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THE IMPORTANCE OF BIOMASS AS AN ENERGY SOURCE IN RURAL DEVELOPMENT IN ANGOLA

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Abstract: The purpose of this presentation is related to the analysis of the existing biomass potential in rural regions in Angola, in its waste in the most different aspects, and in the possibility of its use for energy production in the most diverse ways. The anarchic fires that have been observed throughout the national territory, reflecting a serious aggression to biodiversity and with an evident waste of energy, which could eventually be used for the development of the rural environment, also deserved an analysis and reflection within the scope of this job. Regardless of the fact that biomass is one of the oldest energy sources in the world and that arises with the discovery of fire, the reality in Angola has shown an almost non-use of this important energy source, mainly due to the lack of knowledge of this energy potential, among rural communities.. The almost inexistence of access to electricity in rural areas in Angola, associated with the level of poverty of rural inhabitants, compared to what happens in urban areas in general, makes in some cases they resort to energy sources from fossil fuels, with the inconvenience of their cost, and with the negative consequences they cause to the environment, with the emission of gases causing the greenhouse effect, contributing to climate change on a global scale, and with dramatic consequences that affect humanity in general. The lack of treatment of animal excrement, which exposed to the open air also causes the release of harmful gases to the environment, and providing risks to public health, inconveniences that could be minimized with the proper use of biodigesters, with relatively affordable costs and using combustible gases and biofertilizers to enrich agricultural soils. The rational use of biomass, in its most different forms, and in this case in particular from animal excrement, presents itself as an important energy alternative, for sustainability in rural

areas, and in a global perspective. The absence of electricity in rural areas makes the growth of micro-industry difficult, especially with regard to the milling of grains, to obtain flour that constitutes the food base of most rural inhabitants, as well as the conservation of agricultural and other products. In the same way, the illiteracy observed there could be minimized with access to lighting and sources of information and education remotely, which the lack of access to electricity does not allow. In this presentation, we intend to reflect on the importance of this energy source, based on quantitative data applied to some particular examples, in order to alert and encourage the search for policies that allow the dissemination and implementation of energy generators based on biodigesters, using biomass as fuel, and in the production of biofertilizers for soil empowerment,

Keywords: Biomass, energy, renewable, biodigester, development, rural.

INTRODUCTION

The basis of human development is based on different fundamental needs, one of which is access to energy sources, highlighting here electrical energy as an indispensable source for the evolutionary contribution of the way of life of any human being. The almost non-existence of this important source of energy in rural Angola has not allowed for an acceptable and promising development perspective in these regions. The global evolution, in its most different segments, was undoubtedly due to the availability of energy in the most diverse aspects, and its availability is an indispensable resource for guaranteeing the social, economic and strategic development of any community, rural areas which, in general, have been the most penalized in terms of access to energy sources.

THE CONDITION OF POVERTY IN RURAL AREAS

Although the definitions of poverty are relative in Angola, we can briefly consider poverty as the insufficiency of financial resources to guarantee the basic conditions of subsistence and well-being of any family. Available statistical data indicate that most of this group is found in rural areas, as shown in Figure 1. Source INE (2008-2009).

Access to electricity is crucial for improving the quality of life of any community. The existence of this source in rural areas would significantly contribute to the development of this sector in the most diverse segments, from the conservation of products, access to information associated with an improvement in the quality of education through the possibility of accessing remote education sources, between others. The table in Figure 2 shows the percentage of access to electricity by the rural community, showing that only 7% of the rural population has access to this source of energy. Source from INE (2008-2009) and IMS (2015-2016).

THE MOST USED ENERGY RESOURCES IN ANGOLA

Due to the scarcity of other sources of energy, and especially in rural areas, it appears that the greatest consumption of energy by the populations is related to the preparation of food, where the main energy source comes from firewood and charcoal, as shown in Figure 3.

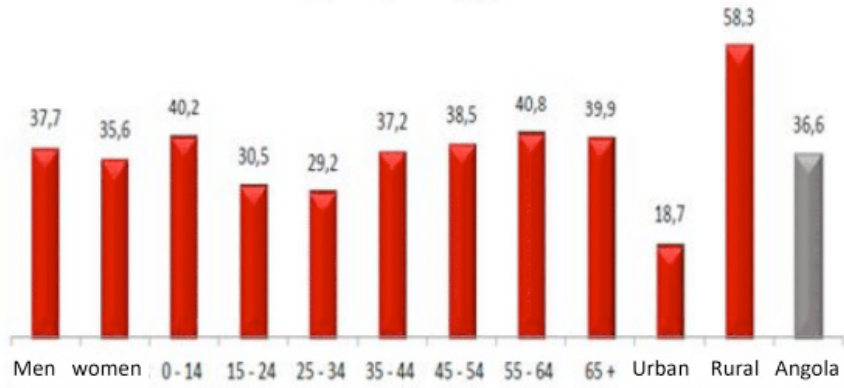
This situation has caused the deforestation of immense forest areas, with negative consequences linked to the environmental impact. It is also associated with the fact that every year large areas of tropical savannas are burned in Angola, causing serious disturbances to nature, and with serious impacts, some of them still unknown, but with a high influence on global warming. The

causes of these fires are mainly related to the preparation of agricultural fields, charcoal production, and hunting. It is worth noting here that the burning also reflects a waste of energy, as there are currently techniques that allow a rational use of forest residues for energy production.

BIOMASS AS AN ENERGY SOURCE

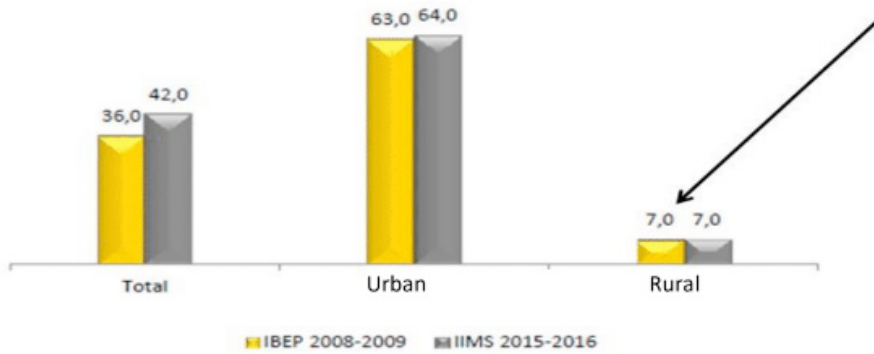
In recent years, biomass has had a relative importance for allowing the use of different organic matter available in nature, highlighting here the use of animal waste as the main source, especially in rural areas.

The biological mass that, by decomposing organic waste, results in energy is called biomass, therefore, from an energy perspective, biomass is the set of all organic matter that may have plant or animal origin, and that can be used for production. energy using the most diverse mechanisms. The differentiation of biomass sources is based on their characteristics and origins, which can be obtained from direct combustion, thermochemical processes and biological processes such as anaerobic digestion and fermentation. Within the scope of this presentation, the latter is highlighted, the biological processes using anaerobic digestion, using biogas from animal waste, using biodigesters, Figure 4 shows an example of an Indian model biodigester, it is a practice of energy use in successful use in several countries, especially in rural areas and whose cost is relatively low. Rural populations commonly resort to animal husbandry for self-sufficiency, and normally the waste of these animals is left outdoors, the constituents of these animal waste affect surface waters as they are made up of organic matter, nutrients, fecal bacteria and sediments. The emission of gases caused by the dejects can produce harmful effects and change in an undesirable



data source: INE, IBEP 2008-2009 Vol. II; IDR 2000-2001

Fig1 – Incidence of poverty by sex, age group and area of residence- Source [1]



data source INE, IBEP 2008-2009 e IIMS-2015-2016

Figure 2 Percentage of households with access to electricity by area of residence - Source [2]

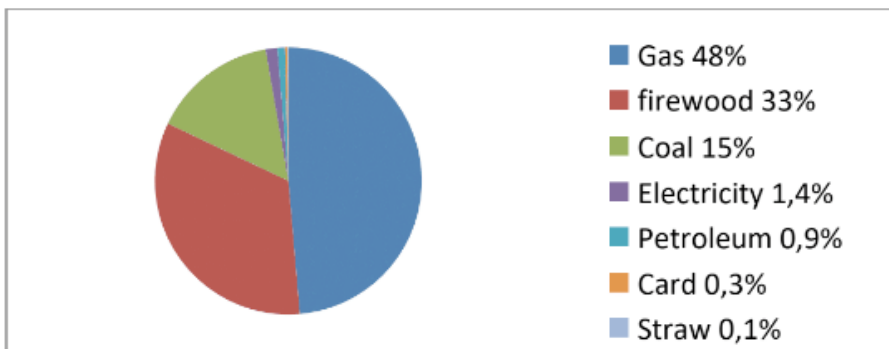


Figure 3 Sources of energy for cooking in Angola - Source [3]

way, the characteristics of the air and the environment and cause eventual damages to the public health, in addition to being able to favor the appearance of acid rain due to the emission of gases originated by the dejects. and contribute negatively to the global warming of the earth.

BIOMASS FROM ANIMAL MANURE FOR BIOGAS PRODUCTION

The decomposition of waste by the action of bacteria, in an environment with no air, a process called anaerobic digestion that occurs naturally with almost all organic compounds, causes the release of gases some of these fuels as shown in Figure 5. This process is carried out by anaerobic digestion in biodigesters, where the process is favored by humidity and by the heating that is caused by the action of the bacteria, with the advantage of using the material resulting from the process as a biofertilizer, which according to experiences obtained in various sectors has a good potential that in many circumstances can replace the usual fertilizer.

Based on the model adopted by the “Intergovernmental Panel on Climate Change” IPCC, we can find an equation to calculate the Methane Emission Factor, FEM Source [8]

$$FEM = SV \times 365 \times \beta_0 \times 0,67 \times \frac{FCM}{100} \times SM$$

Where

FEM - Methane emission factor (kgCH₄/cab.year)

SV -Volatile solids (kgsv/Cab.day)

Bo - Methane production capacity from manure (m³CH₄/kgsv)

0.67 - Conversion from m³ of methane to kg (Dimensional)

FCM - conversion factor according to management (%)

SM - Waste Management System Factor

(Dimensional)

Table 2 shows the comparative relationship of 1mm³ of biogas with other common fuels, in order to better assess the approximate energy potential of biogas.

As an example, a medium-sized swine can produce approximately 0.7 m³ of biogas per day, meaning that four swine of the same could produce the equivalent of 21kWh of electrical energy, enough to power a simple and typical rural dwelling. in Angola.

CONCLUSION

Biogas is a renewable energy, contributes to decentralization and is economically viable. The necessary infrastructures for the construction of the biodigester are available in the Angolan market. It guarantees the sustainability of the environment, due to the absorption of greenhouse gases by the natural carbon neutral cycle, especially during the agricultural season. The biofertilizer, resulting from the process, works as a factor of profitability and economy for the peasants. The production of biogas from animal excrement is a procedure that must be considered, and that can contribute to rural development in Angola.

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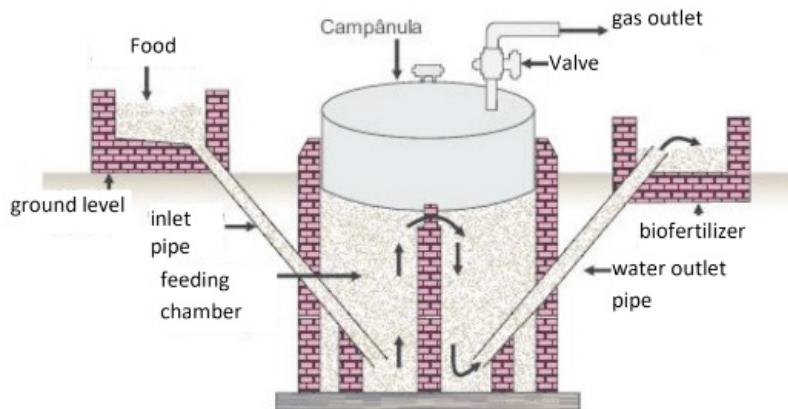


Figure 4 – Example of an Indian biogas digester. (Source Fonseca 2009) Source - [4]

Table 1: Possible percentages of biogas constituents

methane (CH ₄)	50% to 75%
Carbon dioxide (CO ₂)	25% to 40%
Hydrogen (H ₂)	1% to 3%
Nitrogen(N ₂)	0,5% to 2,5%
Oxygen (O ₂)	0,1% to 1%
hydrogen sulfide (H ₂ S)	0,1% to 0,5%
Ammonium (NH ₂)	0,1% to 0,5%
Carbon monoxide (CO)	0% to 0,1%
Water (H ₂ O)	Variable

source : Cassini(2003)

Figure 5 - Approximate percentages of biogas constituents - Source [5]

Table 1: tabulated values of the IPCC methodology for qualitative parameters

Category	SV (kg cab ⁻¹ dia ⁻¹)	B ₀ (m ³ _{CH₄} kg _{SV} ⁻¹)	FCM (%)	SM
swine	0,3	0,29	0,79	1
Milk cow	2,9	0,13	0,79	1
other bovines	2,5	0,1	0,79	1

source: IPCC, 2006.

Table 1 - Qualitative parameters - Source [6]

Gasoline	Gasoil	Biodiesel	GPL	Electricity	Firewood	Pallets wood
0,61 litros	0,7 litros	0,55 litros	0,45 Kg	6,9 kWh	1,538 Kg	0,304 g

source: Silva (2009)

Table 2 - Comparative relation of 1mm³ of biogas with other fuels - Source [7]

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