

Sustainable development and workers' health in the environmental impact assessment on oil refineries in Brazil

Desenvolvimento sustentável e saúde do trabalhador nos estudos de impacto ambiental de refinarias no Brasil

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Resumo

Neste estudo, realizou-se uma análise de convergência dos conteúdos dos Estudos de Impactos Ambientais (EIAs) de refinarias de petróleo no Brasil com o conceito de desenvolvimento sustentável e a saúde do trabalhador. Desenvolveu-se um indicador denominado grau de convergência, segundo as categorias: equidade, intersectorialidade, ações multiestratégicas, participação, empoderamento e sustentabilidade. Essas foram analisadas no diagnóstico ambiental, análise de impactos ambientais e medidas mitigadoras e compensatórias, utilizando indicadores de saúde do trabalhador como critérios para convergência, conforme as dimensões incipiente, insuficiente, intermediário ou avançado. Os resultados mostraram que o grau de convergência dos conteúdos com o desenvolvimento sustentável e saúde do trabalhador são incipientes (0 a 20%) nos EIAs da Refinaria Abreu e Lima (RNEST) e do Complexo Petroquímico do Rio de Janeiro (COMPERJ). No EIA da Refinaria de Paulínia (REPLAN) a convergência é insuficiente (25 a 45%). Em relação ao grau de convergência total, o EIA REPLAN apresentou o grau insuficiente (30%), seguido dos EIA COMPERJ e EIA RNEST que apresentaram o grau incipiente (13%; 23%). Os resultados encontrados sugerem a necessidade da inserção do conceito de desenvolvimento sustentável nos EIAs de refinarias de petróleo, sob a ótica da saúde do trabalhador, como estratégia de controle de riscos socioambientais, reafirmando o caráter preventivo do processo de licenciamento ambiental.

Palavras-chave: Saúde do trabalhador; Saúde ambiental; Desenvolvimento sustentável.

Abstract

This study performed a convergence analysis of the contents of Environmental Impact Assessment (EIA) on oil refineries in Brazil with using the concept of sustainable development and workers' health. We first developed an indicator called degree of convergence, according to the categories: equity, intersectoriality, differentiated actions, participation, empowerment, and sustainability. These were analyzed in the environmental diagnosis, analysis of environmental impacts assessment, and mitigation measures, and compensation measures, using occupational health indicators as criteria for convergence according to indicators such as occupational health criteria for convergence in the following dimensions: incipient, insufficient, intermediate, or advanced. The degree of convergence of the EIA contents to sustainable development and workers' health were incipient (0 - 20) as compared to EIAs of Abreu e Lima Refinery and Petrochemical Complex of Rio de Janeiro. In EIA of Paulinia Refinery the convergence was insufficient (25-45%). Considering the degree of full convergence, EIA of Paulinia Refinery was insufficient (30%), followed by EIAs of Petrochemical Complex of Rio de Janeiro and Abreu e Lima Refinery which were incipient (13%, 23%). These results suggest the insertion of the sustainable development concept in the oil refinery EIAs, considering the worker's health perspective, as a strategy to control socioenvironmental risk, reaffirming the preventive character of the licensing process.

Keywords: Occupational Health; Environmental Health; Sustainable Development.

Introduction

The concept of occupational health as a practice related to sustainable development has been implemented in Brazil for more than a decade through health policies. Moreover, over this period, health regulations, especially in occupational health, have proposed changes in healthcare practices, focusing on workers' health in areas affected by large constructions (Nehmy and Days, 2010).

In this regard, health officials emphasize that health issues should be considered the basis for the preparation of environmental licensing proposals and should be taken into consideration in the search for solutions for health and environmental liability issues introduced by various production processes in these areas (OPAS, 1996; WHO, 2001).

The 1988 Federal Constitution, in addition to creating the Unified Health System (SUS), points to health as an end goal in situations involving environmental protection (Machado, 2004).

Environmental Impact Assessments (EIAs) are the basis for licensing of projects in which production processes pose health liabilities. They enable environmental agencies to consider the feasibility of these processes by evaluating their biological, physical, social, and cultural impacts, which are regulated by Law #6.938/1981 and by Resolutions #001/1986 and #237/1997 from the National Council for the Environment (Brasil, 2007; Machado, 2004).

The joint ordinance no. 259 of the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA) obliges the inclusion of occupational health issues in EIAs and their respective environmental impact reports through a specific chapter on cleaner technologies intended to reduce occupational and environmental health impacts, including thermal and noise pollution, and respiratory health hazards (Brasil, 2009).

The National Policy on Occupational Health, in its second aim to promote health and healthy work environments and processes, highlights the importance of integrating, monitoring, and evaluating health indicators for workers and surrounding populations in the environmental licensing procedures and EIAs (Brasil, 2012).

Recently, environmental legislation, specifically Article 23 of the 1988 Constitution and Law #6938, has been updated with the Complementary Law. 140 of 8 December, 2011, establishing rules for cooperation between federal administrative actions arising from the exercise of common competence regarding environmental protection issues (Brasil, 2011).

Being an industrial production process, oil refining has occupied a place of prominence in public discussions because of the government's expectations in keeping Brazil's self-sufficiency in oil production, which was achieved in 2006. As a consequence, major projects, funded by private investments, have been drafted to expand the current energy grid by increasing refinery capacity and oil and gas distribution networks, and by restructuring refining complexes (Conselho Federal de Economia, 2010).

Considering the potential for installing new refineries in Brazil, we must consider their possible occupational health impacts due to specific occupational hazards caused by exposure to aromatic hydrocarbons and heavy metals (Freitas et al., 2001; Souza and Freitas, 2002).

The introduction of oil refining activities have impacted health through the intensification of diseases such as cancer, neurological and mental disorders, along with skin, liver, cardiovascular, and respiratory diseases, among others. These health problems have also affected the surrounding populations that are exposed and vulnerable to chemical pollutants (Augusto, 1991, 1995).

Occupational accidents in refineries include engineering and maintenance accidents, typical work accidents, and extensive chemical accidents caused by explosions, leaks, improper residue disposal, and inadequate transport of hazard products (Sevá Filho, 2010; Souza and Freitas, 2002).

Occupational liabilities are relevant when we consider the complexity behind economic growth and health issues, considering a socio-productive model and its relation with sustainable development. Sustainable development involves actions that promote economic and social sustainability through the involvement of local communities and reflection on public welfare (Leff, 1994).

The concept of occupational health refers to public health policies intended to promote and

protect workers' health and reduce morbidity and mortality (caused by development models and productive processes) through promotion, surveillance, diagnosis, treatment, recovery, and rehabilitation in health (Brasil, 2012). In this context, occupational health comprises a set of activities aimed to promote sustainable development, taking into consideration social and environmental aspects of labor.

According to the Brundtland Report, sustainable development is a transformation process in which resource exploration, direction of investments, technological developments, and institutional changes are harmonized and current and future transformation capabilities are enhanced in order to meet human needs and goals (*Comisión Mundial del Medio Ambiente y Desarrollo*, 1987).

Thus, human development must be thought of as the synchronization of socio-economic developments with democracy, freedom, and preservation of natural resources for future generations (Rigotto and Augusto, 2007).

This article presents convergent elements for the concept of sustainable development and occupational health in EIAs of refineries. These elements constitute a strategic approach from the standpoint of public health surveillance, considering the oil industry has been recognized for its potential to pollute the environment (Barbosa, 2007; Mariano, 2001; Sevá Filho, 2010).

Methods

As suggested by Cancio (2008), an insertion analysis approach was employed to determine the extent of insertion of conceptual aspects by means of a relational approach.

To gain a critical view of the development model, we selected the concept of sustainable development, considering that oil-refining processes involve the use of natural resources and thus contribute to ecosystem degradation and consequent worker exposure to environmental risks.

The research strategy used was a documental analysis for data interpretation. The reports analyzed were EIAs of the Paulinia Refinery (REPLAN), Campinas, State of Sao Paulo (EIA for improvement), the Petrochemical Complex of Rio de Janeiro (COMPERJ), located in Itaguaí, State of Rio de Janeiro (EIA for installation);

and the Abreu e Lima Refinery (RNEST), which is being installed in Suape, State of Pernambuco.

To analyze EIA contents and their convergence to sustainable development with respect to workers' health, we correlated the categories from the Brundtland Report (Agenda 21) with basic health indicators by aligning them with the adopted reference (United Nations, 1987; OPAS, 2002).

We adopted the following categories as parameters: equity, intersectoriality, multistrategical

actions, participation, empowerment, and sustainability. These categories were analyzed in each EIA component (environmental diagnosis, analysis of environmental impacts, and mitigating and compensatory measures), irrespective of nomenclature. We used the basic indicators of the health of workers and the principles of Brundtland that showed inter-relations and pointed toward sustainable development, embedded in a matrix of analysis to be applied to EIAs, as described in Table 1.

Table 1 - Analysis matrix of EIAs of oil refineries, with a focus on sustainable development and occupational health

Categories	Component of EIA	Criteria for scoring of convergences
Equity Intersectoriality Multistrategical actions	Environmental diagnosis	Multidisciplinary/interdisciplinary team Identification of the reference center List of notifiable complains Morbidity and mortality profiles Involvement of social control Demands of integral attention to workers' health Inventory of chemical substances Contextualisation of risk situations Protocols of diseases related to work Identification of healthcare coverage
Participation Empowerment	Analysis of environmental impacts	Social participation Social perception of risks and benefits Positive estimate - jobs Negative estimate - new aggravations Exposure to chemical pollutants Use of indicators of public health Identification of vulnerable workers Development of risk scenarios Identification of occupational health programs Existence of shared strategies
Sustainability	Mitigating and compensatory measures	Use of sensitive biomarkers Protection and collective security technologies Measures of individual security Innovation in industrial design Risk management technologies Emergency and extended accident plans Monitoring system Method of monitoring Institutional capacity Reference service in health care Indicators for risk monitoring

The degree of convergence was estimated by providing score values for the following situations: 1, for positive convergence of contents toward the criteria, indicating a situation favorable to the concept; 0.5, when divergence or partial convergence were identified; 0, when negative convergence expressed situations in which the contents had not contemplated the ideas of sustainable development or workers' health. Subsequently, the degree of full convergence of each EIA was obtained by summing the scores for all criteria and the percentage between the actual score and the maximum possible score for each category analyzed, considering four degrees of convergence: advanced: 75%-100%, intermediate: 50%-75%; insufficient: 25%-50%, and incipient: 10%-25%.

A consensus was established among researchers under the supervision of a senior professional who assured epistemological vigilance. The present study was part of a larger research project titled "Risk assessment in the oil production process in Pernambuco, and proposals for evaluation indexes for health vigilance and risk communication," approved by the IRB/CPqAM/Fiocruz, Protocol 112 / 08.

Results

Table 2 shows the results of environmental diagnosis in EIA of each refinery. We found an incipient degree of convergence in all EIAs. Moreover, REPLAN and RNEST EIAs described a multidisciplinary/interdisciplinary team having professionals with educational background in health sciences. However, neither of the two teams reached the maximum score of 1 because these health professionals did not participate in the elaboration of socio-economic impact studies. COMPERJ EIA showed the lowest degree of convergence with sustainable development (10%).

REPLAN EIA showed an insufficient degree of convergence with sustainable development (35%), but this degree was superior to that of COMPERJ and RNEST EIAs (20%), as shown in Table 3.

Table 4 shows results related to mitigating and compensatory measures. COMPERJ EIA showed an incipient degree of convergence (10%), whereas both REPLAN and RNEST EIAs showed insufficient degree of convergence (35%). The latter two refineries

showed innovation in the industrial design that represents collective security but had no emergency planning for amplified accidents. None of the EIAs analyzed showed an advanced degree of convergence, represented by 75%-100% of convergence. We should also highlight the failure in considering the use of sensitive biomarkers for preventing morbidities associated with oil refining processes, such as occupational cancer, benzene intoxication, and other blood disorders.

With regard to the degree of full convergence of EIAs to sustainable development (Table 5), it appears that all EIAs studied had <50% of criteria related to basic health indicators. Of note is REPLAN EIA that, despite having an insufficient degree of convergence (30%), outperformed the others, mainly by the introduction of technological innovations in labor safety.

Discussion

This study indicated that EIAs should be prepared by a multidisciplinary team comprising qualified professionals with specific training in health. Accordingly, we verified that in REPLAN and COMPERJ EIAs, health issues and impacts had not been identified by professionals with specific technical qualifications, resulting in scarcity of information on occupational health. In this context, this scarcity reflects a gap between environmental licensing and health sectors, resulting from the lack of health professionals working in environmental agencies responsible for the elaboration of the Terms of Reference that guided the preparation of EIAs or even working in consulting firms designated for this purpose.

The knowledge on occupational health gathered in SUS can contribute to the analysis of environmental impact studies before licensing processes by pointing and explaining the harmful impacts in the workers' health and by instructing the public on occupational health hazards. The latter contribution involves organizing social debates intended to ascertain the democratic nature of environmental licensing and are materialized in public hearings.

Even in RNEST EIA, which had the collaboration of a health professional (a pharmacist), data on workers' health were scarce (25%).

Table 2 - Degree of convergence of the content of EIAs of oil refineries in Brazil in relation to sustainable development for occupational health in the Environmental Diagnosis, Brazil, 2012

EIA/REFINERY	Degree of convergence	Score from convergences with the concept of sustainable development and health of the worker
EIA COMPERJ	Incipient - 10%	<ul style="list-style-type: none"> o Point: multidisciplinary/interdisciplinary team o Point: identification of reference center o Point: list of notifiable complains o Point: morbidity and mortality profiles o Point: involvement of social control o Point: demands of integral attention to the health of the worker o.5 Point: inventory of chemical substances o Point: contextualization of risk situations o Point: protocols for diseases related to work o.5 Point: identification of healthcare coverage SUS
EIA REPLAN	Incipient - 25%	<ul style="list-style-type: none"> o.5 Point: multidisciplinary/interdisciplinary team o Point: identification of reference center o Point: list of notifiable complains o Point: morbidity and mortality profiles o Point: involvement of social control o Point: demands of integral attention to the health of the worker o.5 Point: inventory of chemical substances o.5 Point: contextualization of risk situations o Point: protocols for diseases related to work o Point: identification of healthcare coverage SUS
EIA RNEST	Incipient - 25 %	<ul style="list-style-type: none"> o.5 Point: multidisciplinary/interdisciplinary o Point: identification of reference center o Point: list of notifiable complains o Point: morbidity and mortality profile o Point: involvement of social control o Point: demands of integral attention to the health of the worker o.5 Point: inventory of chemical substances o Point: contextualization of risk situations o Point: protocols for diseases related to work o.5 Point: identification of healthcare coverage SUS

Legend: GI - degree of insertion calculated from the relationship between the score shown divided by total points reachable, multiplied by 100.

Some authors have suggested that the predominance of consultants in engineering and biological sciences seems to concentrate information in two extremes: one biological extreme, with a focus on flora and fauna, and the engineering extreme, including engineering blueprints, along with substantial data on production units, maintenance projects and industrial plants (Porto and Milanez, 2009; Silva et al., 2009).

According to Porto and Milanez (2009), it is essential that ecologists, public health specialists, sociologists, geographers, and anthropologists participate in solving complex situations involving

environmental conflicts, such as licensing processes, because they can examine those events from the group perspective. Similarly, USH health workers should collaborate in EIAs of large operations. In this context, evaluating the health status through integrated approaches, overcoming the paradigms in engineering and biology, is essential (Porto and Milanez, 2009).

The health status, including morbidity and mortality profiles, should be evaluated to propose occupational health protection measures, with possible collaboration of public health specialists

Table 3 - Degree of convergence of the content of EIAs of oil refineries in Brazil in relation to sustainable development for occupational health in the Environmental Impact Analysis, Brazil, 2012

EIA/REFINERY	Degree of convergence	Score from convergences with the concept of sustainable development and health of the worker
EIA COMPERJ	Incipient - 20%	<ul style="list-style-type: none"> 0 Point: social participation 0 Point: social perception of risks and benefits 1 Point: positive estimate - jobs 0 Point: negative estimate - new aggravations 0.5 Point: exposure to chemical pollutants 0.5 Point: use of indicators of public health 0 Point: identification of vulnerable groups of employees 0 Point: development of risk scenarios for accidents at work 0 Point: identification of occupational health programs SUS 0 Point: the existence of shared strategies (public-private)
EIA REPLAN	Insufficient - 35%	<ul style="list-style-type: none"> 0 Point: social participation 0.5 Point: social perception of risks and benefits 1 Point: positive estimate - jobs 0 Point: negative estimate - new aggravations 0.5 Point: presumption of exposure to chemical pollutants 0.5 Point: use of indicators of public health 0 Point: identification of vulnerable groups of employees 0 Point: development of risk scenarios for accidents at work 0 Point: identification of occupational health programs SUS 1 Point: the existence of shared strategies (public-private)
EIA RNEST	Incipient - 20%	<ul style="list-style-type: none"> 0 Point: social participation 0 Point: social perception of risks and benefits 1 Point: positive estimate - jobs 0 Point: negative estimate - new aggravations 0.5 Point: exposure to chemical pollutants 0.5 Point: use of indicators of public health 0 Point: identification of vulnerable groups of employees 0 Point: development of risk scenarios for accidents at work 0 Point: identification of occupational health programs SUS 0 Point: the existence of shared strategies (public-private)

Legend: GI - degree of insertion calculated from the relationship between the score shown divided by total points reachable, multiplied by 100.

working in public services and research centers. These measures are feasible through the correlation of scientific data and national health databases and should anticipate possible health outcomes with repercussions on public health and the environment.

The results of the present diagnosis indicate a lack of concern for vulnerable groups and for chemical exposure and other occupational liabilities common in refineries (Souza and Freitas, 2002).

We confirmed that the role of environmental impact studies has been biased as a bureaucratic and figurative activity that is unable to stop the en-

vironmental impacts, serving only for socio-political legitimacy (Garzon, 2011).

For Augusto (2009) occupational health information is essential for the development of industrial zones because workers tend to migrate in search of labor, resulting in increased demand for health services. Moreover, the population increase in the short term, without proper planning, creates several problems directly affecting municipalities, such as the overburden of the health service network, changes in the epidemiological profile, and increase in violence and traffic.

Table 4 - Degree of convergence of the content of EIAs of oil refineries in Brazil in relation to sustainable development for occupational health and the environmental impact mitigating and compensatory measures, Brazil, 2012

EIA/REFINERY	Degree of Convergence	Score from convergence with the concept of sustainable development and health of the worker
EIA COMPERJ	Incipient - 10%	<ul style="list-style-type: none"> o Point: use of sensitive biomarkers - molecular, cellular o.5 Point: protection and collective security technologies o.5 Point: measures of individual security o Point: innovation in industrial design o Point: risk management technologies o Point: presentation of emergency and extended accident plans o Point: monitoring system o Point: method of monitoring o Point: institutional capacity o Point: specialized health care reference service o Point: indicators for risk management
EIA REPLAN	Incipient - 35%	<ul style="list-style-type: none"> o Point: use of sensitive biomarkers - molecular, cellular o.5 Point: protection and collective security technologies l Point: measures of individual security l Point: innovation in industrial design l Point: risk management technologies o Point: presentation of emergency and extended accident plans o Point: monitoring system o Point: method of monitoring o Point: institutional capacity o Point: specialized health care reference service o Point: indicators for risk management
EIA RNEST	Incipient - 35%	<ul style="list-style-type: none"> o Point: use of sensitive biomarkers - molecular, cellular o.5 Point: protection and collective security technologies l Point: measures of individual security l Point: innovation in industrial design l Point: risk management technologies o Point: presentation of emergency and extended accident plans o Point: monitoring system o Point: method of monitoring o Point: institutional capacity o Point: specialized health care reference service o Point: indicators for risk management

Legend: GI - degree of insertion calculated from the relationship between the scores presented divided by the total achievable points, multiplied by 100.

Table 5 - Total degree of convergence between the contents of EIAs of oil refineries and the concept of sustainable development and occupational health, Brazil, 2012

EIA	Score by category analyzed			*TOTAL DEGREE
	Environmental diagnosis	Environmental impact analysis	Mitigating and compensatory measures	
COMPERJ	1	2	1	Incipient - 13%
REPLAN	2	3.5	3.5	Insufficient - 30%
RNEST	1.5	2	3.5	Incipient - 23%

*Sum of points achieved in each specific category divided by the total achievable points and multiplied by 100.

The concept of environmental sustainability involves the participation of the population in the analysis of situations related to environmental impact vulnerabilities. However, EIAs analyzed did not have societal participation, which demonstrates the lack of social commitment by ignoring the fact that awareness from those who are exposed to industrial contamination might contribute to a closer analysis of reality and the development of strategies to mitigate damages.

For Augusto (2009), societal participation is the most effective way to promote an expanded assessment of health issues. In addition, integration of workers in health issues helps to identify risks and complex threatening situations, and social involvement becomes the basis for this policy (Brasil, 2012).

Although EIAs make use of public health indicators, these indicators are disconnected from the risks introduced by oil refining processes. According to Mariano (2001), the refining process contaminates several environmental spaces (air, water, and soil) and the food chain until it reaches humans.

An important strategy for identifying health liabilities is the inventory for chemical substances used in the production process. Although EIAs indicate the substances used in oil refining, none of these assessments addressed the relation between these substances and health risks. In this context, the inventory becomes essential because it catalogs several health hazards, especially those related to chemical exposure (Mariano, 2001; Brasil, 2008; Seva Filho, 2010). Moreover, this assessment would force entrepreneurs to be legally responsible for worker liabilities in contamination cases during operational processes in different refinery units, including the atmospheric distillation, delayed coking, catalytic cracking, and sulfur recovery units.

None of these studies has acknowledged worker injuries and liabilities, although the literature infers vulnerability situations and changes in morbidity and mortality in the population (Augusto, 1991, 1995; Silva et al., 2009; Souza and Freitas, 2002). Moreover, Augusto (1991, 1995) found a direct relation between workers' exposure to chemical pollutants from oil production and the pathophysiological processes responsible for blood disorders.

Another important aspect to consider is impact caused to other productive chains and other types

of labor in refinery zones. RNEST EIA acknowledges the insistence of fishers from Suape Beach in the city of Cabo de Santo Agostinho to remain in their territory. According to consultants, these fishing workers consider themselves owners of the territory, which demonstrates the need to instruct how anglers may need to adapt, considering that traffic of oil derivatives from the Abreu e Lima refinery will compromise traditional fishing and demand fishermen to resort to ocean fishing activities. Furthermore, Santos (2011) identified that traditional fishing communities are being evicted to places far from the sea in exchange for undervalued entitlements, further contributing to cultural annihilation.

Several authors view this development model as one that excludes and precludes human groups, making them vulnerable. This model also ignores people's historical connection with their territory, which highlights government disengagement from sustainable development and from the creation of freedom (Porto, 2007; Rattner, 2009; Sen, 2000; Santos, 2011).

Considering Augustus's remarks (2009), we can contemplate that environmental conflicts are interconnected to and inseparable from health issues. Similar to many other conflicts, workers' health inequalities result from complex realities marked by political and economic control of social endeavors.

Porto (2007) describes the use of discourses that do not deepen social and environmental impacts but impose through common sense the idea of fatality of risk situations as an unavoidable evil to the development of the country.

None of the EIAs gave contextualized information on potential health liabilities. Despite considering scenarios that impacted the physical and biological environment, these assessments did not consider the relation between environment and labor as an important determinant of health.

We observed that environmental impact studies overestimate the estimated positive impacts such as generating jobs and taxes, while ignoring the potential of accidents and occupational diseases (Augusto, 1991, 1995; Souza Freitas, 2002).

Regarding the use of technologies to reverse damage to your health, use of safer technology alternatives and health plans, or government programs, only REPLAN EIA presented proposals for shared

actions, even if disregarding the municipal health systems as key players in this process.

Both REPLAN and RNEST EIAs presented technological incorporation projects for health safety through innovations in industrial design, including new technologies for pollution control, for waste management and recycling, for production of clean residues, for generation of clean products, and for clean technologies.

The incorporation of technologies such as hydro-treatment and sulfur recovery units, presented in EIAs, generally meet the requirements of competitive markets that demand products with lower sulfur content. However, they are not proposed to protect the workers.

Remarkably, none of the EIAs showed emergency plans to prevent amplified industrial disasters, as emphasized in the national plan for prevention, preparedness and immediate response to environmental emergencies with dangerous chemicals, prepared by the Ministry of Environment, as reported by Santos (2011).

In general, the safety measures proposed in EIAs have become benchmarks for regulatory standards and for various programs, including blood donation, environmental educational for employees and suppliers, and prevention of occupational exposure to organic compounds such as benzene, toluene, and xylene. However, there is neither a guarantee for the availability of resources to achieve these measures nor information on what methods should be used.

Health care programs should be monitored over the years through the monitoring of liabilities and application of sensitive biomarkers for the prevention of benzene intoxication and other related diseases, enabling the early identification of health risks of exposed workers.

We noted the practice of stating in EIAs that further measures will be taken regarding the potential health risks of workers (Silva et al., 2009). Clearly, the priority is not sustainable development as thought from the inclusion of occupational health in EIAs (Augusto, 2009; Silva et al., 2009).

There is almost complete disregard for sustainable development and workers' health in environmental licensing processes in refineries, whose productive processes impact health and the environment. As a consequence, the degree of convergence of all EIAs was below intermediate, indicating the risk negligence for the population in refinery zones.

As advocated by Garzon (2011), diverse mechanisms and procedures, such as planning, policy-making, decision-making, and management of environmental liabilities, should be established with an aim to ensure impartiality principles, such as social equity and involvement.

Conclusions

The results of this study indicate the need to understand the concept of sustainable development in EIAs through the insertion of basic health indicators as minimum prerequisites to be adopted in environmental licensing processes in oil refineries.

Detailed studies need to be conducted to explain the distancing of EIAs from sustainable development concepts and the lack of basic health indicators.

This study does not cover all health and environmental aspects pertaining to the licensing process but contributes to debates on the anticipatory significance of EIAs and their importance as sources of information for health surveillance in SUS. Finally, it highlights the need to inquiry how EIAs are being made, considering their role to promote sustainable development and sustain human health by maintaining environmental balance and welfare.

Therefore, impact assessments, such as the ones described here, should contribute to the prevention of occupation health threats through early intervention. These assessments should focus primarily on the promotion of health by strengthening social groups engaged in licensing potentially hazardous operations through information sharing and social mobilization, and environmental communication in complex settings such as those involving oil refineries.

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