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# Indicators of Sustainability in Educational Practice: Perception of Teachers and Students of UAGro-Mexico

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**Abstract:** Teachers and university students require knowledge to generate positive changes and to overcome environmental challenges through innovative and relevant research. The Autonomous University of Guerrero lacks reliable methodologies and instruments required to evaluate progress towards sustainable development. This research proposes sustainability indicators as substantive functions at the educational levels of high school, bachelor's degree, and postgraduate study. Indicators were developed via two surveys of 63 teachers and 511 students from four educational programs. Data processing was undertaken using SPSS 21 and Excel 2011. The results show that the environment was ranked more highly than the social and economic indicators. In terms of the participants, the functions of extension (61%), research (58%), teaching (45%), and management (43%) were ranked higher for students; in relation to teachers, research (15%), extension (18%), and teaching (43%) were ranked lower. It was concluded that students show greater socio-environmental concern, while teachers focus more on teaching rather than on the other substantive functions. These results represent relevant and well-founded information that can be used to make decisions that lead the university toward sustainability.

**Keywords:** indicators; sustainability; higher education; substantive functions

## 1. Introduction

The basis of sustainability is in policies aimed at preserving ecological processes and natural resources for future generations [1–4]. Some authors have addressed sustainability in different contexts, seeking a balance between sustained economic prosperity, the protection of the natural systems of the planet, and a high quality of life for people [5–7].

During the past thirty years, higher education institutions (HEI), including universities, have also focused their attention towards the environmental agenda. This attention has been concentrated in the conceptual, scientific, and institutional areas, and has targeted environmental policy, education and management, as well as the development of measurement instruments [8]. Since the 1990s, HEIs have sought to incorporate aspects of sustainable development (SD) into their curricula, their academic-administrative activities, and their institutional policies in order to fulfill their societal commitments [9]. By 2000, these actions had been strengthened, with SD integrated into the curriculum,

structure, mission, and vision of some educational institutions [10]. With these actions, universities have become agents of change in the training of students capable of addressing environmental, social, and economic problems for the benefit of society itself, according to the objectives of the 2030 Agenda for Sustainable Development [11].

The United Nations Educational, Scientific, and Cultural Organization (2017) states that for the promotion of SD, the role of universities is fundamental. This is highlighted, in particular, by Too and Bajracharya [12]: Universities should not escape a commitment in the transition towards a better society, and must contribute to the generation and dissemination of scientific knowledge, as well as show leadership that promotes a fundamental change. From the point of view of Garza and Medina [13], universities should be more analytical, creative, critical, and prospective to generate a culture of responsibility, with a more holistic view of the problems facing society. In this context, in Mexico, the National Association of Universities and Institutions of Higher Education, in its vision to 2020, points out that no areas of knowledge are separate from environmental issues and SD, given that they are linked to social and economic conditions; hence the importance of training critical and creative professionals who promote a respect for the environment and propose actions for the efficient management of natural resources. This association, together with the Ministry of Environment and Natural Resources (SEMARNAT), presented the Action Plan for Sustainable Development in HEIs in order to “promote the analysis, solution, and prevention of environmental problems, as well as the construction of future scenarios for the environment and development” through actions and strategies in substantive functions. That is, the functions of HEIs must be strengthened to provide a better service to society and respond to the requirements demanded by their own development [14].

Several universities have managed to integrate this approach into their institutional structures to the point of promoting the restructuring and involvement of students who, in the medium and long term, will be the decision-makers and will end up leading institutions and communities towards sustainability [15,16].

Derived from the global concern on environmental issues, other actors have been involved. For example, in Taiwan, the Ministry of Education implemented programs of “green schools” and “sustainable schools”; when results disappointed expectations, the programs were expanded to universities, where carbon reduction policies and green campus practices were implemented. In collaboration with these educational institutions, the government provides information for future research and the development of an accreditation system for green universities, with the purpose of raising awareness among university students and society in order to achieve the objective of education for SD [17].

It is important to recognize that the notion of sustainability does not only involve the integration of sustainability literature into academic documents. The pedagogical approach and strategies will also determine the degree to which sustainability is present in educational programs; these may be thematic conferences, statements, letters, or initiatives [9,18–24].

In higher education, sustainability is a concept under permanent discussion through extensive debates and various evaluation processes. It is modified according to the context; however, the indicators (environmental, social, and economic) to be considered, as well as the participating actors (teachers, students and administrative staff) are common across all institutions, without neglecting the procedures that are specific to each [25,26].

Universities should also consider the inclusion of social responsibility since it promotes equitable and sustainable development [27]. To achieve this, teachers must perform four substantive functions with particular features:

*Teaching.* This function relates to the academic activities and social responsibility. It promotes learning based on sustainable projects and is applied to the mitigation and solution of problems.

*Research.* The action of this function is to promote applied research and didactics with interdisciplinary projects between teachers and the university community, which provides students with professional training and the capability of solving social, environmental, and economic problems.

*Extension.* This action's function is to link research projects with society at local and regional levels via public and private institutions, thereby strengthening the education of students in sustainable development.

*Management.* This action focuses on the transformational aspects of the university community based on democracy, transparency, and the promotion of SD.

There have been university projects that support the idea that sustainability must be approached from within. Velázquez et al. [28] considers a sustainable university to be “an educational institution that addresses, involves, and promotes, at a regional, state, and national level, the reduction of the environmental, social, and economic effects, and fulfills the teaching functions, research, outreach and partnership and administration to encourage society to have a sustainable lifestyle”. Meanwhile, Garza and Medina [13] consider that this task must be internally and externally approached in a holistic way to promote changes in attitudes, respect for the environment, and coexistence between teachers and education of students to address local and global issues that afflict humanity.

Cole [29] made more progress in this regard and reviewed 13 of the most widely used tools to measure sustainability, among which are the reports of the Global Reporting Initiative (GRI), ISO 14000, and the Ecological Footprint. In his research, he used the general sustainability assessment framework of Prescott-Allen [30] and adapted it to universities; as a result, he proposed the methodology “Frameworks of evaluation of sustainable campuses” through 175 performance indicators, focused on people and the ecosystem.

In 2007, Amaral et al. [31] reported the founding of the International Sustainable Campus Initiative (ISCN) with local, regional and national initiatives to implement, evaluate, and inform sustainability in universities. These were based on the reports of the GRI and the Association for the Advancement of Sustainability in Higher Education AASHE. The ISCN was applied to the Federal Institute of Technology-ETH Zurich, reporting on its sustainability performance.

The selected indicators are part of the daily life of society and are based on models that help identify trends that would otherwise be difficult to detect. According to Gallopín [32,33], Quiroga [34], and Mendoza [35], an indicator is a statistic with specific attributes and characteristics; it is a variable that depends on the value that one assumes; it displays information on guidelines considered relevant to the decision-making process; and, it is the basis for evaluating environmental, social, and economic processes to establish goals and policies. In the words of Belcher et al. [36], indicators are parameters that diagnose and evaluate sustainability from a complex perspective.

The management of environmental indicators began in 1989 by the Organization for Economic Cooperation and Development (OECD), with work to assess environmental progress in its member countries. In 1992, in Rio de Janeiro, Agenda 21 was signed, an action plan to address environmental issues and promote sustainable development. In paragraph 40.4, it states “SD indicators need to be worked to provide a solid basis to help in decision-making and contribute to self-regulating the sustainability of the environment and development systems” [7]. The proposed indicators are:

*Environmental indicator.* This is a parameter that provides information on trends in the environment, natural resources, ecosystems (deterioration and contamination of water, air, soil) and resources (computer equipment, consumables, and paper), pollution, and the use of recycling. It also addresses the curriculum in educational programs: These must be sustainable, transformative, and non-transmissive because they offer knowledge, skills, and vision to students to make decisions with implications for environmental education (EE) and education for the sustainable development of a linking society [37–39].

*Social indicator.* This includes responsibility, the well-being of the teachers and students, respect among peers, safety, working conditions, quality of life for the development of activities within society, and the linkage of projects with emerging social issues in the public and private sectors [39]. In this regard, Hammond and Churchman [40] added the implications of interrelation, the interdependence of staff, and the struggle to live in a constantly changing environment.

*Economic indicator.* This includes costs (not all are financial). Universities assume that having a viable number of students in each academic unit is sustainable in the long term, depending on how financial and material resources are distributed. It also relates to support for research projects [39].

The purpose of these indicators is to facilitate analysis and the application of aspects of institutional identity, education, research, extension, diffusion, and links, constituted in an interrelated system, articulated, and complementary in a complex and systemic way, in relation to the environment and sustainability [41].

In Mexico, all areas of knowledge are considered to inter-related to socio-environmental problems. Therefore, in 1998, the Center for Education and Training for Sustainable Development and SEMARNAT convened the HEIs to share their experiences and develop environmental programs. In a second stage, they formed the Mexican Consortium of University Environmental Programs for Sustainable Development (COMPLEXUS), with their main line of work being the “incorporation of the environmental dimension in the curricula, development and strengthening of environmental management systems, creation of sustainability indicators for universities, and the generation of theoretical and methodological proposals for the incorporation of EE and sustainability in HEIs” [42].

In the words of Leal Filho et al. [43], it is necessary to strengthen sustainability in universities through the implementation of SD assessments and policies, as these promote solutions and initiatives to be efficient and reduce the footprint of their activities. The university, as a human resources trainer, has the responsibility to deliver graduates with knowledge, critical thinking and skills to solve complex problems, to make reasonable use of resources, and to commit to its environment [41].

The Sustainability Assessment was presented as an initiative of the Sierra Club to encourage universities to improve the quality of their campus. The Sierra Club is one of the world’s oldest environmental organizations, founded in the United States of America in 1982. It is a pioneer in the conservation of the environment and the promotion of green policies, and participated in the development of the guidelines for the measurement, performance, and reporting of sustainability for universities [44].

Authors such as Lochner and Moretti [45] consider sustainability evaluations to be partial if they are not associated with higher education and society, and do not contribute to increasing the literacy rate and reducing social problems. Various systems, measurement methodologies, and checklists have been developed to evaluate the insertion and performance of sustainability in universities, even when authors such as Wright [46], Disterheft et al. [47], Posner and Stuart [48] and Gómez et al. [49] state that this remains a vague, debated, and questioned concept.

The literature identifies a large amount of work to be done on sustainability in education, but not many of these studies address sustainability indicators. The number of these studies is further reduced when considering only those of indicators to measure sustainability in substantive functions. This represents an area of opportunity for the generation of reliable information and informed knowledge that serves decision making. This article is derived from a thesis written as part of a Doctorate in Environmental Sciences of the UAGro, whose advances on the function of teaching were presented in a previous work [50]. It provides knowledge on the importance of the role of teaching in the training of students, so that in addition to learning disciplinary issues, they also develop the skills necessary to address the serious environmental problems of our time.

The objective of this research was to propose sustainability indicators for the functions of teaching, research, extension, and management according to the perception of the teachers and students. They participated in four educational levels: the Baccalaureate (High School 2), bachelor’s degree (Tourism), master’s degree (Epidemiology and Public Health), and PhD (Environmental Sciences).

This public institution has a registered enrollment of 85,758 students and a workforce of 2329 teachers in 45 academic units at the intermediate level, 57 units of undergraduates, and 25 graduate units (22 master’s and 3 doctorate programs accredited in the National Postgraduate Program of Quality).

The socio-environmental context in which the teachers and students who participated in the study showed particular characteristics. Acapulco is the third-most highly ranked municipality in terms of health, education, and income in Guerrero; however, this state is the lowest ranked in Mexico in terms of the index of human development and it is the highest ranked in levels of social marginalization [51]. The four academic units that contributed to the study are located in the middle part of Acapulco bay (which is in the form of an amphitheater), in one of the areas with the worst traffic problems, high population density, increasing levels of violence and insecurity, and poor solid waste management.

These characteristics affect the socio-environmental perception of the university community. It has been reported that in this area, teachers from the three UAGro degrees have a “negative” environmental perception [52]; in another nearby school, they show little commitment to the subject [53]. Other works identified that the majority of teachers of educational programs of the UAGro manifested the need to strengthen the environmental theme to contribute to SD and in the formation of students [54]. No reports were found on the perception of students; this research will contribute to this vacuum.

## 2. Materials and Methods

This study was developed through the methodology of qualitative, quantitative, and explanatory analysis, with teachers and students of five educational programs of the four academic units of the UAGro, covering three levels (high school, bachelor’s degree, and postgraduate), in the City and Port of Acapulco, Guerrero (Table 1).

**Table 1.** The participating academic units.

Academic Unit	Educational Level/Program
High School 2 Tourism	Baccalaureate Bachelor’s Degree in Tourism
Tropical Disease Research Center	Master’s Degree in Epidemiology Master of Public Health
Center for Regional Development Sciences	Doctorate in Environmental Sciences

### 2.1. Process

#### 2.1.1. Phase One

The documental analysis was carried out on sustainability indicators [13,24,32,55–57]. This work assumed the proposal of COMPLEXUS because it was believed to reflect the reality of Mexico. Indicators of sustainability (environmental, social, and economic) and substantive functions (teaching, research, extension, and management) were identified.

#### 2.1.2. Phase Two

The proposed variables that integrated the substantive functions were analyzed and reviewed by the tutorial committee, a group of experts in the area but from different disciplines, concluding with the validation and identification of the involved actors (Tables 2–4).

**Table 2.** The environmental indicator and substantive functions.

Substantive Functions	Variables	Actors
Teaching	(1) * Level of environmentalization of the classroom	Teachers and Students Teachers
	(2) Number of courses, workshops on environmental education and/or sustainable development	
Research	(1) Number of theses related to environmental education and/or sustainable development (presented and initiated)	Teachers Teachers
	(2) Number of refereed and indexed articles and chapters of published books, related to environmental education and/or sustainable development	
Extension	(1) Number of projects related to environmental education and/or sustainable development, which have been linked with communities and institutions	Teachers
Management	(1) Existence of a management plan for waste	Teachers and Students

\* The level of environmentalization refers to lighting conditions, ventilation, air conditioning and use of audiovisual material in the classroom.

**Table 3.** The social indicators and substantive functions.

Substantive Functions	Variables	Actors
Teaching	(1) Level of satisfaction with furniture	Teachers and Students Teachers and Students Teachers and Students
	(2) Level of satisfaction with the projection equipment and teaching material	
	(3) Level of teacher performance and mastery of the subject, punctuality, and respect	
Research	(1) Number of academic stays of teachers and exchanges to other institutions	Teachers Students Teachers Students Students
	(2) Number of student stays and academic exchanges to other institutions	
	(3) Level of satisfaction of teachers with the equipment of cubicles	
	(4) Level of satisfaction of students with cubicles for research	
	(5) Level of satisfaction with laboratory equipment, library and computer center	
Extension	(1) Number of projects and activities that have a social impact, which have been carried out in institutions and/or communities	Teachers Teachers
	(2) Number of personnel participating in the projects	
Management	(1) Level of response regarding maintenance and the use of common areas: auditorium, multipurpose rooms and recreational areas	Teachers and Students



**Table 4.** The economic indicators and substantive functions.

Substantive Functions		Variables	Actors
Teaching	(1)	Teacher-student cost	Teachers
Research	(1)	External economic stimuli that benefit teachers	Teachers
	(2)	External economic stimuli that benefit students	Students
Extension	(1)	Cost of conducting mobilities and academic stays for teachers and students	Teachers and Students
	(2)	Cost of performing professional practices in communities and institutions	Students
Management	(1)	Preparation of annual participatory budget	Teachers

*Variables of the environmental indicator:* Perception of the teachers and students about student training; presence of the environmental axis in educational programs (knowledge, skills, attitudes, and values); functions that the teacher develops according to the educational model; and, actions carried out by teachers and students to attend green areas, engage with the final disposal of waste, mainly in the academic units that have laboratories, and management of hazardous biological-infectious waste.

*Variables of the social indicator:* Satisfaction of teachers and students; learning that students have acquired during the performance of social services and professional practices; linking society and public and private institutions through projects; and conditions that favor work performance and quality of life (infrastructure and equipment of classrooms, laboratories, cubicles and areas in which school, extracurricular, and leisure activities are carried out).

*Economic variables:* Economic stimuli that teachers and students receive externally for academic stays; average income from enrollment and the annual re-enrollment of students for administrative expenses and the approximate cost that UAGro invests in the training of students.

### 2.1.3. Phase Three

Two surveys were designed for the collection of information—one for teachers and one for students—each containing two parts. The first part contained the instructions and general data questions (age, sex, semester, and educational program). In the case of teachers, age, sex, academic degree, seniority, job category, and educational program were included. The second part had items to measure the sustainability of the substantive functions using Likert scale response options, with values of 0 to 4, where 4 represents the highest positive response and 0 represents the lowest response. Weighting percentages were also assigned to the indicators, based on Garza and Medina [13] and Sarandón and Flores [57], who considered the percentages do not need to balance as they gave more weight to those who gave rise to the investigation. This weighting was done by consensus by deciding which functions had the greatest importance in the teaching work at the UAGro.

The survey forms were piloted between the teachers and students of different academic units and educational programs, of the three educational levels, obtaining 95% clarity and coherence in survey completion. Surveys were then adjusted. Statistical processing was carried out in SPSS version 21, yielding a Cronbach's Alpha of 0.814, which is considered acceptable and reveals a strong relationship between the indicators. According to Celina and Campo [58], the minimum acceptable value is 0.7.

The number of participants was established by a probabilistic sampling technique. Out of a total of 115 teachers and 2368 students from the four academic units, 54.8% and 21.5%, respectively, were determined to participate (Tables 5 and 6). Subsequently, the survey forms were applied to the participants of the academic units.

**Table 5.** The participating teachers.

Academic Unit	Population of Teachers	Participating Teachers	Percentage of Participants
High School 2	51	24	45.3%
Tourism	40	20	50.0%
Tropical Disease Research Center	12	7	58.3%
Center for Regional Development Sciences	12	12	100%
Total	115	63	

**Table 6.** The participating students.

Academic Unit	Population of Students	Participating Students	Percentage of Participants
High School 2	1348	264	19.6%
Tourism	936	187	20.0%
Tropical Disease Research Center	45	24	53.3%
Center for Regional Development Sciences	39	35	87.7%
Total	2368	511	

#### 2.1.4. Phase Four

With the information obtained, databases were developed to perform statistical analyses in Excel 2011. We determined the mean, variance, standard deviation by substantive function, correlations, and validation of methods by Fisher for two factors.

### 3. Results

The results of the F test for the variance of the two samples (teachers and students), the weighting of the indicators, and the analysis of the sustainability indicators are presented.

#### 3.1. F-Test

By using the F test for variance of the two samples, the environmental and social indicators for teachers were analyzed, showing a mean of XA 1.39 and  $\delta^2$  0.73 and of XS 1.86 and  $\delta^2$  0.56 between the ranges of 4 to 0, where 4 is excellent and 0 is nothing. It was shown that there is no significant difference between the indicators, so there is reliability in the applied method, and it is feasible to be replicated in other similar educational institutions (Table 7).

**Table 7.** The teacher's F test for the variances of the two samples.

Statistical Measures	Environmental Indicator	Social Indicator
Median	1.39	1.86
Variance	0.73	0.56
Observations	4	4
Degrees of freedom	3	3
F	1.29	
P (F <= f) a tail	0.42	
Critical value for F (one tail)	9.28	

Calculated  $F_{215,71es} = 34.01$  assessment framework, uilanter-Autonomous University of Guerrero, Pino s/n, Col. El Roble, lity assessment framework,  $<= F$  tables =  $1.29 < 9.28$ .

For the students, the results showed an average of XS 1.79 and  $\delta^2$  0.33 and of XE 1.81 and  $\delta^2$  0.010, between the ranges of 4 to 0, where 4 is excellent and 0 is nothing. It was shown that there is no significant difference between the indicators, so there is reliability in the applied method, and it can be replicated in other similar educational institutions (Table 8).



**Table 8.** Student's F test for variances of two samples.

Statistical Measures	Social Indicator	Economic Indicator
Median	1.79	1.81
Variance	0.33	0.010
Observations	4	2
Degrees of freedom	3	1
F	34.01	
P (F <= f) a tail	0.13	
Critical value for F (one tail)	215.71	

Calculated  $F_{215.71es} = 34.01$  assessment framework, uilanter-Autonomous University of Guerrero, Pino s/n, Col. El Roble, lity assessment framework,  $<= F$  tables =  $34.01 < 215.71$ .

### 3.1.1. Weighting of the Indicators

The weighting of the environmental, social, and economic indicators is described as follows (Tables 9 and 10):

- *Environmental Indicator* (Weighting 50%). It was assigned a higher percentage because it visualizes the socio-environmental and economic problems. This is related to the methodological design and the incorporation of emerging social issues in the curricula, and represents the backbone of an educational institution.
- *Social Indicator* (Weighting 30%). It includes social responsibility in the fulfillment of teaching; the satisfaction of teachers and students; the work environment; and the conditions of infrastructure and equipment of laboratories, classrooms, and cubicles for the development of academic activities.
- *Economic Indicator* (Weighting 20%). It includes the costs for the permanence and formation of the students; administrative expenses and income from managed projects to obtain scholarships, stays, academic exchanges, and publication of research articles.

**Table 9.** Weighting of indicators for teachers.

Indicators	Indicator Value	Weighting Factor (%)
Environmental	30	50
Social	49	30
Economic	50	20
Total		100

**Table 10.** Weighting of indicators for students.

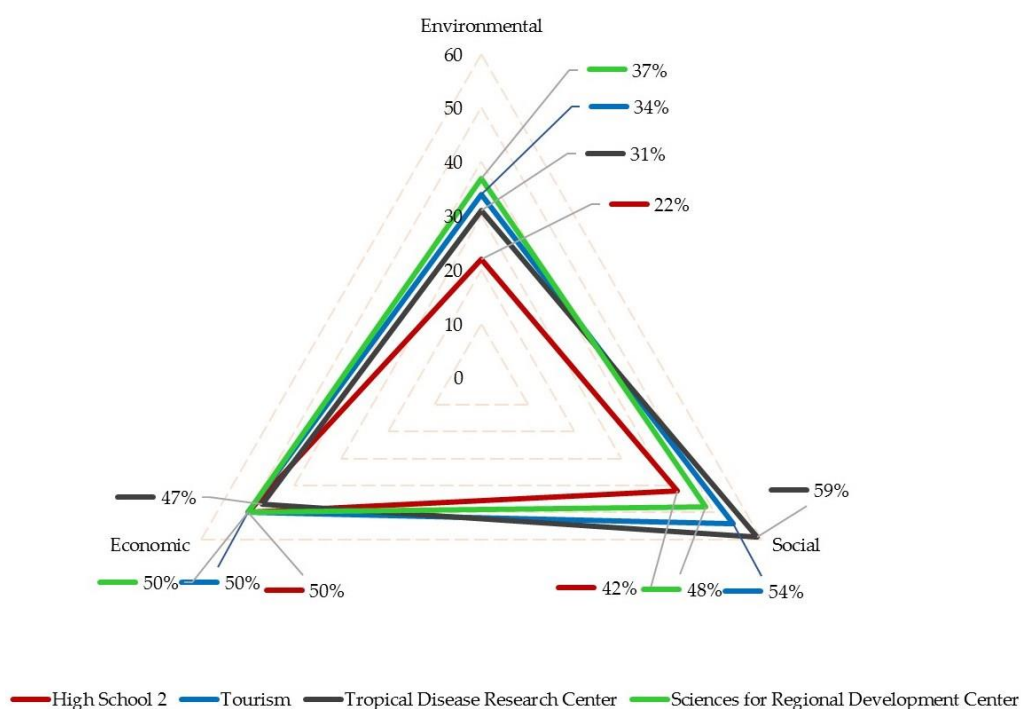
Indicators	Indicator Value	Weighting Factor (%)
Environmental	54	50
Social	51	30
Economic	31	20
Total		100

### 3.1.2. Analysis of Sustainability Indicators

The percentage weightings of the substantive functions were assigned through the discussion of the tutorial committee, which agreed that: Teaching is the teaching-learning process of the students, so that they are critical and responsible, with a vision of the future and the ability to participate with the society; the research is the teaching-learning process of the students, focused on forming skills to develop new scientific methods that contribute in the resolution of problems; extension is the interrelation of teaching and research to make society aware of the projects of teachers and students; and, management is the ability to do administrative proceedings before public and private institutions.

### 3.1.3. Indicators of Sustainability by Academic Unit

The environmental indicator for teachers reflected low percentages in the four academic units (ranging from 22% to 37%), which means that teachers' commitment to the environment is "scarce". This corresponds to the results of Figure 1, which shows a lack of knowledge and training on the subject. On the contrary, the social indicator presented "favorable" results, for the Center for Research on Tropical Diseases with 59%, and Tourism with 54%, highlighting that there are "better" working and attitudinal conditions among the personnel. In the same indicator, the percentages of the graduates of the Center for Regional Development Sciences and High School 2, showed low results (48% and 42%, respectively); the teachers stated that the conditions to develop academic activities are not favorable in infrastructure, equipment, and climate among collaborators. Regarding the economic indicator, the Center for Regional Development, Tourism and High School 2 showed results of 50%, indicating that they receive support from the Institutional Strengthening Program to participate in events and disseminate research projects; meanwhile, the Tropical Disease Research Center presented 47%; this is a "low" result, taking into account the high academic level of the teachers and the support they receive from other institutional and state programs.



**Figure 1.** Teachers: Sustainability indicators by academic unit.

Figure 2 shows that the students of the Center of Sciences of Regional Development presented the highest percentage in the environmental indicator with 76%, followed by the Center for Research on Tropical Diseases with 65%; this means that they show commitment, knowledge and awareness in relation to natural resources and the environment that surrounds them. Tourism registered 56%, which indicates that there is interest in the care and responsible use of resources. On the other hand, High School 2 had the lowest value with 48%. Regarding the social indicator, the students of the Center of Investigation of Tropical Diseases presented 57%; this is explained because there are good conditions to develop academic activities, in addition to a high education level and attitude of respect between the personnel that work in the unit. Students of High School 2 and Tourism registered percentages of 45%, which shows that the perception in these academic units about the conditions for the development of academic and recreational activities and the attitude of students with staff are "unfavorable". Finally, in the economic indicator, the percentages presented by the four academic units are the lowest, ranging

between 28% and 32%, even though there are calls for scholarships and other support for financing activities in institutions.

The fact that students show greater commitment to sustainability in the university represents an opportunity, because they will direct the institutions in the medium and long term, as reported by Colombo and Thomas [15] and Cai, Olsen, and Campbell [16].

### 3.1.4. Sustainability Indicators by Substantive Function

Regarding teachers, Figure 3 shows that the environmental indicator in the research and extension functions presented low percentages of 15% and 18%, respectively; this reveals a “lack of knowledge” about environmental issues and sustainable development, as well as little connection with society. The teaching indicator was 43%, which shows the need to strengthen training on the aforementioned topics. The management showed 58%, so it is considered that there is an interest to develop research on emerging social issues and disseminate results with the university community and society. In as much as the social indicator exhibited favorable results in teaching with 59%, management with 57%, and research with 51%, these data demonstrate the satisfaction of the educational staff, the favorable conditions to develop their academic activities, and the capacity of the management to strengthen substantive functions. Management showed 19% in this same social indicator. Finally, the economic indicator expressed its best result in teaching, with 66%; this was interpreted as the majority of teachers being able to obtain sufficient income for the development of projects. A result of 49% in extension indicates the need to strengthen the link with society; research represented 57%, which reflects the support that is available for academic production. In contrast, and paradoxically, there was a lack of strengthening in management (38%) to disseminate the results of the investigations.

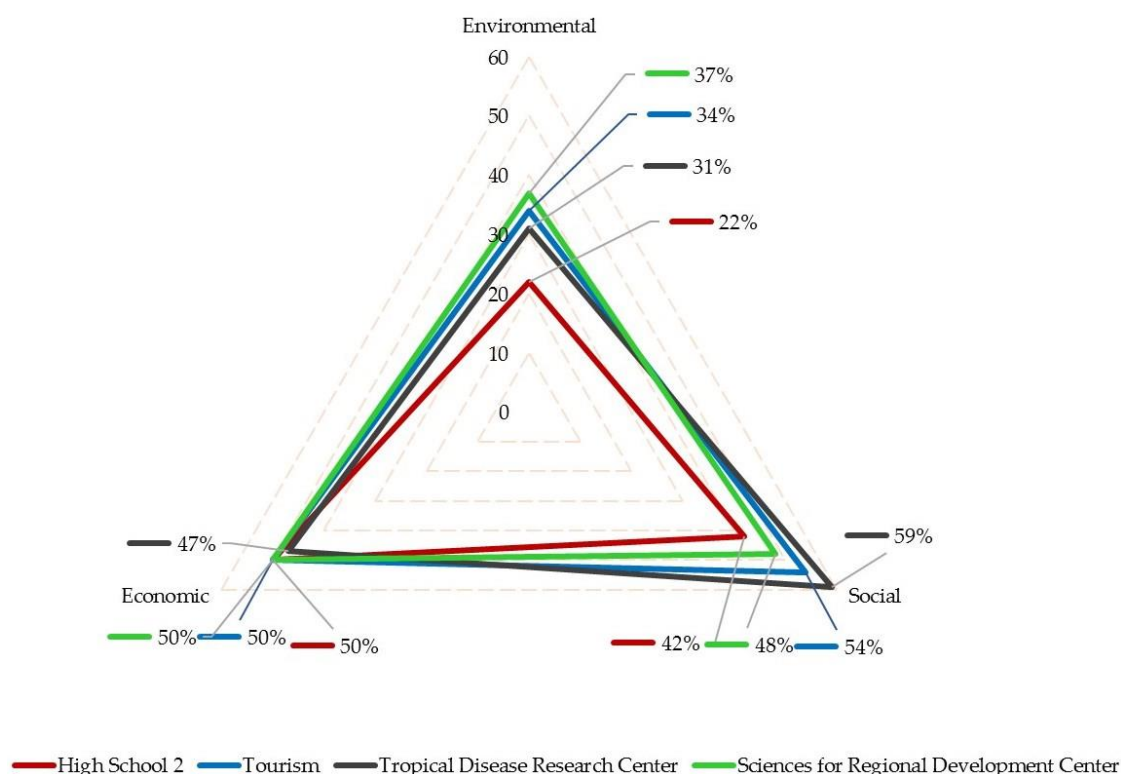


Figure 2. Students: Sustainability indicators by academic unit.

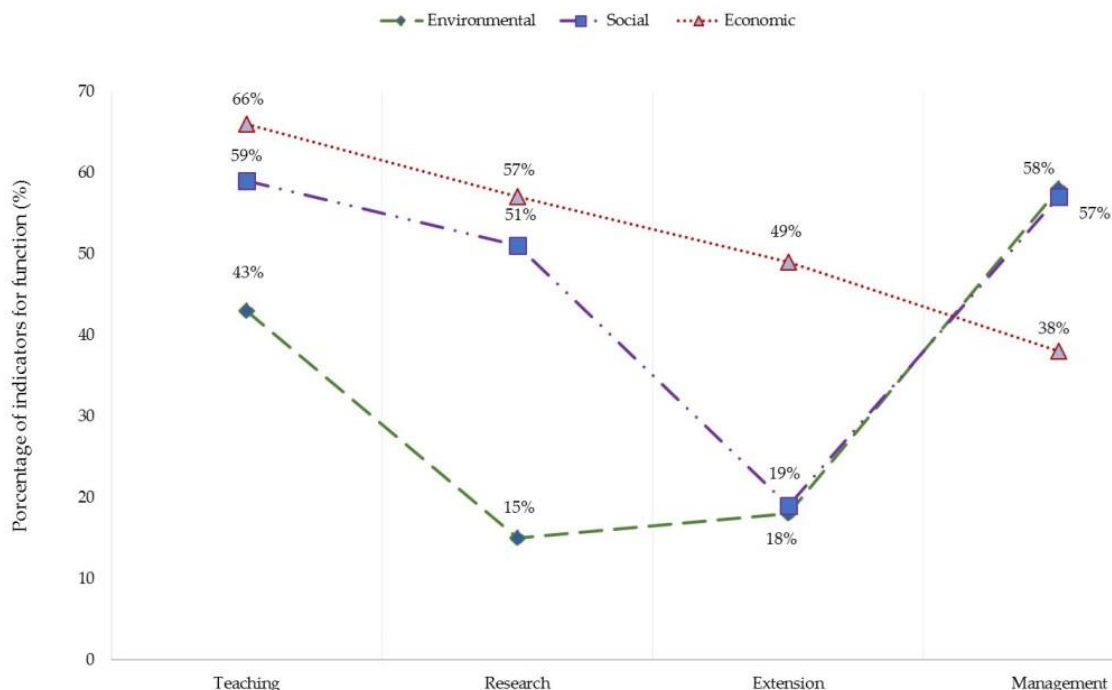
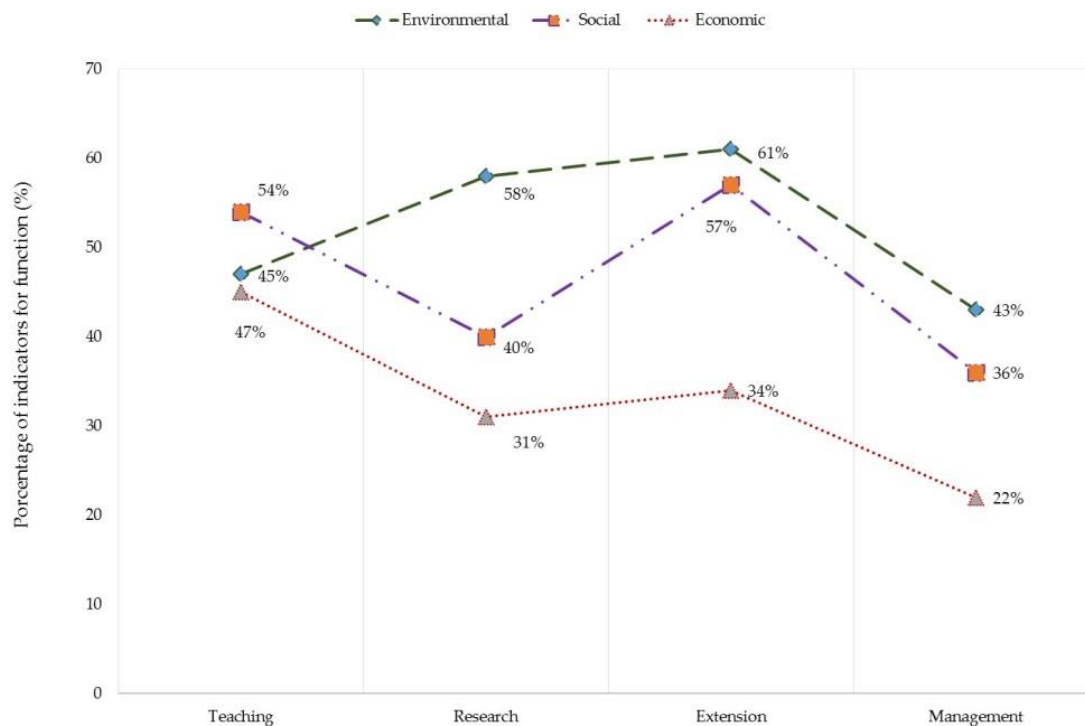


Figure 3. Teachers: Indicators of substantive functions.

Figure 4 of the environmental indicator, regarding the functions of research and extension of students, recorded the highest percentages with 58% and 61%, respectively, which shows the development of research projects, which are also disseminated among the university community and the society. Similarly, they expressed a favorable attitude towards the care of the environment. On the other hand, teaching exhibited a low percentage of 47%; this reflects the need for teachers to be trained in environmental issues. The management showed 43%; this is considered insufficient for the administrative procedures that the students perform, in different instances. In the social indicator, the functions that stood out were the extension with 57% and the teaching with 54%. These are favorable results in environmental knowledge, and indicate that the students present a “good attitude” and willingness to disseminate the projects with public and private institutions and with society through social service, professional practices, or institutional projects. In research, the result of 40% was considered “insufficient”, since the works they undertake have little environmental or sustainable focus. The management, with 36%, was lower than the other functions; this is due to the fact that most students determine that more activities are required to reinforce it. Finally, in the economic indicator, the results of 47% in teaching, 34% in extension, 31% in research, and 22% in management indicate little economic support from educational institutions for students to strengthen their professional training with a critical and responsible approach, and to participate in research that contributes to the achievement of sustainability.



**Figure 4.** Students: Indicators of substantive functions.

The geographical and socio-environmental conditions of the study area should be taken into account when examining the results. The sustainability indicators could have been different in the campuses of other cities of the entity. It would be interesting if other studies might apply the methodology in universities in other territories with better conditions, such as Mexico City or Monterrey; surely there would be remarkable contrasts. Poverty, violence, and environmental deterioration hinder the university's progress toward sustainability.

For this reason, as noted by Lochner and Moretti [45], higher education should be associated with the society, to reduce social and economic environmental problems, and thus meet the objectives of the 2030 Agenda for sustainable development [11].

#### 4. Discussion

In the case of teachers, the environmental indicator indicates a lack of knowledge on topics related to environmental sciences and SD to contribute to the training of a student capable of solving environmental problems. This is not consistent with the position of Scott [39]) and Ceulemans et al. [59], who consider it essential to include emerging social issues in curricula so that, teachers can adopt and develop the competencies to integrate them into study programs, and students can acquire knowledge that allows them to question, think from different points of view and make decisions in favor of sustainability. Jones, Trier and Richards [18] state that in order to achieve sustainability, the integration of emerging social issues into the curriculum is important and that teachers lead the discourse.

The environmental, social and economic indicators of the academic units, in the high school, bachelor's degree, and postgraduate levels, were unfavorable in relation to the care of the environment, the work environment, the quality of life, and the economic support of state and federal projects. This result is in line with the approaches of Beynaghi et al. [60], Amaral et al. [31] and Martínez [14], who refer to the need to consider in the substantive functions the three dimensions of sustainability as an alternative to the challenges of sustainable development, and be able to offer better answers to society.

Students present more encouraging results than teachers; the analysis of substantive functions favors environmental and social indicators in teaching and research. This is attributed to the values

learned at home and applied at school, and to the knowledge they have about emerging social issues from basic education. In addition, they have more awareness and a better perception of their environment, and show willingness to implement strategies and practices in favor of sustainability. It should be noted that they also present more favorable results than teachers to disclose research results. Colombo and Thomas [15] affirm that the integration of sustainability in the structure and mission of universities involves more students as professionals of the future to solve complex problems. Colombo and Alves [61] find that students are key players in sustainability since they are proactive and drivers of change and practices in universities.

Lozano et al. [62] believe that to the extent that environmental, social, and economic indicators are integrated in universities, students will be better prepared for decision-making. Brovetto [63] considers that the substantive functions develop academic-administrative freedom to increase cross-curricular activities between teachers and students, which strengthen their knowledge and their professional training to respond to the challenges of society. Martínez [14] reinforces that the substantive functions are necessary for the formation of students according to the requirements of SD.

In accordance with Velázquez's approach [28] and the results obtained, it is established that the UAGro is not a sustainable university because it does not "address, involve and promote the reduction of environmental, social and economic effects" in its substantive functions.

It should be noted that after an initial consultation and documentary research, these are the first registered studies on indicators of the substantive functions in the UAGro. A next stage will be the evaluation of these indicators since, in reference to Lochner and Moretti [44], evaluations serve to improve decision-making and implement sustainability policies. In this case it is in relation to the participating academic units, even though they remain an indeterminate concept [45–48].

## 5. Conclusions

The low results on environmental, social, and economic indicators registered by the teachers of the four participating UAGro educational programs are related to the lack of integration of emerging social issues in the institutional documents such as the mission, vision, curriculum, and objectives.

There is a need for teachers to strengthen their competences through training and updating processes for the adequate management of environmental issues, sustainability, and other issues of social interest for their integration in the curricula of educational programs, as in their respective learning units.

Students from the three levels examined show favorable results, especially in the environmental indicator, reflecting access to current and diversified information on social issues worldwide, which generates a greater commitment to sustainability, and leads them to perform actions for the care and preservation of the environment. Graduate students present better conditions (physical infrastructure and equipment) for the development of their academic activities, as well as research and links, which are reflected in a better educational performance.

The conclusions obtained in this research can serve as a reference for improving the training processes of students, paying attention to traditionally ignored activities, such as research, management and linking.

With regards to teachers, the results are relevant for the design of strategies that strengthen their skills, relating to both disciplinary and emerging social issues. It is necessary that they appropriate the environmental discourse and the management of concepts that incorporate the topics in their respective subject programs, and implement actions to address environmental problems and sustainable development.

This type of research allows us to evaluate the educational processes of each of the educational programs, as well as the management of concepts, opinions and personal positions on environmental issues. This can be conditioned by the geographic location or the socioeconomic level of the participants. Analysis methodologies should be established that include a holistic view of the problem and the design of integral care proposals.



Research programs and projects designed to address serious environmental problems, in addition to involving the university community, should make society a partner as the ultimate beneficiary of institutional efforts.

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