# The Challenge of drought in Costa Rica: A Preliminary Research with Economic Implications

ROXANA DURÁN SOSA Universidad Nacional-CR. Heredia. COSTA RICA

RUI ALEXANDRE CASTANHO Faculty of Applied Sciences, WSB University 41-300 Dabrowa Górnicza POLAND and College of Business and Economics, University of Johannesburg PO Box 524, Auckland Park SOUTH AFRICA

> GUALTER COUTO School of Business and Economics and CEEAplA University of Azores 9500-321 Ponta Delgada, Portugal PORTUGAL ORCID: <u>https://orcid.org/0000-0001-5560-5101</u>

*Abstract:* In recent decades, Costa Rica has been characterized by the expansion of the forested frontier. More than half of the national territory has forest cover. Despite this, severe drought phenomena in the country compromise the stability of productive units and ecosystems. This article aims to contribute to the approach to drought control. The forest, precipitation, and land use relationship are presented as an alternative modeled by indigenous peoples. For this, an exhaustive review of bibliographic material, databases, and others was carried out. An interactive approach is made between the resources and natural phenomena and the forest linked to the philosophy of the native peoples. All this is part of the reflective analysis method. Contextually, the conclusions are: (i) Despite the expansion of the forest cover, the country has levels of precipitation that tend to decrease; amd (ii) Economic implications in agribusiness caused by droughts.

Key-Words: Forest, Indigenous Populations, Precipitation and Drought, Sustainability.

Received: June 27, 2021. Revised: February 15, 2022. Accepted: March 24, 2022. Published: April 8, 2022.

### **1** Introduction

Costa Rica has a population of 5,111,238 inhabitants, of which 4,426,648 (over 12 years) reside in the Central region 2,778,083, being the one with the highest concentration of population, in the Central Pacific there are 253,490, in Brunca 312,794, in Huetar Caribe 381,675, in Huetar Norte 345,671, in other countries 17,682. The residence 735 is unknown (see figure 1) [1]. This distribution reveals the concentration of the population in the urban area, which creates greater pressure on environmental services, such as water and land use. This growth has demanded the construction of access roads, conglomerates of residences, and infrastructure such as sanitation. The increase in population and the demand for public and private infrastructure have impacted forested areas throughout the national territory. The human development index is 0.794 as of 2018 and is ranked 68 worldwide [2]. Once more, we should highlight that this

distribution reveals the concentration of the population in the urban area, which creates more significant pressure on environmental services, such as water and the use of the territory.



Fig. 1: Costa Rica: Residence of the population over 12 years of age by region, 2021 (%). Source: INEC [1].

On the other hand, five self-defining groups have been registered by ethnicity: Afro-descendant or Black (a) with a total population of 45,228, native peoples (indigenous) with 104,143 people, 289,209 mulattoes, 9,710 Chinese (a), and 3,597,847 White (a) or mestizo (a). However, a no less critical number of people belong to another, none of the undeclared group, whose figure reaches 256,115 [3].

It is essential to highlight that the coexistence of ethnic groups shares the peaceful vision of the republic with the abolition of the Army in 1948 (The Founding Board of the Second Republic, 1949) [4]. For this reason, it can be affirmed that the natural resource, since that time, has not been a battlefield. Since that year, there has been no largescale destruction of nature for war reasons in the country, and this event has allowed savings since it is not invested in the Army but education and the environment [5].

Thus, it is worth noting that ethnic groups have their own cultural principles when interacting with the environment. For this reason, it is necessary to understand that the relationship with the forest determines its protection, development, or extinction. Also, it is urgent to mention that the destruction of the forests does not come from a single ethnic group, but rather that the ethnic groups could contribute in very different ways to protecting the environment. Other factors that intervene in the protection and conservation of forest areas include the conceptualization of forest and environmental jurisprudence.

Therefore, it is worth mentioning that Costa Rica has 52% of the territory with forest cover [6]. This

coverage is understood as: "Forest is an area of land with a minimum size of 1.0 hectare, with a canopy (crown) coverage of more than 30%, with trees with a potential to reach a minimum height of 5 meters to its maturity in situ" [7]. Also, forests are considered closed formations of trees of various strata, understory, and stands that meet the height of 5 meters and canopy coverage of 30%. The paramos, natural grasslands, and African palm plantations are not included as forests [7]. The national territory has 33 Protective Zones, 51 Wildlife Refuges, 29 National Parks, 12 Wetlands, 17 Forest and Biological Reserves, and seven that include Marine Management Areas, Absolute Natural Reserves, and National Monuments established in the National laws of the Republic of Costa Rica [2].

In addition to the aforementioned anthropological factors, it should be noted that the territory belongs to the Central American Dry Corridor (CSC) characterized which is by extreme hydrometeorological events (droughts) that negatively affect productive and populated systems [8]. Within the CSC fringe, a high vulnerability to drought can occur [9]. What impacts agricultural and livestock areas, especially basic grains and cattle [9].

The relevance of this type of research lies in bringing to the discussion about the models of interaction of native peoples with the environment to address the challenge of drought. For this, a recount of the current production model in the agricultural sector is made since it is one of the sectors most affected by the cyclical phenomenon of drought. It is concluded that one production model or another contributes more to facing the drought's challenges. However, a varied panorama is presented to be considered in future research.

### 2 Materials and Methods

For the reflective construction on the drought and the challenges that it implies, the methodological approach begins with the deconstruction of the parameters binding to this natural event. The relationship between forest, climate, precipitation, use of natural resources, and demand is analyzed and exercised by the developed towns and economic activities.

The analysis method is based on the review of bibliography, news, maps, databases, among others, which were selected under the premise of the exact interrelation of the data. In addition, the set of elements that make up the causes and effects of drought is recreated.

The various natural elements that contribute to drought control are analyzed along the same lines. Thus, the main actors to exercise drought control and the current proposal are presented. Finally, the data presented show the values for each of the challenging actions on the drought issue. In fact, these data try to explain the reality of the relationships and the result of the absence or not of actions carried out in the country.

### **3 Results**

For Quesada-Hernández, Hidalgo, and Alfaro [8] it is essential to define the drought. These authors point out that the severity of the phenomenon is related to the duration, affected area, soil characteristics, time of year, human activities, demand for water resources, frequency, and intensity. In general, droughts are measured by precipitation, temperature, evapotranspiration, and soil moisture [8]. However, it is of utmost importance not only to incorporate the historical physical records, but it is also urgent to incorporate, in the comprehensive analysis, aspects of the environmental, social, and economic impact caused by a phenomenon of this type.

As a result of this phenomenon, which has the Niño-Southern Oscillation (ENSO), La Niña, the Low-Level Jet of the Caribbean, and other climatic processes [9], the most affected region is the North Pacific. In 2006, droughts caused losses of 107,553,826 million dollars (USD), representing

5.9% of the total national losses due to extreme natural events and natural disasters [10].

Between 2017-2018, the rainfall reported by the stations located in Linda Vista (Guarco) and Buenos Aires (Pindeco) has decreased, 8% and 5%, respectively. Between 2018-2019, 8.9% (Linda Vista, el Guarco) and 21.5% (Buenos Aires, Pindeco) continue with the same downward trend. The Juan Santamaría, San José (IMN), and Turrialba Airport stations show an oscillating behavior; However, the general trend is down compared to 2017, in which the precipitation data have been higher [11].

The Juan Santamaría Airport, in the period 2017-2018, reduces by 49%, and between 2018-2019, it increases by 56.5%. However, the amount of rainfall in 2019 (1681.2 millimeters) is lower than in 2017 (2105 millimeters). The San José station (IMN), between 2017-2018, decreased by 47.2%. On the contrary, between 2018-2019, it increased to 39%, but the rainfall in 2019 (1873.4 millimeters) did not reach the total of 2553.2 millimeters reported in 2017 [11].

Another station that presents the same phenomenon is Turrialba, the data for 2017-2018 indicates a decrease of 11.6%, and for 2018-2019 it increases by 15.9%; However, in 2019, rainfall is lower (2239.5 millimeters) compared to 2017 (2387.4). It is important to note that of 7 stations with data recorded from 2017 to 2019, six do not reach the level of 2017 (comparing the years 2017 and 2019) [11].

On the contrary, the Limón (Airport) and La Selva (Sarapiquí) stations report a similar behavior to the previous ones, but with the difference that the measurements of 2019 compared to those of 2017 exceed those of this year. Limón (Airport) decreases rainfall by 23.8% in the 2018-2019 period, but the total rainfall for 2019 (3591.7 millimeters) exceeds that of 2017 (2418.2 millimeters). Similarly, La Selva (Sarapiquí) decreases from 2018 to 2019 by 22.6% but compared to 2017 (3482.9 millimeters), 2019 (4225.1 millimeters) is higher, which indicates that this area is the only one in the country with this particular behavior [11].

The Ciudad Neily station (Coto 49) reports a decrease in rainfall in 2017 (6857.6) compared to 2019 (4919.6). Moreover, the Puntarenas and Pacayas stations register data only for 2019, 1223.4 and 1848.2 millimeters, respectively (see figure 2). It is essential to highlight that the absence of data in the stations of Puntarenas, Pacayas, and Ciudad

Neily (Coto 49) limits the total comparison by periods. It is worth mentioning that rainfall that tends to fall does not represent a drought in the territory; however, special attention should be paid to this trend [11].

According to the National Meteorological Institute (IMN) and the Regional Committee for Hydraulic Resources (RCHR) [13];in fact, there is an increasing trend of extreme dry events (see figure 3).



Fig. 2: Costa Rica: Annual precipitation, according to the season, 2017-2019 (in millimeters). Source: Based on the data of INEC [12]. \* The data for the Puntarenas station, to date, is not complete. \*\*\*\* The Pacayas and Ciudad Neily stations have months with missing data. \*\*\* For 2019, the Juan Santamaría and Limón Airport stations correspond to stations 84233 and 81013, respectively.



On the contrary, the forest cover of different types is composed of the mature forest representing coverage of 1,548,583.38 ha, followed by grass with 1,219,425.65 ha trees; the secondary forest has an area of 940,820.31 ha; there are 74,596.85 forest plantations (see figure 4) [14].



Fig. 4: Costa Rica: Type of Forest in hectares (Ha). 2015. Source: Adapted from *Programa REDD/CCAD-GIZ - SINAC* [14].

Suppose the relationship between precipitation and forest cover is taken as a basis. In that case, it could be considered that the Atlantic area of the country does not have drought problems and, on the contrary, the northern area has the most significant droughts.

The challenge of drought in the country is associated, in part, with the significant changes throughout national history in the agricultural sector due to institutional policies and the behavior of the national and international market. Regarding institutional policies, the sector's increased agricultural productivity has been promoted through value-added programs.

It should be noted that the cultivation and export of bananas, pineapple, African palm, and coffee account for 48.5% of the added value in the sector [15]. Therefore, any hydrometeorological event directly affects the national economy, as happened in 2015 when the sector's contraction occurred mainly due to these events [15].

Despite the fact that between 2014 and 2017, an average of 1 304 558 million colones was allocated in both sectors, even though there have been critical natural phenomena such as: "(...) drought in the Pacific, floods in the Caribbean, eruptions of the Turrialba volcano, Hurricane Otto and Storm Nate" [15].

In addition to the presence of droughts and the characteristics of the soils, mainly sloping land, and physical and chemical aspects [9], the lack of technology makes it difficult to diversify production systems, limiting competitiveness in international markets [9].

In a Senara report [16], it is stated that "climate change generates water scarcity in Guanacaste," and Miranda [17] underlines that "Central America is only responsible for 0.5% of greenhouse gas emissions and the region it is considered one of the most vulnerable to the global environmental crisis" and with the problem of food security [18]. It should be noted that experts from the UCR affirm that the province of Guanacaste, in which critical agricultural activities are carried out, is drier than the rest of the Central American countries that belong to the CSC [19]. In summary, "climate change has direct and indirect impacts on ecosystems and biodiversity" [20].

To address the drought in Guanacaste, the State has developed the Arenal Reservoir with which the dry areas of the region are irrigated. Currently, "(...) the waters from the Arenal reservoir are used three times by the Costa Rican Institute of Electricity (ICE) for electricity generation, to later be used for agricultural irrigation in the cantons of Liberia, Cañas and Bagaces" [16].

On the other hand, Muñoz and Nicaragua relate the drought problem to the lack of systems for improving land use. This is due to communication and information systems shortcomings, combined with the digital literacy gap [ twenty-one]. In this sense, the lack of knowledge of the impact generated by the alliance of agribusiness with the oil and chemical industries, which "offers food at low prices but with 'enormous' ecological, economic and social externalities" [22].

As a reflection to address the challenge of drought in the country, it not only requires investment in infrastructure for irrigation, investment in production processes and international markets in the agricultural sector, improvement in land use, or recognizing the gaps in the communication and information system. The challenge of the drought in Costa Rica lies in recognizing the dynamics of the CSC to guide sustainable development policies.

# 4 Discussion

Based on the impact of the drought, the discussion precisely includes all sectors, since, when one link of the production system is affected, the rest suffer the impact, in some cases such as water supply, production costs increased considerably. In others, such as the impact produced by burning due to droughts, it is invaluable from the loss of ecosystems.

Other factors can alter the impacts that drought brings, such as population growth or territorial development policies. As the population increases, the pressure on the water resource is more significant, while the demand for drinking water and the need for environmental sanitation systems increase.

On another line, drought can be controlled by expanding forested areas. Given this statement, the UN highlights that the best managers of forests in Latin America are indigenous peoples [23].

In Costa Rica, the population of native peoples is made up of 8 indigenous peoples (Bribris, Cabécares, Borucas or Bruncas, Chootegas, Huetares, Malekus or Guatusos, Ngöbes or Guaymíes, Térrabas or Teribes) and they have 24 indigenous territories distributed throughout the country [24]. It is determined that most of the territory is located in the southern zone (see figure 5).



Fig. 5: Costa Rica: Indigenous territories in 2011. Source: INEC [25]

The basic principle of caring for the forest is education, in other words, the ability to transmit the value of forest conservation from generation to generation: "Our grandmothers kept telling us that if we did not take care of her, Iriria would get sick. That is what is happening outside our territories", comments Edith Villanueva Reyes, one of the leaders of the Association of the Commission of Indigenous Women of Talamanca (Acomuita) [26]. This development of training capacities has allowed indigenous peoples to implement sophisticated conservation and interaction systems with the forest and ensure the very existence of the population. The conception of natural resources transcends the extractive and exploitative approach of resources, their value, perhaps not found in commercial principles but the essence of preserving the ecosystem and the environment as a whole Another activity that has been implemented in the country is reforestation. Through the Payment for Environmental Services (PES) project, the country has increased the amount of forest cover in the Territory (see figure 6).



Fig. 6: Costa Rica: Map of Payment Projects for Environmental Services in 2012-2018. Source: BioCosta Rica [27].

The increase in coverage areas in the territory has had positive results; however, it is not enough to correct the problems of droughts in the national territory. The productive sectors such as agriculture, livestock, and aquaculture require strategic and contingency plans to address the environmental, economic, and social risks that the phenomenon of drought brings with it. These plans must strengthen the value-added chains and their differentiating attributes to develop the proposed strategic plan.

### **5** Conclusions

The conviction that the environmental policy regarding the increase of forest cover has left tangible results, such as the territories dedicated to reforestation, conservation, protection, and recovery of wildlife refuge areas. However, the challenges of decreasing rainfall in most of the country and the presence of more extended periods of droughts are urgent to be incorporated into national sustainable development agendas.

Another element that must be taken up promptly is the production chains, which must be attended to integrally. For this, it must be provided with the necessary resources to accompany it in the application and adoption of sustainable production systems.

# 6 Study Limitations and Prospective Research Lines

This research advances our knowledge and sensibility about this global relevant issue - once it directly influences the territory of Costa Rica and indirect impacts worldwide due to the critical ecosystemic role in the world's biodiversity. Nevertheless, and bearing in mind that the current work is only preliminary research, several research prospects remain. In this regard, for example, if more advanced statistics were used, the results could be more exciting and accurate. Also, if more variables and different fields within the sustainable development [28-40] concept were considered, a better view we obtain over all these issues impacts.

Nevertheless, future lines of research must necessarily consider the social, political, and natural aspects to carry out the comprehensive analysis required by the challenge of drought. It is impossible to understand drought only as a phenomenon that occurs in the CSC; it is essential to recognize the presence of the human being and the natural baggage that interacts on the site. Likewise, it is crucial to rethink the possibility of carrying out research in maritime-terrestrial areas, which are already affected by droughts. It is also correct to discuss the current and future resources to face the drought. As final remarks, similar studies should be carried out in other territories and geographies to allow some comparisons between countries; therefore, it will enable to find common solutions regarding this increasing problem easily.

#### References:

- [1] INEC. (2021). ENAHO 2021. Población de 12 años y más por región de residencia hace dos años según región de residencia actual, sexo y edad y otros. Online at <u>https://www.inec.cr/</u>
- [2] INEC. (2020). Costa Rica en cifras. Costa Rica: Instituto Nacional de Estadísticas y Censos. Online at https://www.inec.cr/sites/default/files/documet os-biblioteca-

virtual/recostaricaencifras2020\_0.pdf

- [3] INEC. (2011). Censo Nacional, República de Costa Rica. Online at <u>https://www.inec.cr</u>
- [4] La Junta Fundadora de la Segunda República .(11 de 10 de 1949). Decreto de Ley No. 749. la Junta Fundadora de la Segunda República. República de Costa Rica.
- [5] Regidor, C. (03 de 12 de 2018). ¿Cómo vive un país sin ejército? Costa Rica cumple 70 años sin él. Conmemoración- Costa Rica. Obtenido de https://www.france24.com/es/20181202no-ejercito-costa-rica-conmemoracion
- [6] Solano, G., Aguilar, L., & Lizano, M. (2018). Zonificación forestal de Costa Rica y estado Poblacional de especies forestales, basado en el Inventario Nacional Forestal e instrumentos de monitoreo y manejo de bosques naturales. Online at https://www.chm
- [7] MINAE. (2015). Cartografía base para el inventario forestal nacional de Costa Rica 2013-2014 (Vol. 1). Costa Rica: Ministerio de Ambiente y Energía,; Sistema Nacional de Áreas de Conservación.
- [8] Quesada-Hernández, L., Hidalgo, H., & Alfaro, E. (2020). Asociación entre algunos índices de sequía e impactos socio-productivos en el Pacífico Norte de Costa Rica. Ciencias Ambientales, 54(1), 16-32.
- [9] Calvo-Solano, O., Quesada-Hernández, L., Hidalgo, H., & Gotlieb, Y. (2018). Impactos de las sequías en el sector agropecuario del Corredor Seco Centroamericano. Agronomía Mesoamericana, 29(3), 695-709. doi:10.15517/ma.v29i3.30828
- [10] INEC. (2015). Estadísticas Clave sobre el Estado del Ambiente, Costa Rica 2015. Costa Rica: Instituto Nacional de Estadísticas y Censos.

- [11] Alfaro-Córdoba, M., Hidalgo, H., & Alfaro, E.
  (2020). Aridity trends in Central America. A spatial correlation analysis. Atmosphere, 11, 427. doi:10.3390/atmos11040427
- [12] INEC. (2019). Anuario Ambiental 2017-2019. Costa Rica.
- [13] Comité Regional de Recursos Hidráulicos. (2008). El clima, su variabilidad y cambio climático en Costa Rica. Instituto Meteorológico Nacional. Costa Rica: Comité Regional de Recursos Hidráulicos.
- [14] Programa REDD/CCAD-GIZ SINAC.
   (2015). Inventario Nacional Forestal de Costa Rica 2014-2015. Costa Rica: REDD/CCAD/GIZ y SINAC,Costa Rica.
- [15] SEPSA. (2018). Informe de gestión del sector agropecuario y rural (mayo 2014 – abril 2 018). Costa Rica. Secretaría Ejecutiva de Planificación Sectorial Agropecuaria, San José, Costa Rica.
- [16] Senara. (5 de Febrero de 2022). Senara Paacume Río Tempiisque. Obtenido de http://www.senara.or.cr/proyectos/paacume/P aacume.aspx
- [17] Miranda, B. (17 de 3 de 2021). El Corredor Seco de Centroamérica, donde millones de personas están al borde del hambre y la pobreza extrema por el coronavirus y los desastres naturales. BBC News Mundo. Obtenido de https://www.bbc.com/mundo/noticiasamerica-latina-56407243
- [18] FAO. (5 de 2 de 2022). Corredor Seco. (O. R. Caribe, Editor) Obtenido de Organización de las Naciones Unidas para la Alimentación y la Agricultura: https://www.fao.org/americas/prioridades/corr edor-seco/es/
- [19] Blanco-Picado, P. (10 de 7 de 2019). Guanacaste en la encrucijada frente al clima. Suplemento Ciencia Más Tecnología. Obtenido de https://www.ucr.ac.cr/noticias/2019/07/10/gua nacaste-en-la-encrucijada-frente-al-clima.html
- [20] Samper-Villarreal, J., Vincent, A., Álvarez, C., & Gutiérrez-Espeleta, G. (3 de 2019). Simposio sobre cambio climático V Biodiversidad:hacia el fortalecimiento de la resiliencia y acciones requeridasante el cambio climático en Latinoamérica. Cuadernos de Investigación UNED. UNED Research Journal. S7-S17. 11(1),doi:10.22458/urj.v11i1.2315
- [21] Muñoz Alvarado, R. & Nicaragua Nicaragua, R. (2014). Un acercameinto a la Brecha digital

en Costa Rica desde el punto de vista del acceso, la conectividad y la alfabetización digital. Revista e-ciencias de la información. Universidad de Costa Rica. Online at https://revistas.ucr.ac.cr/index.php/eciencias/a rticle/view/12866/12469

- [22] Umaña-González, P. (10 de 8 de 2017). Páramos, bosques secos y arrecifes entre ecosistemas de interés para expertos en cambio climático. Universidad de Costa Rica. Oficina de Divulgación e Información. Obtenido de https://www.ucr.ac.cr/noticias/2017/08/10/par amos-bosques-secos-y-arrecifes-entreecosistemas-de-interes-para-expertos-encambio-climatico.html
- [23] FAO. (25 de 3 de 2021). Nuevo informe de la ONU muestra evidencia de que los pueblos indígenas y tribales son los mejores guardianes de los bosques de América Latina y el Caribe. Online at https://www.fao.org/costarica/noticias/detailevents/es/c/1391445/
- [24] CONAGEBIO. (2021). Comisión Nacional para la Gestión de la Biodiversidad. Protección del conocimiento tradicional de los Pueblos Indígenas y Campesinos. Online at https://www.conagebio.go.cr/Conagebio/publi c/permisosInfoPueblos.html
- [25] INEC. (2011). Mapa 3. Costa Rica: Territorios indígenas. Online at https://www.inec.cr/sites/default/files/docume ntos/inec\_institucional/cartografia/mapas\_tem aticos/impoblaccenso2011-03.pdf.pdf
- [26] CPAL. (11 de 8 de 2021). Costa Rica: mujeres indígenas proponen sistema para conservar bosques. Jesuitas Conferencia de Provinciales en América Latina y el Caribe . Online at https://jesuitas.lat/redes-sociales/noticias-cpalsocial/6669-costa-rica-mujeres-indigenasproponen-sistema-para-conservar-bosques
- [27] BioCosta Rica. (2021). Mapa de Proyectos de Pago por Servicios Ambientales (PSA) en Costa Rica para el periodo 2012-2018. Online at

https://chmcostarica.go.cr/recursos/mapas/ma pa-proyectos-de-pago-por-servicios-

ambientales-psa-en-costa-rica-para-el-periodo

[28] Castanho, R.A. and Garrido Velarde, J., (2022). The Financial – Economic Factors in the Strategic Planning of European Borderlands: Envisioning the So-Desired Sustainable Development. WSEAS Transactions on Business and Economics, vol.

19, pp. 23-29, 2022 DOI: 10.37394/23207.2022.19.3

- [29] Tapia Cachay, L.,M., Couto, G., Pimentel, P., and Castanho, R.A. (2022). Internal Control and Its Application in Public Management: a Literature Review. WSEAS Transactions on Business and Economics, vol. 19, pp. 326-337, 2022 DOI: 10.37394/23207.2022.19.29
- [30] Couto, G., Martins, D., Pimentel, P. and Castanho, R.A., (2021). Investments on Urban Land Valuation by Real Options – The Portuguese Case. Land Use Policy 107 (2021) 104456 https://doi.org/10.1016/j.landusepol.2021.105 484
- [31] Codosero Rodas, J., Castanho, R.A., Cabezas, J., and Naranjo Gómez, J. (2020). Sustainable valuation of land for development. Adding value with urban planning progress. A Spanish case study. Land Use Policy 92 (2020) 104456 <u>https://doi.org/10.1016/j.landusepol.2019.104</u> 456
- [32] Klarin, Tomislav. (2018). The Concept of Sustainable Development: From its Beginning to the Contemporary Issues. Zagreb International Review of Economics and Business. 21. 67-94. 10.2478/zireb-2018-0005.
- [33] Michelsen, Gerd & Rieckmann, Marco.
   (2015). The Contribution of Education for Sustainable Development in Promoting Sustainable Water Use. 10.1007/978-3-319-12394-3\_6.
- [34] Scherak, Lukas & Rieckmann, Marco. (2020). Developing ESD Competences in Higher Education Institutions - Staff Training at the University of Vechta. Sustainability. 12. 10336. 10.3390/su122410336.
- [35] Tolba, Mostafa. (2022). On sustainable development. 10.1017/9780511977961.007.
- [36] Kittiprpas, Sauwalak. (2022). Buddhist Sustainable Development: Inner Happiness as a Direction for Sustainable Development. 10.1007/978-3-030-89559-4\_4.
- [37] Mitra, Ramanuj & Cloutier, Scott & Nautiyal, Snigdha & Paralkar, Siddhanth & Morrison, Beth Ann. (2019). Toward an Applied Assessment Framework for Neighborhood-Level Sustainability and Happiness. The International Journal of Sustainability in Economic, Social, and Cultural Context. 15. 25-43. 10.18848/2325-1115/CGP/v15i01/25-43.

[38] Paralkar, Siddhanth & Cloutier, Scott & Nautiyal, Snigdha & Mitra, Ramanuj. (2017). The sustainable neighborhoods for happiness (SNfH) decision tool: Assessing neighborhood level sustainability and happiness. Ecological Indicators. 74. 10-18.

Rui Alexandre Castanho. Gualter Couto

Roxana Durán Sosa,

[39] Cloutier, Scott & Jambeck, Jenna & Scott, Norman. (2014). Application of the Sustainable Neighborhoods for Happiness Index (SNHI) to coastal cities in the United States. Ocean & Coastal Management. 96. 10.1016/j.ocecoaman.2014.02.017.

10.1016/j.ecolind.2016.11.009.

[40] Peng, C & Rooks, Matthew & Hu, Y. (2018). Survey on the Effects of Frequency of Experiencing Water Environments on Moods in China. IOP Conference Series: Earth and Environmental Science. 178. 012031. 10.1088/1755-1315/178/1/012031.

#### **Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)**

All the authors contributed equally to the development of the present paper. All phases of the paper development have been proper discussed and worked on by the authors. All authors have read and agreed to the published version of the manuscript.

#### Sources of Funding for Research Presented in a Scientific Article or Scientific Article Itself

This paper is financed by Portuguese national funds through FCT – Fundação para a Ciência e a Tecnologia, I.P., project number UIDB/00685/2020. Also, the project is funded under the program of the Minister of Science and Higher Education titled "Regional Initiative of Excellence" in 2019-2022, project number 018/RID/2018/19, the amount of funding PLN 10 788 423,16".

#### **Creative Commons Attribution License 4.0** (**Attribution 4.0 International, CC BY 4.0**) This article is published under the terms of the Creative Commons Attribution License 4.0 <u>https://creativecommons.org/licenses/by/4.0/deed.e</u> n US