Avaliação e Perspectiva de Aplicação de Mecanismos de Desenvolvimento Limpo em Indústrias de Alimentos e Bebidas no Brasil

Potential Assessment of Prospective Application of Clean Development Mechanisms Concerning Brazilian Food and Beverage Industries

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Resumo

Este trabalho tem como objetivo discutir o potencial de aplicação de Mecanismo de Desenvolvimento Limpo (MDL) por indústrias de alimentos e bebidas no Brasil. Evocando dados oficiais, a presente análise demonstra que a indústria de alimentos e bebidas é capaz de aumentar sua participação em projetos de MDL. Com base nos dados apresentados, pode-se perceber que o setor estudado (a) tem um elevado potencial de economia de energia, (b) possui fontes consideráveis de biomassa, (c) é capaz de reduzir suas emissões em grande medida e (d) pode melhorar o seu tratamento de resíduos. Tendo em mente as emissões de gases de efeito estufa, efluentes líquidos e disponibilidade de biomassa, respectivamente, verificam-se níveis mais elevados no setor de alimentos e bebidas em comparação com qualquer outro setor industrial, muito em função da biodegradabilidade de suas emissões. Tal fato sugere que a indústria de alimentos e bebidas tem grande potencial para implementar projetos de desenvolvimento sustentável.

Palavras-chave: Alimentos. Conservação de Alimentos. Desenvolvimento Sustentável.

Abstract

This study aims at discussing the potential exploitation of Clean Development Mechanism (CDM) by Brazilian food and beverage industry. By evoking official data (e.g. Brazilian Energy Balance Report and Brazilian Initial Communication to United Nations Conference on Climate Change), the present analysis demonstrates that Brazilian food and beverage industry is positively able to enhance its participation at proposed CDM projects and thus contribute to greenhouse effect mitigation. Based on presented data and as far as the food and beverage industrial sector is concerned, one may realize that (a) it has a high potential for energy saving, (b) it possesses considerable sources of biomass, (c) it is able to reduce its emissions to a large extent and (d) it may improve its residue treatment. Bearing in mind GHG emission, liquid effluents and biomass availability, food and beverage industry present higher levels than any other industrial sector. This fact suggests that the food and beverage sector has a considerable potential to implement sustainable development projects, thus helping to reduce pollutant emission to the environment.

Keywords: *Food. Food Preservation. Sustainable Development.*

1 Introduction

In view of the Climate Convention signature, several countries have been targeting common goals so as to avoid accelerated atmospheric changes due to human interference. Among the anthropic events over the environment, greenhouse effect increase is a matter that has astonished the international community.

Aiming at reducing the emission of greenhouse gases (GHG), Kyoto Protocol has proposed that emissions by years 2008-2012 should be on average 5% lower than the levels verified in 1990. Among the means proposed to fulfill such objective one may point to the emission trade involving industrialized countries, joint completion of mitigating actions and the so-called Clean Development Mechanisms (CDM) to be accomplished by countries included in Annex 1 of the Climate Convention together with non-Annex 1 countries.

Based on decisions number 17 and number 19 from Marrakech Agreement and subsequent meetings, CDM projects are always categorized into one of the following models:

- Energy saving enhancement;
- Enhancement of sinks / reservoirs for GHG through reforestation and forestation;
- Use of renewable energy sources;
- Emission reduction / limitation at transport areas;
- Residue treatment.

For a CDM project to be considered consistent and to be approved, the following issues should be observed:

- It must be voluntary;
- It should yield measurable and long-term benefits;
- It should bring about additionallity (defined as the difference between GHG emission before and after the implementation of the CDM project);
- It must introduce sustainable development.

Considering the models proposed by the Marrakech Agreement, one might recognize that certain industrial sectors are particularly keen to reduce their emissions. Energy intensive sectors such as siderurgy, metallurgy and mining could also claim for special attention. On the other hand, due to its particular production chain based on the demanding use of biomass, food and beverage industries are showing interesting emission features.

For such industries, the article 12 of Kyoto Protocol grants

the viability of CDM projects. Their application has in turn opened a new horizon for research and technology and it may provide sustainability to food and beverage production, which is of great importance to the Brazilian gross product. Accordingly, the present paper intends to assess the potential for CDM application by Brazilian food and beverage industries.

This study aims at discussing the potential exploitation of Clean Development Mechanism (CDM) by Brazilian food and beverage industry. Using as support and assistance to official data, this review aims to demonstrate that the food and beverage industry is capable of increasing their participation in CDM projects.

2 Material and Methods

Under the light of CDM project execution, this paper discusses the scenario of Brazilian food and beverage industry based on data extracted from IBGE[1], ABIA[2], CETESB[3], Brazilian Energy Balance Report[4], Brazilian Initial Communication to the United Nations Conference on Climate Change[5] and papers related to the issue[6]. The data analyzed include both GHG and effluent emission from food and beverage industries so as to assess the definite potential to apply either energy saving or residue treatment projects and their resultant CDM application.

3 Results and Discussion

According to ABIA[2], since 2000 the food industry has experienced an annual growth ranging from 9.2% to 10.1%, thus keeping a quite fast increase rhythm, even higher then Brazil's gross product evolution. Based on data from Brazilian Ministry of Science and Technology[5], food and beverage industry is the second largest CO_2 emitter (629,000 tons from 1990 to 1994) among all industrial sub-sectors. Such emissions can be divided into three groups:

- Emissions related to energy consumption;
- Industrial emissions; and
- Emissions due to utilization of solvents and other chemical products.

3.1 Energy consumption

Many food and beverage industries generate some sort of biomass as residue, which can be directly employed as boiler fuel (for energy cogeneration) or might undergo anaerobic treatment for methane production to be used as fuels, as suggested by Brazilian Ministry of Energy[4]. Of particular interest, there is a large contribution of biomass as wood or sugarcane bagasse to the final energy consumption. Therefore, the food and beverage industry has a relatively smaller dependence on fossil fuels.

Kyoto Protocol states that biomass fuel data should be included into the national total energy and CO_2 emission accounting inasmuch as biomass is able to recover free carbon, as based on IPCC[7]. For this reason, a significant opportunity comes forward to the food and beverage industry in order to accomplish sustainable development projects if one considers a larger share for natural gas in the Brazilian energy matrix. In fact, such idea is the underlying rationale of the base line related to a recognized CDM project presented to CQNUMC by Brazilian companies[8].

A successful example concerning energy cogeneration from biomass occurs at the sugar-alcohol industry as sugarcane bagasse is utilized to produce electricity and process steam. With respect to energy, biomass fuels were regarded major CH_4 emitters in 1994 (94%), when sugarcane bagasse was the third largest emitter (6.5% of total emissions) and the solely fuel type to show an emission augment. For the analyzed period, CH_4 has indeed experienced a quite high growth rate (41%)[2], if one looks at the food and beverage industry, a sector that includes the sugar-alcohol industry. As bagasse-based cogeneration can yield certified carbon credits, in accordance to an existing approved methodology, alternative biomass exploitation (e.g. rice husk) should be consistently considered.

In line with IBGE[1], many food and beverage industries are ranked as medium energy-intensive industries. In spite of that, a strong reason to invest on sustainable development projects in this sector due to its high potential for energy saving projects, as shown in Figure 1 as it is observed that its energy expenses to yield US$1000 are far larger than the average expense assessed for other industries. Concerning energy consumption, PROCEL studies point up to a 10% reduction potential by simply improving industrial process efficiency.

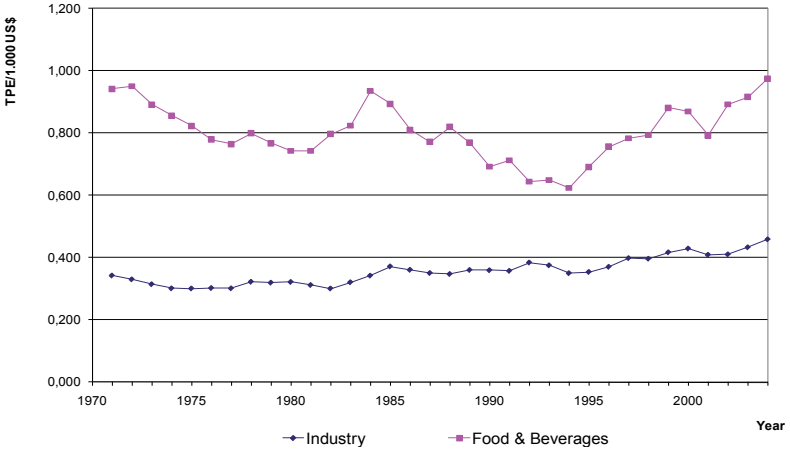

Figure 1: Comparing gross product yield in the food and beverage industry to other industrial sectors

3.2 Residue treatment

Data from CETESB[3] for Sao Paulo state show that food and beverage sector was responsible for 79% of all effluent emissions. On the other hand, data for 11 Brazilian states show that such sector contributes with 58.5% to overall effluent emissions. The wastewater generated by the food industry is derived directly from the processes occurring in the facility, washing the facilities and equipment, storage areas, industrial restaurants and sanitary sewage. Normally, this wastewater has high levels of organic biodegradable matter.

Surrounded by the commonly used biological processes, anaerobic digestion is considered the best option for the treatment of effluents with high concentrations of organic matter. According to Field[9], the food and beverage industries are the first and second among the four top applications of high rate anaerobic reactor systems.

As described by Kassam *et al.*[10], about 26% of the anaerobic reactors installed in North America are used for the treatment of effluents from breweries. Leal *et al.*[11] found removal efficiency of organic matter (expressed in chemical oxygen demand - COD) of 96% using an anaerobic filter of 5.8 m^3 operated at room temperature with the organic loading rate of 8 kg $COD.m^{-3}.d^{-1}$, treating brewery wastewater.

The use of anaerobic filters requires careful removal of suspended solids to avoid clogging of the effluent and, consequently, the formation of short circuits or preferential pathways. Ahn *et al.*[12], using a Up flow anaerobic sludge blanket (UASB) reactor to treat brewery wastewater, found efficiencies of 90 ± 3% of COD removal, operating under organic loading of 25 kg $DQO.m^{-3}$ of sludge.day^{-1}.

Uzal *et al.*[13] studied a two-stage UASB reactor and concluded that this configuration was very effective for the treatment of wastewater from the production of whiskey, even with high organic loads (39 kg $DQO.m^{-3}.d^{-1}$). The use of effluent recirculation combined with taller reactors (or a high height/diameter ratio) resulted in the expanded granular sludge bed (EGSB) reactor[14], an efficient option to treat food and beverage wastewaters. EGSB could efficiently treat palm oil mill effluent at maximum OLR of 5.8 gVS/(L-reactor.d) with more than 90% COD removal and methane yield of 438 ml CH_4/gVS added[15].

Another option for the treatment of wastewater in the food and beverage industry is the anaerobic sequencing batch reactor (ASBR), which is a very promising technology for wineries according to Moletta[16]. The treatment of cheese whey was also tested by Ratusznei *et al.*[17] using an ASBR with biomass immobilized on PUF matrices. The reactor was fed with dehydrated reconstituted cheese whey with rising COD concentration varying from 500 to 4000 mg COD .l-1. Using 8 h of cycle time and 200 rpm (mechanical stirring, at 30 ºC), the global efficiency of the system was always higher than 96% (COD removal).

Finally it seems important to comment about the anaerobic baffled reactor (ABR), which according to Barber and Stuckey[18] promise for industrial wastewater treatment since it can withstand severe hydraulic and organic shock loads, intermittent feeding, temperature changes, and tolerate certain toxic materials due to its inherent two-phase behavior. Besides treatment of the effluent, the anaerobic reactors have the characteristic of producing biogas. It is possible to use biogas as a natural gas substitute and for steam-reforming. Prior to any kind of utilization, there are three compounds that must be removed: water, CO_2 and H_2S which is also present in biogas being toxic and presenting corrosive effects. So for a reasonable utilization of biogas as an alternative energy source, its purification is more than required, it is compulsory.

3.3 Solvent utilization

The first Brazilian counting of GHG anthropic emissions cites the emissions from food industries due to solvent utilization in two situations:

- During cereal and fruit fermentation process, once there are emissions of the so-called non methanic volatile organic compounds (NMVOC);
- During vegetable oil extraction, which is a process using solvents to extract those oils from seeds and grains.

In both instances, Brazilian production related to such sector has increased significantly, despite they are commodities strongly influenced by international market. For the first case, foreseen emissions are associated to alcoholic beverage production and process improvement might be implemented in order to enhance both process efficiency and control over gas escape.

For the other case, the aforesaid report claims that it is reasonable to suppose that emissions depend upon on factors like plant age, emission control efficiency and the sort of processed seed / grain (yet, such report does not make reference to any literature that defines criteria or conditions to assess such emission factors). Considering that Brazil possesses a modern soy processing industry, along with its corresponding technology and exportation sector, the lower range has been opted, namely 0.85 kg-VOC/ton of crushed seed or grain. However, Brazilian grain production (particularly soy) tends to keep its increasing pace, which demonstrates that such sector is continuously concerned with technology innovation so as to avoid emission excess.

4 Conclusion

Based on presented data, it is possible to arrive to the following conclusions concerning the food and beverage industrial sector: (a) It has a quite high potential for energy saving; (b) It possesses considerable sources of biomass; (c) It is able to reduce its emissions to a large extent; (d) It can likely improve its residue treatment using Anaerobic Digestion technologies. By comparing the levels related to GHG emission, liquid effluents and biomass availability one

verifies that levels related to food and beverage industry are higher than their corresponding counterparts related to any other industrial sector. This fact suggests that the food and beverage sector has a considerable high capacity to implement sustainable development projects and thus help reducing pollutant emission to the environment

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