Revista INTERFAZ
Vol. 3, Nro. 2, 2024

https://doi.org/10.57201/interfaz.2024.3.2.4754

Original article

Contribution of infraestructura projects and sustainable development for the community, from extensión activities of the Faculty of Civil Engineering at the National University of Itapúa, year 2023

Contribución de Proyectos de Infraestructura y Desarrollo Sostenible para la Comunidad, desde actividades de Extensión de la Facultad de Ingeniería Civil de la Universidad Nacional de Itapúa, año 2023

Opaitemba'epurupyrã tembiapo'atypegua oporoipotyvõva ha ava'aty ñeñangarekojera tembiapo jepysorekóva guive mbo'ehavete ingeniería civil Mbo'ehaovusu Tetãmba'éva Itapuapegua. 2023 arýpe

Yanina Soledad Ayala[1]

[1] Universidad Nacional de Itapúa, Facultad de Ingeniería. Itapúa, Paraguay.

Abstract

This article presents the contributions made by the Civil Engineering career at the National University of Itapúa generated from the Sustainable Development Goals (SDGs) through the extension work carried out and delivered to randomly selected beneficiaries in the year 2023, free of charge. The purpose is to highlight the importance of engineering in the transformation of the community and the environment. Methodology: non-experimental design, descriptive level, qualitative approach, projects were classified in two groups: curricular approach: 8 projects, and final degree projects: 26 projects. For the analysis, final reports of each project were used to identify the SDGs applied, and a rubric to estimate the impact, evaluating criteria according to the SDG relationship, territorial scope of the project and others; projects completed and with reports accepted by the University Extension Office were included. Result: the projects are linked to the SDGs, highlighting the positive impact on the community and the environment. The estimates of Law No. 1012/1983, provides a perspective of the value delivered free of charge. It is evident how the Faculty meets the academic objectives, promoting sustainable development and thus highlighting the importance of university extension.

Key Words: Sustainable development, university extension, civil engineering, impact, community.

Resumen

Este artículo presenta las contribuciones realizadas desde la carrera de Ingeniería Civil Universidad Nacional de Itapúa generadas a partir de los Objetivos de Desarrollo Sostenible (ODS) a través de los trabajos de extensión realizados y entregados a beneficiarios seleccionados aleatoriamente en el año 2023, de forma gratuita. El propósito es destacar la importancia de la ingeniería en la transformación de la comunidad y el ambiente. Metodología: diseño no experimental, nivel descriptivo, enfoque cualitativo, se clasificaron proyectos en dos grupos: de enfoque curricular: 8 proyectos, y trabajos

Corresponding author
yanina.ayala@fiuni.edu.py

Conflict of interest
The author declares that there is no conflict of interest.

Funding
None.

Historial
Received: 24/09/2024
Accepted: 19/02/2025

finales de grado: 26 proyectos. Para el análisis se utilizaron informes finales de cada proyecto para identificar los ODS aplicados, y rúbrica para estimar el impacto, evaluando criterios según relación ODS, alcance territorial del proyecto y otros; se incluyeron proyectos concluidos y con informes aceptados en Dirección de Extensión Universitaria. Resultado: los proyectos se vinculan con los ODS, destacando el impacto positivo en la comunidad y el ambiente. Las estimaciones de la Ley N° 1012/1983, proporciona una perspectiva del valor entregados gratuitamente. Se evidencia cómo la Facultad cumple con los objetivos académicos, promoviendo el desarrollo sostenible y destacando así la importancia de la extensión universitaria.

Palabras clave: Desarrollo Sostenible, Extensión universitaria, ingeniería civil, impacto, comunidad.

Haipavy

Ko tembiapo rupive ojehechauka ojejapo'akue potyvõ mbo'esyry Ingeniería Civil Mbo'ehaovusu Tetãmba'éva Itapuapegua guive osẽva jehupytyvoirãita ñangarekojera rupive(ODS) umi ojeity'akue po'a rehe oñembojopóireite oñeme'ẽva tembiapo jepysorekóva apopyréva rupi, 2023 arýpe.kóva ningo ohechauka mba'eguasuha mba'eapokuaa omoambueha ava'aty ha tekoha.Taperekokuaaty: andu'aporeko'ỹva, techaukarã,tekoguáva, tembiapo'aty oñemohendakuri mokõi atýpe: mbo'epyrãva: poapy tembiapo'aty ha tembiapo mbo'esyrykatu ñemohu'ãrã: mokõipa poteĩ tembiapo'aty. Ñehesa'ỹjorã ojepuru marandupaha petetĩteĩva tembiapo'atýgui ojehechakuaa hagũa ñangarekojera jehupyryrãita(ODS) ojepuru'akue ha oñembohéra ojeikuaa hagũa hembiapo umi temimo'ã jehupytyvoirãita ñangarekojera(ODS) rehegua, tembiapo'aty rupytykue ha ambue, ojegueroike tembiapo'atykuéra mohu'ãmbyre ha marandu moneimbyréva Dirección de Extensión Universitaria rupi. Hupytypyre: tembiapo'atykuéra ojoaju jehupytyrãita ñangarekojera (ODS) rehe, omoañetévo mba'eapopyre ava'aty ha tekohápe. Ojehecháicha Léi P° 1012/1983, ome'ẽvarecháva umi mba'e me'ẽmby jehepyme'ẽ'ỹre. Ojehechauka mba'éichapa Mbo'ehavete omoañete mbo'epy jehupytyvorãkuéra, omonguékuévo ñangarekoguerojera rehe ha ohechaukávo péicha mba'eguasuha mbo'epysoreko mbo'ehaovusugua.

Ñe'eyta: Ñangarekojera, Mbo'epysorekóva mbo'ehaovusugua, mba'eapokuaa avarekogua, rembiapo,ava'aty.

Introduction

The Sustainable Development Goals (SDGs) are part of the 2030 Agenda, where countries around the world align their efforts to improve sustainability conditions. In this context, engineering in this scenario takes prominence because using science and experience transforms ideas that benefit people, its work can contribute to create solutions that benefit communities and the environment, promoting a more sustainable future for all. (UNESCO, 2020).

The Faculty of Civil Engineering of the National University of Itapúa is aligned with these objectives, and framed in Law No. 356 of Paraguay, which establishes University Extension as a fundamental purpose of universities. Since 2012, this Faculty has developed activities, combining education with service to society. This study focuses on the extension activities carried out in the year 2023 and delivered to society that year.

ObjectiveTo identify the contribution of the Faculty of Civil Engineering of the National University of Itapua to the Sustainable Development Goals (SDGs) through university extension projects carried out in 2023.

Methodology

Non-experimental design, descriptive level, qualitative approach, projects were classified into two groups: curricular approach: 8 projects, and final degree projects: 26 projects. For the analysis, final reports of each project were used to identify the SDGs applied, and rubric to estimate the impact, evaluating criteria according to SDG relationship, territorial scope of the project and others; projects concluded and with reports accepted in the University Extension Direction were included.

Quantify and segregate extension projects that correspond to Civil Engineering: The extension works that specifically refer to those developed by the Faculty of Civil Engineering are called Group 1 and Group 2. Group 1 includes curricular works developed by students and teachers, which respond to formal requests from the community. Group 2 analyzes the Final Degree Projects (TFG) defended for the Civil Engineering degree in the year 2023, which are projects designed to meet identified needs.

Identify SDGs that are linked to extension projects that correspond to Civil Engineering of FIUNI: For Group 1, the Annual Management Report and the projects submitted to the Department of Extension, Research and Graduate Studies of FIUNI are considered,

also the report entitled Extension Projects of the National University of Itapua linked to the SDGs. The data will be arranged in a spreadsheet, where "Project Name", "Activity Description", "Activities", is obtained from the above mentioned, "SDG Linkage" corresponds to the Annual Report 2023, while the columns of "Denomination", "SDG identified" and "SDG Development Goals" are added for the study, leaving the spreadsheet as follows:

For Group 2, the FIUNI Management Report for the year 2023 is considered, in addition to each TFG, available at the Information Resources Center of the National University of Itapúa (CRIUNI). The data will be arranged in a spreadsheet, where "TFG Title", "General Objective of the TFG", "Specific Objectives of the TFG", is obtained from each TFG, "SDG Linkage" corresponds to the 2023 Management Report, while the columns of "Name", "SDG identified" and "SDG Development Goals" are added for the study, leaving the spreadsheet as follows:

Estimation of the Impact of the FIUNI Civil Engineering Extension Project.

To estimate the impact of the study projects, a rubric is elaborated that considers how they will impact the community if they are carried out. The following criteria are considered: "Relationship with the SDGs", "Expected impact on the community", "Territorial scope" and "Response to urgent needs". For the study, the following tables will be analyzed: Table 1 and Table 2, providing a score for each criterion. This will allow estimating the impact, considering A, as High Impact; M, as Medium Impact; B, as Low Impact.

Puntuation

- 10 to 12 points: High impact, strong relationship to SDGs, significantly improves environment and community.
- 7 to 9 points; Moderate impact, related to SDGs.
- 4 to 6 points; Low impact, weak relationship to the SDGs and little benefit to the community.
- 1 to 3 points: Very low impact, little relationship to the SDGs and little benefit to the community. Estimación de Honorarios de los Trabajos de Extensión de Ingeniería Civil de la FIUNI

From the Impact Estimation, we seek to analyze the projects whose Impact is High, in order to exemplify the amount of fees estimated for each project. Considering that these were provided free of charge to the beneficiaries.

Given the lack of specific fee estimates for Civil Engineering works, this study will be based on Law 1012/1983, "On Architects' Fees Tariffs", considering that the works developed by them are similar in terms of situation analysis, preparation of plans

Table 1. Worksheet for identifying SDGs for Group 1

Denomination	Project Name	Activity Description	Activities	Link SDGs from the 2023 annual report	Identified SDGs	SDG Development goals

Table 2. Worksheet for identifying SDGs for Group 2

Denomination	Title of F.D.P	Overall objective of FDP	Specific objectives of the FDP	Linked SDG	Identified SDG	SDG Development Goals

Table 3. Rubric generated to measure the impact of Extension Projects of the School of Civil Engineering.

Rubric to measure the impact of Extension Projects of the School of Civil Engineering.			
Criterion	**Impact Level A (3p)**	**Impact Level M (2p)**	**Impact Level B (1p)**
Relationship with the SDGs	Directly addresses an issue related to the SDGs	Clear link, but does not address all critical aspects.	Links the SDG tangentially
Expected Community Impact	Significant and positive impact on the community or environment.	Limited positive impact	Not significant impact
Territorial Scope	Population/ wide area	Population/ moderate area	Population/ limited area
Response to urgent needs	Responds to urgent and priority needs	Responds to moderate priority needs	does not respond to urgent needs

Table 4. Civil Engineering Extension Projects Fee Estimation Form.

Denomination	Budget for Project execution, expressed in ₲	Estimation base don Law N° 1012/1983					Similar Project awarded (₲)
		Budget, expressed in workdays	% According to law 1012/1983	Art.9	Fee, expressed in workdays	Fee, expressed in ₲	

and other aspects. In addition, considering the fee suggestions of the Mandu'ay Magazine, it will be investigated if there was a previous award in the Dirección Nacional de Contrataciones Públicas (DNCP) that represents a project similar to the one analyzed.

On the other hand, according to Mandu'a Magazine (2024), the reference prices are as follows: 20,000 ₲ per m² for the estimator, 4,000 ₲ per m² for computation, 8,000 ₲ per m² for budget, 11,000 ₲ per plotter copy sheet and 418,000 ₲ per draftsman sheet, which can be analyzed if the projects have these data defined.

Under these considerations, information of the total budget of the analyzed project is used, the data will be presented in a spreadsheet as the following one table 4.

Data required for Table 4 form:

For the "Budget for the execution of the Project, expressed in ₲" it will be taken from the project, if it corresponds to Group 1, it will be taken from "Annex 3: Extension Project Report" submitted to the Research, Extension and Postgraduate Direction; for Group 2 it will be taken from the Budget presented in the TFG document.

In the third column begins the calculation of the fee based on Law No. 1012/1983, considering Resolution No. 507 of the Ministry of Labor, Employment and Social Security (2024), the value of a daily wage equivalent to 107,623 G. For this purpose, the Budget is divided into the amount of one daily wage.

In the fourth column, based on the value of the "Budget, expressed in daily wages" and Article 8 of the Law, the corresponding percentage will be assigned, the value will be between 5 and 15% approximately.

In the fifth column, "Considerations of Art. 9" of the Law, percentages are established based on the different work stages: a) preliminary studies (5%), b) preliminary project (15%), c) detailed architectural design (30%), d) structural design and installations (15%), e) general memory and specifications (5%), and finally f) construction management (30%). Depending on the stage covered by the project, the percentages identified are assigned.

The column "Fees, expressed in daily wages" is the result of multiplying column 2 with column 3 and the equivalent percentage in column 4.

To express it in guaraníes, multiply the previous column with the value of a day's wage.

And finally, for reference purposes, look for a similar project in the DNCP to see the award, the title and the amount.

Results

Quantify extension projects corresponding to FIUNI Civil Engineering

Based on what was described in the previous section, Figure 1 shows the total number of curricular extension works of the different FIUNI careers, the selected works were 16 in total, those developed by Computer Engineering accounted for 37.5%, while 12.5% of the projects were done combining Civil Engineering and Electromechanical Engineering; on the other hand, 12.5% were exclusive to Electromechanical Engineering and 37.5% were exclusive to Civil Engineering. Totaling 50% for Civil Engineering.

Therefore, for the so-called Group 1, 8 projects were selected.

On the other hand, in reference to the Final Degree Projects, which were 26 in total, Figure 2 shows that those delivered to the Community as Extension correspond to 76.9%, while those delivered as Research correspond to 23.1%.

Therefore, for the so-called Group 2, a total of 20 projects are considered.

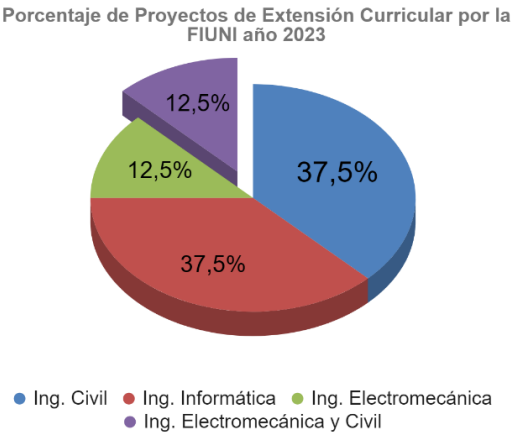

Figure 1. Percentage of Curricular Extension Projects by the different FIUNI careers, by 2023

Figure 2. Percentage of Non-Curricular Extension and Research Projects based on TFG, during the year 2023.

Table 5. SDG linkage of the curricular extensión projects of FIUNI`s Civil Engineering career, year 2023

Denomination	Project Name	Linked SDGs from the 2023 annual report	Identified SDG
G1.1	Preparation of Revitalization Project and pathological studies with their respective budget for the Faculty of Science and Technology.	SDG 9	SDG 3, SDG 9, SDG 11, SDG 12
G1.2	Outdoor lighting of the courtyard and parking lot of the Universidad Nacional de Itapúa Campus.	SDG 9	SDG 9, SDG 11, SDG 12
G1.3	Sizing of generator set installation, adaptation and electrical installation for the FACEA pavilion.	SDG 9	SDG 9, SDG 12
G1.4	Architectural Design of a Dining Room	SDG 9	SDG 9, SDG 11, SDG 12
G1.5	Elaboration of a Longitudinal and Transversal Profile	SDG 9	SDG 9, SDG 11, SDG 12
G1.6	Technical study and proposal for the improvement of playgrounds in the city of Encarnación.	SDG 9	SDG 3, SDG 9, SDG 11, SDG 12
G1.7	Drinking water distribution network, San Borja	SDG 6	SDG 6, SDG 11, SDG 12
G1.8	Survey and Digitalization of Plans of the 1st and 2nd floors of the Governor's Office of Itapúa.	SDG 9	SDG 9, SDG 11, SDG 12

Linking the SDGs identified in the FIUNI Civil Engineering extension projects

Based on Table 1 above, the following summary table is presented for Group 1.

The need to consider the linkage with SDG 3, SDG 11 and SDG 12 was identified in the different projects. SDG 3, Health and Well-Being, because projects such as revitalization of spaces, improvement of playgrounds, promote healthy environments. SDG 11, Sustainable Cities and Communities, is

Table 6. Linking non – curricular extensión projects of FIUNI´s Civil Engineering career, year 2023

Denomination	Title of F.D.P	Linked SDGs	Identified SDG
G2.1	Intervention plan for the recovery of the infrastructure of the west block of the Regional Hospital of the city of Encarnación.	SDG 9 SDG 12	SDG 9, SDG 12, SDG 3
G2.2	Canalization project of an urban micro-watershed between the Kennedy and MbóiKa'ê neighborhoods in the city of Encarnación.	SDG 6 SDG 11	SDG 6, SDG 11, SDG 13
G2.3	Evaluation of groundwater supply in the northern area of Encarnación.	SDG 6 SDG 11	SDG 6, SDG 11
G2.4	Study of urban drainage in the Fátima neighborhood of the city of Encarnación.	SDG 6 SDG 11	SDG 6, SDG 11, SDG13
G2.5	Proposal for structural and non-structural interventions for flood control in the Fátima neighborhood of the city of Encarnación.	SDG 6 SDG 11	SDG 6, SDG 11, SDG13
G2.6	Storm drainage solution plan between Padre VonWinckel and Tupasy Rapé streets.	SDG 6 SDG 11	SDG 6, SDG 11, SDG13
G2.7	Analysis of non-structural anomalies and possible solutions in the building of Basic School No. 3911 Divina Misericordia in the neighborhood of Puerta del Sol in the city of Hernandarias.	SDG 9 SDG 12	SDG 3, SDG 4, SDG 11, SDG 12,
G2.8	Analysis of non-structural anomalies and possible building solutions in the building of Basic School No. 3911 Divina Misericordia in the neighborhood of Puerta del Sol in the city of Hernandarias.	SDG 9 SDG 12	SDG 9, SDG 12, SDG 4
G2.9	Accessibility to the physical environment of UNI's central block facilities.	SDG 4 SDG 9	SDG 4, SDG 9, SDG 10
G2.10	Development of a maintenance manual for the Villa Alegre stadium of the Encarnacena soccer league.	SDG 9 SDG 12	SDG 9
G2.11	Design and structural calculation of the parking lot building project for the Universidad Nacional de Itapúa campus.	SDG 9	SDG 9, SDG 12
G2.12	Pathological report and building intervention proposal for the sports center of the Colegio Nacional República Argentina and the Escuela Básica N.₲65 República Argentina of the Buena Vista neighborhood in the city of Encarnación.	SDG 9 SDG 12	SDG 4, SDG 9, SDG 12
G2.13	Planning solutions to the storm water drainage problem on Matiauda Avenue between Carlos Hrase and Los Perales streets in the Ka'aguy Rory neighborhood.	SDG 6 SDG 11	SDG 6, SDG 10, SDG 11
G2.14	Sanitary sewer system design for the urban area of the municipality of San Cosme y Damián, Itapúa	SDG 6 SDG 11	SDG 6, SDG 10, SDG 11
G2.15	Application of BIM methodology in the management of the use and maintenance of sanitary facilities.	SDG 9 SDG 12	SDG 9, SDG 12,
G2.16	Technical and economic comparative analysis between flexible, rigid and articulated pavements for an urban area	SDG 9 SDG 12	SDG 9, SDG 12
G2.17	Executive project for the asphalt paving of the Hohenau port access road section	SDG 9	SDG 6, SDG11
G2.18	Study of groundwater supply in the southeastern area of Encarnación.	SDG 6 SDG 10	SDG 6, SDG11
G2.19	Design of a sanitary landfill in the city of Capitan Miranda, Itapúa Paraguay	SDG 11	SDG 11, SDG12
G2.20	Design of drinking water distribution network in San Juan del Parana urban center sector.	SDG 6 SDG 10	SDG 6, SDG11

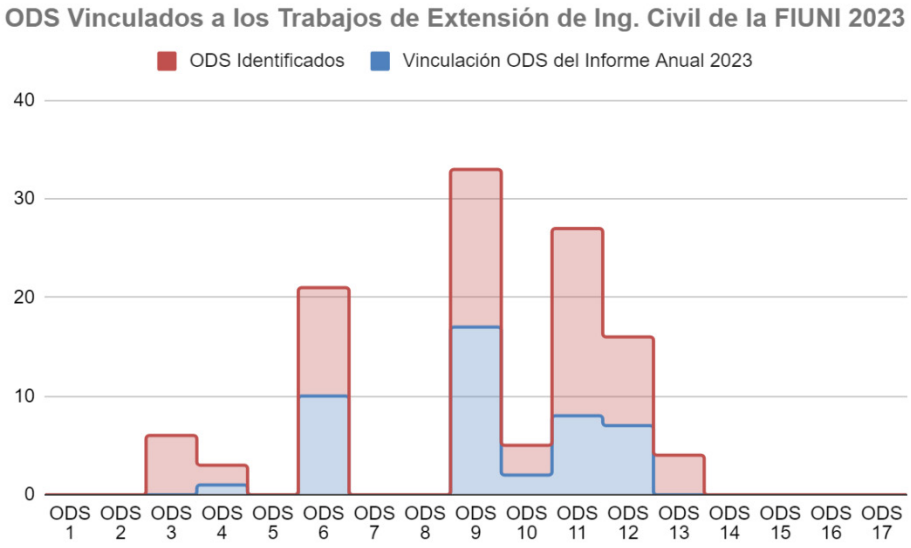

Figure 3. Implication of the 17 SDGs linked to the FIUNI 2023 Civil Engineering Extension Work.

Table 7. Impact of the Civil Engineering Curricular Extension Projects in the year 2023.

	Impact	Score Obtained	Alignment with the SDG´s	Expected community impact	Geographic scope	Response to urgent needs
G1.1	M	9	3	2	2	2
G1.2	M	9	3	2	2	2
G1.3	M	9	3	2	2	2
G1.4	A	11	3	3	3	2
G1.5	M	9	3	2	2	2
G1.6	A	11	3	3	3	3
G1.7	A	12	3	3	3	3
G1.8	M	9	3	2	2	2

due to projects that improve urban infrastructure, such as lighting, dining design. And finally SDG 12, Responsible Production and Consumption, is incorporated because, with planning, using existing structures, the use of resources is optimized.

On the other hand, for Group 2, based on Table 2 mentioned above, the following summary table is presented.

The last column identifies proposed SDGs, such as: SDG 3, which promotes Health and Wellness that is taken into account in initiatives such as the intervention in the hospital, in the sports center of a school; SDG4, Quality Education, in projects that provide safe environments in educational institutions; SDG 10, Reduce Inequalities is visualized in the improvement of infrastructure and accessibility; SDG 12, Responsible Production and Consumption that is seen in the use or proposed improvement of existing structures, ensuring the proper use of resources; SDG 13, Climate Action, is considered in projects that manage drainage.

Finally, Figure 3 shows both curricular and non-curricular outreach work, covering both groups of analysis. Although the SDGs linked in the final report (blue) are the most directly related to the project, the SDGs identified in this study (red) are broader, and although they are not directly linked, they contribute to the achievement of these goals. It is noted that in SDG 3 (Health and Wellbeing) and 13 (Climate Action) no direct implication was perceived; however, their relevance is present, given that the projects focus on the improvement of parks, schools and drainage in the city respectively.

Estimation of the Impact of the FIUNI Civil Engineering Extension Project.

Table 8. Impact of the non – curricular extensión projects of Civil Engineering in the year 2023

	Impact	Score Obtained	Alignment with the SDG´s	Expected community impact	Geographic scope	Response to urgent needs
G2.1	A	12	3	3	3	3
G2.2	A	12	3	3	3	3
G2.3	A	12	3	3	3	3
G2.4	A	11	3	3	2	3
G2.5	A	11	3	3	2	3
G2.6	A	11	3	3	2	3
G2.7	A	11	3	3	2	3
G2.8	A	11	3	3	2	3
G2.9	A	11	3	3	2	3
G2.10	M	9	3	2	2	2
G2.11	A	10	3	3	2	2
G2.12	A	11	3	3	2	3
G2.13	A	11	3	3	2	3
G2.14	A	12	3	3	3	3
G2.15	M	8	3	2	1	2
G2.16	M	9	3	2	2	2
G2.17	A	11	3	3	2	3
G2.18	A	12	3	3	3	3
G2.19	A	12	3	3	3	3
G2.20	A	12	3	3	3	3

For Group 1, Table 3 is considered, scored and the following is obtained (Table 7)

Of the total of 8 projects, 5 scored in the Medium Impact category, while 3 scored in the High Impact category. Of these, the one that obtained the highest score was G1.7, which corresponds to the Drinking Water Distribution Network, San Borja, in the city of Fram, which consisted of drafting a survey form to be applied in the rural community, where the number of people was obtained, the flow rate of the existing tank was measured, and considering heights and pressures, it was calculated how many new connections could be made.

For Group 2, based on the same table, the following was obtained (Table 8).

Of the total of 20 projects, 3 were awarded Medium Impact and 17 were awarded High Impact, of which 7 obtained the highest scores, as described below:

G2.1, consisted of generating an Intervention Plan to recover the infrastructure of the west block of the Encarnación Regional Hospital, its general objective was to restore this area. An architectural survey was carried out, anomalies in the construction were identified, solutions were proposed and costs were estimated for urgent repairs, including a maintenance plan for the structures.

G2.2, Project for channeling an urban microwatershed between the Kennedy and MbóiKa'é neighborhoods in Encarnación, the general objective was to develop a network to channel a specific section of the watercourse. The hydrological and topographical characteristics of the area were identified, the necessary infrastructure for storm drainage in the intervention area was determined, and the plans, calculations and budget for the project were designed.

G2.3 is a project to evaluate groundwater supply in the northern area of Encarnación. The general objective was to establish whether the amount of water available in five sanitation boards is sufficient to meet the basic needs of the users. Therefore, the geological and technical profile of the artesian wells was investigated, the relationship between the number of users and the available flow was determined, the state of the distribution networks and electromechanical equipment was described, and the quality of the water reaching the users' taps was evaluated.

G2.14. Corresponds to the sanitary sewerage network design project for the urban area of San Cosme y Damián, Itapúa, whose general

objective was to create a system for collecting and transporting effluents. Among the specific objectives, the optimal directions for transport and collection were determined, the dimensions of the network components were calculated for a 20-year design period, and a cost estimate for the executive project was presented.

G2.18, corresponds to the study of groundwater supply in the southeastern area of Encarnación, where the supply system in five neighborhoods was analyzed. An economic analysis of the water supply company was carried out, the water source and its quality were described, and the existing network was characterized. In addition, the current and future population was estimated and the strengths and weaknesses of the water distributors were identified to address service delivery problems.

G2.19, Design of a sanitary landfill in Capitán Miranda, Itapúa, sought to create an adequate solution for the final disposal of urban solid waste. The current waste management was described, the daily amount generated was estimated, a suitable site for the project was identified, and the topographic, geotechnical, environmental and hydrological characteristics of the area were analyzed, projecting the necessary infrastructure for the sanitary landfill.

G2.20. The general objective of the design project for the potable water distribution network in San Juan del Paraná was to create a supply system for the urban center sector. The characteristics of the current state of the network were described, the water demand per inhabitant was determined, and the sizing of the new network was established. In addition, design plans were drawn up and project implementation costs were estimated.

Each project described consisted of analyzing the identified problem, proposing a viable solution or evaluation of the situation, and in some cases, a calculation and budget were made.

As for the elaboration, even delivery to the beneficiaries was done free of charge for them, so the following section is considered transcendental to demonstrate monetarily the benefit not only environmental and social that these works represent, but for the community these are of imminent implementation if the economic funds are managed to develop them.

Estimated Fees for FIUNI Civil Engineering Extension Work

For Group 1, the work G1.7 does not have a budget, so the estimate based on the Law cannot be analyzed, nor was it evidenced in the DNCP data, so the monetary quantification is not performed.

For Group 2, whose High Impact scores were higher, each one was checked if it had a budget in the TFG submitted to the Faculty and taking into account Table 4, the following was obtained (Table 9).

The above shows that the fees for the authors of the projects analyzed would be as follows: For G2.1, "Intervention plan for the recovery of the infrastructure of the west block of the Regional Hospital of the city of Encarnación", would correspond8,680,133₲; for G2.2, "Canalization

Table 9. Estimated fees corresponding to the Non-Curricular Extension Projects of Civil Engineering in the year 2023, identified as high impact.

Denomination	Budget for Project execution (₲)	Estimate based on Law N° 1012/1983					Similar Project awarded (₲)
		Budget, expressed in workdays	% according to law 1012/1983	Art.9	Fee, expressed in workdays	Fee, expressed in ₲	
G2.1	411.380.734	3.822	8,44%	a), b), e)	81	8.680.133	-
G2.2	5.646.491.504	52.464	5,82%	a), b), d), e)	1221	131.450.322	-
G2.3	There is no budget allocated	-	-	-	-	-	-
G2.14	10.914.850.040	101.414	5,50%	a), b), d), e)	2231	240.126.701	-
G2.18	There is no budget allocated	-	-	-	-	-	
G2.19	There is no budget allocated	-	-	-	-	-	45.000.000 (ID of licitation 366595)
G2.20	2.059.043.848	19.131	6,52%	a), b), d), e)	499	53.699.864	-
Total, en ₲:						433.957.020	

project of an urban micro-basin between the Kennedy and MbóiKa'ê neighborhoods of the city of Encarnación", would be131. 450,322 ¢; for G2.14, "Design of sanitary sewerage network for the urban area of the municipality of San Cosme y Damián, Itapúa," the amount would be 240,126,701¢; while for G2.20, "Design of drinking water distribution network in San Juan del Paraná urban center sector," the fee would be: 53,699,864¢.

Conclusions

The results reveal a significant commitment to sustainable development and community welfare. From the analysis of 28 extension projects, the following was observed:

Regarding the linkage of the works with the Sustainable Development Goals(SDGs) we have the following, while null participation is evidenced to action SDG1(End Poverty), SDG2(Zero Hunger), SDG5(Gender Equality), SDG7(Affordable Energy), SDG8(Decent Work), SDG14(Underwater Life), SDG15(Life of Terrestrial Ecosystems),SDG16(Peace and Justice) and SDG17(Partnerships), while despite being identified they are not of high frequency for SDG3(Health and Wellbeing), SDG10(Reducing Inequalities), SDG13(Climate Action) and finally those that were identified as most prevalent were: SDG6(Clean Water), SDG9(Industry, Innovation and Infrastructure), SDG11(Sustainable Cities), SDG12(Responsible Production), based on evidenced high impact projects, from Extension provides the possibility to access initiatives such as infrastructure intervention of the Hospital in the area, sewerage design, landfill, city drainage; and regarding drinking water, analysis and distribution.

The implementation of these projects would provide transcendental solutions to the municipalities, emphasizing again that they were provided free of charge.

In the estimation of the fees that would be received, the amounts obtained in this study are indicative, they do not adjust to specific situations, that said, values such as 8 million guaranies for some and even 240 million guaranies for others have been reached.

In conclusion, the extension projects provided free of charge are a key contribution to transform the community, preserving the environment, thus fulfilling one of the objectives of a HEI, which is the assistance or extension to the community that houses it.

Bibliography

Agencia Nacional de Evaluación y Acreditación de la Educación Superior. (2024). El papel de agencias y organismos de evaluación y acreditación en relación con el ODS 4. https://www.aneaes.gov.py/wp-content/uploads/2024/08/El-papel-agencias-organismos-evaluacion-acreditacion-ES-frente-ODS4.pdf

Aportes desde la práctica extensionista para pensar la universidad como bien público. (2024). *E+E: Estudios De Extensión En Humanidades, 11*(17). https://revistas.unc.edu.ar/index.php/EEH/article/view/45441

Brítez González, C. I., & Sosa Duarte, M. R. (2023). Diseño de red de alcantarillado sanitario para la zona urbana del municipio de San Cosme y Damián, Itapúa [Trabajo final de grado, Universidad Nacional de Itapúa].

Cabrera Coronel, A. N., & Sánchez Jaquet, T. D. (2023). Elaboración de un manual de mantenimiento para el estadio Villa Alegre de la Liga Encarnacena de fútbol [Trabajo final de grado, Universidad Nacional de Itapúa].

Campuzano Galiano, L. E. (2023). Evaluación de provisión de agua de fuente subterránea en la zona norte - distrito Encarnación [Trabajo final de grado, Universidad Nacional de Itapúa].

Campuzano Galiano, L. E. (2023). Evaluación de provisión de agua de fuente subterránea en la zona norte - distrito Encarnación [Trabajo final de grado, Universidad Nacional de Itapúa].

Céspedes Borth, L. A., & Gómez Bogado, D. A. (2023). Proyecto ejecutivo para la pavimentación asfáltica del tramo vial del acceso al puerto de Hohenau: Memoria técnica, descriptiva y de cálculo, Tomo I [Proyecto, Universidad Nacional de Itapúa].

Céspedes Cubas, X. F., & Portillo Cardozo, J. I. (2023). Estudio de provisión de agua subterránea de la zona sureste de Encarnación [Trabajo final de grado, Universidad Nacional de Itapúa].

Chávez Franco, E. G., & Ramírez, N. A. (2023). Diseño de red de distribución de agua potable en San Juan del Paraná, sector centro urbano [Trabajo final de grado, Universidad Nacional de Itapúa].

Cuéllar Lobo, C. R. (2023). Análisis de las anomalías no estructurales y posibles soluciones en la edificación de la Escuela Básica N° 3.911

"Divina Misericordia" del Barrio Puerta del Sol de la ciudad de Hernandarias [Trabajo final de grado, Universidad Nacional de Itapúa].

Duette Quiñonez, J. R. (2023). Diseño de un relleno sanitario en la ciudad de Capitán Miranda, Itapúa, Paraguay [Trabajo final de grado, Universidad Nacional de Itapúa].

Esquivel Trinidad, M. D., & Sarubbi Armoa, L. F. (2023). Informe patológico y propuesta de intervención edilicia del polideportivo del Colegio Nacional República Argentina y de la Escuela Básica No 65 República Argentina del barrio Buena Vista de la ciudad de Encarnación [Trabajo final de grado, Universidad Nacional de Itapúa].

Facultad de Ingeniería Universidad Nacional de Itapúa. (2023). Ingenium, Revista de la Facultad de Ingeniería Universidad Nacional de Itapúa: Año XVI, número 01 [PDF]. https://www.fiuni.edu.py/wp-content/uploads/2024/04/Ingenieum2023web.pdf

Facultad de Ingeniería de la Universidad Nacional de Itapúa. (2023, 20 de diciembre). La FIUNI entrega trabajos de extensión universitaria a la comunidad. https://www.fiuni.edu.py/2023/12/20/la-fiuni-entrega-trabajos-de-extension-universitaria-a-la-comunidad/

Franco Chávez, M. A. (2023). Proyecto de canalización de una microcuenca urbana entre los barrios Kennedy y Mboi Ka'e de la ciudad de Encarnación [Trabajo final de grado, Universidad Nacional de Itapúa].

Gobierno de Paraguay. (n.d.-a). Servicios de diseño de proyecto de relleno sanitario, estudio de suelo y licencia ambiental. https://www.contrataciones.gov.py/licitaciones/planificacion/366595-servicios-diseno-proyecto-relleno-sanitario-estudio-suelo-licencia-ambiental-1.html

Gobierno de Paraguay. (n.d.-b). Servicio de consultoría para el diseño y construcción de readecuación de abastecimiento de agua: resumen de adjudicación. https://www.contrataciones.gov.py/licitaciones/adjudicacion/204905-servicio-consultoria-diseno-construccion-readecuacion-abastecimiento-agua/resumen-adjudicacion.html

Ley N° 1012/1983 - De arancel de honorarios de arquitectos. (1983). Base Legal. https://baselegal.com.py/docs/230962e6-b6e5-11ea-b286-525400c761ca

Ley N° 356/1994 - De la Universidad y sus fines. (1994). https://www.bacn.gov.py/leyes-paraguayas/2613/establece-la-carta-organica-de-la-universidad-nacional-de-asuncion#:~:text=%2D%20Son%20fines%20de%20la%20Universidad,diversas%20ramas%20del%20saber%20humano.

León Vera, J. C. (2023). Análisis comparativo técnico y económico entre pavimentos flexibles, rígidos y articulados para una zona urbana [Trabajo final de grado, Universidad Nacional de Itapúa].

Mandu´a. (2024). Información, opinión y cultura al servicio de la construcción. *Mandu´a, 41*(490). https://issuu.com/a.arza/docs/2024-01-31_revista_digital_febrero

Martínez Cardozo, R., & San Miguel Valdez, G. A. (2023). Plan de solución para el drenaje pluvial, entre calles Padre Juan Von Winckel y Tupasy Rape [Trabajo final de grado, Universidad Nacional de Itapúa].

Ministerio de Trabajo, Empleo y Seguridad Social. (2024). Resolución N° 507: Salarios mínimos. https://www.mtess.gov.py/application/files/8217/1983/7836/Resolucion_MTESS_N_507_Salarios_Minimos_30_06_1.pdf

Naciones Unidas. (n.d.). Objetivos de desarrollo sostenible. https://www.un.org/sustainabledevelopment/es/sustainable-development-goals/

Programa de las Naciones Unidas para el Desarrollo. (n.d.). Objetivos de desarrollo sostenible. https://www.undp.org/es/sustainable-development-goals

Rodas Rotela, J. E., & Esquivel Fernández, R. (2023). Planificación de soluciones al problema de drenaje de aguas pluviales en la Av. Matiauda entre las calles Carlos Hrase y Los Perales del barrio Ka'aguy Rory [Trabajo final de grado, Universidad Nacional de Itapúa].

Román Valenzuela, A. I., & Almeida Niven, T. A. (2023). Accesibilidad al entorno físico de las instalaciones del bloque central de la UNI [Trabajo final de grado, Universidad Nacional de Itapúa].

Rojas Bogado, M. A., & Portakiewich González, A. S. (2023). Estudio del drenaje urbano del barrio Fátima de la ciudad de Encarnación

[Trabajo final de grado, Universidad Nacional de Itapúa].

Zárate Troche, L. C. (2022). Plan de intervención para la recuperación de la infraestructura del bloque oeste, del hospital regional de la ciudad de Encarnación [Trabajo final de grado, Universidad Nacional de Itapúa]