

Green Campus and Environmental Preservation on a Brazilian University



Evanisa Fátima Reginato Quevedo Melo, Marcos Antonio Leite Frandoloso and Ricardo Henryque Reginato Quevedo Melo

Abstract The University of Passo Fundo, during its 50 years of implantation, has searched to insert itself into the urban landscape of the city, in urban or landscape terms. The methodology for elaboration of the Environmental Management Plan of the Flora in the Campus I attends the Environmental Management System guidelines of the UPF. Tree species were identified in botanic survey and defining the Permanent Preservation Areas, with individual components from the native vegetation in the region of the Mixed Ombrophilous Forest. From these surveys the formation of an ecological corridor with a strip of native vegetation was pointed as a mitigating measure, creating a green area for the interconnection of these arboreal fragments; it equally indicates the implementation of a vegetal replacement plan with native species. The importance of this area is highlighted by creating an environment where users (internal and external community) can perceive several examples of flora; besides contributing to the improvement of the microclimate with a dense green area interconnecting several buildings. The University does not only strengthen its formation role of students and teachers and external community that use Campus I as an urban park, but also enhances the sustainable performance in the local and regional area.

Keywords Green campus · Green areas · Universities planning

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1 Introduction

Over the last decades, a lot has been spoken about necessary changes in order to obtain Sustainable Development along with social, cultural and economic aspects. However, its conceptual bases still are in discussion and consolidation, meanwhile, in other occasions, they result as partial actions.

Progressively, experiences that concretize the beginnings of a sustainable society are more representative. The University, as part of this society, has a role of extreme importance in this transformation process, recognized by the Talloires Declaration (ULSF 1990) and the UNESCO's DESD (Decade of Education for Sustainable Development) for 2005–2014 (UNESCO 2005), which was called "Education for Sustainability".

Tomashow (2014) highlights some efforts to incorporate sustainability into universities, according to "The nine elements of the sustainable campus": energy, food, material flows, management, investments, well-being, studies programs, interpretation and esthetics. According to him, these elements relate the decisions of the community and along with the integrated implementation of them, leadership and effective results are generated to transform the campus, its agents and the community, to which the university has the role of fostering sustainable ethos; in addition, the campus serves as a new way of thinking about higher education.

The Anglo-Saxon model adopted by many universities in Brazil, like the campi placed on distant areas from the urban center is no longer convincing, considering that, in most cases, urban growth took the direction of these specialized urbanizations, thus, the limits between "cities" and "university cities" no longer show common borders (Carreras 2001; Pinto and Buffa 2009).

The inexistence of implementation and management plans of new urbanized structures resulted in conflicts such as urbanization of rural areas, lack of accessibility and difficulties in mobility (accesses, transit and transport) and the lack of connection to the so-called perimeter city. Beyond these questions, there are also the environmental concerns: the impact on the environment between the natural and the constructed, the generation of residues, the use of hydric and energetic resources, and other themes.

The real situation shows us that though the compromise gathered in the Talloires Declaration, few university institutions include these concerns on their Master Plans, and, more commonly, most do not adopt it.

This way the knowledge about green areas and its various benefits may be seen as an important constituent of urban quality of life, climatically quality and the quality of urban green spaces as a key factor in making cities attractive and viable. Making needed the realization of the urban planning directed to the good coexistence between the most diverse aspects at the infrastructure and sustainability (Grunewald et al. 2017; Li et al. 2017).

Analyzing since the scopes from rural to the urbanized centers, as seen that the cities are growing and crowding itself at the university campus. The formation of heat is directly influenced by the presence of diverse factors, such as the verticalization, the albedo, the lack of green areas and the intense circulation of vehicles (Santana 2014; Gunnarsson et al. 2016).

Being that one of the forms to minimize the climatic changes, is the planting of trees, this way increasing the city landscape and climate resilience (Franco et al. 2013).

Thus, the grow guidelines must predict green areas, as well instigate the preservation of existing areas and increase the use of already modified areas (Sanesi et al. 2016). Where according with Garcia (2017) “Urban ecological sustainability has been considered using an interdisciplinary approach which aims to integrate social aspects, green architecture designs and traditional ecological issues”.

Because, to obtain a pleasurable climatic comfort it is needed public and private management policies that ensure the mutual socialization between green and concreted areas, which provide the necessary comfort at the ambit of climate, visual and heal of users, students and workers (Aronson et al. 2017).

Along with the 50 years of the Campus I of the Universidade de Passo Fundo, located in Southern Brazil, the infrastructures have been enlarged in built stock, open spaces and green areas. Moreover, the present work shows the process of implementation of UPF’s main campus, as well as its specific relations with the green areas and the vegetation species, that recently became as Permanent Preservation Areas (PPAs).

The paper has the objective of discussing the university planning instruments, questioning the managerial practices adopted to improve sustainable principles in all activities within the campuses of the UPF structure, present in eight cities in the North of Rio Grande do Sul—Brazil. Pointing the green areas is a feasible way to show to the academic community their relevance in landscaping terms and micro-climate conditions, and also, seeing that Campus I became a “live laboratory” to learn about environmental and social sustainability, involving the external community that uses the UPF’s main campus as an urban park.

Unfortunately, environmental sustainability knowledge and application is limited in Brazilian universities, together with an introspective view to evaluate their practices and policies that should propose changes to achieve a participatory planning to improve Sustainable Development, as well as concrete actions and the making decision process. That being said, maybe this analysis will encourage other universities to do same assessment.

2 Methodology

The University de Passo Fundo is located in northern Rio Grande do sul—Brazil. The main campus—Campus I—Has 42 ha situated at the borders of the urban zone, as presented by the Fig. 1, with an increasing built area, experimental lands of agriculture, green areas and Permanent Preservation Areas (PPA).

In order to develop the survey, all the administrative instruments of the Fundação Universidade de Passo Fundo [Foundation University of Passo Fundo] were consulted. The analysis started with the purposes and guidelines of the University's creation in the decade of 1960 until the most recent and other bibliographic references, especially those elaborated by Guareschi (2001, 2012) and the analyses formulated by Frandoloso (2018a, b).

In order to document the existent green areas and vegetation at Campus I, survey reports were elaborated along the ten years of field survey, such as the ones published by Melo and Severo (2007) and Melo et al. (2015).

The flora acknowledgement started in 2002 and it was made a monitoring survey each five years of the vegetation composition in UPF's Campus I. Through a botanical data collection, made by wandering through the afforested area and identifying,



Fig. 1 Localization of the UPF Campus I in Passo Fundo—Rio Grande do Sul. *Source* Authors, 2018

quantifying and classifying the arboreal examples by consulting Backes and Irgang (2004), Souza and Lorenzi (2008), Forzza et al. (2010) and consulting specialists.

The botanical data collection, was made considering the whole area, with specimens taller than 10 cm from the chest level (1.30 m) (Brasil 2018). Although, the permanent preservation areas determination was made according to regulations from CONAMA—Conselho Nacional de Meio Ambiente (Conama 2002) and the 12.651 forest code (Brasil 2012).

3 Environmental Planning in UPF's Campus I

In accordance with other Brazilian universities, the foundation of the Universidade de Passo Fundo in 1967 was owed to the incorporation of superior educational centers, already existent and autonomous, not following a pre-established model of university organization, but being built gradually by the local circumstances and attending the standards of higher education laws (Guareschi 2001).

As a physical structure, the first planning reference remits to the “Pré-Plano da Cidade Universitária” [Prior Plan to the University City] (Ariel 1958 *apud* Guareschi 2001). Figure 2 represents the project's image. The project had foreseen a population on 7,600 students in 40 years, which adopted the “city park” guideline, appreciating the green elements of afforestation. The plan also forecasted a residential zone for students, teachers and officials. For economic reasons in that time, the plan was considered impracticable, but it was incorporated in the consolidation of the Campus in the decade of 1970.

This process was registered by Guareschi (2001, 2012), describing the guidelines to the *multicampi* organization, the physical campus and the experience of planning, evaluating and managing. The conception of the Campus I, according to the Master Plan of 1972, followed sharply the North-American models and politics (Atcon 1978; Fávero 2006; Pinto and Buffa 2009).

With the objective of “promoting studies, surveys and planning tending to foment regional development”, the IPEPLAN (Instituto de Pesquisas e Planejamento) was created in 1969, beginning with a generic performance, but incorporating physic planning and the elaboration of budgets for the first buildings of the main campus (IPEPLAN 1970, 1973).

Therefore, from the implantation of the Campus I in 1973 there was the need of specific planning of the building expansion, denominating internal commissions in 1986, 1990 and 1994. They focused on functional aspects of new buildings and a new road system and infrastructure, in environmental terms, as observed by Frandoloso (2018a), the emphasis was concentrated in esthetics and landscaping aspects, not only for the preservation of natural vegetation in a little part of the land, but also the construction of a scenery in the areas mainly occupied by underbrushes.

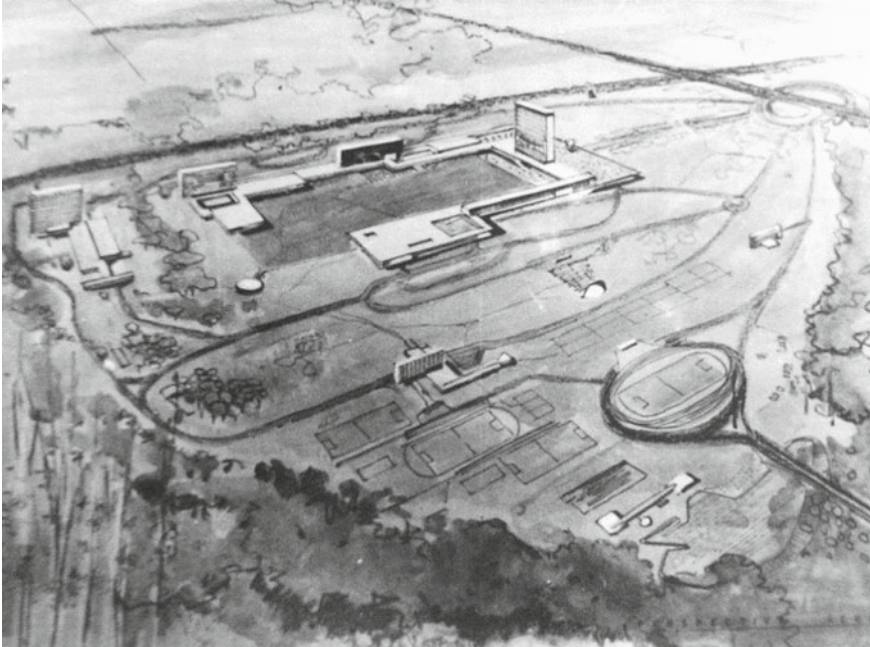


Fig. 2 Image of a 1958' Master Plan for the UPF Campus. *Source* Universidade de Passo Fundo, 2018

The Universidade de Passo Fundo obtained in 2007 the Operating License of the Fundação Estadual de Proteção Ambiental Henrique Luiz Roessler [State Foundation of Environmental Protection Henrique Luiz Roessler] considering it was adequate to the current environmental law. According to the licensing from the making of the Sistema de Gestão Ambiental [System of Environmental Management] (Assumpção 2011); this license was renewed in 2017 for two years longer.

Since 2010, institutional planning has been suffering a process of fundamental decisions that guided the UPF to create the Institutional Development Plan (PDI) for the years 2012–2016 (UPF 2012) and later revised and renewed to the years 2017–2021 (UPF 2016). From the starting point of the PDI 2012–2016, the Social and Environmental Development Policy of the Universidade de Passo Fundo was created (Dalmolin and Moretto 2014), which is why in the year of 2012 spots a new way of viewing sustainable planning.

According to Frandoloso (2018b), the process of consolidation of an environmental plan is this way triggered inside the university structure, but it still needs to be discussed in the proactive group, by the definition of guidelines, principles and goals in each thematic axis and, later, opened to discussion and approval by the academic community and the administrative structures (Rectory and Foundation of Universidade de Passo Fundo).



Fig. 3 Aerial view of the UPF's Campus I in the beginnings of the 1970s decade. *Source* Universidade de Passo Fundo, 2018

The characterization of the Campus I from the University of Passo Fundo, has suffering changes trough the years, demonstrated at the Figs. 3 and 4. Besides identifying its localization among the maps since the national to local level at the Fig. 1.

In the guidelines of the planning instruments of the UPF specific themes were incorporated, between then the preservation of Permanent Preservation Areas (PPAs), which can be seen in the Fig. 4. The original area of pasture and agricultural production were transformed into big wooded areas, that are currently seen as a big urban park, open to the local and regional community.

4 The Monitoring Plan for the Campus' I Flora

Considering the Monitoring plan of the Campus' I flora of September 2012, where the Permanent Preservation Areas (PPAs) were identified and localized according to the guidelines of the institution's Environmental Management System, as well as the conditions of the Operating License (12/2012 DL), alongside with the Fundação de Proteção Ambiental Henrique Luís Roessler (FEPAM—RS) [Environmental Protection Organization]. Regarding the hydric resources, the PPA was defined following the current laws, considering the Forest Code, the Law number 4,711, from September 15th, 1965 and the CONAMA Resolution 303/2002. The Permanent Preservation Area was marked in the Blocks P and K, L, Q, M and I of the Campus I of the UPF, as showed in the Fig. 5, following the law and the natural regeneration of the areas.



Fig. 4 Aerial view of the UPF's Campus I in 2018. Source Universidade de Passo Fundo, 2018

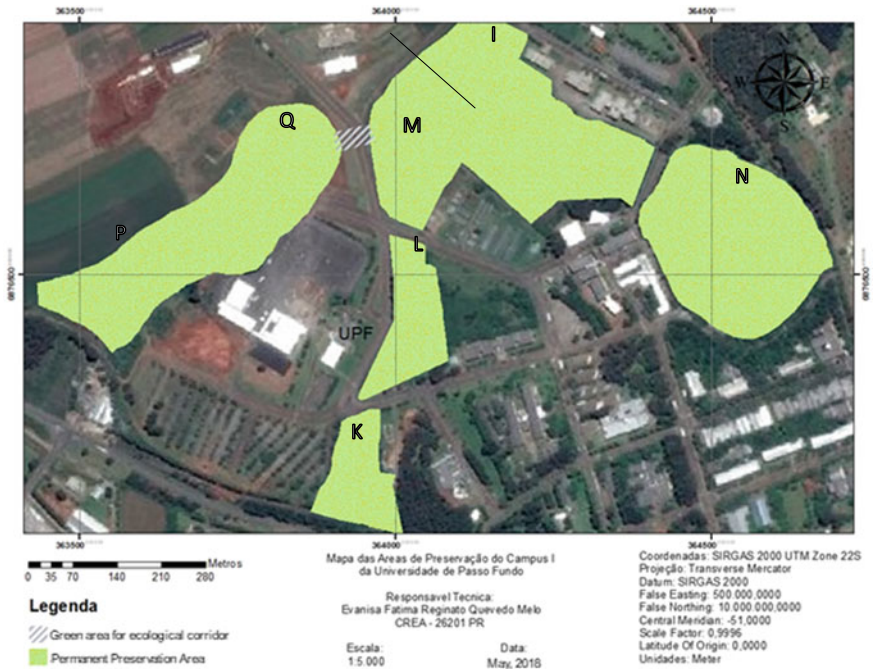


Fig. 5 Map of the Preservation Areas of the Universidade de Passo Fundo's Campus I, with the purpose of an ecological corridor. Source Authors, 2018



Fig. 6 General aspect of the Block L with the natural regeneration of the formed entourage that creates the ecological corridor. *Source* Authors, 2018



Fig. 7 General aspect of the preservation of the Block L with the entourage in natural regeneration ongoing, close to the Food Engineering Building (L1). *Source* Authors, 2018

As a mitigating measure, an ecological corridor can be formed with a native vegetation line, creating a new green area to connect these arboreal fragments, as the Figs. 6, 7 and 8 present.

Between the Blocks K and P the enlargement of the PPA in direction to Block P can be observed, due to the enrichment from native forest species implanted along the years and the natural regeneration with pioneer species of the region in the forest behind the Residues Center (Building K3), in direction to the route BR 285. Furthermore, considering the compensatory measures using enrichment with seeding of native species and allowing the natural regeneration of these fragments it is verified that it is possible to integrate the area to the other PPAs. It is also possible to form an ecological corridor among the Blocks Q, P, M, K, L and I, allowing the reintegration of the flora and fauna in a line of native vegetation, as shown in Fig. 9.



Fig. 8 General aspect of the preservation area of Block Q with the entourage with natural regeneration ongoing, in the farming area close to the street that leads to the Law Building (U1). *Source* Authors, 2018



Fig. 9 General aspect of the preservation area of Block K close to the UPF's effluent treatment station. *Source* Authors, 2018



Fig. 10 Example of Bracatinga (*Mimosa scabrella*) composing the natural regeneration of the preservation area in Block I at the border of the street that gives access to the Law Building (U1).
Source Authors, 2018

A botanical data collection of the main species regeneration found in the Permanent Preservation Areas was made. The following species stand out: Red Aroeira (*Schinus terebinthifolius*), Bracatinga (*Mimosa scabrella*), Guaicá (*Ocotea puberula*), Fumo Bravo (*Solanum* sp.), Leiteiro (*Peschiera fuchsiaefolia*), Mamica de cadela (*Zanthoxylum rhoifolium*), Timbuava (*Enterolobium contortisiliquum*), Vacum (*Allophylus edulis*), Vassoura (*Baccharis* sp.), among others, as illustrated in Fig. 10.

In the month of September 2012, a new data collection was made in the streets that give access to the Center of Events and the Law Building identifying more than 120 examples (Fig. 11). Some flowerbeds were forested with Gerivá ou Jerivá (*Syagrus romanzoffiana*) showing 45 examples of different sizes (Fig. 12).

It was verified the need of an update of the vegetation data, considering the expansion of the infrastructures that attend the increase of the number of students in the University of Passo Fundo's Campus I, as well as inserting the vegetation species that, in the data collection of 2006, showed diameter and chest height smaller than the established as minimum reference to be quantified. Thus, there had already been presented the results of the data collection referred to the Blocks B, C and E, in the 2013 Flora Monitoring Report of the University of Passo Fundo. In this report the blocks A, D, G, H, L, O and Q were also referenced (Fig. 13).

Seeing that, all the tree species that compose the forestation of the Blocks A, D, G, H, L O and Q were listed by popular name, scientific name and component families of the study area. Analyzing some characteristics of the vegetation along the different blocks of the campus the diversity is highlighted, native as well as exotic, the great



Fig. 11 Examples of Canafistula (*Peltophorum dubium*) and Purple Ipê (*Handroanthus heptaphyllus*) used in the forestation of streets in the accesses of the UPF's Campus I. *Source* Authors, 2018



Fig. 12 Examples of Gerivá or Jerivá (*Syagrus romanzoffiana*) used in the forestation of streets and flowerbeds in the Campus I, UPF. *Source* Authors, 2018



Fig. 13 Location of the Blocks A, D, G, H, L, O and Q in the general map of UPF's Campus I, 2014. *Source* University of Passo Fundo, 2014

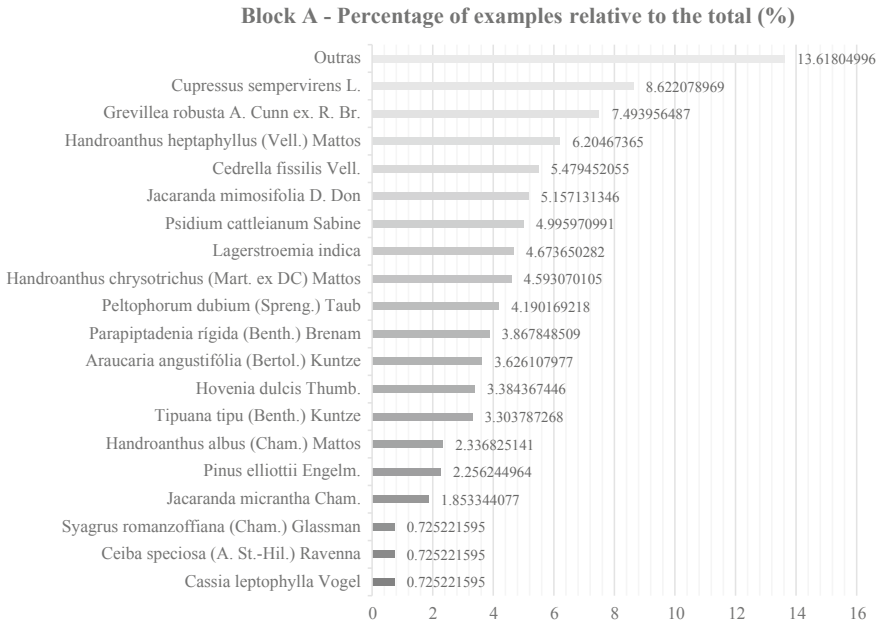
number of examples and the *Myrtaceae* species, the presence of *Handroanthus* sp. planted in line, besides the big areas of prevailing monospecific vegetation.

Frame 1 demonstrates the results obtained by the botanical inventory. The species that showed more occurrence were *Eucalyptus* sp., *Cupressus* sp., *Handroanthus heptaphyllus*, *Handroanthus chrysotrichus*, *Araucaria angustifolia*, *Peltophorum dubium*, *Pinus* sp., *Grevillea robusta*, *Tipuana tipu*, *Hovenia dulcis*, *Cedrella fissilis* and *Jacaranda mimosifolia*. The extinction threatened *Erythrina crista galli*, *Erythrina falcata*, *Araucaria angustifolia*, *Gleditsia amorphoides* and *Dicksonia sellowiana* stand out.

The presence of examples of Xaxim (*Dicksonia sellowiana*), *Araucaria* (*Araucaria angustifolia*), Açucará (*Gleditsia amorphoides*) and Corticeira do Banhado (*Erythrina crista galli*) and Corticeira da Serra (*Erythrina falcata*) is an important document to the vegetation at risk, or extinction threatened, related in the red lists, and, this way, showing its education importance and worries about nature preservation. It is observed that the tree examples implanted along the years and the different administrations had different goals, but always seeking to preserve the older examples already implanted and inserting new native examples. The *Eucalyptus*, *Grevillea* and *Pinus* species were planted in several spaces aiming to serve as “wind-breaking” or “natural curtains”. There is a need of handling because of the phytosanitary damage.

The importance of this area stands out for creating an ambient of unique beauty in the central area of the Campus I, where the users may perceive several examples of regional's flora mixed with exotic species, besides contributing to the improvement of the microclimate with a big and dense green area connecting several buildings.

By the analyzing the results, it shows that there is a big predominance of native species, in relation to the exotic, though it is verified that by the number of examples, the same level of relation is not always maintained. It is important to emphase that



Frame 1 Main tree examples of Block A of UPF’s Campus I, 2014. *Source* Authors, 2018

the Campus I’s native vegetation contains vegetation that needs special conditions of management and attention, being that they may be found in red lists, threatened of extinction.

It is also important to lay emphasis that many epiphytes species occur, such as bromeliads, orchids, besides the bryophytes, lichens and pteridophytes of different families, mainly bioindicators, which demonstrates the good ambient conditions of the area.

The survey identified that in the Campus I’s central area there is an example of Corticeira do Banhado, highlighting specially its inflorescence period, creating a scenic area of contemplation and preservation. This observation is valorized considering the threat of extinction of this example. The preservation of this example in the landscaping composition of the Campus allows the educational recognition, the appreciation of the vegetal heritage and the social responsibility (Figs. 14 and 15). Furthermore, this fact arises the curiosity of the passer-by by the flowering example and less known by most of the people, and could serve as a theme of an environmental education project.

It is also important to highlight the *Erythrina falcata* by its grandiosity and importance in the environment, constituting a reference that can be explored by spreading to the community, allowing the recognition of the native species.

Moreover the social role of this landscape, it is important to stand out that the richness of the species of different origins, the exotics (*Eucalyptus*, *Pinus*, *Cupres-*



Fig. 14 Location of the example of *Erythrina crista galli* in the area of the Zoo, Block N in UPF's Campus I, 2014. *Source* Authors, 2018



Fig. 15 Detailing of the Corticeira's flowers. *Source* Authors, 2018

sus, *Tipuana*, *Grevillea* and *Platanus*) and its respective ethnobotanical values, that adapted to the local climate conditions and integrated to the Brazilian species (*Handroanthus*, *Erythrina*, *Peltophorum dubium*, *Syagrus romanzoffiana*, *Phytolacca dioica* and *Araucaria angustifolia*). This coexistence shows the propriety of mixing examples in order to explore its benefits by different aspects and demonstrates that it is possible to work the changes that involve vegetation and sustainability of an area that represents culture, history and biodiversity.

5 Final Considerations

According to the survey of Flora's Monitoring of UPF's Campus I, the vegetation of the Campus meets its role in cultural, educational and historical preservation, keeping the regional and characteristic vegetation, as well as softening the climatic conditions of this space, maintaining the diversity of the species, contributing to minimize the visual impact of the constructed ambient comparing to the environment, and also to minimize noise and CO₂ emissions. This guarantees more comfort to the users of the area, meeting its social role and improvement of life quality.

In this sense, the paper reflect the valorization needs of green areas to the contribution for a better environmental quality of the college education spaces and its direct linking with the apprenticeship for sustainability.

Therefore, as seen in the operating license, the survey indicated that inspections and annual assistance must be provided along with the respective reports, in order to allow guaranteeing the mitigation of environmental impacts and maintenance of the PPA's, imperious in this kind of activity.

It is also important to highlight the role of the vegetation and green spaces in the university campuses, not only as a factor of environmental quality improvement of these structures—either in aesthetic and landscaping terms, or in microclimate or urban effects, but also as an element of potential valorization of the vegetation in environmental education in the university and regional community, meeting the use of the Campus I as an urban park. Likewise, the green areas can be an example of a “live laboratory” contributing the learning process.

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