

## Perception of environmental quality of nearby localities to the Petrochemical Complex of Rio de Janeiro, Brazil

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**Abstract** *This article aims to verify the residents' perception difference on the environmental quality of two localities near the construction area of the Petrochemical Complex of Rio de Janeiro. Nine environmental quality aspects (water supply services, sewage and garbage collection; leisure areas; public security; health services; streets; air; rivers) were evaluated. Cross-sectional study conducted with 240 residents of the Porto das Caixas and Manilha, both of them located in Itaboraí city, RJ state, Brazil. The statistical analysis involved the chi-square test and Fisher's exact test. Leisure Area was the factor perceived also by participants of both locations of the study with worse quality. The quality perception of health services, security and sanitation differed significantly among the inhabitants of the two studied localities. The worsening of environmental quality was related by 51% of the residents of Porto das Caixas to the absence of mitigatory measures after the occurrence of a local chemical accident in 2005. The prioritization of interventions should be based on the perception of specific population groups such as strategy that can allow a reduction of environmental health inequities in installation and construction contexts of the oil and gas industries.*

**Key words** *Environment and public health, Environmental quality, Petroleum industry*

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## Introduction

The Ottawa letter, product of the I International Conference on Health Promotion, in Ottawa, Canada, in 1986, demarcated the recognition of the important role that the environment plays in influencing the people and collectivities' health. At this moment, the necessity for the establishment of interdependence relations between the health sector and the environmental was prized as primordial and pressing aspect in the health agenda<sup>1</sup>.

This fact has entailed in the channeling of political, scientific and social propositions policies which aimed at the creation, protection and maintenance of healthy environments, through the understanding of the complexity of modes of production, work and life of our societies<sup>1</sup>.

Another action central field proposed in the Ottawa Letter is regarding the increment of the technical and political power of social agents or collective subjects in unequal intervention conditions and decision to participate in decision-making procedures of public policies that interfere with the environment and health quality<sup>2</sup>.

Under this emancipatory perspective, there is the study of the Community perception on the quality of the place's environmental conditions where they live and work as a health promotion intersectorial tool of health promotion that can contribute to the equity in collective health. Such strategy can be used, in a coordinated way, by managers and professionals from various sectors (health, environment, social assistance, education), in order to overcome sectoral, isolated and fragmented actions<sup>3</sup>.

The world's trend over the last decades is to use the communities' perceptions communities involved by environmental problems, which may affect the life health and quality, as indicators of environmental health that subsidize the planning and the political decision-making processes<sup>4</sup>. Recent paradigms such as health ecosystemic approach have placed the affected populations in the center of risk assessment participatory processes and the quality of the environmental conditions and the local health<sup>5</sup>06/02/2016

The practice of popular beliefs incorporation about knowledge production in the field of public health and the environment has contributed to the expansion of social visibility to problems and vulnerabilities in actual scenarios, and thus in individual and groups' strengthening for the coping with inequities in environmental health<sup>6</sup>.

The iniquity in environmental health is understood as an unfavorable degradation situation of environmental essential resources or exclusion to some goods and services access to a specific population group, which affects human health<sup>7</sup>.

The perception of the social actors affected by inequities situations can distinguish the formulation of appropriate public policies to local health contexts, because one of the difficulties imposed in this process is to overcome the centralized decision-making and blurred when it comes to the specificities and actual health needs in the territories<sup>8</sup>.

In the Brazilian scenario, the construction phase of large enterprises has produced new diseases risks and health problems and exacerbated old risks by accentuating the social inequalities and the deterioration of environmental conditions<sup>9</sup>. Thus, the Community perception must be considered in this step as a political and participative socio-environmental management business tool and, whose actions should be directed to the promotion of health and sustainable development.

This article aims to verify the residents' perception difference on the environmental quality of two localities near the construction area of the Petrochemical Complex of Rio de Janeiro (COMPERJ), towards to subsidize the development of health promotion action at the local context.

## Methods

This is a transversal, observational, descriptive population-based study, conducted in the districts of Porto das Caixas and Manilha, both in Itaboraí city, one of the poorest municipalities of the eastern portion of the metropolitan region of Rio de Janeiro State, with human development index of 0.693, Gini index of 0.48 and 9<sup>th</sup> Position of the municipality of the state with the population living in extreme poverty (71.007 inhabitants), according to the last census of IBGE<sup>10</sup>.

Porto das Caixas is one of the territories that houses the construction venture, had a population of 3.782 inhabitants and a Family Health Unit (FHU)<sup>10</sup> in 2010. Manilha, in turn, shows a distance of approximately 22 km away from the industrial plant and in 2010 had a population of 60,000 inhabitants and with 17 public health services, being 15 FHUs, a mid-size state hospital, a specialties polyclinic and an Emergency Unit<sup>10</sup>.

The total study sample comprised 240 subjects aged from 18 years old, responsible for stu-

dents enrolled regularly in municipal schools and residents from the two considered localities. For the requisition of residents samples, a raffle through simple random sampling was conducted, without replacement, from the student's census enrolled in schools in two districts.

The parameters considered in this calculation were: 95% confidence level, margin of error of 10%, and it was considered a possible loss or refusal of, approximately, 10% of the data. By means of the students' registration in teaching units, we asked the competent organ (school board and education secretariat in charge) the access to the list of people responsible for them.

The application of semi-structured questionnaires was carried out by means of interviews in schools and homes of two study localities during the month of December 2014. In this text, it is detailed only the major variables to study the theme: sociodemographic data (gender; locality; family income; age; schooling level); quality perception of environmental factors: Rivers, air, leisure areas and culture, streets, health service, water supply service, garbage collection service, sewage system service, security service; and perception on the occurrence of acute events (accidents, tragedies) which produced environmental damage in the analyzed territories.

The data were tabulated and analyzed using the Statistical Package for the Social Sciences (SPSS) software release 21.0. Descriptive statistics and chi-square tests and/or Fisher Exact test were used to compare responses proportions by groups and categories, considering a significance level of 5%.

This study is an integral part of the entitled project: "Perception of COMPERJ's socio-environmental impacts and their impact on public health in Itaboraí/RJ city: the use of social technology in extension activities", which was approved by the Ethics Committee in Research of the Public Health National School of Oswaldo Cruz Foundation in September 2013.

## Results

The achieved sample was constituted by 240 dwellers, aged ranging between 18 to 84 years (average 40.80 and standard deviation 15, 013); 120 (50%) from Porto das Caixas and 120 (50%) from Manilha; 167 (69.6%) females and 73 (30.4%) were male; 143 (59.6%) with basic education, 86 (35.8%) with high school and 09 (3.8%) with complete or incomplete college edu-

cation; 147 (68.2%) with family income between 1 to 2 minimum wages, 45 (19.2%) with family income less than 1 minimum wage, 37 (15.2%) with family income between 3 to 4 minimum wages, and 05 (2.2%) with income higher than 5 minimum wages.

There was difference statistically in the gender distribution among the Porto das Caixas and the Manilha's inhabitants ( $p$ -value = 0.003), and also there was association between locality and family income ( $p$ -value = 0.001). For the other variables there was no significant association.

There were differences evidences in residents' perception from Porto das Caixas and Manilha on air quality ( $p$  = 0.005), the rivers quality ( $p$  < 0.001) and the streets quality ( $p$  < 0.001) (Table 1). The percentage of residents who noticed the bad quality of the streets and the air was greater within the Manilha's group, while the rivers quality was significantly more perceived by the Porto das Caixas' Group.

There was no significant difference between the two groups, both of them realize the bad leisure areas quality, totaling 92.5%, according to Table 1.

Concerning the quality perception on public services evaluated, there was a significant difference between the perception of the inhabitants of both locations of the study: water supply ( $p$  < 0.001), Sanitary sewage ( $p$  < 0.001), garbage collection ( $p$  < 0.001), health ( $p$  < 0.001), safety ( $p$  = 0.003) (Table 2).

Compared to Porto das Caixas, Manilha had a significantly greater percentage of residents who reported a poor quality of water supply services, health and safety. Now the sewage system service was noticed as bad quality more by the Porto group's residents than by Manilha's group, according to Table 2.

The dwellers frequency who have realized the garbage collection service as bad quality was small at the two study localities, being that the service was better evaluated by the Porto das Caixas' group's residents.

Concerning the knowledge on the community's environmental quality, the reason for acute events, 51% of the Porto das Caixas locality's residents reported on the occurrence of an environmental chemical accident in 2005 and that local mitigatory measures were not taken by public and entrepreneurial authorities responsible for the accident, remaining the impacts on the soil, rivers and the people's health living in the vicinity of the affected area.

**Table 1.** Perception of the quality of environmental factors by location.

Location/ Environmental factor	Porto das Caixas N (%)	Manilha N (%)	Total	p value
Air Quality				p = 0.005
Good	31 (12.9)	28 (11.7)	59 (24.6)	
Regular	54 (45)	38 (31.7)	92 (38.3)	
Bad	35 (32.1)	54 (45)	89 (37.1)	
Rivers quality				p < 0.001
Good	1 (0.8)	1 (0.8)	2 (0.8)	
Regular	4 (3.3)	16 (13.3)	20 (8.3)	
Bad	109 (90.8)	68 (56.7)	177 (73.8)	
Do not know	6 (5)	35 (29.2)	41 (17.1)	
Streets quality				p < 0.001
Good	18 (15)	0 (0)	18 (15)	
Regular	30 (25)	7 (5.8)	37 (30.8)	
Bad	72 (60)	113 (94.2)	185 (54.2)	
Leisure areas quality				p = 0.477
Good	0 (0)	0 (0)	0 (0)	
Regular	8 (6.8)	10 (9.4)	18 (7.5)	
Bad	113 (93.2)	109 (90.6)	222 (92.5)	

**Table 2.** Perception of the local public services quality by location.

Location/ Environmental factor	Porto das Caixas N (%)	Manilha N (%)	Total	p value
Water supply service quality				p < 0.001
Good	34 (28.3)	9 (7.8)	43 (18.3)	
Regular	49 (40.8)	35 (30.4)	84 (35.7)	
Bad	37 (30.8)	71 (61.7)	108 (46)	
Sewage system service quality				p < 0.001
Good	29 (24.4)	4 (3.4)	33 (13.7)	
Regular	29 (24.4)	61 (52.1)	90 (37.5)	
Bad	62 (51.2)	55 (42.5)	117 (48.8)	
Trash collection service quality				p < 0.001
Good	87 (72.5)	60 (50)	147 (61.3)	
Regular	22 (18.3)	54 (45)	76 (31.7)	
Bad	11 (9.2)	6 (5)	17 (7.1)	
Health services quality				p < 0.001
Good	34 (28.8)	3 (2.6)	37 (15.5)	
Regular	56 (45.8)	41 (35.3)	97 (40.4)	
Bad	30 (25.4)	76 (62.1)	106 (44.1)	
Safety services quality				p = 0.003
Good	1 (0.8)	1 (0.8)	2 (0.9)	
Regular	21 (17.5)	5 (4.2)	26 (10.8)	
Bad	98 (81.7)	114 (95)	212 (88.3)	

## Discussion

The leisure area's bad quality perception in two localities of the study suggests sports space and

physical activities absence, which contribute to the persons' physical and psychological well-being, but also, of the communities' entertainment and learning spaces. This factor is probably asso-

ciated to the young people's idleness, drugs use and trafficking, conditioning the local violence pattern<sup>11</sup>.

The results of negative assessment of public security services also indicate concern of territories residents of the study about violence questions, drugs use and traffic accidents, although the concern about the poor quality of this type of service is greater among the Manilha's interviewees, probably for being a more populated area and a greater territorial extension, whose police units' demand and traffic warden is way higher than in Porto das Caixas.

Although lay people do not have mastery on knowledge about environmental quality criteria, they have intuitive perceptions and daily life experiences, that many times, often are disassociated from technical values<sup>12</sup>.

The environmental perception is contextual and dynamic over time and their referential may vary according to the interests and values of the social actors that define it<sup>12</sup>. The environmental hazards may be realized by the Communities also exposed through the perception of their health effects<sup>13</sup>.

Regarding the air quality perception, this differed among the respondents of both locations. Manilha's residents reported an air quality worse than Porto's residents, founded on their possible observations and knowledge about potential pollution sources: industries chimneys, unpaved streets, great vehicles flow, etc. and/or experiences of conviviality with respiratory diseases in their community.

Lima<sup>14</sup> found in his study a high prevalence of asthma symptoms, which ranged from 19.8% to 24.2% in adolescents in the most critical region (great potential for air pollution) of Itaboraí, which includes Porto das Caixas and Manilha.

In these scenarios, the air quality is affected, in part, by the streets quality, because the great dispersion of particulate material occurs in unpaved streets existing in two localities<sup>14</sup>. However, there is a much greater proportion of the evaluation of bad quality streets within Manilha's group in the present study.

In terms of the river quality, the perception of bad quality prevailed in the Porto das Caixas' group of residents. This result suggests a greater closeness with the rivers Aldeia, Caceribu and Porto das Caixas for domestic use and agriculture<sup>15</sup> by the Porto's residents than by the Manilha's residents.

In addition to the daily coexistence with nature, another possible determinant for this

perception is due to the observation of direct discarding of wastes and household trash in the rivers, favoring the perception about the importance of good quality and balance of ecological resources indispensable to their survival, to well-being and human health<sup>12</sup>.

In relation to the quality of the water supply service, the results allow us to infer that the factors that influenced a better perception of the bad service quality by the group of Manilha's inhabitants relate to accessibility, satisfaction about the appearance and odor of the water supplied by the service, and the interruption of the supply system<sup>16</sup>. According to the last IBGE census, the low coverage of the water supply network in 27% of the households in the Itaboraí city corroborates this discussion<sup>10</sup>.

Considering that water is a public good and a human inalienable right, the State must provide public services of abstraction, processing and distribution of potable water to the population<sup>17</sup>.

In this study, a greater proportion of Porto's inhabitants evaluated the sewage system service as bad in comparison with those of Manilha's. This result suggests that the access to this type of service was a determinant perception factor.

The data reported herein, also, allow us to suppose that some participants may ignore the real access condition of their homes to the sewage system service, and realize that they have this type of access, when indeed, they do not have it<sup>16</sup>.

It is noted, according to the 2010 census, that 28.078 (40%) of 69.422 permanent private domiciles in Itaboraí city relied on general network or sewer systems<sup>10</sup>. However, IBGE's data do not reveal the number of households that count on solely with sanitary facilities<sup>10</sup>.

In Brazil, there are two important details that imply on the quality of the environmental sanitation services: effective channeling internal home of the water supply network and effective household connection to the collection network, transportation, sanitary sewage treatment and final disposal until the environment<sup>16</sup> and which may be unknown by the population<sup>18</sup>.

Rubinger's study<sup>18</sup> revealed that the social actors' significance about the environmental sanitation and its services can be quite different from the technical-scientific discourse disclosed by the public power, and should be considered for this in order to achieve the real goals and objectives achieved.

The relation perception between environmental problematic arising from the sanitation practices and health is another factor which may

have contributed to the evaluation of bad quality for these services and it may vary according to the sociocultural and economic characteristics of the territories where the residents are living<sup>19</sup>.

Environmental education actions with the communities guided by a rationale of health promotion should be directed to the knowledge that the implementation of measures to increase the coverage of sanitation services can contribute to reduce the incidence of infectious and parasitic diseases<sup>17</sup>.

In relation to the health services quality, despite a significantly greater percentage of Manilha's group having assessed the quality of health service as poor in comparison with the Porto's group, it was recognized the limitation in the responses of the Manilha's participants, since that the negative care perception at a service may have interfered with the general perception of all other health services.

Thus, a fundamental component of the health quality service is the way it is perceived by the user. The dimensions considered by the users to evaluate the health services are generally of tangible aspects (physical that make up the structure of the service, the location and number of establishments); of interpersonal relationship, of the bond and empathy with the team of health through the ability of the health professional to offer a service based in listening and humanized care to the user<sup>20</sup>.

Data from the 2000 and 2010 censuses show that the number of health establishments in Itaboraí city is the same as from the year 2007 for COMPERJ's deployment, although it is possible to observe a population growth in the order of 16.3%<sup>10</sup>.

The local population pressure produced by the installation and construction processes of refineries and absence of expansion in the number of services offered and the quantity of professionals in the health services in different levels of health care can cause serious losses in health care<sup>9</sup> and, consequently, promote a negative perception in the user about the service quality provided.

The results also raised an environmental chemical accidents diagnosis by diesel oil occurred in the district of Porto das Caixas in year 2005. The residents reported that the Community was directly impacted by diesel oil leak due to the accident of three wagons derailment and tipping four train wagons P 080, coming from REDUC towards Macaé and Campos<sup>21</sup>.

One of the derailed wagons suffered hull rupture, presenting total leakage of the diesel cargo,

causing soil and rivers contamination of the region and health impacts of local residents with clinical symptoms compatible with mild acute intoxication in 66.3% (57) of the population exposed at the time of the accident<sup>21</sup>.

The diesel oils are combustible petroleum derivatives, basically constituted by hydrocarbons with usefulness for ignition and disposal appropriate to the operation of the diesel engines, being therefore flammable products, toxic, volatile, limpid (transparent) and with a strong and characteristic odor<sup>21</sup>.

The environmental chemical accidents or chemical accidents expanded is designated as the acute event in form of explosions, fires, leaks or emissions of one or several chemical substances with the potential to cause multiple damages to the population, environment and work, arising from the industrial activities of production, transport, maintenance or storage of hazardous chemicals<sup>22</sup>.

In the present study, the samples' participants from Porto das Caixas still have described the situation of contamination of the rivers Caceribu and Aldeia and the soil remains the same, making unfeasible planting even of small vegetables since the time of the accident. In addition, the subjects have related this chronic environmental oil exposure to several diseases that are still occurring in residents.

These reports are ratified by the environmental conflict sheet described by FIOCRUZ' researchers<sup>23</sup>, where it is emphasized that the company responsible for the accident has not complied with the environmental remediation measures firmed in the Conduct Adjustment Agreement.

## Conclusions

This study demonstrated the perception difference which the residents of two localities with different distance from the COMPERJ's construction area has on environment quality where they live. It is highlighted the leisure area as the factor perceived equally by the participants of both locations of the study with worse quality.

The perception of bad quality concerning streets, air, and of health services, security and water supply was greater among the Manilha's inhabitants. Whereas, the perception of sewage system service and rivers bad quality was greater among the Porto das Caixas' inhabitants. At the same time that this group related the worsening

of the place's environmental quality where they live due to the absence of mitigatory measures after the occurrence of a chemical accidents site in 2005.

These findings highlight the necessity of being created leisure and culture areas, studies on air monitoring and strategies that would make improvements to infrastructure of public services of security, environmental sanitation and health and of the streets in the two studied localities, in addition to actions for monitoring the conditions of the soil, rivers and health in Porto das Caixas.

In the development perspective, the relationship perceptions between health and environ-

mental quality, based on the territorial dimension, assume the complex trait of the multidimensionality and they are referred to the different interests and economic, political and social values.

It is concluded that, it is necessary that the prioritization of interventions be anchored in the community's environmental concerns involved in oil and gas installation and construction processes in their territories. This strategy is fundamental for a better involvement of these groups in the planning of actions and in making decisions that may allow the reduction of inequities in environmental health.

### **Collaborations**

MA Moniz, CN Carmo, SS Hacon participated equally in all the elaboration stages of the article.

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## References

1. Buss PM. Promoção da saúde e qualidade de vida. *Cien Saude Colet* 2000; 5(1):163-177.
2. Souza JM, Tholl AD, Córdova FP, Heidemann ITSB, Boehs AE, Nitschke RG. Aplicabilidade prática do empowerment nas estratégias de promoção da saúde. *Cien Saude Colet* 2014; 19(7):2265-2276.
3. Silva KL, Sena RR, Akerman M, Belga SMM, Rodrigues AT. Intersetorialidade, determinantes socioambientais e promoção da saúde. *Cien Saude Colet* 2014; 19(11):4361-4370.
4. Burger J, Myers O, Boring CS, Dixon C, Jeitner JC, Leonard J, Lord C, McMahon M, Ramos R, Shukla S, Gochfeld M. Perceptual indicators of environmental health, future land use, and stewardship. *Environ Monit Assess* 2003; 89(3):285-303.
5. Weihs M, Mertens F. Os desafios da geração do conhecimento em saúde ambiental: uma perspectiva ecossistêmica. *Cien Saude Colet* 2013; 18(5):1501-1510.
6. Porto MF, Finamore R. Riscos, saúde e justiça ambiental: o protagonismo das populações atingidas na produção de conhecimento. *Cien Saude Colet* 2012; 17(6):1493-1501.
7. Porto MFS. *Uma ecologia política dos riscos: princípios para integrarmos o local e o global na promoção da saúde e da justiça ambiental*. Rio de Janeiro: Editora Fiocruz; 2012.
8. Gallo E, Setti AFF. Abordagens ecossistêmica e comunicativa na implantação de agendas territorializadas de desenvolvimento sustentável e promoção da saúde. *Cien Saude Colet* 2012; 17(6):1433-1446.
9. Gurgel AM, Medeiros ACLV, Alves PC, Silva JM, Gurgel IGD, Augusto LGS. Framework dos cenários de risco no contexto da implantação de uma refinaria de petróleo em Pernambuco. *Cien Saude Colet* 2009; 14(6):2027-2038.
10. Instituto Brasileiro de Geografia e Estatística (IBGE). Cidades Itaboraí. [acessado 2015 Jul 14]. Disponível em: <http://www.ibge.gov.br>
11. Castro MG. Jovens em situação de pobreza, vulnerabilidades sociais e violência. *Cad Pesqui* 2002; 116:143-176.
12. Marin AA. Pesquisa em educação ambiental e percepção ambiental. *Pesquisa em Educação Ambiental* [serial on the Internet] 2008 [acessado 2015 maio 08]; 3(1):[about 19 p.]. Disponível em: <http://www.revistas.usp.br/pea/article/view/30047>
13. Moniz MA, Castro HA, Peres F. Amianto, perigo e invisibilidade: percepção de riscos ambientais e à saúde de moradores do município de Bom Jesus da Serra/Bahia. *Cien Saude Colet* 2012; 17(2):327-336.
14. Lima CS. *Estudo da asma em Itaboraí/RJ: prevalência, gravidade e poluição atmosférica* [dissertação]. Rio de Janeiro: Fiocruz; 2013.
15. Borges RB, Hora MAGM. *Vulnerabilidade social na área do COMPERJ: O assentamento São José da Boa Morte, Cachoeiras de Macacu-RJ*. Niterói: Editora da UFF; 2014.
16. Instituto Trata Brasil. *Percepções sobre saneamento básico*. São Paulo: ITB/ IBOPE; 2009. [acessado 2015 dez 12]. Disponível em: <http://www.tratabrasil.org.br/datasets/uploads/estudos/pesquisa6/pesquisa.pdf>
17. Heller L. The crisis in water supply: how different it can look through the lens of the human right to water?. *Cad Saude Publica* 2015; 31(3):447-449.
18. Rubinger SD. *Desvendando o conceito de saneamento no Brasil: uma análise da percepção da população e do discurso técnico contemporâneo* [dissertação]. Belo Horizonte: Universidade Federal de Minas Gerais; 2008.
19. Giatti LL. Reflexões sobre água de abastecimento e saúde pública: um estudo de caso na Amazônia brasileira. *Saude Soc* [Internet]. 2007 Apr [cited 2015 dez 12]; 16(1):134-144. Available from: [http://www.scielo.br/scielo.php?script=sci\\_arttext&pid=S0104-12902007000100012&lng=en](http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0104-12902007000100012&lng=en).<http://dx.doi.org/10.1590/S0104-12902007000100012>.
20. Martins LFV, Meneghim MC, Martins LC, Pereira AC. Avaliação da qualidade nos serviços públicos de saúde com base na percepção dos usuários e dos profissionais. *RFO* 2014; 19(2):151-158.
21. Lino CRG, Pacheco-ferreira H. O impacto psicológico de um acidente químico ambiental com óleo diesel. *Psicol Estud* [periódico na Internet] 2009 Jun [acessado 2015 nov 17]; 14(2):[about 7 p.]. Disponível em: [http://www.scielo.br/scielo.php?script=sci\\_arttext&pid=S1413-73722009000200015&lng=en&nrm=iso](http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1413-73722009000200015&lng=en&nrm=iso)
22. Freitas CM, Porte MFS, Gomez CM. Acidentes químicos ampliados: um desafio para a saúde pública. *Rev Saude Publica* 1995; 29(6):5503-5014.
23. Porto MF, organizadores. *Mapa de conflitos envolvendo injustiça ambiental e saúde no Brasil*. Rio de Janeiro: ICICT/FIOCRUZ e FASE (MS); 2014. [acessado 2015 fev 13]. Disponível em: <http://www.confliotoambiental.iciet.fiocruz.br>

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