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Decentralized Biogas Production in Cuba – a Status Report

In the past few years biogas production from biomass has shown high growth rates in industrialized countries. This differs from developing countries, where the energy supply is mostly based on fossil energy resources. Biogas technology, even though not an innovation in Cuba, has recently been gaining a growing interest and offers high potential. Organic wastes mainly originate from intensive pig production, the food industry and private households. Presently small scale biogas plants dominate and only a few large scale joint venture projects exist. A "real national scenario" to adequately exploit Cuba's biogas potential is in progress.

In his Master Thesis M.Sc. Felix Hanke investigated the decentralized biogas production in Cuba. The thesis was supervised by PD Dr. Heide Hoffmann, Humboldt-University Berlin, Department of agriculture and horticulture, Invalidenstr. 42, D-10115 Berlin, Germany; e-mail: *felixhanke@hotmail.com*

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Literature

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Biogas production from biomass shows recently high growing rates in industrialised countries. This is different in developing countries, like Cuba, where energy supply is mainly based on fossil fuels.

Biogas technology, even though not an innovation in Cuba, gains recently a growing interest and offers a high potential. Organic wastes originate from intensive pig production, food industry and private households. Till today small scale biogas plants dominate and only a few large scale joint venture projects exist. A „real national scenario" for an adequate use of the biogas potential in Cuba is in progress.

In opposite to industrialised countries conditions in developing countries are totally different. There is often a lack of infrastructure, financial assets and technical equipment and in many cases there is temporaliy no energy supply, at least. Agricultural surpluses scarcely exist or the countries are even net importers of food, so large scale cultivation of energy crops could lead to a direct competition for food production in these countries. Population suffers from insufficient energy supply and beside local and global environmental hazards result from the production of heat and electricity by fossil fuels.

This situation is also predominant for Cuba, where electricity generation is mainly based on fuel oil, crude oil and diesel [1]. Difficulties in providing electricity and several hours lasting power failures are due to the obsolete supply network in many regions of Cuba the order of the day.

Energy situation in Cuba

With the collapse of the former Soviet block in 1990 Cuba was, due to the changed conditions, confronted with its own restricted energy reserves. Energy delivery from the socialist brother countries was stopped and energy supply of the population could not be ensured any more. From 1989 to 1992 oil import was reduced from 13 Mio. to 6 Mio. tons [2]. Cuba spends one third of its import expenses in fossil fuels – this is 50 % of the 1.8 Billion US$ receipts in foreign currency. In 1993 due to the dramatic situation in the energy sector a "Program for the development of the national energy sources" was established to find alternatives to importation. In this context national expert groups for the different sectors of regenerative energies like Solar, Wind, Hydropower and Biomass were created. These experts shall evaluate within the framework of different activities and research projects the potential of the particular sectors, develop proposals for further approaches, supporting the knowledge transfer and link the particular actors. Since 2007 there exists an expert group "Biogas."

Biogas in Cuba

In the opinion of experts from the Organisación Latinoamericano de Energía (OLADE), Cuba is the Latin-American country with the biggest bio energy potential from organic wastes [5]. The energy production from biomass holds with approximately up to 176.000 tons Oil Equivalent per year a high potential. Organic wastes originate from in-

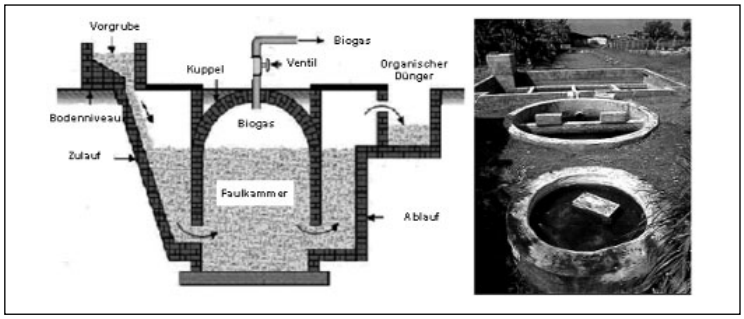

Fig. 1: Fixed dome plant

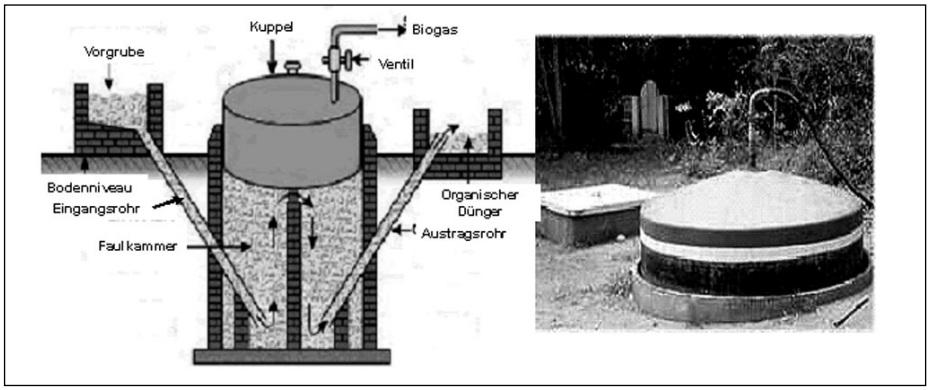

Fig. 2: Floating-drum plant [7]

tensive cattle and pig production, food industry and rubbish tips. Only wastes from sugar, alcohol and coffee production achieve 78 Mio. m^3 wastes per year [6].

The relieving effect for the environment by using these residues is spoken in very clear terms. At the same time industrial approaches for electricity supply, partly as joint venture projects, are possible. But the main focus is, as matters stand, in decentralised energy supply for rural regions with limited or no access to energy.

Fixed-dome and floating drum plant predominant

Today small plants with a digester volume from 2 to 65 m^3 represent the majority of biogas plants in Cuba and are mostly found in rural areas with a low energy demand. Feeding is made almost exclusively with animal excrements and works following the principle of continuous wet fermentation. Predominantly the fixed-dome and floating-drum plant are prevalent throughout Cuba [7, 8].

Fixed-dome plant (Fig. 1)
Characterized by a closed, massive digester, which simultaneously works as gas storage, gas is collected in the upper part of the digester and with growing pressure the digested sludge is displaced into a compensation basin. Due to the easy method of construction and missing moving parts, construction costs are low. Today, there around 400 functioning plants of this type in Cuba [7].

Floating-drum plant (Fig. 2)
Is described by a moving drum, in which the produced biogas is collected. With growing gas pressure the drum is floating up. Filling level in the digester stays constant. Necessary construction materials for the digester are bricks and concrete. The drum is usually made of metal which results in relatively high construction costs as well as by the proneness to rust in a limited lifespan of this plant type. Around 150 functioning plants exist in Cuba today [7].

The fixed-dome plant is more cost effective than the floating-drum plant in both aspects: construction and maintenance [9]. A fixed-dome plant with a 7 m^3 digester to supply a five-head family costs around 470 US $, a comparable floating-drum plant 510 US $. Maintenance of the fixed-dome plant is limited to one cleaning every two years, maintenance costs for the drum of the floating-drum plant are about 20 US $ per year [9].

Even though investment costs amortise in one or two years, financing in Cuba is often not ensured and necessary construction materials as well as equipment are not available [9].

Cling wrap plant - Flujo-pistón until now for private households (Fig. 3)
This type of a tube-like plastic plant is less disseminated in Cuba (Fig. 3). Only one dozen exist [7]. The method of construction is very easy and is suitable for the supply of private households. Purchase costs are marginal. In Cuba it is thought to install this plant type modularly in a row. Especially a use in intensive pig production is discussed [7]. If problems in singular segments appear, these segments can be taken out of production without a breakdown of the complete biogas plant [8]. Disadvantageously is the normally used plastic foil, which renders useless very fast by sun insolation and damages and has to be replaced.

Conclusion

Even though the number of biogas plants in Cuba rose up since the 90´s, a "real national scenario" is still missing. Knowledge level in operating and maintenance is still deficient and own technical approaches for an adequate use of the biogas potential are still under development. The exploitation of existing biogas potentials is difficult also due to the economic situation of Cuba. The negative image of biogas which results from failed projects in the 70´s up to the 90´s shall be improved in public and on decision maker level by successful pilot projects. Biogas production can contribute to the energy supply as well as to the decontamination of waste and wastewater. On the basis of the manifold positive effects for the rural areas a general application of biogas technology in agricultural production – like in China or India – seems desirable and practically realisable. For now an industrial application gives the impression to need an international cooperation in financial and technical aspects, to exploit the potentials of this energy source in an adequate way.

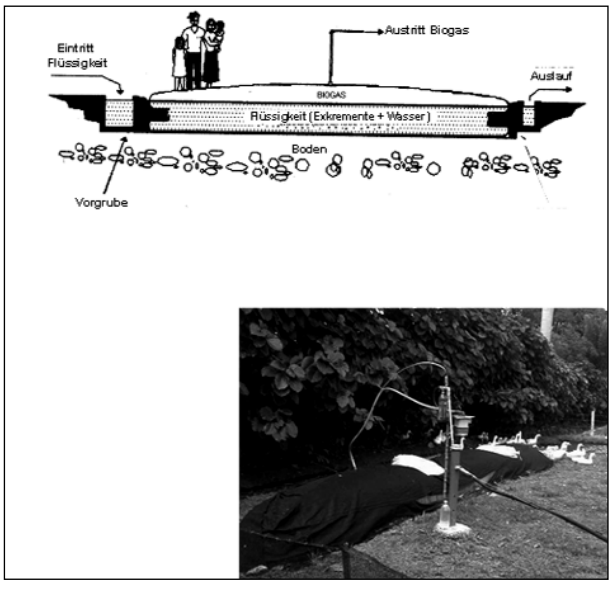

Fig. 3: Cling wrap plant

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