Corporate Sustainable Strategies in Dom Pedro I Industrial Road Axis, São Paulo, Brazil

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Abstract

Among the challenges to sustainability, urban sprawl and an increasing demand for resources and energy can be mentioned. In the state of São Paulo, Brazil, an intense process of industrialization and urbanization has accompanied the recent expansion of major highways. The study of these impacts is important from a sustainable perspective, as is analysis on how they may indicate socioenvironmental public policies and corporate actions. This study seeks to analyze sustainable corporate strategies to address environmental issues and managerial perceptions in industries located along the road axis Dom Pedro I (SP 65), in the Bragantina Region, state of São Paulo, Brazil. Methodological strategies involve analyses of industries' data and interviews with personnel responsible for environmental departments. Data collected indicate a diversity of environmental management actions already adopted by many organizations and it became apparent that the main stimuli for their implementation are the necessity to reduce operational costs, consolidation of an environmentally responsible image and adequacy to the environmental legislation. Nevertheless, they still need to invest more substantially to implement modern sustainable strategies and

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updated socioenvironmental corporate policies for preservation of natural resources.

Keywords
Environmental management · Corporate sustainable strategies · Industrialization · Natural resources · Socioenvironmental policies

1 Introduction

The current challenge for sustainability on a global scale, according to Seto and Satterthwaite (2010), is caused by the confluence of two global trends: transition to an increasingly urbanized world and global environmental changes.

According to these authors, the world from the twentieth century has undergone significant and concomitant changes such as demographic, urban expansion, high demand for resources, energy and consumption of urban products, transforming terrestrial ecosystems and contributing to increasing habitat and species loss and finally, changes in biogeochemical and hydrological systems.

With urban areas contributing to over 70% of the total power demand and a corresponding proportion of the world's carbon dioxide emissions, it is evident that, when analyzed globally, local processes within urban areas have the potential to affect the Earth system. At the same time, global environmental changes result in significant risks to urban areas and their inhabitants and many of these risks will exacerbate vulnerabilities already existing in these areas (Seto and Satterthwaite 2010, p. 127).

As a consequence, the urban global environmental changes are considered today as the deepest dimension of environmental crisis of the century, as they involve climate and ecological systems, and reduction on existing infrastructure and natural cycles. This may cause damage to social and economic activities, to human health and quality of life, affecting populations of various parts of the planet, more intensely the poorest ones that have more precarious access to services and urban infrastructure (Giddens 2010; Kotir 2010; Patz et al. 2007).

However, more intense extreme events (like droughts, floods, heat and cold waves, hurricanes and storms), in developed regions of Europe and North America, as well as in emerging regions, like South America and Asia that cause economic and human losses, endanger biodiversity and aquatic environments, directly interfering with health, agriculture and hydropower, generated warnings and concern for scientists and governments (Mendonça 2005; Marengo and Valverde 2007; Fuchs et al. 2011; Oven et al. 2012; Black et al. 2013).

In this perspective Koren and Butler (2006), consider that built environment affects ecosystem services, human health and well-being. Urban areas, while offering attractive benefits to residents, such as facilities and access to services, can

impact negatively on quality of life, especially in relation to burden on natural resources and infrastructure in a region. The land usage is strongly affected by urban sprawl, which is often responsible for environmental degradation, changing ecosystem function, resulting in consequent reduction of biodiversity (Cinner and Bodin 2010; Marengo 2006).

According to Koren and Butler (2006), sensitive ecosystems are often fragmented or sacrificed for construction of roads, housing, and industrial parks. The authors draw attention to pollution of reservoirs and groundwater due to discharge of chemicals and pathogens in sewer systems located in urban areas, with numerous adverse effects on human health.

It is worth mentioning that increase in environmental impacts related to urbanization and industrialization processes is part of a historical perspective in which urban growth takes place concurrently with industrialization, usually in neighboring territories, generating, as a result, environment pollution. However, in addition to industrial sectors, urban centers alone generate diverse environmental impacts, considering their high energy consumption, earthworks and soil sealing, deforestation, high levels of greenhouse gas emissions, pollution of water courses and soil contamination (Ferreira and Ferrara 2015).

In an analysis on sustainability, Foladori (2001) criticizes the reductionist view of environmental crisis that restricts the issue to lists in which all environmental problems refer to human impacts, external to production processes. These lists include problems such as destruction of forests, water contamination, desertification, depletion of the ozone layer and global warming, which can be reduced to depredation of resources, pollution due to debris, overpopulation and poverty. Under this conception of environmental problems, relations within the production process are not discussed, but only the effects.

This reductionist view, considering the urban environmental issues and productive activities that take place in one space, can create programs and environmental management actions focused on environmental problems but not on their causes, promoting analysis that excludes basic aspects and would require a more complex approach.

Shutzer (2012) mentions that environmental problems continue to be addressed in separated and fragmented ways and, therefore, cities continue to grow without considering the interests of society in building a healthier environment. Actually, environmental degradation is favored by private economic interests, lack of planning, ignoring potentialities and limitations in the relationship between city and environment. Furthermore, this picture introduces simple solutions, such as waste sorting or planting trees, which in practical terms collaborate very little to recovery or preservation of modified areas, as they do not analyze further problems.

Cities need to import a number of other resources to maintain inhabitants' quality of life, such as water, essential for human survival. In exchange they provide manufactured goods, services, information, technology and forms of recreation. There is constant and massive influx of material to support the cities and as a consequence it generally exceeds their ability to eliminate waste. The problem of large volumes of generated waste has been partially resolved through recycling and

composting programs, or use of biodegradable material. However, for many urban centers they involve expensive and uneconomical industrial processes (Jacobi 2009). Consequently, this entropic characteristic causes many other problems, not only ecological. Urban structures and density, in addition to occupants' activities, also give rise to economic, social, cultural, and political problems (Silva and Vargas 2010).

Regarding this issue, it is worth mentioning that for Silva and Vargas (2010), a city can be understood as an ecosystem, considering the concept in its broadest sense. In other words, an environmental unit within which all elements and processes are interrelated and interdependent, so that a change in one will gradually result in changes in all other components. Thus, the search for sustainability in urban areas should consider a multifaceted reality.

Ferreira and Ferrara (2015) point out that the concept of sustainability includes the idea of reversing current urbanization patterns, regarding treatment of inherited environmental liabilities of late industrialization. It also includes the ability to regulate and organize ongoing urbanization into socially fairer and less impactful parameters, especially in small- and medium-sized cities, where possibilities for changes are still widely possible.

Another aspect to be considered is that with urban and industrial expansion, there is a significant increase in means of transportation which involve heavy consumption of natural resources and generation of various negative impacts such as traffic jams, pollution, and accidents. The study of these impacts, their expansion, and resource consumption levels is important from the environmental and economic point of view and from the perspective of sustainability, to identify the causes and who suffers from these changes and how they are reflected among different social groups.

This article aims to identify and analyze socioeconomic and environmental changes that the Dom Pedro I industrial road axis (SP 65), part of the Viracopos Airport-São Sebastião Port Export Corridor, has been generating, specifically along the municipalities of Atibaia, Bom Jesus de Perdões, and Nazaré Paulista, in São Paulo State, Brazil. It also aims to analyze corporate strategies to deal with environmental issues and managerial perceptions in industries located along this industrial road axis, in the same municipalities.

The methodological strategies involve analyses of actions taken by companies located in Atibaia, Nazaré Paulista, and Bom Jesus dos Perdões through research, systematization, and analyses of secondary database (IBGE 2010), semi-structured interviews with personnel responsible for environmental departments (Richardson 1999) and field work. In addition they will involve correlations between enterprises, projects, and economic activities, emphasizing the industrial ones along the road axis and existing social and environmental problems and impacts.

2 Study Area

The State of São Paulo Government presented the Campinas—São Sebastião Export Corridor Project in 2005, which included the privatization of Dom Pedro I, Carvalho Pinto and Ayrton Senna highways and doubling the Tamoios Highway (Fig. 1). The corridor has the function of transferring import and export products from Campinas region and the entire State of São Paulo and runs through areas of the municipalities of Itatiba, Jarinu, Atibaia, Bom Jesus dos Perdões, Nazaré Paulista, Igaratá, Jacarei, Jambeiro, Paraibuna, Caraguatatuba, and São Sebastião (Braga 2008; Braga and Trevisan 2010). These roads connect the capital and the rest of the state, with Viracopos International Airport in Campinas and the Port of São Sebastião in São Sebastião. The government's proposal also involves duplication of Tamoios Highway and construction of a new access between the municipalities of Caraguatatuba and São Sebastião.

The road corridor will have 260 km between Viracopos Airport and Port of São Sebastião, passing through areas of Cantareira Water Supply System, and close to other reservoirs, and Paraíba Valley region, where logistic terminals will be implemented between Carvalho Pinto and Tamoios highways. These logistic terminals will be intermodal, where cargo imported or to be exported can be relocated and distributed to custom areas or recipients of any city (Braga 2008). The new export line will generate more consistent foreign trade logistics, increasing competitiveness of São Paulo State (Oliveira 2012).

However, it is evident that this significant increase in road transportation will bring significant changes to this axis which, among other issues, include changes in air quality, possibility of accidents in areas of intense environmental vulnerability,

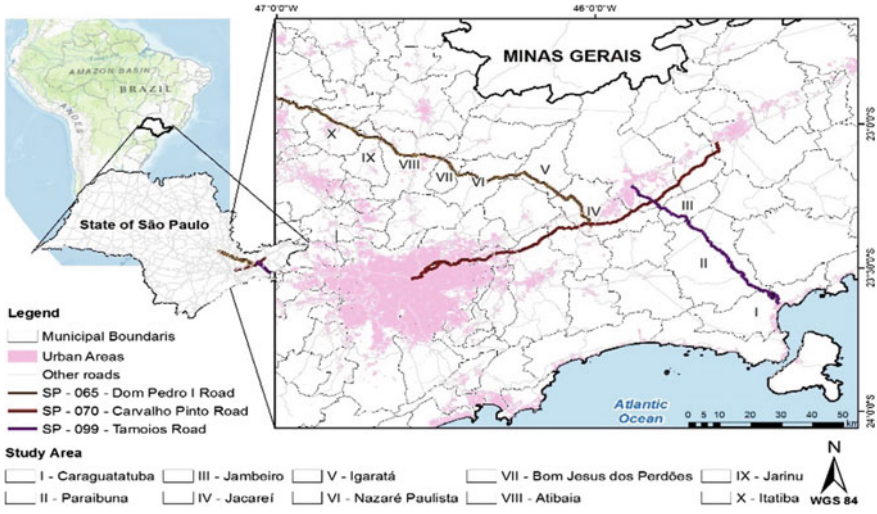

Fig. 1 Road axis—municipalities. *Source* Seixas et al. (2015)

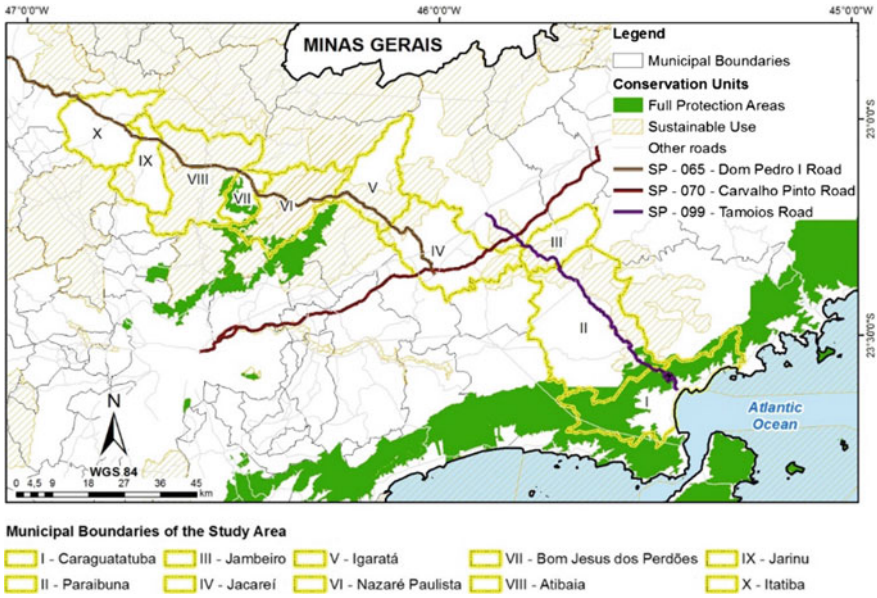

Fig. 2 Conservation units. *Source* Seixas et al. (2015)

increase in urbanization and industrialization processes and even tourism development.

Another significant aspect of the export corridor is the fact that it is too close to conservation units, as for example, state parks and environmentally protected areas, of fragile ecosystems that can go through expressive damage (Fig. 2).

3 Profiles and Actions of Companies Analyzed

The secondary collected data, interviews and field work show intense occupation along Dom Pedro I Highway, in the municipalities of Atibaia, Bom Jesus of Perdões and Nazaré Paulista, by industrial districts and large industrial warehouses. This is stimulated by the economic dynamics of the corridor, which favors the logistics sector, with storage, transportation, and goods distribution (Figs. 3, 4 and 5).

The implementation of these economic centers represents the possibility and expectation of several municipalities along Dom Pedro I Highway Road axis, including, besides Atibaia, Bom Jesus dos Perdões and Nazaré Paulista, the municipalities of Itatiba and Jarinu. Actually, some industrial districts are already being implemented in these municipalities, which will certainly determine a number of changes and new regional dynamics (Hoeffel et al. 2010).

Fig. 3 Location of industrial plants in Bom Jesus dos Perdões. *Source* Hoeffel et al. (2015a, b)

Fig. 4 Location of industrial plants in Nazaré Paulista. *Source* Hoeffel et al. (2015a, b)

Dom Pedro I Highway links Paraíba Valley to the Metropolitan Region of Campinas, allowing a quick connection between these two important industrial centers located in the Anhanguera and Dutra Highways and became one of the main highways of São Paulo state. It was inaugurated in 1972 and the duplication delivered in 1990. Dom Pedro I Highway offers a broad freedom of movement in terms of handling cargo and passengers. Traffic volumes are more intense during weekdays due to transportation of raw materials and goods in the region.

Data collected show that in the municipalities of Atibaia, Bom Jesus dos Perdões, and Nazaré Paulista, real estate speculation has been happening, just as in other municipalities and Metropolitan region of São Paulo, but with accelerated dynamic, and population growth, and this has significantly altered the urban and especially rural areas.

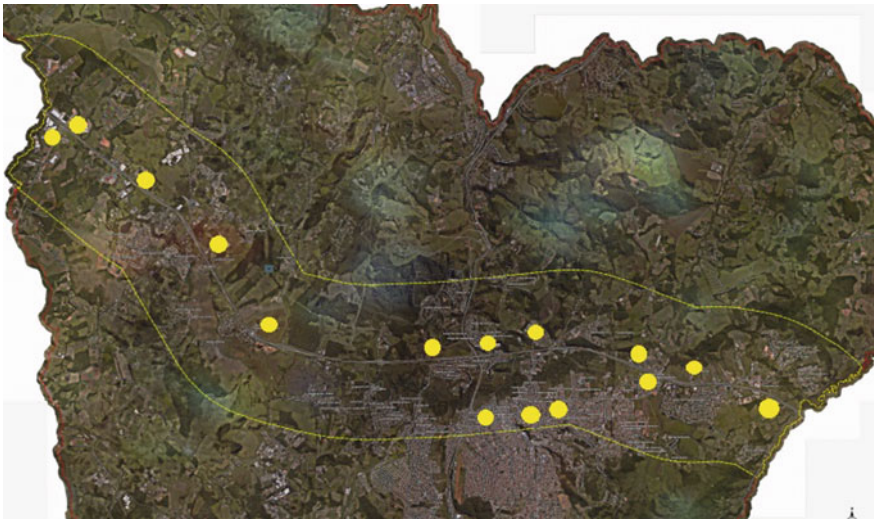

Fig. 5 Location of industrial plants in Atibaia. *Source* Hoeffel et al. (2015a, b)

Data on companies based in Atibaia, Bom Jesus dos Perdões, and Nazaré Paulista were collected in order to analyze expansion and its relationship to the growth of inhabitants in these municipalities. Significant increase has been noticed in the number of companies in Atibaia and Bom Jesus of Perdões and to a lesser degree in Nazaré Paulista. This variation is probably due to the fact that in Nazaré Paulista there is a reservoir of the Cantareira Water Supply System, the Atibainha River Reservoir, which is inserted in two Environmental Protected Areas (EPA)—Piracicaba/Juquery Mirim Area II EPA and Cantareira System EPA and this restrict the settlement of industries.

Through data collected, interviews, and field work, an expressive number of industrial districts and large deposits of industrial products was observed along Dom Pedro I road axis. In Bom Jesus dos Perdões, there are 43 industries located close to this highway and 17 under construction. In Nazaré Paulista, a municipality with severe environmental restrictions as mentioned above, there are eight industries and in Atibaia 45 large industries. A total of 66 industries were analyzed (Table 1).

The data shown in Table 1 indicate that only 11 of the 66 companies analyzed, are certified ISO 14001. From the 10 in the automotive companies, eight were certified, probably due to requirements of car manufacturers. The other sectors with certified companies were electronics industries (two companies) and metallurgical (one company).

The companies' environmental certification is related to development, implementation, and evaluation of environmental management system (EMS) that requires a set of interrelated activities in the company's administrative and operational framework, in order to avoid, minimize, or solve various environmental

Table 1 Industries analyzed in Atibaia, Bom Jesus dos Perdões and Nazaré Paulista

Production area	Number of companies	Certified ISO 14001?		Environmental licences			Main waste	Main environmental management actions
		Yes	No	Yes	No	No data		
Food	1		1	1			Solid waste; liquid effluent	Waste and effluent management
Automotive	10	8	2	9	1		Solid, electronic and chemical waste; liquid effluent; environmental interest residue	Waste and effluent management; environmental interest residue management
Construction	7		7	6		1	Solid waste; liquid effluent; environmental interest residue	Waste and effluent management; environmental interest residue management
Electricity	1		1	1			Liquid effluent; electronic and solid waste; environmental interest residue	Waste and effluent management; environmental interest residue management
Eletronics	3	2	1	2	1		Solid and electronic waste; environmental interest residue	Waste management; environmental interest residue management **Goal**: landfill for non-recyclable
Metallurgical	26	1	25	15	7	4	Solid waste; environmental interest residue	Waste management; Environmental interest residue management
Chemical	9		9	5	1	3	Solid and chemical waste; liquid effluent	Waste and effluent management; 1 PET post use recycling
Textile	5		5	2	1	3	Solid waste	No data available; 1 PET post use recycling
Timber	1		1	1			Solid waste	Waste management
Paper	1		1	1			Liquid effluent; solid waste	Waste and effluent management; post use paper and cardboard reverse logistics
Cargo	1		1			1	Solid waste (tires); gas emissions	Waste management; emissions control (mainly CO_2)
Glass	1		1	1			Solid waste; liquid effluent	Waste and effluent management; water recirculation
Total	66	11	55	44	11	11		

impacts caused by productive activities. In this process, some criteria must be met, such as being in compliance with legal environmental requirements and have an ongoing evaluation process, which in a way helps to understand the performance of companies operating in the Corridor Dom Pedro I. The inexpressive number of certified companies agrees with Amato Neto (2011) analyses, according to which in Brazilian context the issue of sustainability in regulatory framework is still in its infancy as compared to other more developed countries. In Amato Neto (2011) perspective business initiatives are located in specific areas and much of the population has little awareness and perception of such initiatives.

Seiffert (2011) stresses that the arising of ISO 14001 has provided general guidelines for the implementation of Environmental Management Systems, but also that the vast majority of organizations have primarily focused on complying and monitoring environmental laws and specific regulations.

In this context, it is important to emphasize that part of the Atibaia River Basin which is located inside the study area, presents a noticeable contrast between natural areas relatively preserved and extremely urbanized areas. Demanboro et al. (2013) in their studies conducted in this area concluded that the watershed is in intense process of environmental degradation. It is, therefore, essential that companies in Dom Pedro I Corridor, in addition to the ISO 14001 certification, present environmental management systems that are also concerned with water issues, maintaining people quality of life and local ecosystems and their own industrial activity that depends on water.

High degree of human intervention in the water basin, high levels of water consumption and domestic waste dumps, which promote deterioration of watercourses have contribute to this picture.

Although 11 companies are certified, on the other hand, of the 66 companies analyzed 44 were appropriate for the environmental licenses required by the environmental agencies in the state of São Paulo, 11 were in irregular conditions and for 11 it was not possible to obtain data. This table indicates a non-significant compliance with legal requirements, if the location of these companies is considered.

Irregular companies can compromise the quality of environmental resources in the study area, stimulating water, soil and air contamination, the imbalance of ecosystems and removal of riparian vegetation, among others. Therefore, it is important to mention the role of public environmental management regarding development, planning and control of productive activities in the area.

Another aspect to consider is the waste generated, basically solid and chemical, liquid and chemical, electronic, waste classified as environmental interest and gaseous emissions that require proper disposal. As environmental management actions, basically the legally required as wastewater treatment and waste have been noticed.

A focus present on some companies analyzed was the introduction of energy efficiency management system. Thus, a company analyzed presents a universal system to support manufacturers and users of machines that have three purposes: to serve based recommendation for operating industrial companies, be used for the

development of energy-efficient solutions for the mechanical engineering sector and optimize the company's own products.

This system works as an energy savings consultant. It helps to analyze not only individual components, like adapting the energy system to the real needs of specific machines, but also the system as a whole, finding relevant opportunities for energy optimization and savings.

One of the companies mentions working with suppliers so that they minimize usage of hazardous substances with a focus on reducing pollution. Another one states that they continuously invest in technological development, prioritizing preservation of natural resources. With this focus, all processes are planned and executed within the strictest control on the issue and handling of waste and effluents.

Another company participates in a conscious disposal program, in agreement with waste programs created by the State of São Paulo Environmental Department, which requires that manufacturers, importers, distributors, traders, and consumers act together to promote the reverse logistics of lubricating oil filters used in the automotive sector by promoting their collection, recycling, and adequate environmental disposal.

Given the actual socioenvironmental reality in this area of study, it can be said that although there are actions, programs, and proposals aimed at the corporate environmental management, it is still necessary to invest in a more significant way in this perspective. The actions are mainly focused on management of solid waste and effluents, which shows a focus on pollution control. According to Barbieri (2007), this approach refers to a reactive attitude of the company focused on the negative effects of their products and production processes by point solutions, aiming to meet the legal requirements and pressures of the communities.

For the author, exclusively targeted solutions for pollution control, even if they are fundamental, are also inadequate because they are directed only to one side of the problem, the pollution. Barbieri (2007) presents two other approaches that go beyond this perspective: prevention of pollution and strategic approach to environmental problems.

On prevention of pollution, in addition to solid waste management actions, some companies mention working with suppliers so that they minimize use of hazardous substances and installation of solar panels in order to replace fossil fuel in industrial processes.

In this approach, companies seek to take actions to prevent pollution, which requires changes in processes and products in order to reduce or eliminate waste at source (Barbieri 2007). Thus, it has been possible to notice improvements in some companies regarding proposals for environmental management focused previously only on pollution control.

Another company analyzed presents a system to support manufacturers and machine users in reducing electricity costs and increasing productivity, including the environmental issue as a marketing opportunity and also as a measure that can neutralize future environmental threats. In this case, beyond control and prevention of pollution, the company treats environment as a strategic approach.

Considering the expansion of industrial activities in Dom Pedro I road axis, for companies to expand their activities related to environmental issues, public policies are needed so that more efficient command and control measures exist in the region. It is also necessary to consider incentives for the perception that environmental conservation can be a competitive advantage and innovative strategic approaches, combined with measures for preventing pollution.

Seiffert (2011) highlights this issue when considering the great potential that exists for implementation of cleaner production approach, since losses in the process, which generate pollution, also reduce profitability that might be achieved by the product.

Curi et al. (2016) mention, as an alternative, several proposals for environmental management that can prevent and reduce potential environmental impacts, such as responsible action, cleaner production, eco-efficiency, eco-design, among others, that can be adopted by organizations, and besides determining sustainable actions, can be seen as business opportunities for companies.

In view of the above, although some companies present environmental certification (11) and others are in accordance with the law (44) with respect to environmental licensing, actions and environmental management programs are still necessary in Dom Pedro I road axis. These should surpass the simple reductionist view of environmental protection in urban areas aiming the sustainability objective.

4 Conclusions

All elements already identified as intensive urbanization, industrialization, traffic, and consequent pollution, point to significant changes in the urban, social, economic, and environmental dynamics of the municipalities analyzed along Dom Pedro I axis road. They have already caused significant pressure on regional natural resources but further analysis and planning are required about the reflections of these changes in this study area (Hoeffel et al. 2010).

The construction and subsequent duplication of the highway resulted in the establishment of company facilities and various economic activities and consequent population growth. This means that there is a significant demand for investment in the urban and environmental planning sector.

Therefore, it is necessary to recognize that cities need a development plan so that expected growth may occur in an orderly manner, given the magnitude of the challenges they face. Current limitations and improvements should be widely discussed and recognized.

The data collected also indicate a wide diversity of environmental management actions already adopted, as waste and effluent management, energy efficiency and emission control, and it became apparent that the main stimuli for their implementation are the necessity for adequacy to the environmental legislation, reduction of operational cost, and consolidation of an environmentally responsible image. As mentioned before the adoption of responsible environmental actions, that tend to

collaborate with regional socioenvironmental conditions and preservation of natural resources, has been implemented, although some organizations still need to invest more significantly in these strategies and establish modern socioenvironmental corporate policies.

Considering the present expansion of industrial activities in Dom Pedro I road axis, for companies to expand their activities related to environmental issues, public policies are deemed necessary to allow and demand more efficient command and control measures. Nevertheless, also incentives to environmental conservation are necessary so that they can be understood as competitive advantage and innovative strategic approach, coupled with pollution control measures.

Finally, both public and corporate sectors need to implement urban and environmental planning processes to promote improvements and social welfare and sustainable actions. The inclusion of environmental issues in the planning mechanisms is extremely important because it will make possible to predict impacts, and implement a zoning so that each activity interferes as little as possible in the surrounding activities and environment. This will certainly improve social and environmental conditions and preservation of natural resources, guaranteeing the basic rights of local residents.

Another relevant aspect to consider from the perspective of sustainability is the importance of environmental management systems, properly implemented, both to improve organizational environmental performance, and for a better quality of life for individuals, both internally and externally to the organization.

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