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in Natural Sciences for Development after Fifteen Years of Work**

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in Natural Sciences for Development after Fifteen Years of Work**

ABSTRACT

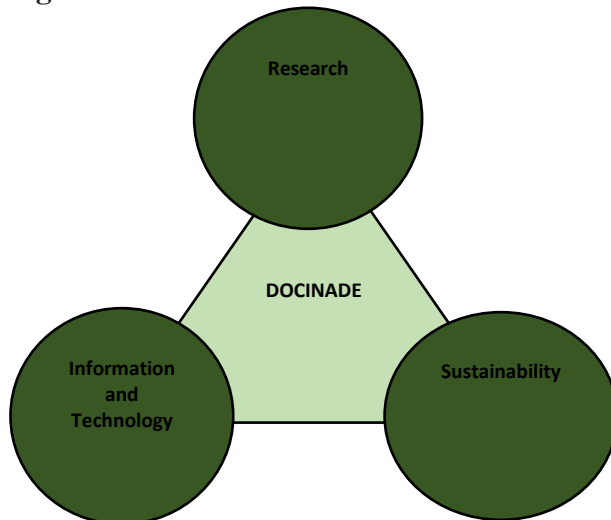
The management and rational use of natural resources, agroforestry systems, care for the environment and clean production systems, together with the use of technology and applied research, are the reason of the postgraduate program Doctorate in Natural Sciences for Development (DOCINADE). This program arises as a need to strengthen applied research at the level of Mesoamerica and Latin America, making use of the concept of sustainability of systems and achieving theses that solve specific problems of production and Natural Sciences, and also applying clean systems and appropriate technologies. It began in 2005, as an interuniversity network, in which participated countries of Central America and North America, joining efforts and resources of public universities. The program works under the bimodal pedagogical mediation model throughout face-to-face academic activities, virtual in real time, synchronous, asynchronous and distance. The permanent contact tool is constituted by virtual platforms, web pages, the permanent contact with a group of high-level academics from different parts of the world. It is a program accredited by the Central American Graduate Accreditation Agency (ACAP), with international quality certification. The impact of the program is materialized in its 82 graduates to date and more than 150 publications in indexed journals.

Keywords: natural sciences, postgraduate studies, bimodal pedagogy

Introduction

The creation of the Doctorate in Natural Sciences for Development (DOCINADE) was based on the need to offer a viable option to professionals with bachelor's and master's degrees from the Mesoamerican Region to continue with their doctoral studies and to consolidate their employment relationship. The program gives them the option of investigating areas of importance to their country, while helping them to better position themselves in the labor market and contribute to the scientific and technological development of the region. This program has made a difference both inside and outside the country. Among the reasons that have contributed to this difference is the fact that this doctorate has been an option for professionals who for personal and work reasons cannot enter face-to-face programs. It is a hybrid program (distance and face-to-face) that is mostly offered at a distance. The curricular axes of DOCINADE are research, technology, sustainability and strategic information management; therefore, the academic activities of the program are planned according to these axes.

Figure 1. *DOCINADE Curricular Axes*



Source: DOCINADE Accreditation Committee.

The DOCINADE program is guided by two general objectives:

1. Develop an Interuniversity Program of Scientific and Intercultural Training, at a Distance, to obtain the Doctorate degree, which trains researchers of the highest academic level in the natural sciences, in accordance with the development needs of the Mesoamerican region to improve individual and collective quality of life.
2. Promote academic cooperation and integrate the strengths of the universities of the Mesoamerican region and of other countries in order to contribute to the strengthening of research and development in the region.

Its mission and vision are elements that guide the decisions and actions that are taken on every day bases:

Mission: Contribute to the training of researchers, teachers and professionals with academic excellence, humanistic vision and social responsibility, both in disciplinary and inter, multi and transdisciplinary areas.

Vision: To become a space of national and international reference for training at the highest university level, based on the quality of a solid tradition that is renewed in the face of the demands of the environment and that also has a perspective that is always higher.

Context

In Costa Rica the Public University System is regulated by the National Council of Rectors (CONARE). This is a body created by the Agreement for the Coordination of State Higher Education in Costa Rica, signed on December 4, 1974, which designates CONARE as the entity in charge of coordinating State Higher Education in the country. This body brings together the rectors of the Public Universities of the country and its main function is to establish the coordination mechanisms necessary for the proper functioning of university higher education in Costa Rica. Nowadays, the Systema is formed by five universities: University of Costa Rica (UCR), Technology Institute of Costa Rica (ITCR), National University (UNA), National State Distance University (UNED) and National Technical University (UTN).

The DOCINADE doctoral program was approved by the respective instances in each university (UNA, TEC and UNED) and submitted for study and subsequent approval by CONARE, which approved the creation of DOCINADE with the emphasis of GCA, GRN and SPA in session 39 article 5 held on November 25, 2003. Subsequently, in session 8 article 4 of March 25, 2008, the creation of a new emphasis on the doctorate, that of TEA, was approved.

Figure 2. *Costar Rican University System*



Source: DOCINADE Accreditation Committee.

The doctorate has managed to become known in the region by the dissemination made by students and graduates, as well as by the calls made using the websites of the universities involved. The interest of potential students is known for the telephone consultations they make, the messages they send by e-mail and the visits made to the Web sites, mainly from different places in Latin America.

To date, all students have done their thesis work in the countries where they reside, providing an alternative solution to a problem or part of it with their doctoral research. Table 1 shows the number of active students by country, as well as the number of graduates. As can be seen, 48% of active students are from Costa Rica and half of the graduates, 51%, are from this country. To date, DOCINADE has graduated 42 new doctors in the country. Colombia is the second country that has sent the most students to the program (17%) and 9 doctors have already graduated (11%). The third country of origin of the students is Guatemala, with 14 active (16%) and a total of 13 graduates (18%).

Table 1. *Active Students and Graduates according to Origin, Cohort (Year)*

Country of origin	Active		Graduated		Total
	Quantity	Percentage	Quantity	Percentage	
Colombia	15	17	9	11	24
Costa Rica	41	48	42	51	83
Cuba	1	1	-	-	1
Ecuador	2	2	-	-	2
El Salvador	1	1	1	-	2
Guatemala	14	16	15	18	29
Honduras	2	2	-	-	2
México	3	3	8	10	11
Nicaragua	2	2	4	5	6

Panamá	1	1	2	2	3
Paraguay	1	1	-	-	1
Perú	1	1	-	-	1
Puerto Rico	1	1	-	-	1
Dominican Republic	-	-	1	1	1
Venezuela	1	1	-	-	1
Total	86	-	82	-	168

Source: DOCINADE Accreditation Committee.

It is an interuniversity program developed by three state universities in Costa Rica: National University of Distance Education (UNED), Costa Rica Institute of Technology (TEC) and the National University (UNA) and has the participation of foreign higher education from Nicaragua, Mexico and Cuba among others. DOCINADE applies a distant learning program to obtaining the Doctorate degree.

The program pretends to create researchers with high academic standards in areas related to natural sciences in accordance with the development needs of the Latin American region. DOCINADE also promotes academic cooperation and integrates strengths of the participant universities and countries to strengthening research and development in the region. Within these areas of study, the program defined the Natural Resources Management (GRN), Environmental Management and Culture (GCA), Agricultural Production Systems (SPA) and Applied Electronic Technologies (TEA) as the emphases of specialization.

Table 2. Student Admission by Cohorts according to Institution Responsible for the Generation

Cohort	Number of students	Emphasis				Responsible University
		SPA	GRN	GCA	TEA	
2005	33	6	15	12	-	Technology Institute of Costa Rica (ITCR)
2007	28	8	10	9	-	National University (UNA)
2009	41	9	11	15	6	National State Distance University (UNED)
2010	16	-	9	7	-	Technology Institute of Costa Rica (ITCR)
2011	32	9	7	9	7	Technology Institute of Costa Rica (ITCR)
2013	20	4	5	5	6	National University (UNA)
2015	07	2	3	1	0	Technology Institute of Costa Rica (ITCR)
2015	22	3	13	3	2	National State Distance University (UNED)
2017	27	4	7	6	1	Technology Institute of Costa Rica (ITCR)/ National University (UNA)
2019	25	11	7	4	3	Technology Institute of Costa Rica (ITCR)/ National University (UNA)
Total	251	58	99	68	26	

Source: DOCINADE Accreditation Committee.

The results obtained to date allow us to visualize the position that DOCINADE has in the region, where it has been consolidated due to its hybrid modality, as well as allowing students to continue in their work and carry out relevant research for the country and the organization or institution where they work. For this reason, different organizations have financially supported the development of the program. The details can be seen in Table 3.

An academic program, which imparts a postgraduate degree at the doctoral level, is called for excellence, which is materialized in the solidity, credibility and regional prestige that has been maintained for the 15 years it has been in operation. Undergoing a first self-evaluation process with an accrediting body as rigorous as the Central American Postgraduate Accreditation Agency (ACAP) (obtained in 2015 and in the process of reaccreditation in 2020), and obtaining its quality seal is, hence, a great achievement. The program recently gained international accreditation by the Central Agency for Graduate Accreditation (ACAP), which certifies the quality of activities carried out and the academic production and is in the process of achieving the official accreditation as a Regional Program of Central American Higher University Council (CSUCA) which will ensure that quality and with it provide greater regional visibility to the program.

Table 3. *Organizations providing Economical Support to Students*

Organization	Location
National Council for Scientific and Technological Research and Telecommunications (CONICIT)	Costa Rica
National Council for Science and Technology (CONACYT)	México
Tropical Agronomic Center for Teaching (CATIE)	Costa Rica
Ministry of Science and Technology (MICIT)	Costa Rica
Dutch Organization for Internationalizations in Education (NUFFIC)	Netherlands
University of Costa Rica (UCR)	Costa Rica
University of San Carlos de Guatemala	Guatemala
National State Distance University (UNED)	Costa Rica
National University (UNA)	Costa Rica
Technology Institute of Costa Rica (ITCR)	Costa Rica
National Autonomous University of Mexico	México
Chapingo Autonomous University	México

Source: DOCINADE Accreditation Committee.

The Program

The novelty of this postgraduate course not only lies in the modality in which it is taught or in having students from different disciplines in the emphasis, but also in the fact that, since it is a doctorate for development, it is essential to provide a holistic vision to train professionals who respect the environment, supportive and

capable of facing their work in an interdisciplinary way, as well as proposing feasible experiences of sustainable development in their countries. The academic training is complemented with the preparation and defense of the graduate thesis product of an investigation carried out in the applicant's country of residence, the presentation of a candidacy examination corresponding to the emphasis in which he is studying and the completion of an internship.

The study plan lasts for 4 years and includes a total of 100 credits distributed in a theoretical phase and a research phase. The study plans for the doctorate were approved in two moments: at the beginning it was proposed only for three emphases SPA, GCA and GRN and, later, TEA was included. For the SPA, GRN and GCA emphases, the theoretical phase comprises 33 credits and the research phase 67 credits, and includes the following academic elements: mandatory courses, elective courses, specialty course, thesis research work, professional internship and compulsory courses. The PhD Program was designed for working students who must spend at least part time studying their workday. It lasts for 4 years, equivalent to 8 semesters.

The DOCINADE pedagogical model promotes autonomy and self-directed training so that the student manages his own training process by learning to learn, learning to investigate and learning to generate knowledge. The investigative work of its students responds to the needs of the social context in which they operate. The program seeks that people continue with the development of social, intellectual, personal and professional skills. This pedagogical model is unique in the Mesoamerican region as it is the first program taught bimodally by national and international universities.

Main Achievements of the Program

These 15 years of continuous work had led to an integration of the scientific, human resources, infrastructure and material strengths present in three Costa Rican state universities to develop a joint postgraduate training strategy with high quality. This integration is relevant, since it is a case of success in the whole region.

Since the beginning of the conceptualization of what the program is today, it has had collaboration and support from prestigious universities in Mexico, Cuba, Nicaragua and other countries. This collaboration gets wider with every new students and professor and researcher that is included in the program.

As part of the quality accreditation process that DOCINADE carries out include students and graduates' consults. All of those consults correspond to satisfactory opinions of for the quality of the program and the professional benefit it has implied.

The program itself is basically a network that implies an interinstitutional and international cooperation that pursuits common objectives regarding sustainable development and research to solve local or regional problems through doctorate level research.

The quality of the program is guaranteed by an international accreditation certification with the ACAP that periodically evaluates different aspects of the program including: administrative and academic processes, impact of the research, faculty suitability, technological facilities, relevance of research axes, among many others.

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