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Manure of Animals for Generation of Electricity and Production of Combustive (Vehicle Natural Gas) at Chitima District /Tete Province in Mozambique

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Abstract: Once the energy is one of the very important in the development and the economy of Countries, all the nations are working in order to find the renewable sources for it. Knowing that the fossil fuel will varnish, associated to their impact in the environment linked to green house gases responsible of the global warming and acid rain, Mozambique is not behind this process. Researchers have been studying the away to generate energy friendly to the environment by using the cheapest sources and technologies, as well as, Municipal solid waste, water, solar, wind, ocean, thermal, now manure of animal, for instance, chickens, elephants, cows, pigs and human.

The waste our bodies produce doesn't have to be a significant strain on our already limited resources. Harnessing it as a renewable energy source can also improve sanitation and reduce water pollution throughout the world and particular at Chitima district, Tete province in Mozambique. It's not a solution to the world energy problem, but the technology already exists and it is being shown to be economically feasible in a variety of situations. It is toilet to energy for domestic and cars use.

It will help the rural area and the country to develop its economy, giving jobs, power and reduce the deforestation for nearly 9000 citizens in the first step, solving the objective of Mozambique as well as sustainable development goals such as; the Ensure of: availability and sustainable management of water and sanitation; access to affordable, reliable, sustainable and modern energy, for all; Ensure healthy lives and promote well-being for all at all ages, End poverty in all its forms everywhere; Make cities and human settlements inclusive, safe, resilient and sustainable; and Take urgent action to combat climate change and its impacts.

Human excrement, as well as, of others animals to energy will generate power, biogas for cooking propose and be used to move cars reducing the impact of the increasing uses of fossil fuel, petrol and diesel, the principal responsible of green house gases.

Keywords: *Electricity, Manure of Animals, Generation, Source Energy, Petrol, Sustainable, Chitma, Mozambique.*

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I. INTRODUCTION

Mozambique is depending on hydroelectrically energy in 90%, one of renewable energy source, which just has capacity to generate energy for nearly 20% percentage of the Nation, and majorette in the urban area, but is important to say that the Country is working in order to change the scenario and knows that way to develop the nation is by generating huge energy to the country and sell for others countries.

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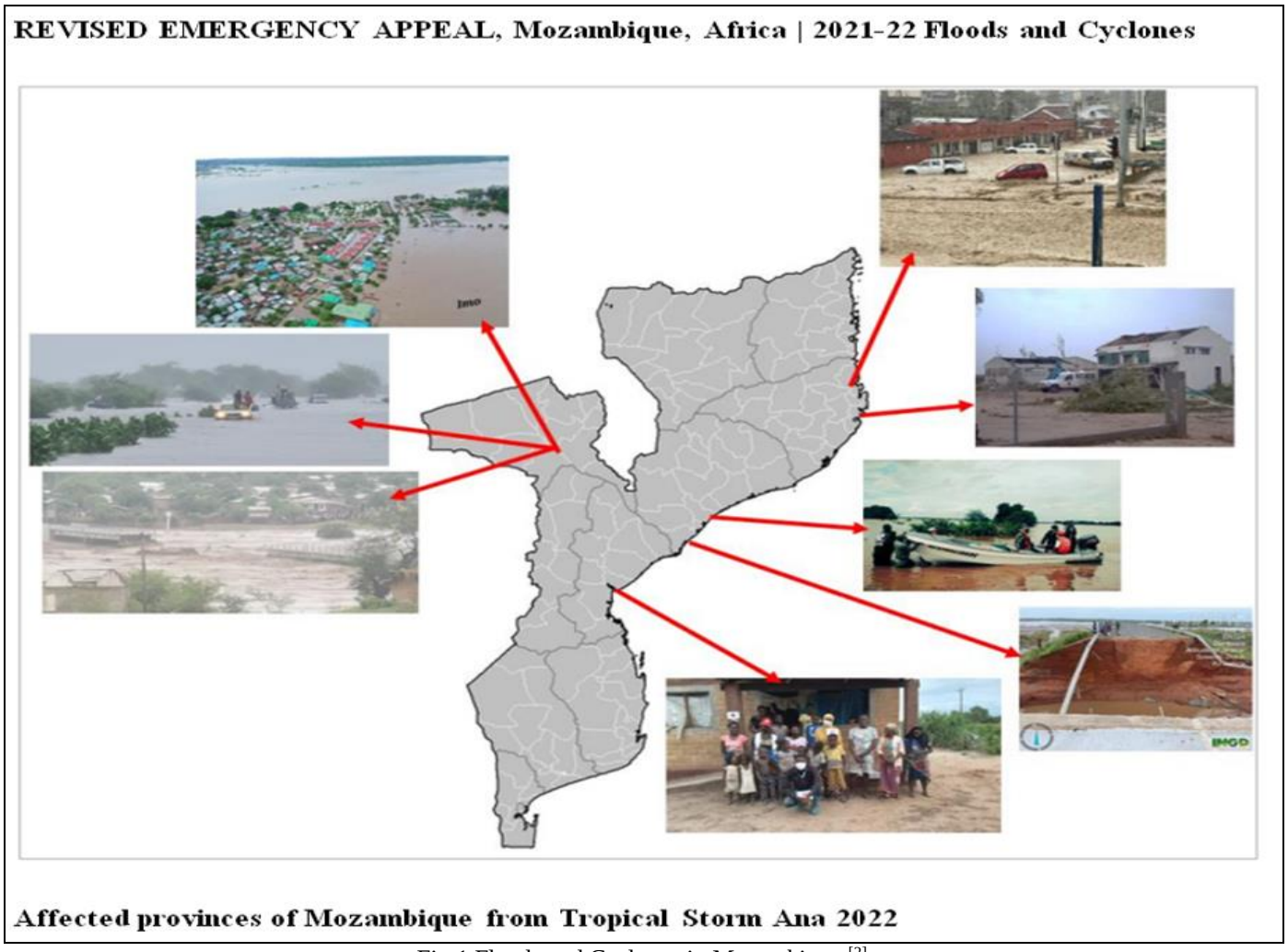

Fig 1 Floods and Cyclones in Mozambique [2].

Nowadays, the rain has been scarce linked to the climatic change, and world worming; Which are responsible of floods and cyclones, as illustrated in the Figure 01. What results in the reduction of the capacity of the generation of energy from the hydropower plant, as it is the principal source of energy in the country; counting with some thermo power plant. This situation brought out the necessity of saving or management of energy; and the need to find out the local sources for energy. Which will reduce the cost of transmission line; tours to transport the energy and the risk of incident, as the grids are to be near the consumers. The population and industrials have been growing day after day. Without any doubt, they are growing with the need of using electrical power, but the source of energy is decreasing in the same way.

Municipal Solid waste, manure of different animals like cow, chickens, elephant, human are seen as sources of renewable energy. It is possible through a process called anaerobic digestion, which breaks down organic matter into something called raw biogas. The biogas is then collected and upgraded to RNG – at pipeline quality – and can be used as electricity, heat or transportation fuel. Municipal Solid Waste and Human waste are seen as well as the future alternative source of energy and combustive, manifold technologies are in use around the world showing excellent results. So, Mozambique has to introduce these technologies to overcome many issues in the country; leackage of power, toilet in many rural.

Accord to William Cash in his study illustrated these ideas; One of the most popular topics in today's world is finding ways to reduce waste. There is considerable drive to increase recycling, decrease energy consumption, and reduce emissions. However, one form of waste we often ignore is our own human excrement. It's a topic that's often ignored because of taboos, but dealing with human waste is a problem all societies have faced. Failing to remove it properly can often have deadly consequences, as is currently illustrated by the cholera outbreak in Haiti. [36] A significant portion of the energy content of the food we ingest remains after it leaves our bodies, but it is largely ignored in modern waste treatment.[37][38]

Continuing in this discussion, another import comment is: “a portion of the world's 1020 J/year is used to treat this waste, but it's hard to estimate how much because the methods of treating the waste vary significantly. In developed nations, centralized plumping transports the waste to large waste-water treatment facilities, but 2.6

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billion people still have no form of toilet". [8] About 1% of England's total electricity is spent on wastewater treatment, but in some places, excrement can simply be left exposed or even dumped into water sources. [40]

There is evidence, in particular, that starting with a well-planned community engagement programme well in advance of any planning proposal will help build active support and minimise opposition.[58].

This work comes in order to change the situation a creasing more alternatives ways to generate energy and combustive without putting in reduce and minimize the problem of fewer sources to energy. So, this work comes to develop and use local source of renewable energy for lighting and for vehicles. The principal purpose is to generate energy by using manure of human to generate energy and to produce LPG to move vehicles at Chitima in Mozambique. 1000 citizen dwelling in chitima district will generate 500 kWh of energy enough for 200 families with 5 members; 5 trees and; 5800 liters of water saved, per day in the first year of human manure to energy chitima project reducing the environment e climate change, green house gases emission, illnesses. increase the economy of the country at all.

➢ *Chitima*

Cahora-Bassa District is a district of Tete Province in western Mozambique. Its administrative center is the town of Chitima. The district is located in the southwest of the province, and borders Marávia District in the north, Chiuta District in the northeast, Changara District in the east, Zimbabwe in the south, and Magoé District in the west. The area of the district is 8,712 square kilometres (3,364 sq mi). The location of Chitima district may be seen in the Figure 02, in orange colour. [63]. It has a population of 58 669, as the table 01 illustrates and, 9% of the households in the district have access to electricity.[63]

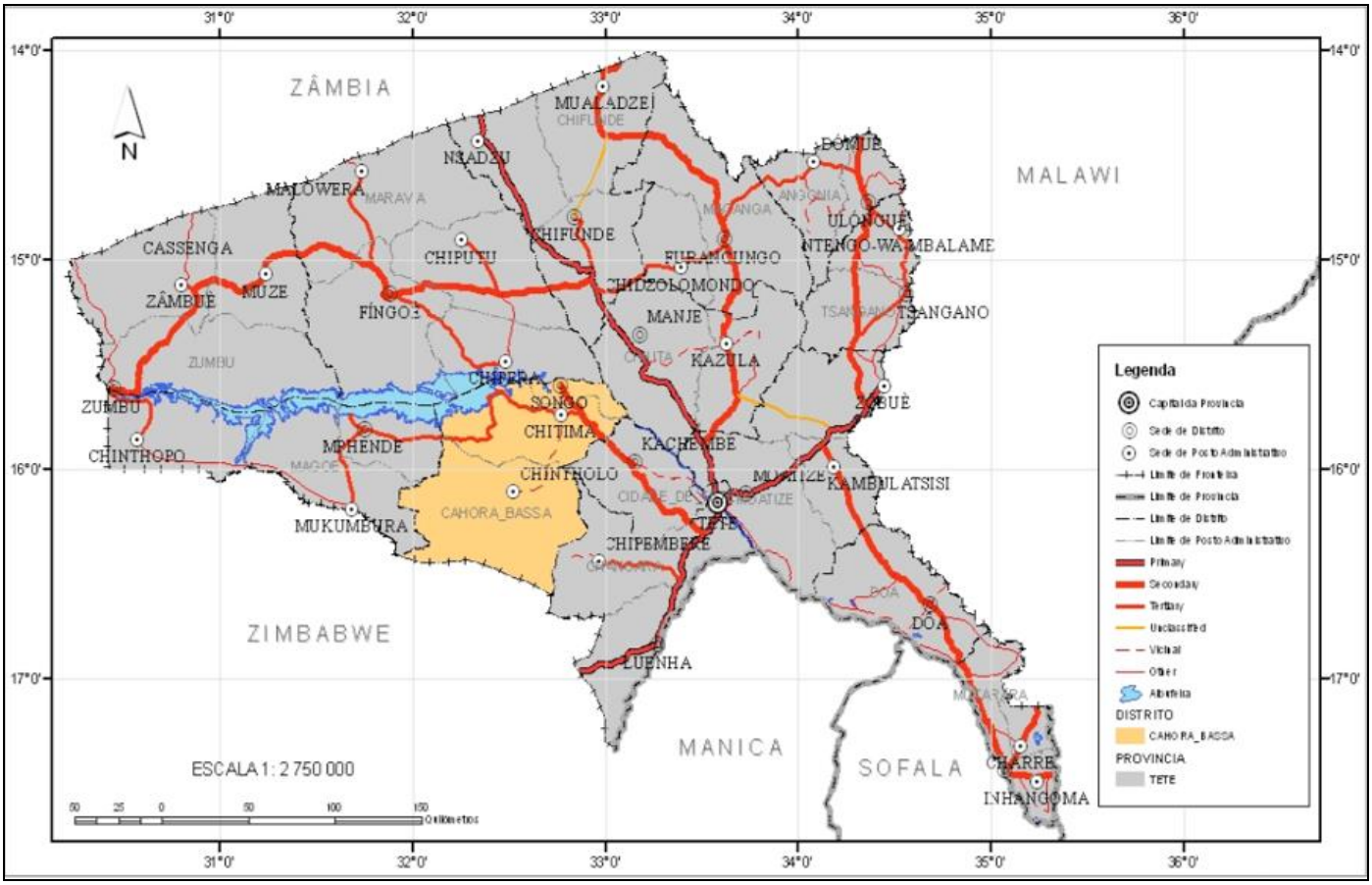

Fig 2 Map of Tete Province and the Chitima District
Source: CBASSA PDF [70]

Table 1 The Population in Chitima District, 1/07/2012

	Years					Total
	0 -4	5 -14	15 - 44	45 - 64	65 and more	
Female	5 310	8 459	12 354	2 460	980	29 563
Male	5 244	8 322	12 558	2 191	791	29 106
Total	10 554	16 781	24 912	4 651	1 771	58 669

Source: CBASSA PDF http://www.portaldogoverno.gov,mz [5]

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II. METHODOLOGY

We used literature review from some projects of toilet to energy existing in India, as well as others countries, which are for long time and having good results, generating energy for their population in rural, and giving jobs to the citizen dowelling near the project increasing the economy; papers, articles, thesis as well as Google Scholar, , related to manure to energy and animals to energy , from 2017 to 2024 were used.

To estimate the amount electrical energy generates and the environmental conditions parameters will be done by help of COCO (CAPE-OPEN TO CAPE –OPEN) Simulation Software. Technologies aim to exploit wastes in order to recover energy, decrease the depletion rate of fossil fuels, and reduce waste disposal [4].

III. PROJECTS OF MANURE TO ENERGY IN SOME COUNTRIES

Biogas from human waste, safely obtained under controlled circumstances using innovative technologies, is a potential fuel source great enough in theory to generate electricity for up to 138 million households.

Bio toilet is a decomposition mechanized toilet system which decomposes human excretory waste in the digester tank using specific high graded bacteria (aerobic or anaerobic) further converting it into methane gas and water. Bio toilet is a different toilet as compare to the traditional restrooms. It saves a lot of water.[3]

The biodigester then provides electricity which powers a pump for ground water. [73] Unfccc.int reported that in Bio-toilets: Sustainable Solution for Impoverished Urbanites – India, that that activity was a women-led business organization engaged in providing bio-toilets for poor, urban families as well as families in peri-urban areas. The bio-toilet system disposes human waste and saves energy, conserves water and produces energy in the form of biogas.[74][71]

That activity was introducing a bio-toilet system which disposes human waste and saves energy, conserves water and produces energy in the form of biogas. These bio-toilet systems meet the need for a basic, easy-to-install and hygienic human waste disposal mechanism in areas with no infrastructural facilities, such as sewage treatment plants. It also addresses the need for a cheaper and easy-to-operate alternative to the traditional waste disposal system. The sanitation systems can be installed in places where conventional toilets facilities cannot be made available.[74].[71]

Waste to Wealth is one of several pilot projects in Africa to have received seed grants from Grand Challenges Canada for the systematic collection of waste for processing into a variety of energy or agricultural products.[60]

The way in which the scientist assigns value to human waste is through a merit-based system. As such, every time someone uses the toilet located at UNIST, they can earn 10 Ggool (a form of cryptocurrency). [56]

Generating methane gas from excrement is a very well understood process. The waste is broken down by anaerobic bacteria in digester devoid of oxygen. The bacteria feed on the excrement and produce methane gas. This process is very attractive because it can be scaled from individual residences to city-wide networks.[52]

IV. RESULTS AND DISCUSSIONS

Approximately 460 gasoline gallon equivalents (GGEs) are produced on-site daily. Human poop, however, is not the only waste that produces RNG. Other renewable resources like landfills, food waste and animal manure can also be used.[17]

Age and gender are two other important factors. Adults with a high-fiber diet produce an average of 349 g/day of wet-stool. [38] Thus, a generous estimate of the mass of faeces produced by the world's 6.8 billion people is 866 billion kilograms per year. [39] However, only 260 billion kilograms of viable fuel are produced, because water makes up approximately 70% of the stool weight. [40,41] The energy content of dry stool is about 2.3 x 107 J/kg [39]. Thus, a high-fiber population produces 5.98 x 1018 J/year of energy, well short of the 1020 J/year of energy consumed in the world. [42]

The quantity of methane produced at these plants is significant enough to be used to generate electricity on a large-scale and cities are beginning to see the value in this. The city of Cleveland is currently constructing a steam-powered electricity plant at it's wastewater treatment facility. The plant will be able to produce 25% of its total electricity demand and expects to pay off the investment in 11 years. [44] San Antonio and San Diego have plans to pipe the collected methane and sell it to utility companies. [41][43] New York City is currently seeking proposals for how to efficiently dispose of its waste for the next twenty years. [45]

Scientists from Nanyang Technological University (NTU) have invented a new toilet system that will turn human waste into electricity and fertilisers and also reduce the amount of water needed for flushing by up to 90 per cent compared to current toilet systems in Singapore.[54]

Biogas from human waste, safely obtained under controlled circumstances using innovative technologies, is a potential fuel source great enough in theory to generate electricity for up to 138 million households the number of households in Indonesia, Brazil, and Ethiopia combined.

- *Projects in the Would Using Manure to Energy / Saved Water in the Toilet Use in Mozambique*

Dubbed the No-Mix Vacuum Toilet, it has two chambers that separate the liquid and solid wastes. Using

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vacuum suction technology, such as those used in aircraft lavatories, flushing liquids would now take only 0.2 litres of water while flushing solids require just one litre.[54]

The existing conventional water closet uses about 4 to 6 litres of water per flush. If installed in a public restroom flushed 100 times a day, this next generation toilet system, will save about 160,000 litres in a year, enough to fill a small pool 10 x 8 metres x 2m. [54]

The Price of water in Mozambique specially in Tete province when is located Chitima, the place in study is 36.54 Mz/m3. (0,58 dollars). But nowadays the private which a distributing water at Chitima are using 80 Mz (1,2 dollars') date of 2024. Table 02, shows the quantity of water to be saved per day in chitima, the place that is facing varies problems to obtain this precise liquid. The project demonstrates the possiblelity for the solution.

Table 2 Quantity of Water Which May be Saved Using Vacuum Suction Technology in Chitima District

Number of person	0.2 litres of water a person /day	4 litres of water a person/day	6 litres of water a person/day	Saved water /day if 4 litres
1000	200	4000	6000	3800
2000	400	8000	12000	7600
3000	600	12000	18000	11400
4000	800	16000	24000	15200
5000	1000	20000	30000	19000
7000	1400	28000	42000	26600
8000	1600	32000	48000	30400

Table 3 Money that May be Saved Per Day and Per Year Using

Number of person	Saved water /day if 4 litres	Saved water /day if 6 litres	Money saved per day in dollar	Money saved per day in Mz	Money saved per year in dollar	Money saved per year in Mz
1000	3800	5800	4,56	304	1664,4	110960
2000	7600	11600	9,12	608	3328,8	221920
3000	11400	17400	13,68	912	4993,2	332880
4000	15200	23200	18,24	1216	6657,6	443840
5000	19000	29000	22,8	1510	8322	554800
6000	22800	34800	27,36	1824	9986,4	665760
7000	26600	40600	31,92	2128	11650,8	776720
8000	30400	46400	36,48	2432	13315,2	887680

The cost of water per 1 m^3, in privates, is 80 Mz equivalent to 1,2 dollars (2024). Using this exchange rate. We concluded, from the table 03, that the project may save more than 887 680 Mz (13315,2 dollars). This money will be use to construction other infrastructure like: schools, hospitals and similar project around the country.

- *Quantity of Power [Kwh], Methane in Liters [L] and the Distance Which a Normal Car May in [Km].*

On average, a person defecates about 500g a day which can be converted to 25 litres of methane. Said amount can generate 0,5kWh of electricity or be used to drive a car for 1,2 km. [56]

1 kg dung will produce 0.04 m3 of biogas. Hence, 1/0.04 = 25 kgs is required to produce 1 m3 of Biogas.

1 m3 = 1000 liters=2 persons

0,04 m3= 40liters = 2 persons; from this: 1 person = 20 liters of methane

From the data's, we calculated by approximation for the case of our study, Chitima, in the interval of nine (9) years. Considering, the increment of a project per year of 1000 persons. The results may be ssen in the table 04.

Table 4 Quantity of Power [Kwh], Methane in Liters [l] and the Distance Which a Normal Car May in [km].

Year	Number of person	quantity of manure produce 500g/day	quantity of methane 20 litres per day	Generete 0,5 kwh of electricity	Drive car for 1.2 Km
1	1000	500000	20 000	500	1200
2	2000	1000000	40 000	1000	2400
3	3000	1500000	60 0000	1500	3600
4	4000	2000000	80 000	2000	4800
5	5000	2500000	100 000	2500	6000
6	6000	3000000	120 0000	3000	7200
7	7000	3500000	140 000	3500	8400
8	8000	4000000	160 000	4000	9600
9	9000	4500000	180 000	4500	10800

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Mozambique electricity prices; The residential electricity price in Mozambique is MZN 8.122 per kWh or USD 0.127. The electricity price for businesses is MZN 5.117 kWh or USD 0.080. These retail prices were collected in March 2024 and include the cost of power, distribution and transmission, and all taxes and fees. Compare Mozambique with 150 other countries.

➢ *Fuel Consummation of Motorbikes or Car*

- *Price of Fuel*

Table 5 Price of Fuel in Mozambique

	Litre	**Gallon**
MZN	83.300	315.325
USD	1.304	4.936
EUR	1.220	4.618

Source: https://www.globalpetrolprices.com/Mozambique/gasoline_prices [30]

Gasoline prices per litre, octane-95: We show prices for Mozambique from 28-Feb-2022 to 06-Jun-2022. The average value for Mozambique during that period was 75.79 Mozambique Metical with a minimum of 69.04 Mozambique Metical on 28-Feb-2022 and a maximum of 83.30 Mozambique Metical on 23-May-2022. For comparison, the average price of gasoline in the world for this period is 125.44 Mozambique Metical. Use the drop menu to see the prices in gallons [30]

- *Fuel Consumption of Motorbikes and Cars Per 100km*

On average, how much gas does a motorbike use to travel 100km?

An example is a basic 50 cc motorbike, which consumes the least fuel among all motorbikes, including large displacement motorbikes. A normal 50cc car can run 60 - 70 km with 1 liter of gasoline. Thus, if you run 100km, a 50cc car will consume 1.43 - 1.65 liters of gasoline.[31]

It is important to make some calculation just to know, how many liters of gasoline a motorbike uses to travel 100km; and factors in which this depends. We took some examples of which it depends, according to proship, such as: Vehicle's cubic cc number, engine quality, usage time, manufacturer's brand, etc., so it CANNOT be calculated accurately.

To calculate the saved gasoline consummation or mony, for the Chitima project, we used the Honda 50 cc, as the one that is possible to find in the district. According to table 06, it uses 1.54 liters/100km.

Table 6 the Fuel Consumption of Certain Car or Motorbikes of 50cc Models on the Market Today:

models on the market	**fuel consumption**
Honda Future	1.54 liters/100km
Yamaha Sirius	1.57 liters/100km
Yamaha Jupiter	1.55 liters/100km
Honda Wave Alpha	1.6 liters/100km
Yamaha Grande Hybrid	1.69 liters/100km

Source: https://proship.vn/en/news/cach-tinh-so-lit-xang-tren-100km

The principal transport used at Chitima, as well as, many others rural areas in Mozambique are motorbikes. From the table 07, the population of Chitima may have a benefit of nearly 18,48 liters per day, using 1000 person for the human excrement to energy and methane. More than 12 motorbikers may be drived 100 km, with is enough for 12 hours of work in a day, and 1 540,12 Mz (25 dollars) saved to buy petrol per day.

Table 7 Quantity of Methane Per Liters for Motorbikers

Number of person	**quantity of methane 20 litres per day**	**Drive car for 1.2 Km**	**liters of methane per day (Drive car for 1.54 liters/100Km)**	**Price of gasoline saved [Mz]**
1000	20 000	1200	18,48	1 540,12
2000	40 000	2400	36,96	3 080,25
3000	600 000	3600	55,44	4 620,30
4000	80 000	4800	73,92	6 160,49
5000	100 000	6000	92,4	7 700,62
7000	120 000	7200	110,88	9 240,74
8000	140 000	8400	129,36	10 780,86
9000	160 000	9600	147,84	12 320,99

➢ *Number of Families Which May Have Benefit of Power in Chitima*

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Table 8 Number of Families Which Will Get Benefits of Power and the Money Saved in Mz and Dollars Per Day.

Number of person	Generete 0,5 kwh of electricity	Number of family with 6 members per use 5 Kwh	5 Kwh cost 60 Mz	5 kwh cost 0,95 dollars (per day)
1000	500	100	6000	95
2000	1000	200	12000	190
3000	1500	300	18000	285
4000	2000	400	24000	380
5000	2500	500	30000	475
7000	3000	600	36000	570
8000	3500	700	42000	665
9000	4000	800	48000	760

In Table 08 calculated the number of families, we had considered a family composed by six (6) members, which will get benefits of power and the money saved in Mz and dollars per day. the price of power nowadays in Mozambique is about 12 Mz for 1 Kwh. The family having six element use per day approximately 5 kwh, with the cost of 60 Mz (0,95 dollars). So, 500 Kwh generated by 1000 person should benefit 100 families.

From the information in the table 05, assuming that 1 tree is used by 20 family just to cook per day. More than five (5) trees should be save per day, day more than 1 825 per year.

V. CONCLUSION

The project of toilet to energy to Chitima will Reduce the use of water in 80%. it is, the number of populations using contaminated water from the rivers and underground; the diseases; leakage of toilets will pass to story, because 1000 person will get benefit of this basic resource. it shows that the use of water, which is seen as the next gold. more than 1000 people of Chitima saved 5800 liters per day, a but 5800 x 365 per year, it is very wonderful for one district which face difficulties to find water. using human and cows manure, just to reduce the impact of the price of petrol and diesel with have been increasing day after day. the environment impact by reducing the use of fossil fuels, one of thee responsible of the world warming and climate changes. more than 900 families will use power from the grids to illuminate; to cook their means the rural area of Chitima at Tete province. These will reduce the deforestation, as more than 1800 may be saved in the first stage of the project. It keeps the environment controlled and the emission of green house gases responsible for the climate change; by using the renewable energy. Deforestation will be minimized as nowadays all the rural area are using the biomass from the cutting of the trees without looking for the importance of them in the environment. Environment saved vs people with safety toilet, more than 650 trees may be saved in one year of the project. That will surely contribute significatively for the reduce of the emission of green house gases in the district as well as in the country and in the world at all.

The safe treatment of human manure will turn or give the global hearth and the environment and the population will get benefit at all. reduce the money and increase the development of Chitima, tete, Mozambique and the world, giving job to people, good health, power to schools, hospitals and other social infrastructures.

The implementation of this project at schools, hospitals, and others socials place will benefit more than 2000 person per day. in term of money more than () MZ or dollars will be saved and used for construction of others infrastructure for the chitima district. these small dates illustrate the availability of the manure to energy for chitima distrist project. more than 650 trees may be saved in one year of the project. that will surely contribute significatively for the reduce of the emission of green house gases in the district as well as in the country and in the world at all.

VI. FURTHER WORKS AND LIMITATIONS

The next work will consist of calculating the viability of the project human manure to energy for the implementation in Chitima, in Mozambique and comparate it with the cost of management of it in the country.

REFERENCES

[1]. www.wlox.com, 2019/01/2019Toilet turns into energy (accessed in 15.09.2021)
[2]. https://reliefweb.int/report/mozambique/rapid-geospatial-analysis-impact-tropical-cyclone-gombe-mozambique-2022 accessed 12.06.2022
[3]. www.cnbc.com, Dec 5, 2019 (accessed 15.09.2021)
[4]. DZECO, F. A. & MOHAN, A.; Municipal Solid Waste – To - Energy for Mozambique; International Journal of Scientific & Engineering Research Volume 11, Issue 7, July-2020 544 ISSN 2229-5518 IJSER © 2020; http://www.ijser.org.
[5]. Source: http://www.portaldogoverno.gov,mz accessed: 12/11/2024
[6]. Global Green Growth Institute (2017). Country Brief: Mozambique. Off-grid solar power in Mozambique: Opportunities for universal energy access and barriers to private sector participation. fckLRfckLRhttps://sun-connect news.org/fileadmin/DATEIEN/Dateien/New/Country-Brief-Mozambique.pdf
[7]. Source LR: https://www.theguardian.com/environment/2016/jan/16/colorado-grand-junction-persigo-wastewater-treatment-plant-human-waste-renewable-energy

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/25aug1636

[8]. S. Tuttle, "Another Way to Die," Newsweek, 8 Nov 10.
[9]. D. P. Burkitt, A. R. P. Walker and N. S. Painter, "Effect of Dietary Fibre on Stools and Transit Times and Its Role in the Causation of Disease," Lancet 300, No. 7792, 1408 (1972).
[10]. "World Development Indicators," The World Bank.
[11]. J. L. Murphy et al., "Variability of Fecal Energy Content Measured in Healthy Women," Am. J. of Clinical Nutrition. 58, 137 (1993).
[12]. J. B. Wyman et al., "The Effect on Intestinal Transit and the Feces of Raw and Cooked Bran in Different Doses," Am. J. of Clinical Nutrition. 29, 1474 (1976).
[13]. "International Energy Annual, U.S. Energy Information Administration.
[14]. C. T. Pope, "Rose George's World of Human Waste and Why It Matters," Circle of Blue, 24 Nov 08.
[15]. "Energy and Sewage," U.K. Parliamentary Office of Science and Technology, Postnote 282, April 2007.
[16]. T. Rosenberg, "Green Strategies for the Poorest," New York Times, 19 Nov 10.
[17]. Source LR: http://large.stanford.edu/courses/2010/ph240/cash2/
[18]. https://www.sciencedaily.com/releases/2012/06/120626072942.htm
[19]. https://waste-management-world.com/a/human-waste-turned-into-energy-and-cryptocurrency
[20]. file:///D:/aa%20phdee/301%20PHD%20diss/WP4A12_-_Energy_Farms_-_Anaerobic_Digestion.pdf
[21]. Website: http://inweh.unu.edu/waste-to-wealth
[22]. "Perfil do Distrito de Cahora Bassa" (PDF) (in Portuguese). Ministry of State Administration. 2005. Archived from the original (PDF) on 30 September 2011. Retrieved 15 December 2016.
[23]. "População da Provincia de Tete". Censo 2007 (in Portuguese). Instituto Nacional de Estatística. Archived from the original on 19 December 2007.
[24]. "Chitima, Tete, Mozambique," Mindat.org, accessed June 2, 2021
[25]. https://energysavingtrust.org.uk/can-your-toilet-generate-electricity/
[26]. https://www.un.org/sustainabledevelopment/health/
[27]. https://www.bbc.com/news/business-41680867
[28]. https://unfccc.int/climate-action/momentum-for-change/activity-database/bio-toilets-sustainable-solution-for-impoverished-urbanites
[29]. S. M. K Hosseini-Assal and S. D Hosseini. "Determination of the Mean Daily Stool Weight, Frequency of Defecation and Bowel Transit Time: Assessment of 1000 Healthy Subjects," Archives of Iranian Medicine. 3, No. 4, 204 (2000).
[30]. https://www.globalpetrolprices.com/Mozambique/gasoline_prices/ accessed 12.06.2022
[31]. https://proship.vn/en/news/cach-tinh-so-lit-xang-tren-100km. Accessed: 15/11/2024