproduction

Σgoats=#colonyhouseholdsx85%x2goats+#villagehouseholdsx15%x1goat
= (10+5)*0.85*2+45*0.15*1
=32.5goats
Σcows=#colonyhouseholdsx85%x2cows+#villagehouseholdsx15%x1cow
(10+5)*0.85*2+45*0.15*1
=32.5cows
Cowsyield175Lperheadperdayofgas.(Fig1)
Yield(cows)=Σcowsx 175
=32.5*175
=5687.5L/d
Goats yield 150Lperheadperdayofgas.(Fig1)
Yield(goats) =Σgoatsx150
=32.5* 150
= 4875L/d
Humansyield 30Lperheadperday ofgas.(Fig1)
Yield(humans)=Σhumansx30
=32.5*30
=975L/d
Yield(total)=5687.5+4875+975
=11537.5L/d
≈480.73/hr

GasUsage

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 07 July 2024, pp: 345-381 www.ijaem.net ISSN: 2395-5252

(Duetotheunpredictablenature oftheenergyusageofthevillage(notknowingcooking habitsetc.),acasestudyhasbeenadaptedforthepurposes)

Acommunityconsistingof30peoplesimilartotheE b i n p e j o community conditionsuseda total of 3000L/dof gasintheirdailydutiesincludingcooking,makingteaandusinggaslamps [NETSSAF].

Bydividing thisby30 wecangettheaverageusageperperson,butmultiplyingthisby500willprovide adecentestimation totheenergyconsumption of theentire villagecommunity.

Usage(perperson)=3000÷30=100L/d

Usage(total)=500 *100

= 50000L/d

≈ 2083.3L/hr

This proposal is not effective since the estimatedgasproductionis lesser than estimatedgasusage.

GasStorageCapacity

Usingtheabovecasestudy,themaximumgasconsumptionforthesmallcommunitywas 500L/h,byadaptingthisvaluefortheconsumptionoftheEbinpejocommunityusingthe sametechniqueasabove:

Consumption(max) =500÷30x 500 =8333.3L/h

However,biogas isstillbeingproduced asthisis beingused, therefore the maximum decreasein gasisthemaximumusageminusproduction

Consumption-Yield=8333.3-11537.5=3202.4L/h

Asthecasestudycommunityconsumedthegasatthisratefor5hoursthetotalstorage requiredwillbetherateatwhichitsbeingconsumedmultipliedbythetime

Volume(gasstorage)=3202.4L/hx 5=16021L

Andinordertoaccountforfluctuationsinthis,itisthen multipliedbyasafetyfactorof 1.25,toensureadequategasshouldconsumptionincreaseby2\5%.

Volume(gas)=16021x1.25 =7526.25L

SludgeStorageCapacity

Inordertocopewiththeamount ofwastecomingintothechamberandtheamount of timeitstaysthere beforeitleavestothecompensationtankandfinallythedryingbed,it hastobeofsufficientsize.Inordertocalculatethis,thevolumeofwastegoinginneedsto beestimatedandthehydraulicretentiontime(HRT)needstobedecided. Thehigherthe HRT, the greater efficiency ofthe biogassettler,however the volumeisthen increased resultinginalargerarearequiredandincreased costs.Ideally,theHRTwouldbeover100 days,butanythingover50daysisacceptable,forthiscaseaHRTof70dayswillbeused.

Thequantityofmanure(slurry) willbemeasuredasfollows:

Cowsproduce16kgperheadperday ofmanure.(Table1)

Quantity(cows)=Σcowsx16kg

=32.25* 16

=520L/d

Goatsproduce 2 kgperheadperday ofmanure.(Table1)

Quantity(goats) =Σgoatsx2kg

= 32.5*2

=65L/d

Humansproduce0.75kgperheadperdayofmanure(Table1)

Quantity(humans)=Σ humansx0.75kg

= 32.5 *0.75

=24.375L/d

Quantity(total)=520+65 +24.375

=609.375L/d

Nowasthiswillbestoredinthetankforthe HRTof70days, thiswillneedtobemultiplied by80togetthefinalvolumeofsludgeinthetank.

Volume(sludge)=609.375L/dx70

=42656.25L

VolumeofTank

Nowthatthevolumerequiredforgasandthatforsludge areknown,thesecansimplybe addedtogethertodeterminethevolumeofthechamber

Volume(total)=Volume(gas)+Volume(sludge)=65,000+136,000≈200,000L

AswedonotexpectthewholeoftheEbinpejocommunity toembracethenewsystem, wewillthenneedtomultiplythisnumberby 0.6,forthe60%ofvillagersthatwillendup usingthissystem,

Volume(adjusted)=200,000x0.6=120,000L

Byusingtheformulaforthe volumeofahemisphere,itcanthen becalculatedthat theradiusofthechamberwillbeinthevicinityof 3.85m

$120{,}000 = 120\ m^3$

$120 = (2 * R^3 * \pi)/3$

$R^3 = 57.27 m^3$

$R \approx 3.8545$ m

VolumeofCompensationTank(CT)

Thevolumeof thecompensationtankisequaltothatof thevolumeofthegasinthemain chamber,inordertoallowforanexcessofgasbeingproducedwithoutexcessivepressure in thechamber.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 07 July 2024, pp: 345-381 www.ijaem.net ISSN: 2395-5252

Volume(gas)=65,000L=Volume(CT)

.∴Volume(CT)=65,000Lx60%

∴Volume(CT)≈39,000L=39m³ ,39=(2*R³*π)/3

R≈2.65m

BiogasPlantProposal
For
Oloparun, a village in ObafemiOwode, Ogun State, Nigeria

Abatan O.A, Adewale A.O Oseni K.Jand Sodunke M.A
[1]Department of Science Laboratory Technology, MoshoodAbiola Polytechnic, P.M.B 2210, Abeokuta, Ogun State, Nigeria
E-mail: abatanadio4xrist@yahoo.co.uk

Abstract
This proposal suggests installing biogas plants in villages to provide sustainable energy and improve sanitation. The biogas plants would use animal and human waste as feedstock to produce methane gas for fuel. Calculations estimate the plants could produce enough gas to meet the villages' energy needs. Benefits include reducing disease, generating renewable energy without external inputs, creating local jobs, and helping alleviate poverty in the communities.

INTRODUCTION

Oloparun, ObafemiOwode, Ogun State, Nigeria ;ObafemiOwode, Ogun State, Nigeria · 7° 7' 0'' N · 3° 38' 59'' E · 7.11667,3.65 · Aw : Tropical savanna, wet.
. The village has a populationof716people with 172householdsspread acrossthevillage and atleast 142live belowthepovertyline.Themajorityofthepopulationis agriculturalworkersand every householdownslivestock.

NEED

Ithasbeenreported thatonly70households haveaccesstoa decent toilet each resulting into widespread practiceof opendefecation behindhomesasanorm.Thissystem brings about ahealthrisk scenario. Sources of water are contaminated when deposits arewashedin likely causing diseasespreading in the village. Most of the villagers living below the poverty line are involved in everyday practice of using firewood orkerosenefuelledstovesindoors bringing detrimental health effects.

CALCULATIONS

FromtheinformationgivenbytheEWBchallenge,thefollowingpopulationstatistics canbe estimated-

- 716People
- 172householdsin village,54in bottomcolonyand46in topcolony
- 3goatsperhouseholdintopandbottomcolonies(85% ofhouseholds)
- 3cowsperhouseholdintopandbottomcolonies(85% ofhouseholds)
- 1goatperhouseholdinvillage(15%ofhouseholds)
- 1cowperhouseholdinvillage(15%ofhouseholds)

Thesevalueswillform thebasisofallfollowingcalculations

Gasproduction
Σgoats=#colonyhouseholdsx85%x3goats+#villagehouseholdsx15%x1goat
= (54+46)*0.85*3+172*0.15*1
= 513goats
Σcows=#colonyhouseholdsx85%x3cows+#villagehouseholdsx15%x1cow
=(54+46)*0.85*3+172*0.15*1
=513 cows
Cowsyield175Lperheadperdayofgas.(Fig1)
Yield(cows)=Σcowsx 175
=513*175
= 89,775L/d
Goats yield 150Lperheadperdayofgas.(Fig1)
Yield(goats) =Σgoatsx150
= 513* 150
= 76,950L/d
Humansyield 30Lperheadperday ofgas.(Fig1)
Yield(humans)=Σhumansx30
= 513*30
=15,390L/d
Yield(total)=89,775+76,950+15,390
= 182115L/d
≈7588L/hr

GasUsage

(Duetotheunpredictablenature oftheenergyusageofthevillage(notknowingcooking habitsetc.),acasestudyhasbeenadaptedforthepurposes)
Acommunityconsistingof30peoplesimilartotheOloparun community conditionsuseda total of 3000L/dof gasintheirdailydutiesincludingcooking,makingteaandusinggaslamps [NETSSAF].
Bydividing thisby30 wecangettheaverageusageperperson,butmultiplyingthisby716willprovide adecentestimation

totheenergyconsumption of theentire villagecommunity.
Usage(perperson)=3000÷30=100L/d
Usage(total)=716 *100
= 71600L/d
≈ 2983L/hr
This proposal is effective since the estimatedgasproductionis greater than estimatedgasusage.

GasStorageCapacity

Usingtheabovecasestudy,themaximumgasconsumptionforthesmallcommunitywas 500L/h,byadaptingthisvaluefortheconsumptionoftheOloparuncommunityusingthe sametechniqueasabove:
Consumption(max) =500÷30x 716 =11933L/h
However,biogas isstillbeingproduced asthisis beingused, therefore the maximum decreasein gasisthemaximumusageminusproduction
Consumption-Yield=11933-7588= 4345L/h
Asthecasestudycommunityconsumedthegasatthisratefor5hoursthetotalstorage requiredwillbetherateatwhichitsbeingconsumedmultipliedbythetime
Volume(gasstorage)= 4345x 5= 21725L
Andinordertoaccountforfluctuationsinthis,itisthen multipliedbyasafetyfactorof 1.35,toensureadequategasshouldconsumptionincreaseby35%.
Volume(gas)=21725x1.35 = 29328.75L

SludgeStorageCapacity

Inordertocopewiththeamount ofwastecomingintothechamberandtheamount of timeitstaysthere beforeitleavestothecompensationtankandfinallythedryingbed,it hastobeofsufficientsize.Inordertocalculatethis,thevolumeofwastegoinginneedsto beestimatedandthehydraulicretentiontime(HRT)needstobedecided. Thehigherthe HRT, the greater efficiency ofthe biogassettler,however the volumeisthen increased resultinginalargerarearequiredandincreased costs.Ideally,theHRTwouldbeover100 days,butanythingover50daysisacceptable,forthiscaseaHRTof70dayswillbeused.
Thequantityofmanure(slurry) willbemeasuredasfollows:
Cowsproduce16kgperheadperday ofmanure.(Table1)
Quantity(cows)=Σcowsx16kg
= 513* 16
=8208L/d
Goatsproduce 2 kgperheadperday ofmanure.(Table1)
Quantity(goats) =Σgoatsx2kg
= 513*2
=1026L/d
Humansproduce0.75kgperheadperdayofmanure(Table1)
Quantity(humans)=Σ humansx0.75kg
= 716 *0.75
=537L/d
Quantity(total)=8208+1026 +537
= 9771L/d
NowasthiswillbestoredinthetankfortheHRTof70days, thiswillneedtobemultiplied by80togetthefinalvolumeofsludgeinthetank.
Volume(sludge)=9771x70
=683970L

VolumeofTank

Nowthatthevolumerequiredforgasandthatforsludge areknown,thesecansimplybe addedtogethertodeterminethevolumeofthechamber
Volume(total)=Volume(gas)+Volume(sludge)
=65,000+136,000
≈200,000L
AswedonotexpectthewholeoftheOloparuncommunitytoembracethenewsystem, wewillthenneedtomultiplythisnumberby 0.6,forthe60%ofvillagersthatwillendup usingthissystem
Volume(adjusted)=200,000x0.6
=120,000L
Byusingtheformulaforthe volumeofahemisphere,itcanthen becalculatedthat theradiusofthechamberwillbeinthevicinityof 3.85m
120,000=120 m^3
$120=(2*R^3*\pi)/3$
$R^3= 57.27m^3$
R ≈3.8545 m
VolumeofCompensationTank(CT)
Thevolumeof thecompensationtankisequaltothatof thevolumeofthegasinthemain chamber,inordertoallowforanexcessofgasbeingproducedwithoutexcessivepressure in thechamber.
Volume(gas)=65,000L=Volume(CT)
∴Volume(CT)=65,000Lx60%
∴Volume(CT)≈39,000L=39m^3
$39=(2*R^3*\pi)/3$
R≈2.65m

BiogasPlantProposal
For

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 07 July 2024, pp: 345-381 www.ijaem.net ISSN: 2395-5252

Isagolu, a village in ObafemiOwode, Ogun State, Nigeria

Abatan O.A, Adewale A.O Oseni K.Jand Sodunke M.A
[1]Department of Science Laboratory Technology, MoshoodAbiola Polytechnic, P.M.B 2210, Abeokuta, Ogun State, Nigeria
E-mail: abatanadio4xrist@yahoo.co.uk

Abstract
This proposal suggests installing biogas plants in villages to provide sustainable energy and improve sanitation. The biogas plants would use animal and human waste as feedstock to produce methane gas for fuel. Calculations estimate the plants could produce enough gas to meet the villages' energy needs. Benefits include reducing disease, generating renewable energy without external inputs, creating local jobs, and helping alleviate poverty in the communities.

Isagolu, ObafemiOwode, Ogun State, Nigeria. Alternative Names: Amushan ... Region: ObafemiOwode, Ogun State, Nigeria. Latitude: 7° 5' 59" N. Longitude ...

INTRODUCTION

Isagolu is a populated place-a village, city, town, or other agglomeration of buildings where people live and work in ObafemiOwode, Ogun State, South West Nigeria, West Africa. It is on latitude 7° 4' 59" N, longitude 3° 40' 59" E, lat/long (dec) 7.08333,3.68333 with tropical savanna climate type (source : Mindat.org) and is situated nearby to the villages Isagolu and Owojo.
. The village has a populationof716people with 172householdsspread acrossthevillage and atleast 142live belowthepovertyline.Themajorityofthepopulationis agriculturalworkersand every householdownslivestock.

NEED

Ithasbeenreported thatonly70households haveaccesstoa decent toilet each resulting into widespread practiceof opendefecation behindhomesasanorm.Thissystem brings about ahealthrisk scenario. Sources of water are contaminated when deposits arewashedin likely causing diseasespreading in the village. Most of the villagers living below the poverty line are involved in everyday practice of using firewood orkerosenefuelledstovesindoors bringing detrimental health effects.

CALCULATIONS

FromtheinformationgivenbytheEWBchallenge,thefollowingpopulationstatistics canbe estimated-

- 716People
- 172householdsin village,54in bottomcolonyand46in topcolony
- 3goatsperhouseholdintopandbottomcolonies(85% ofhouseholds)
- 3cowsperhouseholdintopandbottomcolonies(85% ofhouseholds)
- 1goatperhouseholdinvillage(15%ofhouseholds)
- 1cowperhouseholdinvillage(15%ofhouseholds)

Thesevalueswillform thebasisofallfollowingcalculations

<u>Gasproduction</u>
Σgoats=#colonyhouseholdsx85%x3goats+#villagehouseholdsx15%x1goat
= (54+46)*0.85*3+172*0.15*1
= 513goats
Σcows=#colonyhouseholdsx85%x3cows+#villagehouseholdsx15%x1cow
=(54+46)*0.85*3+172*0.15*1
=513 cows
Cowsyield175Lperheadperdayofgas.(Fig1)
Yield(cows)=Σcowsx 175
=513*175
= 89,775L/d
Goats yield 150Lperheadperdayofgas.(Fig1)
Yield(goats) =Σgoatsx150
= 513* 150
= 76,950L/d
Humansyield 30Lperheadperday ofgas.(Fig1)
Yield(humans)=Σhumansx30
= 513*30
=15,390L/d
Yield(total)=89,775+76,950+15,390
= 182115L/d
≈7588L/hr

<u>GasUsage</u>

(Duetotheunpredictablenature oftheenergyusageofthevillage(notknowingcooking habitsetc.),acasestudyhasbeenadaptedforthepurposes)
Acommunityconsistingof30peoplesimilartotheI s a g o l u community conditionsuseda total of 3000L/dof gasintheirdailydutiesincludingcooking,makingteaandusinggaslamps [NETSSAF].

Bydividing thisby30 wecangettheaverageusageperperson,butmultiplyingthisby716willprovide adecentestimation totheenergyconsumption of theentire villagecommunity.
Usage(perperson)=3000÷30=100L/d
Usage(total)=716 *100
= 71600L/d
≈ 2983L/hr
This proposal is effective since the estimatedgasproductionis greater than estimatedgasusage.

GasStorageCapacity

Usingtheabovecasestudy,themaximumgasconsumptionforthesmallcommunitywas 500L/h,byadaptingthisvaluefortheconsumptionoftheIsagolucommunityusingthe sametechniqueasabove:
Consumption(max) =500÷30x 716 =11933L/h
However,biogas isstillbeingproduced asthisis beingused, therefore the maximum decreasein gasisthemaximumusageminusproduction
Consumption-Yield=11933-7588= 4345L/h
Asthecasestudycommunityconsumedthegasatthisratefor5hoursthetotalstorage requiredwillbetherateatwhichitsbeingconsumedmultipliedbythetime
Volume(gasstorage)= 4345x 5= 21725L
Andinordertoaccountforfluctuationsinthis,itisthen multipliedbyasafetyfactorof 1.35,toensureadequategasshouldconsumptionincreaseby35%.
Volume(gas)=21725x1.35 = 29328.75L

SludgeStorageCapacity

Inordertocopewiththeamount ofwastecomingintothechamberandtheamount of timeitstaysthere beforeitleavestothecompensationtankandfinallythedryingbed,it hastobeofsufficientsize.Inordertocalculatethis,thevolumeofwastegoinginneedsto beestimatedandthehydraulicretentiontime(HRT)needstobedecided. Thehigherthe HRT, the greater efficiency ofthe biogassettler,however the volumeisthen increased resultinginalargerarearequiredandincreased costs.Ideally,theHRTwouldbeover100 days,butanythingover50daysisacceptable,forthiscaseaHRTof70dayswillbeused.
Thequantityofmanure(slurry) willbemeasuredasfollows:
Cowsproduce16kgperheadperday ofmanure.(Table1)
Quantity(cows)=Σcowsx16kg
= 513* 16
=8208L/d
Goatsproduce 2 kgperheadperday ofmanure.(Table1)
Quantity(goats) =Σgoatsx2kg
= 513*2
=1026L/d
Humansproduce0.75kgperheadperdayofmanure(Table1)
Quantity(humans)=Σ humansx0.75kg
= 716 *0.75
=537L/d
Quantity(total)=8208+1026 +537
= 9771L/d
NowasthiswillbestoredinthetankfortheHRTof70days, thiswillneedtobemultiplied by80togetthefinalvolumeofsludgeinthetank.
Volume(sludge)=9771x70
=683970L

VolumeofTank

Nowthatthevolumerequiredforgasandthatforsludge areknown,thesecansimplybe addedtogethertodeterminethevolumeofthechamber
Volume(total)=Volume(gas)+Volume(sludge)
=65,000+136,000
≈200,000L
AswedonotexpectthewholeoftheIsagolucommunitytoembracethenewsystem, wewillthenneedtomultiplythisnumberby 0.6,forthe60%ofvillagersthatwillendup usingthissystem
Volume(adjusted)=200,000x0.6
=120,000L
Byusingtheformulaforthe volumeofahemisphere,itcanthen becalculatedthat theradiusofthechamberwillbeinthevicinityof 3.85m
$120{,}000 = 120\ m^3$
$120 = (2 * R^3 * \pi)/3$
$R^3 = 57.27 m^3$
$R \approx 3.8545$ m

VolumeofCompensationTank(CT)

Thevolumeof thecompensationtankisequaltothatof thevolumeofthegasinthemain chamber,inordertoallowforanexcessofgasbeingproducedwithoutexcessivepressure in thechamber.
Volume(gas)=65,000L=Volume(CT)
∴Volume(CT)=65,000Lx60%
∴Volume(CT)≈39,000L=$39m^3$
$39 = (2 * R^3 * \pi)/3$
$R \approx 2.65$

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 07 July 2024, pp: 345-381 www.ijaem.net ISSN: 2395-5252

Debonre, a village in ObafemiOwode, Ogun State, Nigeria

Abatan O.A, Adewale A.O Oseni K.Jand Sodunke M.A
[1]Department of Science Laboratory Technology, MoshoodAbiola Polytechnic, P.M.B 2210, Abeokuta, Ogun State, Nigeria
E-mail: abatanadio4xrist@yahoo.co.uk

Abstract
This proposal suggests installing biogas plants in villages to provide sustainable energy and improve sanitation. The biogas plants would use animal and human waste as feedstock to produce methane gas for fuel. Calculations estimate the plants could produce enough gas to meet the villages' energy needs. Benefits include reducing disease, generating renewable energy without external inputs, creating local jobs, and helping alleviate poverty in the communities.

INTRODUCTION

Debonreis a populated place-a village, city, town, or other agglomeration of buildings where people live and work in ObafemiOwode, Ogun State, South West Nigeria, West Africa. It is on latitude 7° 4' 00" N, longitude 3° 40' 59" E, lat/long (dec) 7.08333,3.68333 with tropical savanna climate type (source : Mindat.org) and is situated nearby to the villages Isagolu and Owojo.

. The village has a populationof1680people with 228householdsspread acrossthevillage and atleast 187live belowthepovertyline.Themajorityofthepopulationis agriculturalworkersand every householdownslivestock.

NEED

Ithasbeenreported thatonly108households haveaccesstoa decent toilet each resulting into widespread practiceof opendefecation behindhomesasanorm.Thissystem brings about ahealthrisk scenario. Sources of water are contaminated when deposits arewashedin likely causing diseasespreading in the village. Most of the villagers living below the poverty line are involved in everyday practice of using firewood orkerosenefuelledstovesindoors bringing detrimental health effects.

CALCULATIONS

FromtheinformationgivenbytheEWBchallenge,thefollowingpopulationstatistics canbe estimated-

- 1680People
- 228householdsin village,30in bottomcolonyand25in topcolony
- 2goatsperhouseholdintopandbottomcolonies(75% ofhouseholds)
- 2cowsperhouseholdintopandbottomcolonies(75% ofhouseholds)
- 1goatperhouseholdinvillage(25%ofhouseholds)
- 1cowperhouseholdinvillage(25%ofhouseholds)

Thesevalueswillform thebasisofallfollowingcalculations

<u>Gasproduction</u>

Σgoats=#colonyhouseholdsx75%x2goats+#villagehouseholdsx25%x1goat
= (30+25)*0.75*2+228*0.25*1
=139.5goats
Σcows=#colonyhouseholdsx75%x2cows+#villagehouseholdsx25%x1cow
=((30+25)*0.75*2+228*0.25*1
=139.5cows
Cowsyield175Lperheadperdayofgas.(Fig1)
Yield(cows)=Σcowsx 175
=139.5*175
=24412.5L/d
Goats yield 150Lperheadperdayofgas.(Fig1)
Yield(goats) =Σgoatsx150
=139.5* 150
=20925L/d
Humansyield 30Lperheadperday ofgas.(Fig1)
Yield(humans)=Σhumansx30
=139.5*30
=4185L/d
Yield(total)=24412.5L/d +20925L/d +4185L/d
=49522.5L/d
≈2063.4L/hr

<u>GasUsage</u>

(Duetotheunpredictablenature oftheenergyusageofthevillage(notknowingcooking habitsetc.),acasestudyhasbeenadaptedforthepurposes)

Acommunityconsistingof30peoplesimilartotheD e b o n r e community conditionsuseda total of 3000L/dof gasintheirdailydutiesincludingcooking,makingteaandusinggaslamps [NETSSAF].

Bydividing thisby30 wecangettheaverageusageperperson,butmultiplyingthisby1680willprovide adecentestimation

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 07 July 2024, pp: 345-381 www.ijaem.net ISSN: 2395-5252

totheenergyconsumption of theentire village community.
Usage(perperson)=3000÷30=100L/d
Usage(total)=1680 x100
=168000L/d
≈ 7000L/hr
This proposal is not effective since the estimatedgasproductionis lesser than estimatedgasusage.

GasStorageCapacity

Usingtheabovecasestudy,themaximumgasconsumptionforthesmallcommunitywas 500L/h,byadaptingthisvaluefortheconsumptionoftheD e b o n r e communityusingthe sametechniqueasabove:
Consumption(max) =500÷30x1680=28000L/h
However,biogas isstillbeingproduced asthisis beingused, therefore the maximum decreasein gasisthemaximumusageminusproduction
Consumption-Yield=28000–49522.5= -21522.5L/h
Asthecasestudycommunityconsumedthegasatthisratefor5hoursthetotalstorage requiredwillbetherateatwhichitsbeingconsumedmultipliedbythetime
Volume(gasstorage)=21522.5x 5=107612.5L
Andinordertoaccountforfluctuationsinthis,itisthen multipliedbyasafetyfactorof 1.25,toensureadequategasshouldconsumptionincreaseby25%.
Volume(gas)=107612.5Lx1.25=134515.625L

SludgeStorageCapacity

Inordertocopewiththeamount ofwastecomingintothechamberandtheamount of timeitstaysthere beforeitleavestothecompensationtankandfinallythedryingbed,it hastobeofsufficientsize.Inordertocalculatethis,thevolumeofwastegoinginneedsto beestimatedandthehydraulicretentiontime(HRT)needstobedecided. Thehigherthe HRT, the greater efficiency ofthe biogassettler,however the volumeisthen increased resultinginalargerarearequiredandincreased costs.Ideally,theHRTwouldbeover100 days,butanythingover50daysisacceptable,forthiscaseaHRTof70dayswillbeused.
Thequantityofmanure(slurry) willbemeasuredasfollows:
Cowsproduce16kgperheadperday ofmanure.(Table1)
Quantity(cows)=Σcowsx16kg
=139.5* 16
=2232L/d
Goatsproduce 2 kgperheadperday ofmanure.(Table1)
Quantity(goats) =Σgoatsx2kg
=139.5*2
=279L/d
Humansproduce0.75kgperheadperdayofmanure(Table1)
Quantity(humans)=Σ humansx0.75kg
=1680 *0.75
=1260L/d
Quantity(total)=2232L/d +279L/d+1260L/d
=23863L/d
NowasthiswillbestoredinthetankfortheHRTof70days, thiswillneedtobemultiplied by80togetthefinalvolumeofsludgeinthetank.
Volume(sludge)=23863x70
=1670410L

VolumeofTank

Nowthatthevolumerequiredforgasandthatforsludge areknown,thesecansimplybe addedtogethertodeterminethevolumeofthechamber
Volume(total)=Volume(gas)+Volume(sludge)
=65,000+136,000
≈200,000L
AswedonotexpectthewholeoftheD e b o n r e communitytoembracethenewsystem, wewillthenneedtomultiplythisnumberby 0.6,forthe60%ofvillagersthatwillendup usingthissystem
Volume(adjusted)=200,000x0.6
=120,000L
Byusingtheformulaforthe volumeofahemisphere,itcanthen becalculatedthat theradiusofthechamberwillbeinthevicinityof 3.85m
120,000=120 m^3
$120=(2*R^3*\pi)/3$
$R^3= 57.27m^3$
R ≈3.8545 m

VolumeofCompensationTank(CT)

Thevolumeof thecompensationtankisequaltothatof thevolumeofthegasinthemain chamber,inordertoallowforanexcessofgasbeingproducedwithoutexcessivepressure in thechamber.
Volume(gas)=65,000L=Volume(CT)
∴Volume(CT)=65,000Lx60%
∴Volume(CT)≈39,000L=$39m^3$
$39=(2*R^3*\pi)/3$
R≈2.65m

BiogasPlantProposal
For

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 07 July 2024, pp: 345-381 www.ijaem.net ISSN: 2395-5252

Onigbodogi, a village in ObafemiOwode, Ogun State, Nigeria

Abatan O.A, Adewale A.O Oseni K.Jand Sodunke M.A
[1]Department of Science Laboratory Technology, MoshoodAbiola Polytechnic, P.M.B 2210, Abeokuta, Ogun State, Nigeria
E-mail: abatanadio4xrist@yahoo.co.uk

Abstract
This proposal suggests installing biogas plants in villages to provide sustainable energy and improve sanitation. The biogas plants would use animal and human waste as feedstock to produce methane gas for fuel. Calculations estimate the plants could produce enough gas to meet the villages' energy needs. Benefits include reducing disease, generating renewable energy without external inputs, creating local jobs, and helping alleviate poverty in the communities.

INTRODUCTION

Onigbodogi is a populated place-a village, city, town, or other agglomeration of buildings where people live and work in ObafemiOwode, Ogun State, South West Nigeria, West Africa. It is on latitude 7° 4' 59" N, longitude 3° 37' 59" E, lat/long (dec) 7.08333,3.68333 with tropical savanna climate type (source : Mindat.org) and is situated nearby to the villages Isagolu and Owojo.
.
The village has a populationof839people with 85householdsspread acrossthevillage and atleast 480live belowthepovertyline.Themajorityofthepopulationis agriculturalworkersand every householdownslivestock.

NEED

Ithasbeenreported thatonly15households haveaccesstoa decent toilet each resulting into widespread practiceof opendefecation behindhomesasanorm.Thissystem brings about ahealthrisk scenario. Sources of water are contaminated when deposits arewashedin likely causing diseasespreading in the village. Most of the villagers living below the poverty line are involved in everyday practice of using firewood orkerosenefuelledstovesindoors bringing detrimental health effects.

CALCULATIONS

FromtheinformationgivenbytheEWBchallenge,thefollowingpopulationstatistics canbe estimated-

- 893People
- 85householdsin village,15in bottomcolonyand10in topcolony
- 2goatsperhouseholdintopandbottomcolonies(85% ofhouseholds)
- 2cowsperhouseholdintopandbottomcolonies(85% ofhouseholds)
- 2goatsperhouseholdinvillage(15%ofhouseholds)
- 2cowsperhouseholdinvillage(15%ofhouseholds)

Thesevalueswillform thebasisofallfollowingcalculations

<u>Gasproduction</u>
Σgoats=#colonyhouseholdsx85%x2goats+#villagehouseholdsx15%x2goats
= (15+10)*0.85*2+85*0.15*2
= 68goats
Σcows=#colonyhouseholdsx85%x2cows+#villagehouseholdsx15%x2cows
=(15+10)*0.85*2+85*0.15*2
=68cows
Cowsyield175Lperheadperdayofgas.(Fig1)
Yield(cows)=Σcowsx 175
=68*175
= 11900L/d
Goats yield 150Lperheadperdayofgas.(Fig1)
Yield(goats) =Σgoatsx150
= 68* 150
=10200L/d
Humansyield 30Lperheadperday ofgas.(Fig1)
Yield(humans)=Σhumansx30
= 68*30
=2040L/d
Yield(total)=11900+10200+2040
=24140L/d
≈1005.83L/hr
<u>GasUsage</u>

(Duetotheunpredictablenature oftheenergyusageofthevillage(notknowingcooking habitsetc.),acasestudyhasbeenadaptedforthepurposes)
Acommunityconsistingof30peoplesimilartotheOnigbodogicommunity conditionsuseda total of 3000L/dof gasintheirdailydutiesincludingcooking,makingteaandusinggaslamps [NETSSAF].
Bydividing thisby30 wecangettheaverageusageperperson,butmultiplyingthisby839 willprovide adecentestimation totheenergyconsumption of theentire village community.

Usage(perperson)=3000÷30=100L/d
Usage(total)=839 *100
=83900L/d
≈3496L/hr
This proposal is not effective since the estimatedgasproductionis lesser than estimatedgasusage.

GasStorageCapacity

Usingtheabovecasestudy,themaximumgasconsumptionforthesmallcommunitywas 500L/h,byadaptingthisvaluefortheconsumptionoftheOnigbodogicommunityusingthe sametechniqueasabove:
Consumption(max) =500÷30x 839 =13983L/h
However,biogas isstillbeingproduced asthis is beingused, therefore the maximum decreasein gasisthemaximumusageminusproduction
Consumption-Yield=13983-24140=-10157L/h
Asthecasestudycommunityconsumedthegasatthisratefor5hoursthetotalstorage requiredwillbetherateatwhichitsbeingconsumedmultipliedbythetime
Volume(gasstorage)= 10157x 5= 50785L
Andinordertoaccountforfluctuationsinthis,itisthen multipliedbyasafetyfactorof 1.25,toensureadequategasshouldconsumptionincreaseby25%.
Volume(gas)=50785Lx1.35= 263481.25L

SludgeStorageCapacity

Inordertocopewiththeamount ofwastecomingintothechamberandtheamount of timeitstaysthere beforeitleavestothecompensationtankandfinallythedryingbed,it hastobeofsufficientsize.Inordertocalculatethis,thevolumeofwastegoinginneedsto beestimatedandthehydraulicretentiontime(HRT)needstobedecided. Thehigherthe HRT, the greater efficiency ofthe biogassettler,however the volumeisthen increased resultinginalargerarearequiredandincreased costs.Ideally,theHRTwouldbeover100 days,butanythingover50daysisacceptable,forthiscaseaHRTof70dayswillbeused.
Thequantityofmanure(slurry) willbemeasuredasfollows:
Cowsproduce16kgperheadperday ofmanure.(Table1)
Quantity(cows)=Σcowsx16kg
= 68* 16
=1088L/d
Goatsproduce 2 kgperheadperday ofmanure.(Table1)
Quantity(goats) =Σgoatsx2kg
= 68*2
=136L/d
Humansproduce0.75kgperheadperdayofmanure(Table1)
Quantity(humans)=Σ humansx0.75kg
= 839 *0.75
=629.25L/d
Quantity(total)=1088L/d+136L/d +629.25L/d
=1853.25L/d
NowasthiswillbestoredinthetankfortheHRTof70days, thiswillneedtobemultiplied by80togetthefinalvolumeofsludgeinthetank.
Volume(sludge)=1853.2L/dx70
=129727.5L

VolumeofTank

Nowthatthevolumerequiredforgasandthatforsludge areknown,thesecansimplybe addedtogethertodeterminethevolumeofthechamber
Volume(total)=Volume(gas)+Volume(sludge)
=65,000+136,000
≈200,000L
AswedonotexpectthewholeoftheOnigbodogicommunitytoembracethenewsystem, wewillthenneedtomultiplythisnumberby 0.6,forthe60%ofvillagersthatwillendup usingthissystemVolume(adjusted)=200,000x0.6
=120,000L
Byusingtheformulaforthe volumeofahemisphere,itcanthen becalculatedthat theradiusofthechamberwillbeinthevicinityof 3.85m
$120,000=120^3$
$120=(2*R^3*\pi)/3$
$R^3= 57.27m^3$
$R \approx 3.8545$ m

VolumeofCompensationTank(CT)

Thevolumeof thecompensationtankisequaltothatof thevolumeofthegasinthemain chamber,inordertoallowforanexcessofgasbeingproducedwithoutexcessivepressure in thechamber.
Volume(gas)=65,000L=Volume(CT)
∴Volume(CT)=65,000Lx60%
,∴Volume(CT)≈39,000L=$39m^3$
$39=(2*R^3*\pi)/3$,R≈2.65m

BiogasPlantProposal
For
Aberuagba, a village in ObafemiOwode, Ogun State, Nigeria

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 07 July 2024, pp: 345-381 www.ijaem.net ISSN: 2395-5252

Abatan O.A, Adewale A.O Oseni K.Jand Sodunke M.A
[1]Department of Science Laboratory Technology, MoshoodAbiola Polytechnic, P.M.B 2210, Abeokuta, Ogun State, Nigeria
E-mail: abatanadio4xrist@yahoo.co.uk

Abstract
This proposal suggests installing biogas plants in villages to provide sustainable energy and improve sanitation. The biogas plants would use animal and human waste as feedstock to produce methane gas for fuel. Calculations estimate the plants could produce enough gas to meet the villages' energy needs. Benefits include reducing disease, generating renewable energy without external inputs, creating local jobs, and helping alleviate poverty in the communities.

INTRODUCTION

Aberuagba, is a populated place-a village, city, town, or other agglomeration of buildings where people live and work in ObafemiOwode, Ogun State, South West Nigeria, West Africa. It is on latitude 7° 4' 59" N, longitude 3° 40' 59" E, lat/long (dec) 7.08333,3.68333 with tropical savanna climate type (source : Mindat.org) and is situated nearby to the villages Isagolu and Owojo.
. The village has a populationof500people with 45householdsspread acrossthevillage and atleast 350live belowthepovertyline.Themajorityofthepopulationis agriculturalworkersand every householdownslivestock.

NEED

Ithasbeenreported thatonly5households haveaccesstoa decent toilet each resulting into widespread practiceof opendefecation behindhomesasanorm.Thissystem brings about ahealthrisk scenario. Sources of water are contaminated when deposits arewashedin likely causing diseasespreading in the village. Most of the villagers living below the poverty line are involved in everyday practice of using firewood orkerosenefuelledstovesindoors bringing detrimental health effects.

CALCULATIONS

FromtheinformationgivenbytheEWBchallenge,thefollowingpopulationstatistics canbe estimated-

- 500People
- 45householdsin village,10in bottomcolonyand5in topcolony
- 2goatsperhouseholdintopandbottomcolonies(85% ofhouseholds)
- 2cowsperhouseholdintopandbottomcolonies(85% ofhouseholds)
- 1goatperhouseholdinvillage(15%ofhouseholds)
- 1cowperhouseholdinvillage(15%ofhouseholds)

Thesevalueswillform thebasisofallfollowingcalculations

<u>Gasproduction</u>
Σgoats=#colonyhouseholdsx85%x2goats+#villagehouseholdsx15%x1goat
= (10+5)*0.85*2+45*0.15*1
=32.5goats
Σcows=#colonyhouseholdsx85%x2cows+#villagehouseholdsx15%x1cow
(10+5)*0.85*2+45*0.15*1
=32.5cows
Cowsyield175Lperheadperdayofgas.(Fig1)
Yield(cows)=Σcowsx 175
=32.5*175
=5687.5L/d
Goats yield 150Lperheadperdayofgas.(Fig1)
Yield(goats) =Σgoatsx150
=32.5* 150
= 4875L/d
Humansyield 30Lperheadperday ofgas.(Fig1)
Yield(humans)=Σhumansx30
=32.5*30
=975L/d
Yield(total)=5687.5+4875+975
=11537.5L/d
≈480.73/hr

<u>GasUsage</u>

(Duetotheunpredictablenature oftheenergyusageofthevillage(notknowingcooking habitsetc.),acasestudyhasbeenadaptedforthepurposes)
Acommunityconsistingof30peoplesimilartotheAberuagba,community conditionsuseda total of 3000L/dof gasintheirdailydutiesincludingcooking,makingteaandusinggaslamps [NETSSAF].
Bydividing thisby30 wecangettheaverageusageperperson,butmultiplyingthisby500willprovide adecentestimation totheenergyconsumption of theentire villagecommunity.
Usage(perperson)=3000÷30=100L/d
Usage(total)=500 *100

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 07 July 2024, pp: 345-381 www.ijaem.net ISSN: 2395-5252

= 50000L/d
≈ 2083.3L/hr
This proposal is not effective since the estimatedgasproductionis lesser than estimatedgasusage.

GasStorageCapacity

Usingtheabovecasestudy,themaximumgasconsumptionforthesmallcommunitywas 500L/h,byadaptingthisvaluefortheconsumptionoftheAberuagba,communityusingthe sametechniqueasabove:
Consumption(max) =500÷30x 500 =8333.3L/h
However,biogas isstillbeingproduced asthisis beingused, therefore the maximum decreasein gasisthemaximumusageminusproduction
Consumption-Yield=8333.3-11537.5=32024L/h
Asthecasestudycommunityconsumedthegasatthisratefor5hoursthetotalstorage requiredwillbetherateatwhichitsbeingconsumedmultipliedbythetime
Volume(gasstorage)=32024L/hx 5=16021L
Andinordertoaccountforfluctuationsinthis,itisthen multipliedbyasafetyfactorof 1.25,toensureadequategasshouldconsumptionincreaseby2\5%.
Volume(gas)=16021x1.25 =752625L

SludgeStorageCapacity

Inordertocopewiththeamount ofwastecomingintothechamberandtheamount of timeitstaysthere beforeitleavestothecompensationtankandfinallythedryingbed,it hastobeofsufficientsize.Inordertocalculatethis,thevolumeofwastegoinginneedsto beestimatedandthehydraulicretentiontime(HRT)needstobedecided. Thehigherthe HRT, the greater efficiency ofthe biogassettler,however the volumeisthen increased resultinginalargerarearequiredandincreased costs.Ideally,theHRTwouldbeover100 days,butanythingover50daysisacceptable,forthiscaseaHRTof70dayswillbeused.
Thequantityofmanure(slurry) willbemeasuredasfollows:
Cowsproduce16kgperheadperday ofmanure.(Table1)
Quantity(cows)=Σcowsx16kg
=32.25* 16
=520L/d
Goatsproduce 2 kgperheadperday ofmanure.(Table1)
Quantity(goats) =Σgoatsx2kg
= 325*2
=65L/d
Humansproduce0.75kgperheadperdayofmanure(Table1)
Quantity(humans)=Σ humansx0.75kg
= 325 *0.75
=24.375L/d
Quantity(total)=520+65 +24.375
=609.375L/d
Nowasthiswillbestoredinthetankfortheof70days, thiswillneedtobemultiplied by80togetthefinalvolumeofsludgeinthetank.
Volume(sludge)=609.375L/dx70
=42656.25L

VolumeofTank

Nowthatthevolumerequiredforgasandthatforsludge areknown,thesecansimplybe addedtogethertodeterminethevolumeofthechamber
Volume(total)=Volume(gas)+Volume(sludge)=65,000+136,000≈200,000L
AswedonotexpectthewholeoftheAberuagba,communitytoembracethenewsystem, wewillthenneedtomultiplythisnumberby 0.6,forthe60%ofvillagersthatwillendup usingthissystem,
Volume(adjusted)=200,000x0.6=120,000L
Byusingtheformulaforthe volumeofahemisphere,itcanthen becalculatedthat theradiusofthechamberwillbeinthevicinityof 3.85m
$120{,}000 = 120\ m^3$
$120 = (2*R^3*\pi)/3$
$R^3 = 57.27m^3$
$R \approx 3.8545$ m

VolumeofCompensationTank(CT)

Thevolumeof thecompensationtankisequaltothatof thevolumeofthegasinthemain chamber,inordertoallowforanexcessofgasbeingproducedwithoutexcessivepressure in thechamber.
Volume(gas)=65,000L=Volume(CT)
∴Volume(CT)=65,000Lx60%
∴Volume(CT)≈39,000L=39m³ ,$39=(2*R^3*\pi)/3$
R≈2.65m

BiogasPlantProposal
For
Saromi, a village in ObafemiOwode, Ogun State, Nigeria

Abatan O.A, Adewale A.O Oseni K.Jand Sodunke M.A
[1]Department of Science Laboratory Technology, MoshoodAbiola Polytechnic, P.M.B 2210, Abeokuta, Ogun State, Nigeria

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 07 July 2024, pp: 345-381 www.ijaem.net ISSN: 2395-5252

E-mail: abatanadio4xrist@yahoo.co.uk

Abstract
This proposal suggests installing biogas plants in villages to provide sustainable energy and improve sanitation. The biogas plants would use animal and human waste as feedstock to produce methane gas for fuel. Calculations estimate the plants could produce enough gas to meet the villages' energy needs. Benefits include reducing disease, generating renewable energy without external inputs, creating local jobs, and helping alleviate poverty in the communities.

INTRODUCTION

Saromi,is a populated place-a village, city, town, or other agglomeration of buildings where people live and work in ObafemiOwode, Ogun State, South West Nigeria, West Africa. It is on latitude 7° 4' 59" N, longitude 3° 40' 59" E, lat/long (dec) 7.08333,3.68333 with tropical savanna climate type (source : Mindat.org) and is situated nearby to the villages Isagolu and Owojo.
. The village has a populationof716people with 172householdsspread acrossthevillage and atleast 142live belowthepovertyline.Themajorityofthepopulationis agriculturalworkersand every householdownslivestock.

NEED

Ithasbeenreported thatonly70households haveaccesstoa decent toilet each resulting into widespread practiceof opendefecation behindhomesasanorm.Thissystem brings about ahealthrisk scenario. Sources of water are contaminated when deposits arewashedin likely causing diseasespreading in the village. Most of the villagers living below the poverty line are involved in everyday practice of using firewood orkerosenefuelledstovesindoors bringing detrimental health effects.
CALCULATIONS

FromtheinformationgivenbytheEWBchallenge,thefollowingpopulationstatistics canbe estimated-

- 716People
- 172householdsin village,54in bottomcolonyand46in topcolony
- 3goatsperhouseholdintopandbottomcolonies(85% ofhouseholds)
- 3cowsperhouseholdintopandbottomcolonies(85% ofhouseholds)
- 1goatperhouseholdinvillage(15%ofhouseholds)
- 1cowperhouseholdinvillage(15%ofhouseholds)

Thesevalueswillform thebasisofallfollowingcalculations

Gasproduction
Σgoats=#colonyhouseholdsx85%x3goats+#villagehouseholdsx15%x1goat
= (54+46)*0.85*3+172*0.15*1
= 513goats
Σcows=#colonyhouseholdsx85%x3cows+#villagehouseholdsx15%x1cow
=(54+46)*0.85*3+172*0.15*1
=513 cows
Cowsyield175Lperheadperdayofgas.(Fig1)
Yield(cows)=Σcowsx 175
=513*175
= 89,775L/d
Goats yield 150Lperheadperdayofgas.(Fig1)
Yield(goats) =Σgoatsx150
= 513* 150
= 76,950L/d
Humansyield 30Lperheadperday ofgas.(Fig1)
Yield(humans)=Σhumansx30
= 513*30
=15,390L/d
Yield(total)=89,775+76,950+15,390
= 182115L/d
≈7588L/hr
GasUsage

(Duetotheunpredictablenature oftheenergyusageofthevillage(notknowingcooking habitsetc.),acasestudyhasbeenadaptedforthepurposes)
Acommunityconsistingof30peoplesimilartotheSaromi,community conditionsuseda total of 3000L/dof gasintheirdailydutiesincludingcooking,makingteaandusinggaslamps [NETSSAF].
Bydividing thisby30 wecangettheaverageusageperperson,butmultiplyingthisby716willprovide adecentestimation totheenergyconsumption of theentire villagecommunity.
Usage(perperson)=3000÷30=100L/d
Usage(total)=716 *100
= 71600L/d
≈ 2983L/hr
This proposal is effective since the estimatedgasproductionis greater than estimatedgasusage.

GasStorageCapacity

Usingtheabovecasestudy,themaximumgasconsumptionforthesmallcommunitywas 500L/h,byadaptingthisvaluefortheconsumptionoftheSaromi,communityusingthe sametechniqueasabove:
Consumption(max) =500÷30x 716 =11933L/h
However,biogas isstillbeingproduced asthisis beingused, therefore the maximum decreasein gasisthemaximumusageminusproduction
Consumption-Yield=11933-7588= 4345L/h
Asthecasestudycommunityconsumedthegasatthisratefor5hoursthetotalstorage requiredwillbetherateatwhichitsbeingconsumedmultipliedbythetime
Volume(gasstorage)= 4345x 5= 21725L
Andinordertoaccountforfluctuationsinthis,itisthen multipliedbyasafetyfactorof 1.35,toensureadequategasshouldconsumptionincreaseby35%.
Volume(gas)=21725x1.35 = 29328.75L

SludgeStorageCapacity

Inordertocopewiththeamount ofwastecomingintothechamberandtheamount of timeitstaysthere beforeitleavestothecompensationtankandfinallythedryingbed,it hastobeofsufficientsize.Inordertocalculatethis,thevolumeofwastegoinginneedsto beestimatedandthehydraulicretentiontime(HRT)needstobedecided. Thehigherthe HRT, the greater efficiency ofthe biogassettler,however the volumeisthen increased resultinginalargerarearequiredandincreased costs.Ideally,theHRTwouldbeover100 days,butanythingover50daysisacceptable,forthiscaseaHRTof70dayswillbeused.
Thequantityofmanure(slurry) willbemeasuredasfollows:
Cowsproduce16kgperheadperday ofmanure.(Table1)
Quantity(cows)=Σcowsx16kg
= 513* 16
=8208L/d
Goatsproduce 2 kgperheadperday ofmanure.(Table1)
Quantity(goats) =Σgoatsx2kg
= 513*2
=1026L/d
Humansproduce0.75kgperheadperdayofmanure(Table1)
Quantity(humans)=Σ humansx0.75kg
= 716 *0.75
=537L/d
Quantity(total)=8208+1026 +537
= 9771L/d
NowasthiswillbestoredinthetankfortheHRTof70days, thiswillneedtobemultiplied by80togetthefinalvolumeofsludgeinthetank.
Volume(sludge)=9771x70
=683970L

VolumeofTank

Nowthatthevolumerequiredforgasandthatforsludge areknown,thesecansimplybe addedtogethertodeterminethevolumeofthechamber
Volume(total)=Volume(gas)+Volume(sludge)
=65,000+136,000
≈200,000L
AswedonotexpectthewholeoftheSaromi, communitytoembracethenewsystem, wewillthenneedtomultiplythisnumberby 0.6,forthe60%ofvillagersthatwillendup usingthissystem
Volume(adjusted)=200,000x0.6
=120,000L
Byusingtheformulaforthe volumeofahemisphere,itcanthen becalculatedthat theradiusofthechamberwillbeinthevicinityof 3.85m
120,000=120 m³
$120=(2*R^3*\pi)/3$
$R^3= 57.27m^3$
R ≈3.8545 m
VolumeofCompensationTank(CT)
Thevolumeof thecompensationtankisequaltothatof thevolumeofthegasinthemain chamber,inordertoallowforanexcessofgasbeingproducedwithoutexcessivepressure in thechamber.
Volume(gas)=65,000L=Volume(CT)
∴Volume(CT)=65,000Lx60%
∴Volume(CT)≈39,000L=39m³
$39=(2*R^3*\pi)/3$
R≈2.65m

BiogasPlantProposal
For
Amushan, a village in ObafemiOwode, Ogun State, Nigeria

Abatan O.A, Adewale A.O Oseni K.Jand Sodunke M.A
[1]Department of Science Laboratory Technology, MoshoodAbiola Polytechnic, P.M.B 2210, Abeokuta, Ogun State, Nigeria
E-mail: abatanadio4xrist@yahoo.co.uk

Abstract
This proposal suggests installing biogas plants in villages to provide sustainable energy and improve

sanitation. The biogas plants would use animal and human waste as feedstock to produce methane gas for fuel. Calculations estimate the plants could produce enough gas to meet the villages' energy needs. Benefits include reducing disease, generating renewable energy without external inputs, creating local jobs, and helping alleviate poverty in the communities.

INTRODUCTION

Amushan, is a populated place-a village, city, town, or other agglomeration of buildings where people live and work in ObafemiOwode, Ogun State, South West Nigeria, West Africa. It is on latitude 7° 4' 59" N, longitude 3° 40' 59" E, lat/long (dec) 7.08333,3.68333 with tropical savanna climate type (source : Mindat.org) and is situated nearby to the villages Isagolu and Owojo.

. The village has a populationof716people with 172householdsspread acrossthevillage and atleast 142live belowthepovertyline.Themajorityofthepopulationis agriculturalworkersand every householdownslivestock.

NEED

Ithasbeenreported thatonly70households haveaccesstoa decent toilet each resulting into widespread practiceof opendefecation behindhomesasanorm.Thissystem brings about ahealthrisk scenario. Sources of water are contaminated when deposits arewashedin likely causing diseasespreading in the village. Most of the villagers living below the poverty line are involved in everyday practice of using firewood orkerosenefuelledstovesindoors bringing detrimental health effects.

CALCULATIONS

FromtheinformationgivenbytheEWBchallenge,thefollowingpopulationstatistics canbe estimated-

- 716People
- 172householdsin village,54in bottomcolonyand46in topcolony
- 3goatsperhouseholdintopandbottomcolonies(85% ofhouseholds)
- 3cowsperhouseholdintopandbottomcolonies(85% ofhouseholds)
- 1goatperhouseholdinvillage(15%ofhouseholds)
- 1cowperhouseholdinvillage(15%ofhouseholds)

Thesevalueswillform thebasisofallfollowingcalculations

Gasproduction

Σgoats=#colonyhouseholdsx85%x3goats+#villagehouseholdsx15%x1goat
= (54+46)*0.85*3+172*0.15*1
= 513goats
Σcows=#colonyhouseholdsx85%x3cows+#villagehouseholdsx15%x1cow
=(54+46)*0.85*3+172*0.15*1
=513 cows
Cowsyield175Lperheadperdayofgas.(Fig1)
Yield(cows)=Σcowsx 175
=513*175
= 89,775L/d
Goats yield 150Lperheadperdayofgas.(Fig1)
Yield(goats) =Σgoatsx150
= 513* 150
= 76,950L/d
Humansyield 30Lperheadperday ofgas.(Fig1)
Yield(humans)=Σhumansx30
= 513*30
=15,390L/d
Yield(total)=89,775+76,950+15,390
= 182115L/d
≈7588L/hr

GasUsage

(Duetotheunpredictablenature oftheenergyusageofthevillage(notknowingcooking habitsetc.),acasestudyhasbeenadaptedforthepurposes)

Acommunityconsistingof30peoplesimilartotheAmushancommunity conditionsuseda total of 3000L/dof gasintheirdailydutiesincludingcooking,makingteaandusinggaslamps [NETSSAF].

Bydividing thisby30 wecangettheaverageusageperperson,butmultiplyingthisby716willprovide adecentestimation totheenergyconsumption of theentire villagecommunity.

Usage(perperson)=3000÷30=100L/d
Usage(total)=716 *100
= 71600L/d
≈ 2983L/hr

This proposal is effective since the estimatedgasproductionis greater than estimatedgasusage.

GasStorageCapacity

Usingtheabovecasestudy,themaximumgasconsumptionforthesmallcommunitywas

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 07 July 2024, pp: 345-381 www.ijaem.net ISSN: 2395-5252

500L/h,byadaptingthisvalothefortheconsumptionofth eAmushancommunityusingthe sametechniqueasabove:
Consumption(max) =500÷30x 716 =11933L/h
However,biogas isstillbeingproduced asthisis beingused, therefore the maximum decreasein gasisthemaximumusageminusproduction
Consumption-Yield=11933-7588= 4345L/h
Asthecasestudycommunityconsumedthegasatthisrat efor5hoursthetotalstorage requiredwillbetherateatwhichitsbeingconsumedmul tipliedbythetime
Volume(gasstorage)= 4345x 5= 21725L
Andinordertoaccountforfluctuationsinthis,itisthen multipliedbyasafetyfactorof 1.35,toensureadequategasshouldconsumptionincre aseby35%.
Volume(gas)=21725x1.35 = 29328.75L

SludgeStorageCapacity

Inordertocopewiththeamount ofwastecomingintothechamberandtheamount of timeitstaysthere beforeitleavestothecompensationtankandfinallythed ryingbed,it hastobeofsufficientsize.Inordertocalculatethis,thevo lumeofwastegoinginneedsto beestimatedandthehydraulicretentiontime(HRT)nee dstobedecided. Thehigherthe HRT, the greater efficiency ofthe biogassettler,however the volumeisthen increased resultinginalargerarearequiredandincreased costs.Ideally,theHRTwouldbeover100 days,butanythingover50daysisacceptable,forthiscas eaHRTof70dayswillbeused.
Thequantityofmanure(slurry) willbemeasuredasfollows:
Cowsproduce16kgperheadperday ofmanure.(Table1)
Quantity(cows)=Σcowsx16kg
= 513* 16
=8208L/d
Goatsproduce 2 kgperheadperday ofmanure.(Table1)
Quantity(goats) =Σgoatsx2kg
= 513*2
=1026L/d
Humansproduce0.75kgperheadperdayofmanure(Tab le1)
Quantity(humans)=Σ humansx0.75kg
= 716 *0.75
=537L/d
Quantity(total)=8208+1026 +537
= 9771L/d

NowasthiswillbestoredinthetankfortheHRTof70days, thiswillneedtobemultiplied by80togetthefinalvolumeofsludgeinthetank.
Volume(sludge)=9771x70
=683970L

VolumeofTank

Nowthatthevolumerequiredforgasandthatforsludge areknown,thesecansimplybe addedtogethertodeterminethevolumeofthechamber
Volume(total)=Volume(gas)+Volume(sludge)
=65,000+136,000
≈200,000L
AswedonotexpectthewholeoftheAmushancommunit ytoembracethenewsystem, wewillthenneedtomultiplythisnumberby 0.6,forthe60%ofvillagersthatwillendup usingthissystem
Volume(adjusted)=200,000x0.6
=120,000L
Byusingtheformulaforthe volumeofahemisphere,itcanthen becalculatedthat theradiusofthechamberwillbeinthevicinityof 3.85m
120,000=120 m³
$120=(2*R^3*\pi)/3$
$R^3= 57.27m^3$
R ≈3.8545 m

VolumeofCompensationTank(CT)

Thevolumeof thecompensationtankisequaltothatof thevolumeofthegasinthemain chamber,inordertoallowforanexcessofgasbeingprod ucedwithoutexcessivepressure in thechamber.
Volume(gas)=65,000L=Volume(CT)
∴Volume(CT)=65,000Lx60%
∴Volume(CT)≈39,000L=39m³
$39=(2*R^3*\pi)/3$
R≈2.65m

BiogasPlantProposal
For
Egbeji, a village in ObafemiOwode, Ogun State, Nigeria

Abatan O.A, Adewale A.O Oseni K.Jand Sodunke M.A
[1]Department of Science Laboratory Technology, MoshoodAbiola Polytechnic, P.M.B 2210, Abeokuta, Ogun State, Nigeria
E-mail: abatanadio4xrist@yahoo.co.uk

Abstract

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 07 July 2024, pp: 345-381 www.ijaem.net ISSN: 2395-5252

This proposal suggests installing biogas plants in villages to provide sustainable energy and improve sanitation. The biogas plants would use animal and human waste as feedstock to produce methane gas for fuel. Calculations estimate the plants could produce enough gas to meet the villages' energy needs. Benefits include reducing disease, generating renewable energy without external inputs, creating local jobs, and helping alleviate poverty in the communities.

INTRODUCTION

Egbeji,is a populated place-a village, city, town, or other agglomeration of buildings where people live and work in ObafemiOwode, Ogun State, South West Nigeria, West Africa. It is on latitude 7° 4' 59" N, longitude 3° 40' 59" E, lat/long (dec) 7.08333,3.68333 with tropical savanna climate type (source : Mindat.org) and is situated nearby to the villages Isagolu and Owojo.
. The village has a populationof716people with 172householdsspread acrossthevillage and atleast 142live belowthepovertyline.Themajorityofthepopulationis agriculturalworkersand every householdownslivestock.

NEED

Ithasbeenreported thatonly70households haveaccesstoa decent toilet each resulting into widespread practiceof opendefecation behindhomesasanorm.Thissystem brings about ahealthrisk scenario. Sources of water are contaminated when deposits arewashedin likely causing diseasespreading in the village. Most of the villagers living below the poverty line are involved in everyday practice of using firewood orkerosenefuelledstovesindoors bringing detrimental health effects.

CALCULATIONS

FromtheinformationgivenbytheEWBchallenge,thefollowingpopulationstatistics canbe estimated-

- 716People
- 172householdsin village,54in bottomcolonyand46in topcolony
- 3goatsperhouseholdintopandbottomcolonies(85% ofhouseholds)
- 3cowsperhouseholdintopandbottomcolonies(85% ofhouseholds)
- 1goatperhouseholdinvillage(15%ofhouseholds)
- 1cowperhouseholdinvillage(15%ofhouseholds)

Thesevalueswillform thebasisofallfollowingcalculations

Gasproduction

Σgoats=#colonyhouseholdsx85%x3goats+#villagehouseholdsx15%x1goat
= (54+46)*0.85*3+172*0.15*1
= 513goats
Σcows=#colonyhouseholdsx85%x3cows+#villagehouseholdsx15%x1cow
=(54+46)*0.85*3+172*0.15*1
=513 cows
Cowsyield175Lperheadperdayofgas.(Fig1)
Yield(cows)=Σcowsx 175
=513*175
= 89,775L/d
Goats yield 150Lperheadperdayofgas.(Fig1)
Yield(goats) =Σgoatsx150
= 513* 150
= 76,950L/d
Humansyield 30Lperheadperday ofgas.(Fig1)
Yield(humans)=Σhumansx30
= 513*30
=15,390L/d
Yield(total)=89,775+76,950+15,390
= 182115L/d
≈7588L/hr

GasUsage

(Duetotheunpredictablenature oftheenergyusageofthevillage(notknowingcooking habitsetc.),acasestudyhasbeenadaptedforthepurposes)
Acommunityconsistingof30peoplesimilartotheEgbeji,community conditionsuseda total of 3000L/dof gasintheirdailydutiesincludingcooking,makingteaandusinggaslamps [NETSSAF].
Bydividing thisby30 wecangettheaverageusageperperson,butmultiplyingthisby716willprovide adecentestimation totheenergyconsumption of theentire village community.
Usage(perperson)=3000÷30=100L/d
Usage(total)=716 *100
= 71600L/d
≈ 2983L/hr
This proposal is effective since the estimatedgasproductionis greater than estimatedgasusage.

GasStorageCapacity

Usingtheabovecasestudy,themaximumgasconsumptionforthesmallcommunitywas

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 07 July 2024, pp: 345-381 www.ijaem.net ISSN: 2395-5252

500L/h,byadaptingthisvaluefortheconsumptionoftheEgbeji,communityusingthe sametechniqueasabove:
Consumption(max) =500÷30x 716 =11933L/h
However,biogas isstillbeingproduced asthisis beingused, therefore the maximum decreasein gasisthemaximumusageminusproduction
Consumption-Yield=11933-7588= 4345L/h
Asthecasestudycommunityconsumedthegasatthisratefor5hoursthetotalstorage requiredwillbetherateatwhichitsbeingconsumedmultipliedbythetime
Volume(gasstorage)= 4345x 5= 21725L
Andinordertoaccountforfluctuationsinthis,itisthen multipliedbyasafetyfactorof 1.35,toensureadequategasshouldconsumptionincreaseby35%.
Volume(gas)=21725x1.35 = 29328.75L

SludgeStorageCapacity

Inordertocopewiththeamount ofwastecomingintothechamberandtheamount of timeitstaysthere beforeitleavestothecompensationtankandfinallythedryingbed,it hastobeofsufficientsize.Inordertocalculatethis,thevolumeofwastegoinginneedsto beestimatedandthehydraulicretentiontime(HRT)needstobedecided. Thehigherthe HRT, the greater efficiency ofthe biogassettler,however the volumeisthen increased resultinginalargerarearequiredandincreased costs.Ideally,theHRTwouldbeover100 days,butanythingover50daysisacceptable,forthiscaseaHRTof70dayswillbeused.
Thequantityofmanure(slurry) willbemeasuredasfollows:
Cowsproduce16kgperheadperday ofmanure.(Table1)
Quantity(cows)=Σcowsx16kg
= 513* 16
=8208L/d
Goatsproduce 2 kgperheadperday ofmanure.(Table1)
Quantity(goats) =Σgoatsx2kg
= 513*2
=1026L/d
Humansproduce0.75kgperheadperdayofmanure(Table1)
Quantity(humans)=Σ humansx0.75kg
= 716 *0.75
=537L/d
Quantity(total)=8208+1026 +537
= 9771L/d

NowasthiswillbestoredinthetankfortheHRTof70days, thiswillneedtobemultiplied by80togetthefinalvolumeofsludgeinthetank.
Volume(sludge)=9771x70
=683970L

VolumeofTank

Nowthatthevolumerequiredforgasandthatforsludge areknown,thesecansimplybe addedtogethertodeterminethevolumeofthechamber
Volume(total)=Volume(gas)+Volume(sludge)
=65,000+136,000
≈200,000L
AswedonotexpectthewholeoftheEgbeji,communitytoembracethenewsystem, wewillthenneedtomultiplythisnumberby 0.6,forthe60%ofvillagersthatwillendup usingthissystem
Volume(adjusted)=200,000x0.6
=120,000L
Byusingtheformulaforthe volumeofahemisphere,itcanthen becalculatedthat theradiusofthechamberwillbeinthevicinityof 3.85m
120,000=120 m³
120=(2*R³*π)/3
R³= 57.27m³
R ≈3.8545 m
VolumeofCompensationTank(CT)
Thevolumeof thecompensationtankisequaltothatof thevolumeofthegasinthemain chamber,inordertoallowforanexcessofgasbeingproducedwithoutexcessivepressure in thechamber.
Volume(gas)=65,000L=Volume(CT)
∴Volume(CT)=65,000Lx60%
∴Volume(CT)≈39,000L=39m³
39=(2*R³*π)/3
R≈2.65m

BiogasPlantProposal
For
Olodo/ Idi-Emi cow market, a village in Imeko-Afon local govrnment, Ogun State, Nigeria

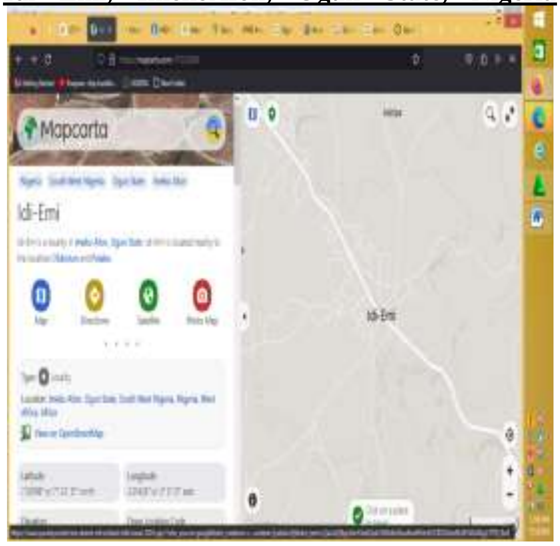
Abatan O.A, Adewale A.O Oseni K.Jand Sodunke M.A
[1]Department of Science Laboratory Technology, MoshoodAbiola Polytechnic, P.M.B 2210, Abeokuta, Ogun State, Nigeria
E-mail: abatanadio4xrist@yahoo.co.uk

Abstract
This proposal suggests installing biogas plants in villages to provide sustainable energy and improve sanitation. The biogas plants would use animal and

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 07 July 2024, pp: 345-381 www.ijaem.net ISSN: 2395-5252

human waste as feedstock to produce methane gas for fuel. Calculations estimate the plants could produce enough gas to meet the villages' energy needs. Benefits include reducing disease, generating renewable energy without external inputs, creating local jobs, and helping alleviate poverty in the communities.

Idi Emi, ImekoAfon, Ogun State, Nigeria



Mindat
https://www.mindat.org › feature-2339074

INTRODUCTION

Idi Emi, ImekoAfon, Ogun State, Nigeria. Type: Populated place - a city ... Region: ImekoAfon, Ogun State, Nigeria. Latitude: 7° 24' 0" N. Longitude: 3 ...very close to Olodo cow market. The village has a populationof880people with 55householdsspread acrossthevillage and atleast565live belowthepovertyline.Themajorityofthepopulationis cattle- rearing and selling while few are also engaged in agriculturalfarming sometimes as workersand every householdownslivestock.

NEED

Ithasbeenreported thatonly15households haveaccesstoa decent toilet each resulting into widespread practiceof opendefecation behindhomesasanorm.Thissystem brings about ahealthrisk scenario. Sources of water are contaminated when deposits arewashedin likely causing diseasespreading in the village. Most of the villagers living below the poverty line are involved in everyday practice of using firewood orkerosenefuelledstovesindoors bringing detrimental health effects.

CALCULATIONS

FromtheinformationgivenbytheEWBchallenge,thefollowingpopulationstatistics canbe estimated-

- 880People
- 55 householdsin village,15in bottomcolonyand10 in topcolony
- 5goatsperhouseholdintopandbottomcolonies(85% ofhouseholds)
- 5cowsperhouseholdintopandbottomcolonies(85% ofhouseholds)
- 3goatsperhouseholdinvillage(15%ofhouseholds)
- 3cowsperhouseholdinvillage(15%ofhouseholds)

Thesevalueswillform thebasisofallfollowingcalculations

<u>Gasproduction</u>

Σgoats=#colonyhouseholdsx85%x5goats+#villagehouseholdsx15%x3goats
= (15+10)*0.85*5+55*0.15*3
=131goats
Σcows=#colonyhouseholdsx85%x3cows+#villagehouseholdsx15%x3cows
(15+10)*0.85*5+55*0.15*3
=131cows
Cowsyield175Lperheadperdayofgas.(Fig1)
Yield(cows)=Σcowsx 175
=131*175
= 22925L/d
Goats yield 150Lperheadperdayofgas.(Fig1)
Yield(goats) =Σgoatsx150
=131* 150
= 1,9650L/d
Humansyield 30Lperheadperday ofgas.(Fig1)
Yield(humans)=Σhumansx30
=131*30
=,3930L/d
Yield(total)=22925+196,50+3930
=46505L/d
≈1938L/hr

<u>GasUsage</u>

(Duetotheunpredictablenature oftheenergyusageofthevillage(notknowingcooking habitsetc.),acasestudyhasbeenadaptedforthepurposes)

Acommunityconsistingof30peoplesimilartotheOlodo/ Idi-Emi cow marketcommunity conditionsuseda total of 3000L/dof gasintheirdailydutiesincludingcooking,makingteaandusinggaslamps [NETSSAF].
Bydividing thisby30 wecangettheaverageusageperperson,butmultiplyingthisby880willprovide adecentestimation totheenergyconsumption of theentire villagrecommunity.
Usage(perperson)=3000÷30=100L/d
Usage(total)=880 *100
= 88000L/d
≈3667L/hr
This proposal is not effective since the estimatedgasproductionis lesser than estimatedgasusage.

GasStorageCapacity

Usingtheabovecasestudy,themaximumgasconsumptionforthesmallcommunitywas 500L/h,byadaptingthisvaluefortheconsumptionoftheOlodo/ Idi-Emi cow marketcommunityusingthe sametechniqueasabove:
Consumption(max) =500÷30x880 =14667L/h
However,biogas isstillbeingproduced asthisis beingused, therefore the maximum decreasein gasisthemaximumusageminusproduction
Consumption-Yield=14667-46505= -31838L/h
Asthecasestudycommunityconsumedthegasatthisratefor5hoursthetotalstorage requiredwillbetherateatwhichitsbeingconsumedmultipliedbythetime
Volume(gasstorage)= -31838 x5=159130L
Andinordertoaccountforfluctuationsinthis,itisthen multipliedbyasafetyfactorof 1.25,toensureadequategasshouldconsumptionincreaseby25%.
Volume(gas)=159130Lx1.25 =795650L

SludgeStorageCapacity

Inordertocopewiththeamount ofwastecomingintothechamberandtheamount of timeitstaysthere beforeitleavestothecompensationtankandfinallythedryingbed,it hastobeofsufficientsize.Inordertocalculatethis,thevolumeofwastegoinginneedsto beestimatedandthehydraulicretentiontime(HRT)needstobedecided. Thehigherthe HRT, the greater efficiency ofthe biogassettler,however the volumeisthen increased resultinginalargerarearequiredandincreased costs.Ideally,theHRTwouldbeover100 days,butanythingover50daysisacceptable,forthiscaseaHRTof70dayswillbeused.
Thequantityofmanure(slurry) willbemeasuredasfollows:
Cowsproduce16kgperheadperday ofmanure.(Table1)
Quantity(cows)=Σcowsx16kg
=131* 16
=2096L/d
Goatsproduce 2 kgperheadperday ofmanure.(Table1)
Quantity(goats) =Σgoatsx2kg
=131*2
=262L/d
Humansproduce0.75kgperheadperdayofmanure(Table1)
Quantity(humans)=Σ humansx0.75kg
=131 *0.75
=98.25L/d
Quantity(total)=2096+262 +98.25
=2456.25L/d
NowasthiswillbestoredinthetankfortheHRTof70days, thiswillneedtobemultiplied by80togetthefinalvolumeofsludgeinthetank.
Volume(sludge)=2456.25L/dx70
=171937.5L

VolumeofTank

Nowthatthevolumerequiredforgasandthatforsludge areknown,thesecansimplybe addedtogethertodeterminethevolumeofthechamber
Volume(total)=Volume(gas)+Volume(sludge)
=65,000+136,000
≈200,000L
AswedonotexpectthewholeoftheOlodo/ Idi-Emi cow marketcommunitytoembracethenewsystem, wewillthenneedtomultiplythisnumberby 0.6,forthe60%ofvillagersthatwillendup usingthissystem
Volume(adjusted)=200,000x0.6
=120,000L
Byusingtheformulaforthe volumeofahemisphere,itcanthen becalculatedthat theradiusofthechamberwillbeinthevicinityof 3.85m
120,000=120 m^3
$120=(2*R^3*\pi)/3$
$R^3= 57.27m^3$
R ≈3.8545 m
VolumeofCompensationTank(CT)
Thevolumeof thecompensationtankisequaltothatof thevolumeofthegasinthemain chamber,inordertoallowforanexcessofgasbeingproducedwithoutexcessivepressure in thechamber.
Volume(gas)=65,000L=Volume(CT)
∴Volume(CT)=65,000Lx60%
∴Volume(CT)≈39,000L=39m^3

39=(2*R³*π)/3
R≈2.65m

BiogasPlantProposal
For
Timirin, a village in ObafemiOwode, Ogun State, Nigeria

Abatan O.A, Adewale A.O Oseni K.Jand Sodunke M.A
[1]Department of Science Laboratory Technology, MoshoodAbiola Polytechnic, P.M.B 2210, Abeokuta, Ogun State, Nigeria
E-mail: abatanadio4xrist@yahoo.co.uk

Abstract
This proposal suggests installing biogas plants in villages to provide sustainable energy and improve sanitation. The biogas plants would use animal and human waste as feedstock to produce methane gas for fuel. Calculations estimate the plants could produce enough gas to meet the villages' energy needs. Benefits include reducing disease, generating renewable energy without external inputs, creating local jobs, and helping alleviate poverty in the communities.

Everyday Ogun State - The royals of TIMIRIN ...

Facebook
https://m.facebook.com › photos › the-royals-of-timirin-...

INTRODUCTION

Timirin is a populated place-a village, city, town, or other agglomeration of buildings where people live and work in ObafemiOwode, Ogun State, South West Nigeria, West Africa. A visit to TIMIRIN village! Imagine a school where all is free...... Food, clothes, tuition fee. _. All these happening in a village in the city of Abeokuta!

A village has a populationof716people with 172householdsspread acrossthevillage and atleast 142live belowthepovertyline.Themajorityofthepopulationis agriculturalworkersand every householdownslivestock.

NEED

Ithasbeenreported thatonly70households haveaccesstoa decent toilet each resulting into widespread practiceof opendefecation behindhomesasanorm.Thissystem brings about ahealthrisk scenario. Sources of water are contaminated when deposits arewashedin likely causing diseasespreading in the village. Most of the villagers living below the poverty line are involved in everyday practice of using firewood orkerosenefuelledstovesindoors bringing detrimental health effects.
CALCULATIONS

FromtheinformationgivenbytheEWBchallenge,thefollowingpopulationstatistics canbe estimated-

- 716People
- 172householdsin village,54in bottomcolonyand46in topcolony
- 3goatsperhouseholdintopandbottomcolonies(85% ofhouseholds)
- 3cowsperhouseholdintopandbottomcolonies(85% ofhouseholds)
- 1goatperhouseholdinvillage(15%ofhouseholds)
- 1cowperhouseholdinvillage(15%ofhouseholds)

Thesevalueswillform thebasisofallfollowingcalculations

Gasproduction
Σgoats=#colonyhouseholdsx85%x3goats+#villagehouseholdsx15%x1goat
= (54+46)*0.85*3+172*0.15*1
= 513goats
Σcows=#colonyhouseholdsx85%x3cows+#villagehouseholdsx15%x1cow
=(54+46)*0.85*3+172*0.15*1
=513 cows
Cowsyield175Lperheadperdayofgas.(Fig1)
Yield(cows)=Σcowsx 175
=513*175
= 89,775L/d
Goats yield 150Lperheadperdayofgas.(Fig1)
Yield(goats) =Σgoatsx150
= 513* 150
= 76,950L/d
Humansyield 30Lperheadperday ofgas.(Fig1)
Yield(humans)=Σhumansx30
= 513*30
=15,390L/d
Yield(total)=89,775+76,950+15,390
= 182115L/d
≈7588L/hr
GasUsage

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 07 July 2024, pp: 345-381 www.ijaem.net ISSN: 2395-5252

(Duetotheunpredictablenature oftheenergyusageofthevillage(notknowingcooking habitsetc.),acasestudyhasbeenadaptedforthepurposes)
Acommunityconsistingof30peoplesimilartotheTimirincommunity conditionsuseda total of 3000L/dof gasintheirdailydutiesincludingcooking,makingteaandusinggaslamps [NETSSAF].
Bydividing thisby30 wecangettheaverageusageperperson,butmultiplyingthisby716willprovide adecentestimation totheenergyconsumption of theentire village community.
Usage(perperson)=3000÷30=100L/d
Usage(total)=716 *100
= 71600L/d
≈ 2983L/hr
This proposal is effective since the estimatedgasproductionis greater than estimatedgasusage.

GasStorageCapacity

Usingtheabovecasestudy,themaximumgasconsumptionforthesmallcommunitywas 500L/h,byadaptingthisvalthefortheconsumptionoftheTimirin,communityusingthe sametechniqueasabove:
Consumption(max) =500÷30x 716 =11933L/h
However,biogas isstillbeingproduced asthisis beingused, therefore the maximum decreasein gasisthemaximumusageminusproduction
Consumption-Yield=11933-7588= 4345L/h
Asthecasestudycommunityconsumedthegasatthisratefor5hoursthetotalstorage requiredwillbetherateatwhichitsbeingconsumedmultipliedbythetime
Volume(gasstorage)= 4345x 5= 21725L
Andinordertoaccountforfluctuationsinthis,itisthen multipliedbyasafetyfactorof 1.35,toensureadequategasshouldconsumptionincreaseby35%.
Volume(gas)=21725x1.35 = 29328.75L

SludgeStorageCapacity

Inordertocopewiththeamount ofwastecomingintothechamberandtheamount of timeitstaysthere beforeitleavestothecompensationtankandfinallythedryingbed,it hastobeofsufficientsize.Inordertocalculatethis,thevolumeofwastegoinginneedsto beestimatedandthehydraulicretentiontime(HRT)needstobedecided. Thehigherthe HRT, the greater efficiency ofthe biogassettler,however the volumeisthen increased resultinginalargerarearequiredandincreased costs.Ideally,theHRTwouldbeover100 days,butanythingover50daysisacceptable,forthiscaseaHRTof70dayswillbeused.
Thequantityofmanure(slurry) willbemeasuredasfollows:
Cowsproduce16kgperheadperday ofmanure.(Table1)
Quantity(cows)=Σcowsx16kg
= 513* 16
=8208L/d
Goatsproduce 2 kgperheadperday ofmanure.(Table1)
Quantity(goats) =Σgoatsx2kg
= 513*2
=1026L/d
Humansproduce0.75kgperheadperdayofmanure(Table1)
Quantity(humans)=Σ humansx0.75kg
= 716 *0.75
=537L/d
Quantity(total)=8208+1026 +537
= 9771L/d
NowasthiswillbestoredinthetankfortheHRTof70days, thiswillneedtobemultiplied by80togetthefinalvolumeofsludgeinthetank.
Volume(sludge)=9771x70
=683970L

VolumeofTank

Nowthatthevolumerequiredforgasandthatforsludge areknown,thesecansimplybe addedtogethertodeterminethevolumeofthechamber
Volume(total)=Volume(gas)+Volume(sludge)
=65,000+136,000
≈200,000L
AswedonotexpectthewholeoftheTimirincommunitytoembracethenewsystem, wewillthenneedtomultiplythisnumberby 0.6,forthe60%ofvillagersthatwillendup usingthissystem
Volume(adjusted)=200,000x0.6
=120,000L
Byusingtheformulaforthe volumeofahemisphere,itcanthen becalculatedthat theradiusofthechamberwillbeinthevicinityof 3.85m
120,000=120 m^3
$120=(2*R^3*\pi)/3$
$R^3= 57.27m^3$
R ≈3.8545 m

VolumeofCompensationTank(CT)

Thevolumeof thecompensationtankisequaltothatof thevolumeofthegasinthemain chamber,inordertoallowforanexcessofgasbeingproducedwithoutexcessivepressure in thechamber.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 07 July 2024, pp: 345-381 www.ijaem.net ISSN: 2395-5252

Volume(gas)=65,000L=Volume(CT)
∴Volume(CT)=65,000Lx60%
∴Volume(CT)≈39,000L=39m³
$39=(2*R^3*\pi)/3$
R≈2.65m

TRANSPORTATIONOFMATERIALS

Toimplementthisproject,wemustfirsttransportallnecessarygoodstothesiteoflocation. Pondicherrypossessesallnecessaryresourcestodoso. However,roadconditionsleading intoAbatanverypoor,especiallyinwetseasonandtheroadsarealsorather narrow. Thisaffectsthesizeofthetrucksmeaning theywouldhavetobesmallertherefore either moretrucks willhavetobehiredorthetrucks wouldhavetomakemorerounds.Inorderto limit theimpact of thetrucksontheenvironment,itwillbebetterifmoretruckswereused ratherthanmakingmorethanonerounds.Once materials havereachedthevillage,wheel barrelsandpossiblyoxcartsorsomethingsimilarwould beusedtotransport thematerials tothemainsitewhereitwillallbebuild. Aonewaytriptothevillagewilltakeapproximately1houratminimum.Howevertravel timemay varydependingonfactorssuchasweather,stateof roadandfrequencyofpeople usingit.ThetotaldistanceofIdi - EmifromthecityofPondicherryisapproximately50 kilometres.Amapwithasuggestedroutetotakehasbeen providedbelow.

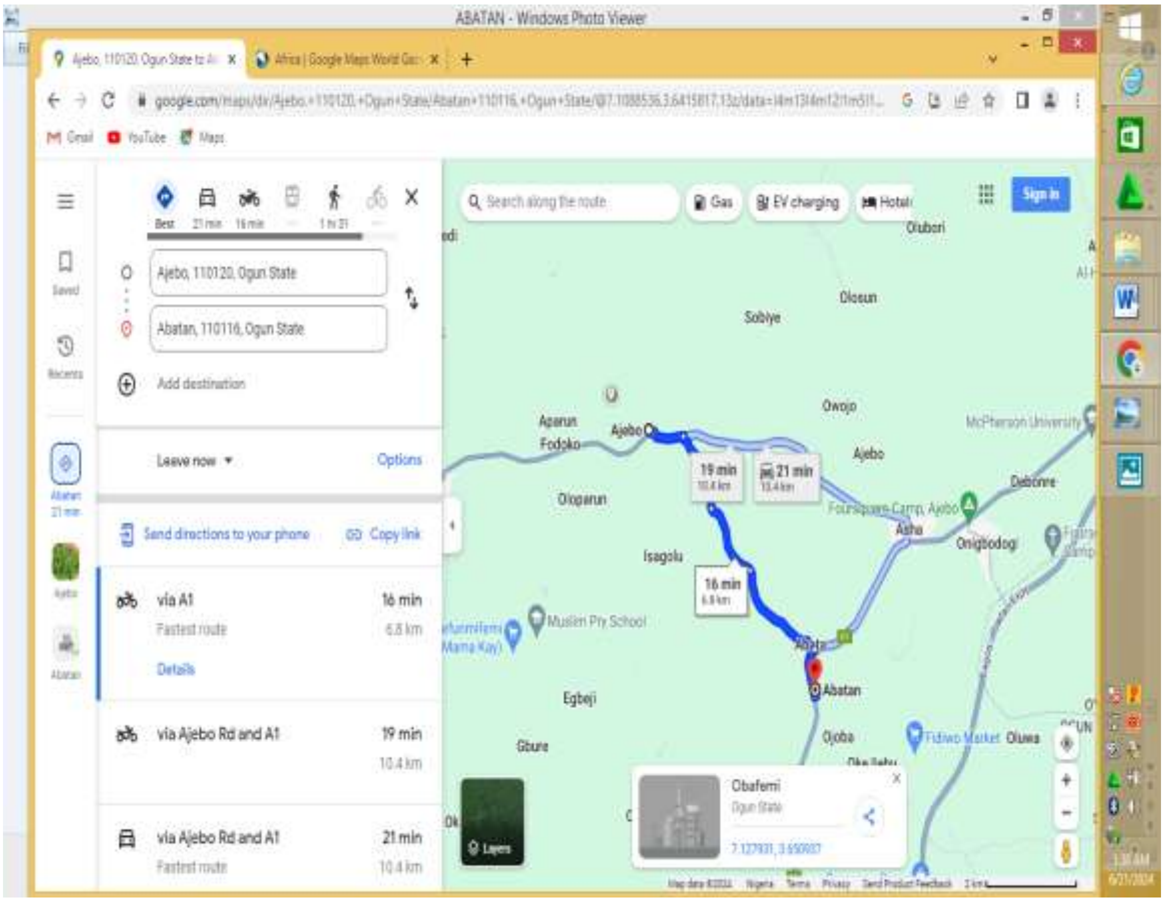


Figure2-Suggestedroute(GoogleMaps,2024)

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 07 July 2024, pp: 345-381 www.ijaem.net ISSN: 2395-5252

REASONFORDESIGN

Inordertoaccommodate theentirevillage,a200000litretankisrequired.However, itis expectedthatnotallthevillageswillfullycooperate withtheidea.Thereforethetankhas beenreduced insizeby40%toa120000litretank.Peopleinthevillage whohavelived withoutusingtoilets eversincewerebornwillrequiretimeandeducationinorderfor them to accept the new plan.This canbe done byteachingthe villagersthe manypossible benefitsthattheplanmayprovideandthatthereisnothingwrong withusingatoilet.

COST

PARTS

BiogasDigester: Concrete:
-Base: 56x 0.4mx #50perm (cubed) #11200
-Walls:(4/3pircubed/2-inside)x#50 #23200
-Base(small tank)28m(sqrd)x.4x#50 #5600
-Walls(smalltank)(1/2)4/3pircubed–inside#71300
-CorrugatedIron:50msqrdx #4000/msqrd. #200,000
GasPipes: 3000mx#700m#210,000
ToiletRoom: #30000

DELIVERY

Transportation:#25,500
SETUP
Installation:#200,000
ConnectiontoHomes: homes38x#5000 #190000
LABOUR
Onsiteengineer:#200000
Hourlyratex#oflabourers:#300 x 10x 40hours #120,000
MAINTENANCE
Labour #100,000/year Allowancefordamages: #50000/year SAVINGS
Gas: #200,000/year Fertilizer: #200000/year TOTALCOST: #1,836,800

SOCIALIMPLEMENTATION

Foranynewprogramorservicetowork successfullyinruralcommunityitisimportantthatthe entirecommunityisonboard.Forcingaschemeuponthegroupwillresultinresistanceand seetheschemefailduetolackof useandsupport.Toensurethatthebiogassettlerisused toitsfullpotentialawell-developedbehaviourchangeprogrammustbecreated withthe viewsandvaluesofthecommunitykeptin mind.

Thestagewhichcallsforthedevelopmentoftoolstoovercomepossiblechangebarrierswill bepricelessinpre-empting participantresistanceandhopefullyprovideoptionsfor addressingsuchissues.Thekeystepsinthisprocessare;

- Identificationofthebehaviourstochange
- Brainstormingofbarriersanddrivers
- Developmentoftoolstoovercomebarriersandreinforcedrivers
- Pilotingandimplementationoftheprogram
- Evaluationoftheprogramandadjustmentofitsrunning accordingly

Thereareanumberoffactorsthatmay hindertheeffectivenessorsuccessofthisinitiative fromtechnical,cultural andeconomicstandpoints.Thefirsthurdlethatmustbe overcome pertainstothedesignoftheplant.Itisimportantthatthe plantisnottoolargeortoosmall asbotherrorswillresultinunderfeedingof thesystemandconsequentialfailure.Projected participationratesof householders andthewastestheycontributemustbeaccuratesoto ensure thatthe mostefficientsizedigesterisbuilt.Unexpectedevents suchasdrought, floodandalikemustalsobefactoredintothedesignastheywillalleffecttheunitdirectly aswellasthebiomasssources.

Constructionisalsoavery importantissuetoconsider.Ithasbeenreported inothercases acrossIndiathatprudence whenitcomestofinding,employingortrainingskilledworkers hasseenthefailureofanumberofsystems Governmentsupportforsuchprogramscanbeverydifficulttosecureandcanbeunreliable once secured. This further highlights the need for true support of the community of Abatanthemselves.

Persuadingthe citizens to approve ofas well as actively engage in the biogassettler initiativewillbepivotaltotheprogram’ssuccess.Itisimportantthattheuniqueconcernsof

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 07 July 2024, pp: 345-381 www.ijaem.net ISSN: 2395-5252

thepopulationareunderstood andaddressedaswellasanyotherbarrierstothischange. In atownwhereonly twenty five housesownfridges,theinstallationofalarge'machine' maybe provedaunting(EngineersWithoutBorders,2011).Thereisalsothepossibilityofreligious orcultural beliefs reducingtheuseandacceptanceoftheunit.Thefollowingplanhasbeen developedin an attempt to avoidor overcome some ofthese barriersand support a successfulinnovation;

- Education–thecitizensmustbeschooledinhowtheinnovationworksinsimpleto understand termsthatallofthemcancomprehendandappreciate.Thiswillbemost fectiveifdonebyapersonwhospeaksthelocallanguage andisfromanearby areaastheremay beabetter senseof trustbetween themandmorechanceofthe citizensaskingquestions andalike.Thiseducationshouldincludetheinputsintothe system,howthesystemconvertstheseproductsandmostimportantly theresulting productsofthesystemandtheadvantagesofusing them.
- Involvementinplanningandconstruction –asthecitizenswillhaveto'feed'the systemitisvitalthat they aresatisfiedwithplacement,layoutand construction plansforit.Commentsandconcernsofcitizensshouldbetaken onboard when finalisingtheplanning stage.Implementingtheconstruction of thesystemasatown projectandgetting asmanypeopleaspossibleinvolvedinsomepartof the constructionandlogisticssurroundingitwillhelptocreate asense ofownership overthesystemandhopefullyincreasethechanceoftakeup.
- Postinstallationjobs–therewillbeaneed forasmallamount ofcitizenstobe employedtomaintain thesystemaswellasengageinthede-sludgingprocess.This taskwillprovidejobsforthe communityorcouldevenbebased onarotational timetablesystem.
- Examplesfrom othervillages–thevoiceof otherlocalswhohavehadbiogassettlers installedin their villageswillworkwonders in villages.

These examples can demonstratehowsuccessful andfruitful theschemecanbeandalsohelptodampen anyconcernsthecitizens have.

- Cultural–thereisaconcernthatculturalvaluesandbeliefsmayconflictwiththeuse ofthissystem.Thisissuehasbeen dealtwithinothercommunitiesbyreinforcing thevisionof thereveredMahatmaGandhiandhisbelief thatonedayIndianswould live inself-sufficientcommunitiesobtainingtheirneedsfromthelocalenvironment andgeneratingincomeandbenefitsfromco-operativestructures(Lawbury,J)

ENVIRONMENTALIMPACT

Aspreviously mentioned,presentdaywastemanagement andenergysourcesinAbatanaresubstandard. Thisprojectwillhavemanypositiveenvironmental effectsseeinga sustainableshiftinthearea,theseinclude;

- Lowerodourduetoreductioninopendefecation
- Reductionin spreadofdiseaseduetolesswasteleftopenlyacrossthetown
- Reductionofgreenhousegasemissionsofpresentfuel/ energysources
- Noexternalenergysourcerequired
- Generationofsustainableandcleanerbiogas
- Generationofsustainablenaturalfertiliser
- Reduceddemandonelectricitygrid

SOCIALIMPACT

Thereare atotalof716 people(172families)livinginAbatan(2010).TheAbatan householdoccupancyisgenerallybetween 3-8people perfamily.There housesaremostly hutstyles builtwitheithercementormudfloors,wallsareusually madefrommudorburnt brickwithathatchedrooforonethatismadefrompalmleafandthisisaclearreflectionof theirlowsocialstatus. Mostofthehousesgenerallyhavethatched bathrooms withouta toiletmostcommunitymembers relyonopendefecationasthecommonpractice,which posesalotofhealthissuesthewholecommunity.AccordingtoNagandVizayakumar(2005) 'solidwasteprovides anattractivehabitattodiseasevectors' suchasfliesorrodents.These aresomeofthehealthhazardsthatcouldbereducedifthe biogassettlerprojectweretobe implementedsuccessfully. Most householdsown some livestock witha variationfrom cattle,goatsorchickensandinmostcasesownershipofsuchanimalscould beameasureof wealthwithintheirhouseholds,meaningthemorelivestockyouhavethemorecapableyou areoffeedingyourfamily. Themainformofemploymentforthe peopleofAbatanis limitedto farmingand agriculturallabour,practicedmainly withintheircommunities.A fewlucky peopleare employedasprawnfarminglabourersinsurroundingf armsorby thelocalfishingindustry. Againthis isareflectionof theirlowsocialstatuswhichinturndetermines limitedaccessto healthcare. With the introduction of the biogas settler it is anticipated that disease prevalencewillbelowerandthecommunitywouldimpr ovetheirhealthstatus.

PoorcommunitieslikeAbatanarealwaysfacedwithhea lthandenvironmentalissues suchastheproblemof wastedisposalandthelackofsustainableenergysource slikemost developing countries in the third world. In most cases suchcommunities discharge untreatedwasteorrelyonuntreatedwaterfor theirdailyconsumptionaccordingtoAmudaandIbrahi m,(2006).Lackofinfrastructurefacilities, suchasthesimplebiogasproject,poses a lot ofhealth and wellbeing challenges and often leave these communities exposed diseases.

Ifsuccessfullyimplemented,thebiogassettlerprojecth asthepotentialimprove thequality ofairintheatmosphere, particularlyaroundAbatan,byeliminatingodoursfrom waste thatisdumpedeverywhere.Thereisanticipationforani ncreaseddemandforavariety of agriculturalproductsarisingfromincreaseduseoffertil izerthatisaby-productofthewhole process. Thiswillinturn makemore foodavailabletothecommunityandwithawide choicethanthepresentstate.

As aresultofthe project thereisalikelihoodofsocialissuessuchasthe creationof employmentopportunitiesforthosewhowouldbeinc hargeoftheprojectmaintenance. The expansionofagricultural activities couldresultinincreasedfoodproductionandmost importantly improvedhealthand wellbeing.Thebiogas settler project wouldenhance Abatanpeople'sabilitytodevelopsustainableeconom icactivitiesthat aredesignedin suchawaythatitcouldreducepovertyin theircommunity.

REFRENCES

Amuda,O.SandIbrahim,A.O(2006)African JournalofBiotechnology, Vol5August, AcademicJournals,Lagos.
DepartmentofTransport(Vic),Theoriesandmodelsof behaviourchange.pdf.Availableat: http://www.doi.vic.gov.au/doi/doielect.nsf/2a6bd 98dee287482ca256915001cff0c/ea c8a984b717095bca256d100017ba50/$FILE/Theori es%20and%20models%20of%20beh aviour%20change.pdf[AccessedAugust30,2011m].
EngineersWithoutBordersAustralia,2011[http://w ww.ewb.org.au/explore/initiatives/ewbchallenge/ 2011ewbchallenge/maps]
EngineersWithoutBorders,2011,availableat [http://www.ewb.org.au/explore/initiatives/2011e wbchallenge/transportation]
EngineersWithoutBorders,2011. Energy-EngineersWithoutBordersAustralia.Available at:http://www.ewb.org.au/explore/initiatives/201 1ewbchallenge/power[Accessed September15,2011]. Google Maps,2024,availableat https://www.google.com/maps/dir/Ajebo,+110120,+Ogun+State/Abatan+110116,+Ogun+State/@7.1088536,3.6415817,13z/data=!4m13!4m12!1m5!1m1!1s0x103a2add80fd69bd:0xd295da501836ec7d!2m2!1d3.6585216!2d7.1228881!1m5!1m1!1s0x103a2b31e9958397:0xece314bcc566511f!2m2!1d3.6920397!2d7.0849347?entry=ttu
Lawbury,J.,BiogasTechnologyin India:MorethanGandhi'sDream? Availableat: http://www.ganesha.co.uk/Articles/Biogas%20Tec hnology%20in%20India.htm#Table[AccessedSepte mber14,2011]
Nag,A.andVizayakumar,K.(2005)EnvironmentalEdu cationandSolidWasteManagement, NewInternationalPublishers,NewDelhi.
NationalCentreofSustainability,CourseMaterials.Bla ckboardLearn.Availableat: http://ilearn.swin.edu.au/webapps/portal/framese t.jsp?tab_group=courses&url=%2F webapps%2Fblackboard%2Fexecute%2FdisplayLea rningUnit%3Fcourse_id%3D_10775 0_1%26content_id%3D_2252543_1%26framesetW rapped%3Dtrue[AccessedAugust20,2011].
NETSSAF(2006)-Small-ScaleBiogasSanitationSystems [http://www.google.com.au/url?q=http%3A%2F%2Fwww.netssaftutorial.com%2Ffileadmin%2FDATA_CD%2F06_Step6%2F10_Biogas_Sanitation_Systems_-_NETSSAF_20080714.ppt&sa=U&ei=pw9fTvfbE-rViAKz1Zi2Dg&ved=0CB4QFjAF&usg=AFQjCNFY1v0I6Pjk8bDYZrVZkzXu43G_pA]
ODAM,2011.CharcoalBriquette.Availableat:http:// www.odamindia.org/our-projects/climate-change/charcoal-briquettes/[AccessedAugust20,2011].
PovertyActionLab,CookingStoves,IndoorAirPollutio n,andRespiratoryHealthinIndia. Availableat:http://www.povertyactionlab.org/eval uation/cooking-stoves-indoor-air-pollution-and-respiratory-health-india[AccessedSeptember15,2011].

Raven,P.H.Berg,L.R.Johnson,G.B(1998)Environment 2nd Ed, SaundersCollegePublishing, NewYork.
SSWM(2010)-BiogasSettlers[http://www.sswm.info/print/1249?tid=854]
SSWM,Direct UseofBiogas,2011,http://www.sswm.info/category/implementation-ools/reuse-and-recharge/hardware/reuse-energy-products-form-waste-and-was-1
TRPrestonandLylianRodríguez,Low-costbiodigestersastheepicenterofecological farmingsystem,[http://www.mekarn.org/procbiod/prest.htm]
UNICEF,2010.India-Statistics.Availableat:http://www.unicef.org/infobycountry/india_statistics.html[AccessedSeptember12,2011].