



The U.D.C.A. on the Road to Environmental Sustainability in Its Infrastructure and Environment

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Article Info

Received:

04 June 2024

Accepted:

18 June 2024

Published:

28 June 2024

DOI:

[10.14710/jsp.2024.24789](https://doi.org/10.14710/jsp.2024.24789)

Presented in the 10th International Workshop on UI GreenMetric World University Rankings (IWGM 2024)

Abstract. The Universidad de Ciencias Aplicadas y Ambientales U.D.C.A. has been walking a path from Sustainable Development to Environmental Sustainability, which is evidenced through initiatives in infrastructure and its environment, according to the Institutional Educational Project, which recognizes the Campus as a Living Classroom. In this opportunity, the process that is being advanced in terms of infrastructure and environmental management with three initiatives will be presented: 1. The U.D.C.A. environmental memory trail, an ecological trail under construction, which allowed articulating teaching, research, and social projection from a research seedbed of Environmental History, which collects environmental information related to biological, ecological and cultural aspects of the species of fauna and flora that are present on Campus. 2. The Tingua Refuge, an emblematic site of the University recognized for its conservation of wild species such as Tinguas and ducks, where classroom projects are being developed with students of the Environmental Analysis Technology program to measure the quality of the water as a first step for its ecological restoration process, to turn it into a bio-indicator of environmental health for the University. 3. The development of infrastructure as an axis of change toward the environmental sustainability of the University is part of the University's Infrastructure Master Plan, which defines the conditions under which the U.D.C.A. advances the necessary actions in environmental, urban, rural, and architectural aspects to adapt the academic spaces.

Keyword:

Sustainability, U.D.C.A., Infrastructure, Territory, Sustainable Communities, Environmental Report, Preservation.

1. Introduction

The Universidad de Ciencias Aplicadas y Ambientales U.D.C.A. is a private Higher Education Institution founded in 1983, which, since its inception, has established sustainability as a transversal and strategic axis in the fulfillment of its substantive functions and its administrative and environmental management. The University has seven faculties: Agricultural Sciences, Sciences, Environmental and Sustainability Sciences, Health Sciences, Legal Sciences, Administrative and Commercial Sciences, and Educational Sciences, offering undergraduate programs in Chemistry, Pharmaceutical Chemistry,

Business Administration, Public Accounting, Finance; Commercial Engineering; Marketing; International Business; Agronomic Engineering; Veterinary Medicine; Veterinary Medicine and Animal Husbandry in Cartagena and Bogotá; Animal Husbandry, Environmental Sciences; Geographical and Environmental Engineering; Environmental Analysis Technology; Sports Science; Nursing; Medicine; Professional Technician in Sports Training and Law. The postgraduate offer consists of two doctorates, one of them in Sustainability Sciences, seven master's degrees, five of them related to environmental management, fourteen on-site specializations, four distance learning specializations, one on-site and one distance learning specialization, and one medical-surgical specialization.

The University Community comprises 4,984 students, 508 professors, and 304 administrative staff. The main Campus is in Bogotá, in the north of the city, and two additional campuses are located at strategic points. There is also a campus in Cartagena, which has a total built area of 44,065 square meters and 84% green areas.

The harmony between society, the environment, and the economy must be a constituent part of every higher education project; for this reason, the U.D.C.A. adopts the 17 Sustainable Development Goals (S.D.G.s) in the University's work, indicating the unrestricted commitment to provide high-quality education, for the formation of global citizens who express their commitment to a more sustainable and equitable world.

The concept of sustainability appeared on the academic, scientific, and institutional scene when the ideas of having an inexhaustible nature broke down due to the conditions of the planet in the mid-20th century: accelerated atmospheric pollution, destruction of jungles and forests, loss of biodiversity, pollution and deterioration of rivers, increase in poverty, among other aspects [1]. The environmental crisis of the mid-twentieth century initiated the urgent need to find efficient and definitive solutions to this situation, "the environmental problem emerges as a crisis of civilization: of western culture; of the rationality of modernity; of the economy of the globalized world" [2], and it is with this panorama that the idea of sustainability arises, this subject has been talked about and discussed too much, and the look that has been given to it has also changed over the years.

There are various definitions and categorizations of sustainability. Let us begin with the weak and strong sustainability proposals [3]. The former is located within the mechanistic and reductionist paradigm, typical of the current economy, and proposes a subordination of the conservation of nature to economic growth [4], without incompatibilities between economic growth and conservation of natural capital, since it proposes that resources that are depleted can be replaced unlimitedly as long as technology evolves [5]. However, the principle of substitutability only sometimes works [6] because many natural ecological processes cannot be substituted. On the other hand, strong sustainability is defined as the viability of the relationship between a socioeconomic system and an ecosystem, being fundamental to the interaction between the two dynamic systems [7]. Finally, the view of Sustainable Development given by the United Nations generates a concept of integral sustainability, where ecological, social, and economic sustainability is articulated and interrelated; some authors [8] consider that these types of sustainability should be constituted in three irreducible dimensions of a single concept.

Other authors have put forward three perspectives to understand it. The first is a social and political project of humanity, which is indirectly assumed as a synonym of the concept of Sustainable Development [9]. The second is the balanced relationship of human beings with their environment (social, economic, and environmental) [10]. Moreover, the third phenomenon can be observed in specific socio-ecological systems [11] [12]. In this third

perspective, the authors propose that sustainability is understood as the socio-ecological resilience of the system itself, understanding it as the capacity of systems to self-organize adaptively, to arrange socio-ecological interactions to face and buffer disturbances, and maintain their essential attributes; therefore, it would be concluded that systems are sustainable when they are resilient [13].

At the Universidad de Ciencias Aplicadas y Ambientales U.D.C.A (from now on used U.D.C.A.) considers sustainability to be the balanced relationship of human beings with their environment (social, economic, and environmental). This is in accordance with the Institutional Educational Project [14], which recognizes the Campus as a Living Classroom.

Higher Education Institutions have formed citizens with competencies that contribute to constructing a better planet. Since the nineties of the twentieth century, "this great phenomenon of integral and global transformation has been taking place, involving all types of actors, dimensions, and aspects, both epistemological and cultural, economic, political, axiological or organizational, to mention some highly significant ones" [15]. This has generated transformations and redefinitions in their functions, objectives, and organizational structures. Thus, university networks have been created to make the transition towards sustainability, such as the Global Higher Education for Sustainability Partnership (G.H.E.S.P.), the International Association of Universities, the Association of University Leaders for Sustainable Future (U.S.L.F.), the Copernicus-Campus University Network for Sustainability, the Global Universities Partnership on Environment and Sustainability (G.U.P.E.S.); the Alliance of Ibero-American Networks of Universities for Sustainability and the Environment (A.R.I.U.S.A.); the Promotion of Sustainability in Postgraduate Education and Research Network (ProsPerNet); and Mainstreaming Environment and Sustainability in Africa (MESA), among others; all recognized by UNESCO.

Other authors [16] propose that Universities should carry out educational activities to generate the transition towards sustainability, among which they highlight: a) build a new model based on the principles of sustainability, b) understand the connection of environmental, social, economic and cultural processes from complexity and an interdisciplinary approach; c) know the local and global socio-environmental problems and their relationships (systemic vision); d) train to analyze socio-ecological conflicts, in the debate of alternatives and individual and collective decision making; e) favor the extension of "good sustainable practices" in different contexts and cultures.

This article will present the experience that U.D.C.A. has been developing for some years to become a Sustainable University, not only because it is necessary to do so given the moment we are going through but also because we are within a strategic territory for the sustainability of the city of Bogotá Capital District, the Borde Norte, a complex territory that houses essential ecosystems for the city such as wetlands, the eastern hills, and the Bogotá River.

2. Theoretical Approach/Methodology/Scenario

The process being developed by the U.D.C.A. in terms of infrastructure and environmental management will be explained with three initiatives: 1. The environmental memory trail U.D.C.A., an ecological trail under construction, which allowed articulating teaching, research, and social projection from the research group "Environmental History" and which collects environmental information related to biological, ecological and cultural aspects of the species of fauna and flora that are present on Campus. The Tingua Refuge, an emblematic site of the U.D.C.A. recognized for its conservation of wild species such as

Tinguas and ducks where we are developing through classroom projects with students of the Environmental Analysis Technology program the measurement of water quality as a first measure for its ecological restoration process, to turn it into a bio-indicator of environmental health for the University. 3. Infrastructure development as an axis of change toward environmental sustainability is part of the University's Infrastructure Master Plan, which defines the conditions under which the U.D.C.A. advances the necessary actions in environmental, urban, rural, and architectural aspects to adapt the academic spaces. Likewise, and in articulation with this Plan, the Sustainable Campus Strategic Project is framed in the Institutional Development Plan 2024-2028.

In the three processes that have been developed, the general methodology has been Participatory Action Research (P.A.R.), as it seeks to recover the knowledge and experiences hidden in the communities. It is based on the social construction of knowledge, i.e., with the participation of the community, who finally generate knowledge for the recognition and appropriation of the territory [17]. However, each experience has had particular methodologies that have allowed the development of successful processes.

The first experience, the U.D.C.A. Environmental Memory Trail, is being developed in phases. In the first phase, the trail was diagnosed in the field to determine the best design to develop. Primary and secondary sources related to the project theme were consulted to generate a wealth of information for each of the proposed stations. This work was coordinated and developed with the students participating in the Environmental History Seminar of the Environmental Sciences program. In the second phase, the thematic spaces were designed through consultation meetings with the Academic Subsystem, the Directorate of Planning and Development, the Integrated Environmental Management System S.I.G.A. and the Directorate of Management of Information Technology and Communications I.C.T., in order to trace the route of the trail, locate the spaces where the thematic stations that provide information for visitors to the trail will be adapted and generate the design of the Web page where the Q.R. codes of each station will be directed. The last phase includes the projection of a monitoring and follow-up plan, from the collection and analysis of data and information to verify that the project meets the proposed objectives and that it responds to the environmental needs that will identify the U.D.C.A. and its evaluation depends on making improvements or corrections to situations that arise.

In the case of El Refugio de la Tingua, water sampling was carried out through point surface and depth water samples taken on-site in the field at four points zoned about the wetland area identified as samples Refugio de la Tingua (M.R.T.), which were typified with the following acronyms: MRT_1, MRT_2, MRT_3, and MRT_4. Sampling of direct parameters in the field (in the field) in the intermediate zone of the lake typified as MRT_0 through a probe with multi-parameter equipment (Image 1). Finally, in the development of infrastructure as an axis of change towards the environmental sustainability of the University, part of the University's Infrastructure Master Plan, which defines the conditions under which the U.D.C.A. advances the necessary actions in environmental, urban, rural, and architectural aspects to adapt the academic spaces. The Plan is based on a respectful vision of the environment and the location of the academic spaces and is in coherence with the University's Environmental Policy; for this reason, the remodeling that is carried out has the best environmental and comfort conditions, taking into account the following design parameters: water, materials, energy, and responsible and sustainable purchases.



Figure 1. Location of sampling points at Refugio de la Tingua. Source: Faculty of Environmental and Sustainability Sciences, 2023.

3. Results/Discussions/Implementation

3.1. Environmental Memory Trail U.D.C.A.

It is an environmental trail under construction, which has allowed us to articulate the teaching, research, and social projection processes from the research group "Environmental History." This trail gathers information on biological, ecological, and cultural aspects of the Campus's most representative species of fauna and flora. The trail consists of 14 main stations and 15 points with Q.R. that will take the visitor to a page where all the information on the trail can be found.

The design revolves around the relationship between society - culture - and nature. In this same sense, it is proposed that our cultural tradition has built an image of life where nature is separated from culture and the mind from the body, which is reinforced by the belief that nature is outside of us and is an independent element. He underlines the mistake made by separating nature and culture in any vital process involving human beings; this rejection of this separation led him to propose that between mind and body, there is a single sacred and indissoluble unity, "the supreme unifying beauty" [18]. Nowadays, nature has become an object of appropriation and exploitation, thus generating environmental conflicts: nature is in dispute [19].

Considering the above, this trail allows the university community of the U.D.C.A. to access environmental knowledge to strengthen environmental thinking that leads to a new relationship with nature. By knowing a territory and knowing the biodiversity it possesses and the ecological and cultural importance of each species, the university community can begin to redefine its relationship with nature to understand the importance of other species for our sustainability, given that we are all part of this network called the environment. This path is a strategy to learn to live in harmony with other living beings, as the Good Living proposal proposed. This initiative is even more critical for the U.D.C.A. because we are located in a territory where we are part of the Productive Forest Reserve of the North Thomas van der Hammen, and it is an institutional responsibility to contribute to the

conservation of sustainable territories.

The trail was consolidated from a systemic perspective, with a central perimeter axis and interconnections to some sites inside the UniversityUniversity, to demonstrate the importance of the interrelationships between elements of a system, which for this trail will be fauna and flora. At this point, we have taken up the complex environmental view [20] that proposes a look toward the emergence and construction of a concept of environment that redefines the conceptions of progress, development, and unlimited growth to configure a new social and environmental rationality, which is reflected in the field of production and knowledge, politics and educational practices. Each station presents biological, ecological, social, and cultural information on the species and the threat category. The development of the trail has been carried out in phases. In the first phase, the species to be worked on were chosen because they represent the Campus's biodiversity. The joint construction of the document presents the theoretical information from the consultation of primary and secondary sources that allows the development of each station. This exercise allowed the articulation of teaching, research, and social projection with the students of the mentioned research group, which has generated positive effects on their formation as future environmental professionals.

The collective result of this process is the publication of a booklet (Figure 2), authored by the students of the Environmental History workshop, which provides information on the different stations. The fauna species chosen were the bee, the opossum, domestic animals including dogs, cats, horses, cows, and poultry (this station is a tribute to the work done for 41 years by the Veterinary Medicine and Veterinary Medicine and Zootechnics programs), the green-billed tinguia (environmental symbol of the UniversityUniversity), the savannah frog, the ladybug, the tufted duck, the hummingbird and the savannah snake. The species of flora chosen were the Chicalá, the Romerón pine (environmental symbol of the University), the thymus or bracero, the walnut tree, and the guayacán. In the additional stops with Q.R. codes, the community will find historical information related to the territory of the Borde Norte, the Torca Guaymaral wetland, the Reserva Forestal Productora del Norte Thomas van der Hammen, and the pre-Hispanic hydraulic systems of the Muisca culture, in order to expand knowledge about the territory from the perspective of environmental history.



Figure 2. Tingua de pico verde station.
Source: U.D.C.A. Environmental Memory Trail Booklet (2023).

In the second phase, the design of each thematic space was carried out in consultation with other university processes, such as the Academic Subsystem, the Planning and Development Department, the Integrated Environmental Management System S.I.G.A. (by its Spanish acronym), and the Information and Communications Technology Department T.I.C. The trail route was traced, and the spaces were the thematic stations that provided information for visitors and where the Q.R. codes would be located. Work on the web platform will house the trail's information, accessible through the Q.R. codes. The last phase, monitoring and follow-up, includes the design of a monitoring and follow-up plan, which will be carried out when the trail is built and operational.

This project was framed within the framework of the I.A.P., where students of the Environmental History research group actively participated in searching for information and constructing the document. This initiative allows us to generate a social appropriation of knowledge. However, it also becomes a strategic space for induction days, where new students learn about the territory and biodiversity present on Campus. The goal is to strengthen knowledge and environmental thinking that contributes to forming professionals with an environmental stamp.

3.2. Tingua Refuge

It is an artificial wetland built in 1990; it became an emblematic site of the University, recognized for its conservation of wild species such as the red-billed gull (*Gallinula galeata*), green-billed gull (*Gallinula melanops*) and domestic ducks (*Cairina moschata domestica*), and sometimes migratory species such as the blue gull (*Porphyrio martinica*). For the past year, classroom projects have been developed with the Environmental Analysis Technology program students to measure water quality as a first step in ecological restoration and turn it into a bioindicator of environmental health for the University. The impact that this initiative has generated is significant in forming the students of the Environmental Analysis Technology program because it has turned the Campus into a Living Classroom that allows opening spaces for environmental practices beyond the laboratories. It allows approaching the environmental reality in a more direct way, where the results of the classroom projects serve as inputs to nurture the Action Plan we have on the Tingua Refuge and contribute to the process of turning this space into a bioindicator of Institutional Environmental Health (S.A.I.) (by its Spanish acronym).

Environmental health is conceived as a state of complete equilibrium between a given space's physical, biological, and human factors [21]. This balance is prone to imbalances that generate undesired impacts on the environment; thus, understanding the need to establish the harmony of each element, whose variables become bioindicators of a geographic space. The environmental variables that describe the behavior and environmental quality are translated into concrete indicators such as air pollution, water and basic sanitation, chemical agents, radiation, environmental noise, and changes in the environment in general that lead us to configure an in situ state of what is expressed in the Agenda 2030 of the United Nations as Sustainable Development Goals. In recent years, environmental health has acquired a singular relevance, mainly from the political sector, which has had repercussions within public and private institutions. In Colombia, the National Institute of Health has developed studies on environmental health in the country. It estimates that 8% of deaths (about 17,549) in Colombia were related to environmental factors for the year 2016. Indirect costs related to the loss of productivity due to deaths occurring before reaching life expectancy represented 585,476 million pesos; of these, about 451,862 million are due to air quality, mainly due to exposure to particulate matter 2.5, followed by water and other

environmental risk factors.

The measurement of variables and indicators will be done through practical exercises from the different related academic courses offered by the School of Environmental and Sustainability Sciences, which will allow for the continuity of biannual and annual measurements, the creation of environmental statistics, the increase of academic practices, interdisciplinary work and the strengthening of the institutional environmental identity. The products expected to be derived from these measurements and follow-ups would be: - diagnoses of the state of Environmental Health of the Tingua Refuge, Environmental Statistics bulletin, and research projects associated with the research seedlings of the faculty of Environmental Sciences and Sustainability.

Currently, a study of the social representations of the university community of the U.D.C.A. about the Tingua Refuge is being carried out to strengthen the actions being developed regarding this space that generates institutional identity.

3.3. Infrastructure development as an axis of change towards sustainability.

U.D.C.A. is committed to advancing toward sustainable and inclusive development aimed at preserving the environment, improving training activities, production, dissemination, and use of knowledge, science, technology, and innovation, with social relevance; for this reason, and our imminent commitment to contributing to the 2030 Agenda, the U.D.C. By its strategy and institutional perspective identified in its Institutional Development Plan 2024-2028, The U.D.C.A. by and for Sustainable Development, the interrelation and contribution to the 17 Sustainable Development Goals from its academic, financial, and administrative actions. The development of infrastructure as an axis of change toward the University's environmental sustainability is part of the University's Infrastructure Master Plan, which defines the conditions under which the U.D.C.A. advances the necessary actions in environmental, urban, rural, and architectural aspects to adapt the academic spaces. The institutional objective is to continue to ensure the growth and modernization of the Campus, planning, designing, and executing physical infrastructure projects within the framework of a master plan for integrated architectural development that has been implemented since 2022, with a new urban design, inclusive and responsible with the ecosystem, designed to offer new academic, administrative and welfare areas that will serve the development of the University.

U.D.C.A. Campus has 17 hectares and is surrounded by one of the most important ecosystems for the country's capital, the Torca Guaymaral wetland. In turn, it is immersed in the Productive Forest Reserve of North Thomas van der Hammen, decreed as such in 2011 by the Regional Autonomous Corporation of Cundinamarca C.A.R., is a protected area of 1,395 hectares, which is part of the Main Ecological Structure of the Capital District, which allows the university community, enjoy a unique environmental setting that is also the subject of their research and preservation efforts by the University. This situation demands architectural planning that guarantees the care of the natural resources present in the academic space. However, it also indicates that the Campus is a Living Classroom for the development of academic, research, and cultural activities required by the students to advance their training process. In this sense, seven outdoor learning spaces have been implemented, which favor the use of the green area of the Campus, as well as pedagogical innovations in the classroom.



Figure 3. Main Campus. Source: Communication unit

Likewise, by the second year of execution of the Master Plan, the "Green and Sustainable Campus" project has been defined in articulation with the Institutional Development Plan, which contemplates actions for the mitigation and adaptation to climate change and the efficient use and saving of campus resources, in this sense, initiatives aimed at establishing a Sustainable Infrastructure have been promoted. We adopted our physical plant so that all people can arrive, enter, use-socialize, and leave (even in emergencies) our infrastructure in conditions of safety, comfort, equity, and with the most significant possible autonomy, intervening 75m² with accessible ramps, stairs, and the renovation of 8 bathrooms that allows the care of water with recycling systems in toilets and sinks that rationalize the use of the resource.

In July of this year, 478 solar panels will be installed on roofs; the buildings to be intervened are the Laboratories, where academic practices are performed; the Health Sciences Building-Q, where 16 classrooms operate; the human amphitheater and in Block O, where 35 administrative offices, 12 classrooms, the library, the institutional gym and study areas are concentrated to integrate the use of renewable energies that support our environmental work.

4. Conclusions/Summary/Future Perspectives

The U.D.C.A. has a significant commitment to environmental sustainability, which is evidenced in the proposals presented that contribute to the training of professionals with environmental seal and the consolidation of a sustainable campus, which are in line with the conservation of the territory where it is located, an environmentally strategic area for the city of Bogota, the Northern Border that has the Northern Productive Forest Reserve Thomas van der Hammen and the Torca Guaymaral wetland. U.D.C.A. not only generates an environmental education for its students but also contributes with concrete actions to the sustainability of the territory by conserving spaces that would avoid conurbation processes with the northern municipalities, also because it would generate an ecological corridor between the reserve of the eastern hills and the Bogotá River in the west of the city, which would generate environmental benefits for all the inhabitants of the Capital District.

The institutional interest of the U.D.C.A., which has been raised for several years in contributing to universities' reflection on how to contribute to the 2030 Agenda, has continued. We are aware that these times require more and more proactive work to position this debate in the spaces of discussion traditionally appropriated by the States. Therefore, we appropriate the concept of sustainability so that from different points of view, it is possible to think about Education for Sustainable Development.

From U.D.C.A., we can talk about the main lessons learned in developing the proposals related to the Environmental Memory Trail and the Tingua Refuge. To date, it has been a successful experience of being able to articulate the fundamental pillars of teaching, research, and social projection in the framework of a research seedbed and the subjects of the Environmental Analysis Technology program. This has allowed a continuous learning process in the students, consolidating formative research from the first semesters and generating an immense contribution in the process of consolidation of the University as a sustainable campus and a Living Classroom that contributes to the teaching-learning processes of its students, but also in the conservation and protection of the biodiversity of an environmentally strategic territory for the city.

In converting the University into a sustainable campus, articulating academic, research, and social projection processes with the generated infrastructure projects is fundamental. The above shows the importance of generating a vision of transversal sustainability in the University, which permeates all the processes developed based on a strategic planning model that puts sustainability at the center of the University's strategy. This is the only way to achieve success in a process that must be continuous, articulated, and known by all levels and actors who participate in university life.

The U.D.C. A has adopted constructivism as its pedagogical model, where the student is responsible for his or her learning and where professors guide the academic activities that allow for achieving the learning objectives; in this model, knowledge is built and additional to the existing one from this point of view the approach of the Participatory Action Research I.A.P. that has been developed in some Sustainability projects allows the university community with its knowledge to promote and feed the actions of improvement and growth that the Campus needs on the road to sustainability. Thus, the consolidation of our institutional seal is strengthened: the environmental. We reaffirm that the U.D.C.A. promotes the collegiate spirit for its decisions and, in that sense, reaffirms that the infrastructure of the University must be analyzed and connected to the environmental realities and the conservation of the surrounding environment.

We understand that everything must be understood from a systemic approach, understood as a system that studies the parts and the whole in turn, but above all that focuses on the functions of the parts of the system and their interactions, as well as the environmental circumstances in which the system is immersed. It is based on four fundamental concepts: the interaction between the elements of the system; the totality because the whole is more than the sum of its parts, and these act synergistically, the organization that denotes permanence or stability for it to function and the complexity because it is composed of a variety of elements that have special functions, there are internal hierarchical levels of organization, which are linked by a variety of relationships and interactions that are not of a linear type [22]. Therefore, our projects to address sustainability involve all levels and processes of the university community.

In line with the Sustainable Development Goals, it is necessary to start generating sustainable and resilient cities. Thinking and acting sustainably on the construction and

reorganization of cities guarantees citizens a decent quality of life and that they are part of the productive dynamics of the city, generating greater shared prosperity and social stability without harming the environment. Moreover, in this case, Higher Education Institutions can contribute by converting our campuses into sustainable spaces that become Living Classrooms to generate environmental knowledge and strengthen environmental thinking in our university community.

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