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Pertinence and demand of the biology career at the state technical University of Quevedo, Ecuador

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Abstract---The article analyzes from a reflective practice the elements of pertinence and demand of the Biology career at the State Technical University of Quevedo, Ecuador. It is pertinent because it is important, significant, and useful for sustainable development to contribute to the conservation of ecosystems and biodiversity of species, and therefore to food security and health for the country, through the training of competent professionals to solve the problems that favor the goal of the National Development Plan 2017-2021 "Toda Una Vida" (A whole life). Finally, according to student demand and labor demand, it is inferred that there is an imperative need to offer a career in Biology.

Keywords---pertinence, curriculum design, biology, sustainable development.

Introduction

Since ancient times, it has been an obligation for nations in general to identify the workforce they need or will have to qualify for in a theoretical and practical way, to achieve the objectives, set by the States to achieve development in international, regional, and local levels, which are changing according to the contexts and global trends. The Biology Career is a relevant project for the Zonal Region 5 and the State Technical University of Quevedo, as it is the house of higher education where professionals in Agricultural and Environmental Sciences are trained. This program has a relationship of affinity and effectiveness with the training needs of the social and labor environment and therefore is congruent with the demands of the need for training professionals who work in the field. An academic offer designed under these needs is provided to achieve in an adequate and congruent way, the improvement of students to be able to offer scientific and technical solutions to the main problems presented in the region such as; loss of biodiversity, pollution of ecosystems, food insecurity, technological gap, infectious and contagious diseases, climate change (Miguel Ángel Medina et al, 2021).

It is pertinent because it is important, significant, and useful for sustainable development to contribute to the conservation of ecosystems and biodiversity of species, and therefore to food security and health within this Zonal 5 region and for the country, through the training of competent professionals to solve the problems, thus favoring the goal of the National Development Plan 2017-2021 "A whole life", in the country for Ecuadorian households contributing to food sovereignty. The proposal of this career is viable, given that its design and planning provide a project with a focus on environmental care, to achieve economic profitability, and manage market needs efficiently, which confers social benefit enabling success. The term sustainability refers to the quality of being able to maintain itself, without outside help and without exhausting the resources available in the field of ecology, in harmony with nature. Because life manifests itself in different forms, biology has been divided into specialties that study the wide diversity of organisms that populate the planet. Biology continues to expand into new fields and branches of research, as is the case of the career of genetic biology, a product of the progress and sophistication of the knowledge that the study of genes, molecular biology, and biophysics have yielded. Some branches of biology are zoology, botany, mycology, protozoology, and bacteriology. The sciences that support the study of biology are chemistry, physics, mathematics, geography, earth sciences, and logic. Therefore, the objective of this research is to determine the relevance and demand for a biology career in the province of Los Rios and the surrounding areas of the Zonal Agenda 5.

Development

UNESCO in the World Declaration on Higher Education in the 21st century defines relevance as "matching what society expects of institutions and what they do". This requires ethical standards, political impartiality, critical capacity, and,

at the same time, a better articulation of society's problems. The importance of the natural world is revealed in the thousands of different ways in which the Earth's organisms interact with each other to contribute to the balance of the global ecosystem and the survival of the planet. No single form of life can live in isolation. Ecosystems and the biodiversity they harbor are the life support of the Earth - we depend on them, for the air we breathe, the food we eat, and the water we drink. Wetlands filter pollutants from water; plants and trees reduce global warming by absorbing carbon; microorganisms break down organic matter and fertilize the soil to provide food. Biodiversity helps pollinate flowers and crops and also provides food and medicines for our well-being. Without it, we would not be able to survive.

The challenge of a career in biology is to maintain an efficiency that allows facing the problems at local, regional, and global levels, so that crops have profitability that justifies their existence and that socioeconomic benefits are derived from them. That is why the future will depend to a great extent on the establishment of strategic plans and the identification of priorities that allow development through the implementation of creative models (FAO, 2017). The Republic of Ecuador is considered a country with wide biodiversity of species; however, this capacity has been limited by the lack of knowledge of the proper management of the Management and Preservation Systems of Natural Resources in line with the new approaches to the care of the quality of water, soil, the ecosystem environment and its surroundings (Méndez Martínez *et al.*, 2021st). In this sense, the biology career establishes a strategy of integration of scientific, technological, and humanistic knowledge that responds to the expectations and needs of society and the country's planning.

In this sense, the National Development Plan 2017-2021 *Toda Una Vida* consists of 3 axes, where the first axis of the Plan, "Rights for all throughout life", establishes the protection of the most vulnerable people, affirms plurinationality and interculturality, raises the fight against poverty in all its dimensions and all types of discrimination and violence, and guarantees the rights of nature. The second axis, "Economy at the service of society", proposes to consolidate the social and solidarity-based economic system, expand productivity and competitiveness, generate decent employment, defend dollarization, and equitably redistribute wealth; it also seeks to guarantee food sovereignty and integral rural development. Finally, the third axis, "More society, better State", promotes citizen participation and the construction of a new social ethic based on transparency and solidarity, a close State with quality and warm services, open to permanent social dialogue, as well as sovereignty and peace, strategically positioning Ecuador in the world (Méndez Martínez *et al.*, 2021b; Morales Torres *et al.*, 2022).

To implement the proposed development model, it is essential to look at the territory as the mirror where all the proposed goals are concretized; this is why the National Territorial Strategy is based on the interpretation of the Ecuadorian territorial model, understanding it as a social construction, with its limitations and potentialities; knowing the physical environment and its natural resources, as the central axes of development and satisfaction of needs. A career in Biology aims to train professionals in the management and preservation of natural resources with a scientific and research base, to solve problems of biodiversity

loss, ecosystem contamination, food insecurity, technological gap, infectious diseases, and climate change. To achieve this, the present academic offer proposes an integrative vision that will allow training, and formation, and will contribute to understanding and provide solutions to the problems detected to achieve greater efficiency in the productive processes of crops, achieve food security, conserve natural resources and the environment in the ecosystem, thus contributing to the development of the productive matrix within the context of the country, region, province and community linked to what is stated in the National Development Plan 2017-2021. A Whole Life. Among the main challenges for Biology are the main needs and/or problems to solve.

Issue 1. Ecological Footprint

The Ecological Footprint can help a population live within the ecological budget. While Biocapacity expresses the supply of resources, the Ecological Footprint measures the amount of biologically productive land and water that an individual, a region, all of humanity, or a given human activity requires to produce the resources it consumes and absorb the waste it generates. Historically, carbon is the most representative component of the Ecological Footprint. According to the latest estimate made by Global Footprint Network, in 2012 it constituted 59.5% of the Global Ecological Footprint. Global Biocapacity has increased between 1961 and 2012, from 9,609 to 12,243 million global hectares (gha). During this same period, the world population increased from 3.1 billion to 7 billion, thus reducing the available Biocapacity per capita from 3.14 gha to 1.73 gha. While the Ecological Footprint per capita increased from 2.28 to 2.84 gha per capita (Global Footprint Network, 2016). THE ECUADOR SITUATION: At the national level, the composition of the Ecological Footprint has not been constant. In the last 15 years, the dominant component of the National Ecological Footprint is the carbon emitted by burning fossil fuels, representing 42% of the total Ecological Footprint in 2013. From 1961 to 2013, the Biocapacity per capita decreased by 69.3%, from 7.21 to 2.21 gha per person. On the contrary, the Ecological Footprint shows an increasing trend in the same period, the per capita value increased 32.1%, from 1.19 gha to 1.57 gha. However, the indicator decreased by 6.9% compared to 2013. In 2013, the per capita Ecological Footprint of an average Ecuadorian was approximately 1.8 times lower than the world average, remaining below the world average Biocapacity (1.73 gha per capita).

Problem 2. Ecosystem contamination

The use of chemical compounds and the demand for high protein diets is extremely costly and at the same time, their indiscriminate use causes harmful effects of contamination in ecosystems, from the environmental and human health point of view (Méndez Martínez *et al.*, 2021b). In addition, it has been proven that the indiscriminate use of these inputs not only implies a high cost but also contaminates the soil, reduces biodiversity, increases the risk of salinization, considerably reduces soil energy reserves, and contaminates surface and groundwater, according to the Zonal Development Agendas (Agendas zonales de desarrollo) (2013-2017) y FAO (2018).

Problem 3. Food insecurity

The population increase requires a greater demand for agricultural products; therefore, producers are forced to look for alternatives to obtain greater production, making excessive use of agrochemicals. This same situation is faced by the livestock and poultry industry, where hormones are injected to obtain greater growth of organisms in less time (FAO, 2016).

Biodiversity loss

Biodiversity is declining rapidly due to factors such as changes in land use, climate change, invasive species, exotic species, diseases, overexploitation, and pollution. The reduction of biodiversity has resulted in ecosystem instability, vulnerability to disturbances, loss of genetic base (genetic erosion), disruption of ecosystem functions, nutrient recycling, regulation of hydrological processes, microclimate control, soil fertility, population regulation, loss of adaptability, and loss of productivity. Incidence of pathogens and diseases due to the excessive use of monocultures and poor technical management of the crop according to the Zonal Development Agendas (2013-2017) y FAO (2018).

Problem 6. Pathogens and Infectious and Infectious Diseases

Batista Casaco *et al.* (2019) state that infectious diseases are diseases caused by germs. It is important to understand that not all germs (bacteria, viruses, fungi, and parasites) cause diseases. A host of bacteria usually live on the skin, eyelids, nose, mouth, and gut. These bacteria are called normal flora and are considered normal inhabitants. Bacteria in the intestines break down food and form vitamin K, an essential vitamin for all of us. The normal bacteria on our skin and in our mouth protect us by preventing or decreasing the risk of infection with harmful bacteria and fungi. The normal balance of bacteria can be disturbed by antibiotics and some diseases. Viral infections often damage body surfaces and are the prelude to infection by harmful bacteria. Bacteria often exist on a body surface such as the nose or throat, or in the intestines, but no disease is present. This is called carriage of the bacteria and the person with the bacteria is called a carrier. There is no disease in the carrier, but the carrier can sometimes transmit or spread the bacteria to another person. Many of the bacteria carried can cause infection and disease. It is not always clear why the same strains of bacteria cause carriage in one child, mild illness in another, and severe infection in others. Sometimes it is due to factors in the child or the bacteria, but often physicians do not understand the reasons.

Issue 7. Climate change.

Climate change will worsen the living conditions of farmers, fishermen, and forest dwellers, already vulnerable and food insecure populations. Hunger and malnutrition will increase. Rural communities, especially those living in fragile environments, face an immediate and increasing risk of crop and livestock losses, as well as reduced availability of marine, forestry, and aquaculture products (FAO, 2018). Increasingly frequent and intense extreme weather events will harm food availability, access, stability, and utilization, as well as livelihood assets and

opportunities in both rural and urban areas. The impoverished population will be at risk of food insecurity due to loss of assets and lack of adequate insurance coverage (Méndez Martínez et al., 2021a). The ability of the rural population to cope with the impacts produced by climate change depends on the cultural context and existing policies, as well as on socioeconomic factors such as gender, household composition, age, and the distribution of household assets (Méndez Martínez et al., 2021b). Climate change is having an impact on oceans, seas, lakes, and rivers and on the animals and plants that live or are farmed in them. Climate change will affect approximately 200 million families around the world whose livelihoods depend on fisheries and aquaculture (FAO, 2018).

In what ways will future professionals contribute to the solution of problem needs?

The career program in Biology at the State Technical University of Quevedo will contribute to the understanding and/or solution of problems and tensions, local and national; linked to the axes of strengthening democratic institutions, services, and rights of good living and social economy is given from various angles such as a) promote the production of sufficient and healthy food, b) promote the existence of alternative markets, to meet local and national demand with cultural relevance. With a generalist and respectful vision of the environment in the different facets that comprise the management and conservation of living resources while maintaining health and well-being. All this favors the goal of diversifying and increasing food production in the country for the consumption of Ecuadorian households, contributing to food sovereignty.

Biology is a profession that trains human capital and must meet the demands in the production of food, raw materials, and services of animal origin, with professionals capable of developing, validating, and evaluating technologies appropriate to the physical and socioeconomic resources available to Ecuadorians. Professionals will be trained capable and competitive to solve problems due to biodiversity loss, ecosystem contamination, food insecurity, technological gap, infectious diseases, and climate change, related to production, exploitation, management, and conservation of natural resources. Therefore, they will be trained in a global and specialized integrative vision that allows them to achieve greater efficiency, with the application of innovative techniques, profitability in the development and implementation of projects with a multidisciplinary approach to the study and development of applications in Molecular Biology, Biotechnology, Biomathematics, Biogeography, for the development of new technologies and materials with high impact on health, industry and the management and use of natural resources, and thus achieve food security, conserving natural resources and the environment in the ecosystem and contributing to the needs and development of the productive matrix within the context of the country, region, province, and community. This training involves the study of various sciences, using appropriate teaching-learning methods and techniques that lead future professionals towards an effective multiplication and improvement of organisms, as well as the conservation, management, transformation, and commercialization of natural resources, achieving diversification and added value of production, aspects of great importance in today's modern world.

They will be able to work in the business-productive sector, research, teaching, and dissemination of scientific and technological development providing solutions for the management, conservation of species, animal health, genetic selection and improvement, and production systems in general, through biological diagnostics in the laboratory and/or field, census and inventory of biotic resources, ecological management, biotic resource management plans, design of biological models, management and implementation of biotechnologies, statistical analysis of biological information, design of biological control systems, biological risk analysis, bioinformatics studies, teaching using appropriate field and laboratory methods and procedures, to propose their best use to achieve better productivity and welfare. Develop, establish and evaluate norms and reference standards for products of animal origin or their derivatives according to the needs of society and to satisfy the demand for products of high biological and innocuous value according to biological, physical, and economic conditions, to obtain a good quality product. Will be able to design and apply the norms for the conservation, distribution, commercialization, and certification of the quality of products and inputs to safeguard human health and the ecosystem.

The Biologist is a professional who has the competencies to apply the scientific method, know biodiversity, analyze biological processes, and contribute to the sustainable use of natural resources. The professional graduate in biology will be able to Lead or join interdisciplinary groups to solve problems in the biological sciences. Manage and participate in productive chains for the generation of development and innovation products derived from biodiversity. Perform technically and scientifically as director, advisor, consultant, auditor, or auditor in public and private institutions related to the management and use of natural resources and the environment. Communicate and disseminate knowledge in the biological field.

The Biologist will be trained under a methodology based on active research and solution of problems and needs of the area, region, and country. To this end, in their training as Biologists, they will be introduced to learning activities assisted by professors and integrated by lectures, practical and laboratory classes, seminars, workshops, case studies, debates, and other collaborative activities, which will be developed as part of the main teaching activities. These activities will also be systematically complemented by face-to-face tutorials with the development of updated bibliographic reviews on topics of the contents developed in the subjects, essays, problem-solving, reviews, summaries of bibliographic materials, and others. In the humanistic field, the professional will be trained for an integral, personal development of qualities, principles, and values (artistic development, self-esteem, self-training, excellence, creativity, responsibility) and to maintain and disseminate our knowledge and ancestral cultures.

This career proposal is inserted and linked to the National Development Plan 2017-2021 A Whole Life, in Axis 2, with objectives 4, 5, and 6. Future professionals will be able to respond to the problems and need to move towards a social and solidarity economy, ecological, based on knowledge and human talent, achieve full employment, achieve greater productivity, and democratize the means of production and wealth and are linked and contribute to the axes and objectives of the economy at the service of society.

Materials and Methods

Relevance study

Student and occupational demand in Zone 5 and its surroundings

Student demand: The following data was collected from various cantons in zone 5, from the following population segments for the year 2019, of students in the third year of high school in the school year 2019 - 2020; a total of 2351. A ballot was prepared for data collection which includes a section for the general information of the respondents, such as age, sex, and address. It also includes questions to determine interest in continuing university studies and studying a career in Biology. The study was carried out in public and private educational establishments, at a diversified level. The ballots were classified by region and tabulated using the Excel program, making graphs for the presentation of results and their respective analysis.

Occupational demand

The study was conducted in Zone 5 and its surroundings, considering historical series, and production statistics by INEC. To determine the occupational demand, simple random sampling was applied, using primary and secondary information using for this purpose a form of questions for companies directly or indirectly related to biology, also secondary information reported in the territorial agenda of zone five, statistical information established in INEC was used. Regarding labor demand, the survey inquired about future perspectives of businessmen on sales, investments, innovations, threats, and opportunities in the next three years; and identified and characterized those occupations with the largest number of personnel, with more difficulties in selecting personnel and/or with greater prospects for growth and the need to hire new personnel. The survey was based on the population census of livestock and agricultural enterprises established in the province of Los Ríos and its surroundings. Documentary analysis, interviews, and surveys were used in this study.

Analysis of the population sample

The sample size was constituted 20 % of the total population and was determined by the following formula:

$$E = \sqrt{\frac{s^2 pq(N - n)}{n(N - 1)}}$$

Where:

E = statistical error

s = confidence level

p and q = variability of the chosen parameter

N = population

n = sample

Results

The following is an analysis of the main results of the survey developed within the framework of this study. The results of the student demand survey showed that 98.60% of those surveyed wish to continue university studies, which is a favorable situation for UTEQ since it has a large potential market (Figure 1). It is important to expand the educational offerings to attract new market segments to cover a greater demand. It is important to indicate that in addition to satisfying demand, the university must contribute to society by training professionals in careers or areas that are a priority for the area and the country.

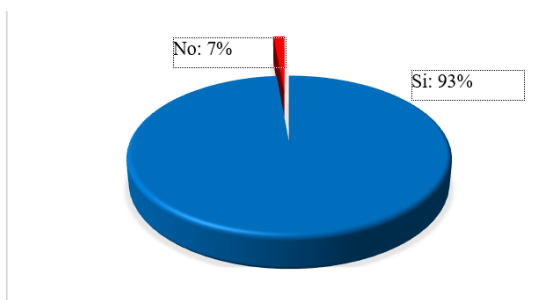


Figure 1. I wish to continue my university studies in biology.

93% of the student demand for university careers is made up of young people between 15 and 20 years of age. It is necessary to diversify the offer to meet the demand for higher education and contribute to the training of these young people, who are the source of development of the Zone 5 region and the country. 60.36% of those surveyed indicated that they are interested in studying a career in Biological Sciences, which corresponds to a total of 1419 students in the area of influence (Figure 2).

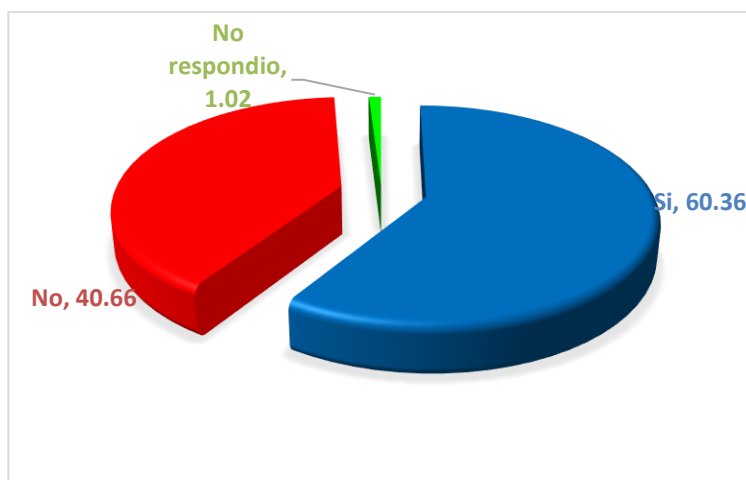


Figure 2. Interest in pursuing a career in Biological Sciences

The interest shown by 60.36% of the student population for a career in Biology is closely related to the current situation in the region and the country, as there is a

pressing need as a country to train professionals who contribute to the management, use, and conservation of natural resources with emphasis on the rescue of native species, besides being one of the main exporters in Latin America of products such as white shrimp and bananas. The biology program was designed to be part of the Faculty of Agricultural Sciences, which already has degrees in Animal Husbandry and Agriculture that are currently offered at the La María Campus. Considering the above, 7.66% of the university students showed interest in studying Biology (Figure 3). This shows the importance of the biology career from the point of view of student demand, without forgetting that it is a priority subject for the region and the country.

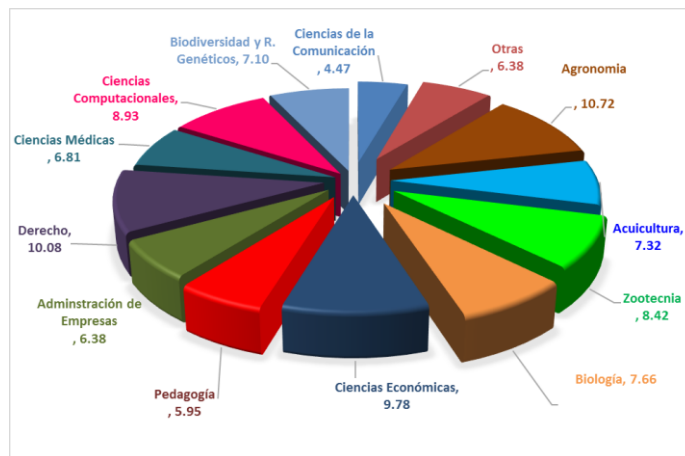


Figure 3. Interest in studying careers at the university level.

It is necessary to point out that the biology career has a high social and economic impact, having professionals who can manage, produce, improve and conserve natural resources. In addition, zone 5 needs the training of biologists, since all public and private projects may be developed in the region or the country in general in this field of study, it is essential to have professionals in this area of training.

Estimated demand for Biology

Considering the population of 2351 students surveyed, 180 students showed interest in studying a university degree in Biology, thus achieving a favorable response from students interested in studying a degree in Biology at UTEQ. This would constitute a potential market demand for the area and the country. Considering a scenario of the potential market demand, there would be enough demand for admission to the first cycle of the career for the year 2020, without considering the increase of the student population per year. It should be noted that the two types of scenarios, one negative and the other optimistic, would result in acceptable student demand. In addition, it should be considered that the Biology program will be part of the Faculty of Agricultural Sciences, so the student population in the faculty would grow considerably. In agreement with the research of Robles *et al.* (2018), who point out that the relevance that any

curriculum needs transformations according to the evolution of society and the particular demands of the area.

Conclusions

Considering the studies of student demand and labor demand, it can be inferred that there is an imperative need to offer a career in Biology. 98.60% of the surveyed student population has an interest in pursuing university studies. 60.36% of the students indicated that they are interested in studying a career in biological sciences at the university level, such as Biology. 7.66% of the population is interested in studying specifically for a degree in Biology, for a total of 180 students per year. Thus, the formation of a labor market takes place, since its application in the social reality occupies a delimited space, within which knowledge, specialties, and actions of great importance for the development of the area and country are used. The analysis of the documentary and experiential research carried out in planning zone 5, shows that it is necessary to attend all the producers that integrate it, to meet the continuous demand of professionals of environmental, public and private agricultural and livestock companies, fulfilling the relevant roles and functions, a challenge that has the State Technical University of Quevedo through the career in Biology, also highlighting that there is no other HEI in the same region of influence that offers the same career, so it is required that the State Technical University of Quevedo meets this objective of training in this area.

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