

## Article

# Teaching *Down to Earth*. Service-Learning Methodology for Science Education and Sustainability at University Level. A practical approach

Míriam Hernández-Barco <sup>1</sup>, Jesús Sánchez-Martín<sup>1</sup>, José Blanco-Salas <sup>2\*</sup>, and Trinidad Ruiz-Téllez <sup>2</sup>

<sup>1</sup> Departamento de Didáctica de las Ciencias Experimentales y Matemáticas, Faculty of Education, University of Extremadura, 06006 Badajoz, Spain; mhdelbarco@unex.es (M.H.-B.); jsanmar@unex.es (J.S.-M.)

<sup>2</sup> Departamento de Biología Vegetal, Ecología y Ciencias de la Tierra, Faculty of Sciences, University of Extremadura, 06006 Badajoz, Spain; blanco\_salas@unex.es (J.B.-S.); truíz@unex.es (T.R.-T.)

\* Correspondence: blanco\_salas@unex.es; Tel.: +34-924-289-300

**Abstract:** The Bologna Process and the European Higher Education area require the application of new active methodologies in the classroom that place the student at the center of his or her learning process. In the present work we analyze the application of a Service-Learning methodology in the context of a Final Degree Dissertation (FDD) in the degree in Environmental Sciences at the University of Extremadura (Spain). The project deals with an isolated Kichwa community in Ecuador and involves the development of alternative science education materials for the capacitation of in-service science teachers. This paper evaluates how an FDD carried out according to self-learning (SL) principles can help in the acquisition of so-called *soft skills* and how these can be focused in the promotion of the Sustainable Development Goal (SDG) knowledge and achievement. To this end, a qualitative study of the experience and a deep evaluation, followed by a final reflection, were carried out. According to the preliminary results, we can conclude that Higher Education should include SDGs in its teaching praxis and could do this successfully using the SL methodology.

**Keywords:** Service-Learning methodology; environmental sciences; higher education; Sustainable Development Goals; rubric

## 1. Introduction

The need for more novel and practical methodologies in science education has become a reality at present. In addition, sustainability as a knowledge objective (linked to many other transversal competences in Higher Education) is becoming commonplace. This article is the result of merging these two realities.

The current work is structured as follows:

1. An introduction where the theoretical background of sustainability (Sustainable Development Goals, Sumak Kawsay, and other paradigms for education sustainability) is presented as the first approach. Then, practical and applied educational methodologies are also explained, including the Service-Learning (SL) methodology.
2. Secondly, the experience of SL itself is presented and described.

3. Then, SL experience is analyzed and evaluated to check whether it helps the promotion of sustainability (in a wide sense) and transversal competences.
4. Lastly, the applicability of SL as a methodology, under the lens of being used in this experience, is evaluated.

### 1.1. Theoretical background

#### 1.1.1.- Sustainable Development Goals in higher education.

The process of European Convergence (also known as the *Bologna Process*) envisages a shift from teacher-centered education to student-centered education, where the teacher becomes a facilitator of the learning process of students, not a mere knowledge transmitter. This process focuses on teaching the autonomous and active learning of the student [1–6].

Today's information- and knowledge-based society is characterized by rapid changes in difficult contexts [7]. Traditional techniques thus become obsolete in ever shorter times. Successive educational studies around the world have reiterated that education systems should better connect with the new personal, social, and employment needs of citizens: verbal communication skills, resilience, adaptation, reflection, cooperation, or creativity [8–10]. In order to meet these challenges effectively, educational systems must educate all citizens in transversal skills (known as *soft skills*) [11,12], which go beyond disciplinary knowledge and activities because they enable lifelong learning and can be transferred to face unpredicted, diverse and changing environments<sup>1</sup> [13–15].

In this context, Sustainability, as a concern, has increased in recent years [16]. What is the role of universities in sustainable development, sustainability, and global citizenship? Universities are relevant when a paradigm (such as the current one, regarding the way human beings navigate their relationship with the environment) should, and must, be changed. Specifically, sustainable development is engaged with by university activity in three concomitant ways: new knowledge generation, the arousal of new and appropriate competences, and cultivating social interest in sustainability [16–19]. The Sustainable Development Goals (SDGs) explicitly include education in Target 4.7 as a tool for all students to acquire the theoretical knowledge and skills necessary to promote sustainable development [20,21]. Although SD is still at a very early stage of development within Higher Education, it seems that SDGs must be taken into account even inside the educational system, in order to achieve these goals [22–24]. It is not an easy task to drive teaching activities according to SD principles [25]. Higher education institutions have difficulties with the implementation of such activities [26]. Traditional syllabi constructed at the university level do not facilitate critical, innovative, or creative learning. Our own experience as university teachers also confirms this, alongside similar results in the literature [27–29]. Furthermore, University Degrees are rarely thought of as resulting from syllabi focused on competence development but instead focus on mere content transmission programs.

The role of universities is far from teaching only professional skills. The new globalized world needs new and more competent citizens [30,31], but even focusing on the current challenges faced by pre-service worker, society needs professionals that address current environmental challenges facing sustainability [32]. The objective of this process is to involve students, faculty, and staff in a global vision<sup>2</sup> of local activities, and to value positive attitudes toward the environment and the desire to live *a better life in a safer world for all* [17,33].

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<sup>1</sup> As a matter of fact, these are more required aspects in recently graduated students by the employers, as recently Bill Gates have been defending for a long time [<https://www.businessinsider.com/bill-gates-skills-better-than-degrees-2013-8?IR=T>]

<sup>2</sup> The well-known expresión “Think globally, act locally” focuses on the real worldwide impact of our local actions, highlighting the need for awareness of the consequences of our acts.

Consequently, alternative methods of teaching (and consequently, different ways of learning) are needed in order to promote integral education for students [32,34,35]. Sustainable development cannot be taught as traditional higher education content. Instead, students must be taught through a dynamic and holistic teaching methodology [36]. It is not enough to teach students many things about sustainability but to make them competent in real-life situations, where the sustainable aspects of different ways of living will be crucial for the well-being of everyone and for the planet's future survival. Sustainability-related skills will be required in the training of future professionals if society chooses a sustainable future [37,38]. In this sense, it is important to incorporate knowledge, values, and sustainability criteria as essential dimensions in the training of future professionals and in the educational community in general [39–41].

### 1.1.2. The transition from Education for Sustainable Development to Education for Good Living

The very concept of "sustainable development" has been interpreted in different ways and is unclear. Both the SDGs and education for sustainable development (ESD) have been criticized for their ambiguity. This ambiguity has generated different interpretations. Some authors [42] have suggested that ESD should serve to change our relationship with the environment from an anthropocentric and egocentric model to an "ecocentric" model. The SDGs and ESD impose a paradigm in which the sustained growth of the economy obeys the rules of the relationship between human societies (understood as a set of producers and consumers), and the environment, understood as a set of resources that must not be exhausted. These previous conceptions can contribute to hiding paradoxes, such as maintaining a growing and increasingly richer population while protecting the environment [42,43].

Unlike this idea of sustainable development, South America indigenous communities share a different conception of life: *Sumak kawsay* [44], a way of life in harmony with nature and other human beings. This is a philosophy of life that starts from a conception of desirable life inspired by indigenous cultures that is based on the principles of the ancestral traditions of social equity and environmental sustainability and is part of aboriginal cosmovision [45].

*Sumak kawsay*, a proposal resulting from the self-inclusion of the excluded, proposes three Objectives of Good Living [44]: **biocentric sustainability**, which would reflect harmony with all beings in nature; **social equity**, which would embody harmony with all human beings; and **personal satisfaction**, which would manifest harmony with oneself [43]. Good Living refers to living from a non-egocentric or anthropocentric view and recognizes our interdependence and eco-dependence [44]. Good living is the effective enjoyment of the individual rights of people—and the fulfillment of their responsibilities—and of the collective rights of communities in a framework of participatory democracy, harmonious coexistence with citizens, and harmonious coexistence with nature, in which the common good and the general interest prevail [45]. The aim of this type of living is to lead a dignified but austere life that conceives well-being holistically, identifying it as harmony with the social environment (the community), with the ecological environment (nature), and with the supernatural environment [46].

Environmental education for Good Living must seek experiential learning [25]. For this, learning outside the classroom must be a key element through which students are allowed to understand the environment as a part of the society in which they live, in order to understand both its fragility and its benefits—intangible than economic—that they can draw from it [47]. It is needed, therefore, to more critically learn science (which is intimately linked to the western vision of the world), thereby allowing the development of a new vision of the relationships between societies and individuals with the environment, which must be complemented with other voices and epistemologies that give rise to intercultural dialogue as a key process in the attainment of Good Living [42–44,46,47].

### 1.1.3. SL as a resource to teach Good Living at University

Higher education should provide not only professional training or knowledge about SD but also personal development, enabling one to cope with complex situations and teaching how to act upon reflection and make decisions accordingly [36]. University should be the place where personal skills,

such as responsibility, ethical standards, and judgment, can be achieved, as well as other personal, knowledge, skills, and attitudes dimensions, such as systemic thinking, critical thinking, emotional intelligence, interdisciplinary work, and empathy [48].

Educating for autonomous learning implies that students develop competences, such as learning, to build knowledge through meaningful learning [1]. It is true that competency-based assessment has received criticism from different viewpoints. Some authors experience limitations because they steer away from measuring superior capacities, such as the transfer of knowledge or argumentation. Others (Tiana, 2014) criticized that the most outstanding element of the LOMCE (spanish education legislative framework) [49] model is its return to mandatory assessments to complete this stage, similar to those deleted in obsolete laws [50].

Service-Learning (SL) is one of the so-called active education methods [51,52]. Others include Problem-Based Learning (PBL) [53,54], Inquiry-Based Learning (IBL) [55], Gamification [56], Flipped Classroom [57], or Game-Based Learning (GBL) [58]. These methods are based on the idea that students will learn better if they directly apply their knowledge to improve real-life situations. For this, activities inside the community must be designed to overcome challenges under the perspective of social justice [59]. SL cannot be considered without the active participation of students in service, meeting actual community needs with a reflexive exercise afterwards [60]. SL promotes the discovery of being competent by being useful to others [59].

SL offers a large variety of configurations. Under the SL umbrella there are different levels of engagement and different methods of participation, from volunteer experience to project-learning, applied to specific situations inside a community [61].

Compared to other educative methods, such as those referenced above, the link to reality, practical reciprocal exchange with partners, and the didactically supported reflection of theory and practice are specifically important in SL. SL contributes to the development of self-efficacy and leadership skills, which are related to entrepreneurial strategic management and action competence. In this way, students develop skills at the same time they learn academic knowledge. Obviously, students feel positive emotions when their studies deal with “the real world” and not a mere theoretical conceptualization [62].

Although SL facilitates many ways of carrying out the experience, it needs to be based on a contextually located community (at a large or small scale), which makes the students handle real and unique situations. The objective of SL is to find a feasible solution within the specific needs of a context [62].

It is important to note that SL is not a voluntary service, practice, or internship. It is also remarkable that SL must be a guided, course-based activity and not an isolated action as an extracurricular voluntary service. In addition, the output of SL involves not only knowledge content but also experience that fulfills the meaning of the study itself because students experiment with the applicability and validity of their studies. SL is much more than practice and internships, it is a vital way to experiment with how knowledge (and education) is useful for a specific community—that is, its internal sense [63].

SL promotes several skills that are largely required by employers, so learning via SL could be a reasonable requirement inside the European Higher Education Area (EHEA). SL also presents multiple advantages for teachers, such as the promotion of ethics skills, service, and social responsibility, as well as the broad applicability of the contents being taught [62].

However, the implementation of SL is not usually recommended at the university level [64]. Academic programs can also engage students in the community, but the learning objectives of these activities are typically focused only on extending a student’s professional skills and do not emphasize the importance of service within the community or lessons of civic responsibility [65].

### *1.2. Why is the implementation of this methodology appropriate in this case?*

The application of the Service-Learning methodology in this case is particularly suitable because of its curricular context, because of its possibility to develop SDGs (including knowledge of Good Living), for its potential to promote the skills required for a graduate in environmental sciences, and

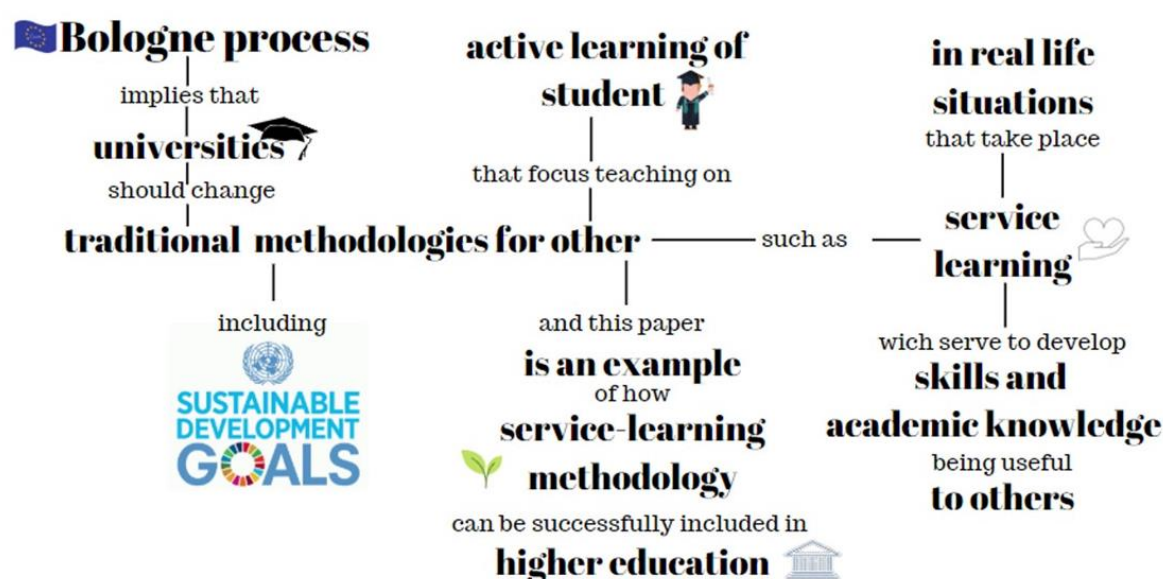
because it has real-world implications, in which students can see that what they do is useful and relevant.

### 1.3. Objectives, aims, and planning of the current work

According to the preceding sections, SL can be a useful tool for promoting SDGs and Good Living during University Degrees. Subsequently, our objective is to confirm the following working hypothesis:

*Service-Learning, as an active-based learning methodology, can be used to achieve SDG comprehension, understanding, and promotion among university students.*

To do this, we consider a real SL experience and analyse it under the principles of evaluation, reflection, and celebration [66]. In a graphical way, Figure 1 can easily condense the multiple implications we have pointed out previously.



**Figure 1.** Ideas tree for visualizing the multiple implications of self-learning (SL), sustainable development goals (SDGs), and Higher Education. Source: Own elaboration.

Consequently, this article presents an experience of SL linked to SDG promotion. This experience consisted in the design of adapted botanical didactic units (see below for further details) that were mailed to Canelo-Kichwa communities in Ecuador.

## 2. Method

This paper addresses a SL experience that was also used as a research-action activity. This is why this method is different from that of other pure-research works. The following sections describe how this experience was carried out.

SL is a very useful methodology if one aims to improve active-learning in any curricular context. However, we think it is especially interesting and fruitful when dealing with environmental issues (such as an Environmental Studies Degree; the study case) because a) it allows one to work with multiple environmental concerns and promote the understanding of many environmental contents (scientific issues), b) it allows the ethical development of the students, and c) it promotes critical thinking of the link between a) and b). Based on current experience, as will be shown afterwards, this methodology facilitated the study of botanicals (species, vegetal biology, population ecology, etc.)



and the implications they have within the social community (Canelo-Kichwa indigens). In addition, the ethical dimension is achieved by SDGs and Sumak Kawsay promotion.

## 2.1. Description of higher education experience

### 2.1.1. Framework

This study was carried out at the University of Extremadura (Spain), Faculty of Sciences, during the final semester of the Degree of Environmental Science. This semester consisted in the Final Degree Dissertation (FDD) presented by one of the authors (M.A H-B) under the direction of two authors of the current paper (T.R-T and J.B-S). The FDD was based on the Aramburuzabala Template Proposal available at Table A1 (Appendix), framed as a process of action-research [67,68].

### 2.1.2. Context of the FDD

The FDD consisted of an SL activity designed around the abovementioned Aramburuzabala Protocol. It was developed in coordination with an indigenous community from the Ecuadorian Amazon and was an environmental educational project designed in Spain under the *amazonic* perspective (and was field-tested afterwards). It was based on the needs of the Kichwa community's teachers from an area where the population has a high illiteracy rate but a perfect traditional knowledge of *Sumak Kawsay*—Good Living [69].

This project started between 2013 and 2017, during the investigation of the PhD student, C.X. Luzuriaga [69]. The directors of the PhD thesis (T.R-T and J. B-S.) learned the necessity for didactic material to teach sciences in the sociocultural context of the community based on part of the community (teachers and students) when they were there engaging in botanical studies. The researchers felt the need to improve this situation. This project was ultimately proposed to be developed as the Final Degree Dissertation (FDD) for a pre-graduate student (M.H-B). This FDD was publicly defended in September of 2017. Two years later (2019), after some time for reflection and diffusion, the authors feel prepared to share this experience with the scientific community.

The starting project's kick-off point was a workshop held at Sarayaku. This workshop was conducted by Luzuriaga alongside young people from the Kichwa amazonian community during her PhD field work. Community members were asked about plant uses and their importance in Canelo-Kichwa cosmovision. Finally, they selected the most important 20 species for the community. These 20 species were then selected as the focus of the FDD work and SL project. An in-depth study was carried out to elaborate 20 botanical fact sheets described in the results section. The creation of these sheets provided a valuable botanical apprenticeship itself for the FDD pre-graduate student.

In addition to this, the official curriculum of the Ministry of Education of Ecuador for Natural Sciences (Biology and Plant Sciences) [70] was carefully examined in order to determine and meet the requirements and competences that must be achieved by Basic Superior and High Level students (12–17 years old) of the Intercultural Bilingual Kichwa Education System [71]. Indigenous students are allowed access to the university. However, it is quite difficult to achieve all competences and achieve the same academic success as students who come from the city due to the conditions in which they live.

The principal aim of the FDD was to create didactic material adapted to social conditions described in the Background Part of the Appendix Protocol. Applying the SL methodology should achieve every learning objective included in the curriculum of the Environmental Sciences Degree [72]. In addition, it could be possible to engage in interdisciplinary work by integrating different curricular areas. This was accomplished by developing special kinds of knowledge (not just concepts): skills, ethoi, and capacities [73].

Previous research [69] has shown that some botanical practices are unique in this indigenous community. These practices were never registered and could offer significant progress in various medical fields [74]. Conservation of this traditional knowledge must be taken into account [75] and is a priority according to several international agreements [76]. Perhaps the first milestone is given

by the Declaration on the Rights of Indigenous Peoples (2007), [77] (p. 10) in which the UN included the following text:

*Article 13.1. Indigenous peoples have the right to revitalize, use, develop and transmit to future generations their histories, languages, oral traditions, philosophies, writing systems and literatures, and to designate and retain their own names for communities, places and persons.*

Traditional knowledge must, therefore, be cared for. This idea was taken into consideration when the Service Objective of the present SL project was developed.

## 2.2. FDD evaluation

FDD analysis and evaluation were made by using a specific rubric, a modification from Rovira, García, and Serrano [78], summarized in Table 1. A rubric is an evaluation tool that synthetically shows the precise quantitative and qualitative criteria to be evaluated [79]. A rubric consists of assigning an objective score according to the criteria being evaluated. The use of rubrics gives a student continuous feedback for his or her leaning process [80].

**Table 1.** Evaluation Rubric for SL. Source: [81]

	<b>A Good</b>	<b>B+ Medium</b>	<b>B- Medium</b>	<b>C Bad</b>
	4	3	2	1
Learning objectives	The source of learning is placed in a research activity, linked to the curriculum and to a relationship with community service. All objectives have been achieved through interdisciplinary work.	Learning plan and different activities are clearly linked to service. Their acquisition favors the better quality of the intervention. Some learning objectives were achieved.	Service is not clearly distinguished in the learning programme, although this plan is well-designed. Some objectives were achieved partially.	No plan is designed for learning, no activities are scheduled, and learning is acquired informally. All objectives were achieved.
Service objectives	Service was completely covered. Obtaining a long-term service made up of complex tasks that the participants themselves must design to solve a problem that demands creativity and involvement.	Service was achieved by obtaining service of a long duration that allows the acquisition of experience and skills in the accomplishment of tasks of notable complexity, whose accomplishment supposes a high exigency and some other implications.	Achieved through repetitive tasks and / or easy to learn, whose implementation involves moderate demands and involvement.	Not achieved, simple tasks with a low degree of implications.
Requirements	Real needs are discovered by participants through a collective research project in which they carry out work that critically examines reality.	The participants decide on the needs upon which they want to act through the analysis of different problems and choosing one of them. Educators accompany them.	Educators and/or social entities decide on the needs upon which to perform the service without consulting the participants.	No need-identification is carried out; needs are merely put into the project without reflection or research activity.

Purpose of Service	Although a need is identified by participants, they also are aware of the political implications of the specific situation.	Service responds to a needs of the community whose social dimensions the participants are aware of.	Service responds to the needs of the community, although the participants do not always manage to perceive political and social implications.	Service does not start from a detected need, from which the participants do not perceive its social dimension.
Evaluation of the SL activity	The participants with the educator actively intervene in different moments of the process for the preparation and application of a competency evaluation plan.	An evaluation plan is carried out. Objectives and other parameters are evaluated, and the project's outcome defines the accreditation of the participants.	Educators limit themselves to verifying the achievement of certain general learning objectives without defined criteria or indicators that could be accredited.	There is no established evaluation plan, although educators can spontaneously and punctually evaluate and communicate their assessment to participants.
Reflection of the SL activity	Reflection involves participants in a dynamic that promotes new contributions to the community.	Reflection is not only focused in some moments, but also on a specific exercise that allows the visualization of the whole project.	Reflection is programmed but comprises a limited time with no link to the rest of the project.	Reflective activities are not foreseen, nor are areas proposed to promote them, although, in a natural way, these activities can be thought and submitted to debate one's own experience.
Celebration of the SL activity	Both parts celebrated the success of service together.	Each part separately celebrated the end of the service.	Only one of the involved parties celebrated the SL.	The SL activity has not been celebrated.
Diffusion of the SL activity	The project was taken to conferences, written, and reflected on through the diffusion.	The project has been taken to conferences without any reflection process.	The project has been written and reflected but not shared.	The SL has not been written or diffused.

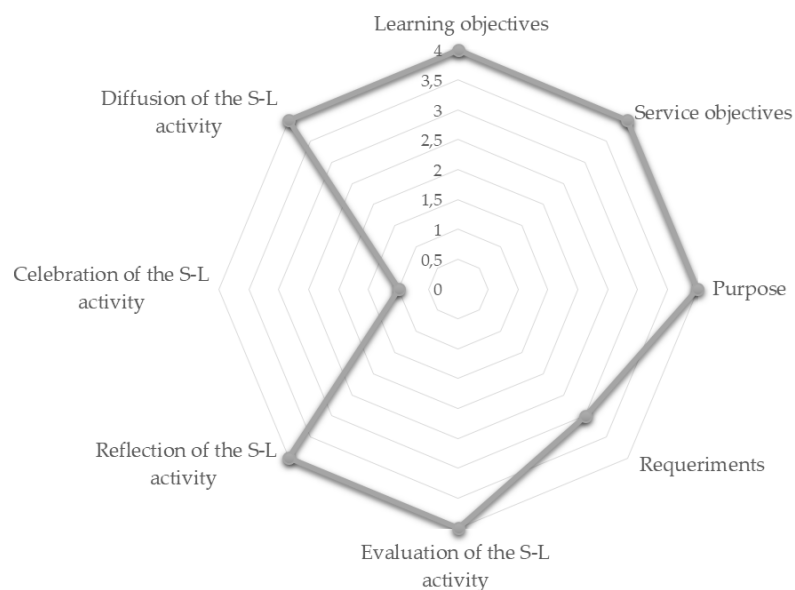
According to Table 1, the maximum score is 32 and represents a rate of 10 out of 10.

From a graphical point of view, Figure 2 represents an example score obtained once the experience is analyzed.

- Learning objectives: A (4)
- Service objectives: A (4)
- Requirements: B (3)
- Purpose: A (4)
- Evaluation of the SL activity: A (4)
- Reflection of the SL activity: A (4)
- Celebration of the SL activity: C (1)
- Diffusion of the SL activity: A (4)

For this SL experience, the score obtained is 28 and represents a rate of 8.75 out of 10.





**Figure 2.** Example of the evaluation of SL.

### 3. Results

As Arambuzabala [66] recommends, an SL experience must be evaluated according to the seven points included in Figure 3. However, the specific evaluation of this SL experience can be developed descriptively according to the following five subpoints: Learning objectives, Service objectives, reflection, celebration, and diffusion. These are the results of the current experience.

As a result of this work, we obtained real experience of the SL methodology at a higher educational level merged with the academic study and development of specific indigenous knowledge. As Gallardo [82] also noted, this was not a mere anthropological work but also included a) the interest of the stakeholders and b) the active learning of the involved students. This experience shows that the inclusion of these kinds of methodologies is quite easy to do it in the context of an Environmental Sciences degree. In this section, we will include the results of each part that must be considered in service learning, referring to learning objectives (a syllabus requirement and the necessity to acquire knowledge), service objectives (that were covered and achieved), a deep reflection (about improvements in learning), a celebration (after finishing the activity), and diffusion (sharing with the scientific community is a way to promote the implementation of this kind of methodology).

#### 3.1. Learning objectives

The learning objectives of this project are presented in Appendix A. As an actual SL project, it required connecting with the environment of the community [39]. Therefore, it was necessary to engage in a complex and in-depth study of the Canelo-Kichwa community, which included different topics, such as geography, biodiversity, costumes and culture, alongside studying the official curriculum of the Ministry of Education of Ecuador and understanding the important role of culture in achieving sustainability.

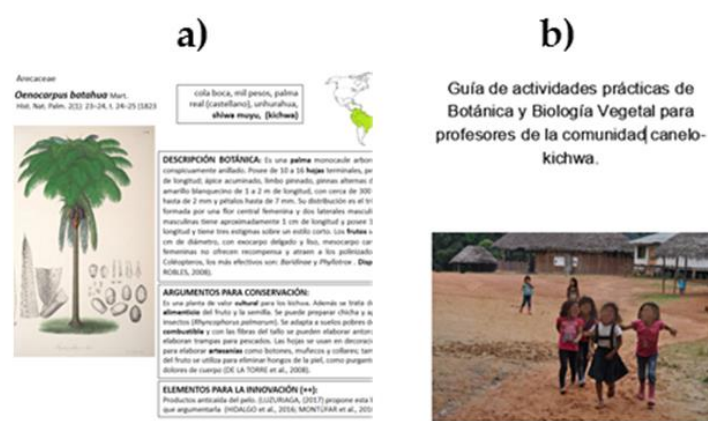
The transversal competences included in the academic curricula of the Environmental Science Degree [72] are covered by enabling the student to recognize the ethical dimension of the problems and to comply with a professional code of conduct. The professional deontology of environmentalists

includes, for example, an obligation to respect the culture, religion, and customs of the people in the region where the activities are carried out, as expressed in the Nagoya Protocol of the Conference of Parts 2010 of the Biological Diversity Convention of the United Nations [76].

### 3.2. Service objectives

Twenty cards were designed and created, as shown in Figure 3 (a). These cards included the names of botanical species (scientific and vernacular), botanical description of the species, reproductive biology (pollination, seed dispersal), conservation arguments, and elements for innovation.

These fact sheets were designed in order to help teachers perform the activities found in the activity book (Figure 4 (b) is based on the Primary and Secondary Education official curriculum of Ecuador [70]). We designed more than 40 activities adapted to the socioeconomic conditions of the community. Some of them can be found in the supplementary section.



**Figure 3.** An example of an *Oenocarpus batahua* card (a) and Botany and the vegetal biology workbook activity for the Canelo-Kichwa community b).

According to the main principles of SL and cooperation for development, the final outcome of this project (the didactic material) was sent to the community, in order to meet the requirement of returning the knowledge extracted to the beneficiaries. This workbook included activities to reinforce adaptation for the Canelo-Kichwa community, with the aim of preserving the customs giving it an identity value.

It is also remarkable that both the flash cards and the workbook are made with the objective of teaching, so they are science education materials. This aligns this project with SDGs since it promotes universal access to education (Goal 4).

### 3.3. Reflection in SL activity

Some of the competences that UNESCO recommends for graduates are “to achieve open-minded perception, trans-cultural understanding and cooperation, ability to feel empathy, sympathy and solidarity, to reflect in a distanced manner on individual and cultural concept” [83]. This kind of experience presents completely different realities to the student, helping them to question their own western lifestyles. Working with indigenous communities is a practical approach to the so-called *Sumak Kawsay*, a life in harmony with nature, community, and all living creatures [84].

The development of this project was useful to determine the great challenges for teachers to ensure that the training of students living in tropical rural areas is equivalent to the training of urban students. This project can also serve as a resource, to awaken critical thinking within students. In this sense, this project facilitates a reflection on socioeconomic global situation (North–South differences), capitalism’s worldwide implications, cultural homogenization, the devaluation of traditional knowledge, and many other issues. On the other hand, this project is focused on a particular service:

the idea that everyone should have access to education, thereby highlighting the promotion of the right to universal education.

It has been useful to learn the amount of resources and the enormous possibilities that the jungle offers as a place for biological studies. There are few school resources, such as pencils and pens [69], but there is enough time to engage in one of the most important tasks for science: observation [85]. This area was found to be a paradise for any researcher who wants to understand floral populations and the ecology of populations. This area is rich with many resources (in many cases unknown) worth knowing and exploring [86–88].

Working with indigenous communities is useful for dealing with a multitude of ethical issues, as it invites reflection on topics of bioethics and environmental justice [89,90], and well as the right of all human beings to be able to live in a healthy environment [89,91,92] and to be protected from environmental threats [93,94]. Social and economic justice refers to the exploitation of territories and military occupation (which is often exercised with strong repression and violence on indigenous peoples, in order to obtain raw materials and control the territory) [95]. It is also possible to question aspects related to the need to conserve biodiversity [96–98] and, at the same time, the importance of research for knowledge and the development of new products to improve the quality of life of human beings [74]. For patents, in the field of ethnobotany, the main beneficiaries are usually pharmaceutical companies, which in many cases take advantage of the botanical knowledge that communities have on the use or application of plants and their components, with little or no impact in terms of economic benefits on indigenous communities [99,100].

Finally, to emphasize the importance of the conservation of the indigenous cosmovision, and to revalue traditional knowledge and community values, there is a need to perpetuate knowledge based on personal experience and inquiries of human, who have been known to explore the innumerable resources that nature offers.

### 3.4. *Celebration*

According to the scarce literature on the steps of a SL project [66], a celebration is the best way to conclude the work done. Preparing and holding a party can be a small project inside a large project [101]. This is usually one of the weak points of a project, because of the difficulty of the mobility of a student within the community (Ecuador). The celebration of an SL project shares with the community the work done and the success of the project.

### 3.5. *Diffusion of the SL Activity*

The diffusion of an SL activity is crucial to give the work prestige and to conclude the experience [102]. In this case, this project has been taken to different conferences and has been proposed for inclusion in a national conference as a resource for awakening vocations to study sciences [103]. ethnobotanical studies could be useful for teachers and help to reduce the abandonment of the study of science that has been taking place in recent decades [104]. Another national conference provided an example of how to integrate ethical competences in the official curricula of higher education. Finally, this project was shared at the II National Conference of Service-Learning [105].

## 4. Discussion and conclusions

### 4.1. *Learning objectives*

This work is an example how to integrate sustainability (understood in a wide sense) in higher education. It includes the following sustainable aspects provided by Tejedor et al. [59] for the Conference of Rectors of the Spanish Universities (CRUE-Sustainability) as recommended measures to promote Sustainability:

- Having an integrated approach to knowledge, procedures, attitudes and values in teaching, as other service-learning project that was already achieved [106].
- Promoting work in multidisciplinary and transdisciplinary teams: Students should be taught to realize that complex issues involve moral choices and that information from

several disciplines enables them to make more informed decisions. They should feel comfortable in acquiring information from different disciplines, as students will live and work in a world where information from several disciplines must be integrated [66].

- Stimulating creativity and critical thinking: the ability to reflect on one's values, perceptions, and actions, and to take a position in sustainability discourse [17,107,108].
- Encouraging reflection and self-learning: The learner is able to use all opportunities for their own education throughout their life and to apply the acquired knowledge in everyday situations to promote sustainable development [17]. Thoughtful reflection on the service process is explicitly designed to foster learning and development [83].
- Reinforcing systemic thinking and a holistic approach: integrating different knowledges is a main objective.
- Training participatory and pro-active people who are capable of making responsible decisions: a goal of the SL methodology is to train students in values and transversal competencies, such as participation, social responsibility, entrepreneurship, ethical sense, and solidarity. As students become more experienced with SL, some can assume leadership roles in courses as student assistants and site coordinators and participate in the design and implementation of action research that focuses on needs assessment, program evaluation, and advocacy [63].
- Acquiring awareness of the challenges posed by globalization: Community SL has the potential to transform student worldviews [61].
- Promoting respect for diversity and a culture of peace: Indigenous worldviews and practices are a valuable resource for knowledge based on memory with a link to the environment [42].

UNESCO [20] defines the following domains as specific learning objectives for achieving the SDGs: the cognitive domain (comprises knowledge and thinking skills necessary to better understand the SDGs and the challenges in achieving them); the socio-emotional domain (includes social skills that enable learners to collaborate, negotiate, and communicate to promote SDGs, as well as self-reflection skills, values, attitudes, and motivations that enable learners to develop themselves); and the behavioral domain, which describes action competencies. Through this work and SL, it is possible to explore and to develop the three areas mentioned above.

#### 4.2. Service objectives

Education for Good Living proposes that, assuming the complexity of personal reality, dialogue is invited with its own spiritual experience. The spiritual criterion is defended as an integral part of its identity [42]. The objective is to educate people to respect cultural diversity and identity, as well as the right to education in one's native language with content appropriate to each culture [84].

This SL is a consequence of the need to apply the International Agreements of the Nagoya Protocol and the Convention on Biological Diversity [76] after a Doctoral Thesis has been defended [69], the field work of which was carried out in an Amazonian indigenous community in Ecuador. The University of Extremadura needed to comply with environmental legislation. This agreement regulates, inter alia, the sharing of benefits from associated traditional knowledge genetic resources held by indigenous communities, for which UN included explicit text [109] (p. 6):

#### *Article 5. FAIR AND EQUITABLE BENEFIT-SHARING*

*1. In accordance with Article 15, paragraphs 3 and 7 of the Convention, benefits arising from the utilization of genetic resources as well as subsequent applications and commercialization shall be shared in a fair and equitable way with the Party providing such resources that is the country of origin of such resources or a Party that has acquired the genetic resources in accordance with the Convention. Such sharing shall be upon mutually agreed terms.*

*2. Each Party shall take legislative, administrative or policy measures, as appropriate, with the aim of ensuring that benefits arising from the utilization of genetic resources that are held by indigenous and local communities, in accordance*

*with domestic legislation regarding the established rights of these indigenous and local communities over these genetic resources, are shared in a fair and equitable way with the communities concerned, based on mutually agreed terms.*

Thus, after researching in the community, it was necessary to give back to the community in a in an effective and understandable way for them.

Work has been done by promoting sustainability and taking care of ecosystems; by trying to reduce the levels of inequality in the capacities and opportunities of the community; by recognizing and respecting ethnic differences; by harmonious coexistence, contributing to the flowering of their culture, and understanding contextual education; by recognizing, respecting, and promoting various forms of literacy, depending on the social and environmental context, so that these goals can be fulfilled by the people; by respecting and promoting simple lifestyles; and by recognizing different spiritual practices in the community [110].

This powerful tool for learning and social transformation allows students to learn while acting on the various needs of the environment with the aim of transforming reality through improving actions, while reflecting in a structured way on lived experience [111]. In SL, students engage in community service while at the same time gaining academic knowledge and skills [73].

#### *4.3. Evaluation challenges in an SL Project*

Teachers in Higher Education are called to design activities that facilitate a student's learning. If these activities are focused on sustainability issues, the educational needs for interdisciplinarity (because sustainability is not constrained to a single dimension), creativity (because new challenges need new methods), and fun (because there is not a better way of making teaching efficient). Carrying out interdisciplinary work is demanding, and to consider ethical issues within the curriculum means that teachers have to make such an effort that not all of them are willing to do so [110].

SL guarantees the connection between the academic lives of students and local environments. It is an active learning method that gives sense to the study activity. Regarding the community where it is actuated, SL allows a feasible solution to specific situations and real problems [83,112]. SL is a useful method for familiarizing students with the local environment. It connects living environments meaningfully to the lives of students and to the communities they come from [112].

SL can be used, as in the current experience, as an additional method for educational purposes when the service has meaning within academic development. For this end, we must link objectives and activities, as well as evaluate the service itself. Planification and proper scheduled activities are required in order to realize a successful SL experience. Ultimately, SL can engender new modes of living education in the classroom, giving a sense of utility to almost every piece of knowledge and content and making learning more interesting and enjoyable [63]. Moreover, SL can help students attain the necessary competences and develop other types of skills that would not have been possible following a traditional teaching methodology, such as global citizenship (understanding the global circumstances of local communities, the implications of our western way-of-life, etc.), empathy, and adaptations to different (and more difficult) environments for education.

This SL experience yields the following reflections. Social sustainability deals with different aspects of human rights. The customs, uses, and practices of indigenous peoples are compatible with the protection of natural resources and ethnocultural diversity [50]. Good Living seeks to take care of the nature that we are part of [45].

#### *4.4. Service impact*

The impact that an SL could have seems impossible to quantify. An SL acts in two directions: on the community affected by the service and on the institution driving the project [78]. In this sense, it is important to note that the University is involved in the SL project as an institution—that is, the initial academic space where the SL began. In addition, the personal implications of the students (those who developed the SL project) made the students develop new skills (such as those referred to above) and (most importantly) sensitiveness toward global situation of inequality, the search for



justice, and individual and collective responsibility. These and other competences can be encapsulated in so-called global citizenship and ethics [16]. The following table shows a summary taken by Torres and Laprida [112] on some benefits of working using a service-learning methodology in the classroom.

**Table 2.** Summary of the benefits of SL [110].

Benefits
Increases student engagement and motivation
Improves academic learning
Encourages reflection and critical thinking
Promotes the personal and social development of students
Reduces risky behaviors among students
Greater linkage to the educational institution
Connects education with the needs of the environment
Increases teacher motivation and increases teacher satisfaction

Emotions play an important role in the whole teaching–learning process, especially in scientific disciplines [57]. Studies suggest that the application of active methodologies in Biology improves academic learning and emotional responses toward learning science [113]. When the students engaged in active and authentic tasks, they were more likely to plan and evaluate their learning [114]. SL, in this case, is an example of how every benefit cited in Table 2 has been integrated.

SL projects have the potential to develop a vision of social justice, to acquire critical awareness of problems, motivations for change, and a commitment and accountability to results [114]. Through SL, students increase their awareness of social justice [115].

#### 4.5. Not only benefits: a SWOT analysis

SWOT is the acronym for Strengths, Weaknesses, Opportunities, and Threats. It is a well-known dynamic for analysing experiences and situations in a systematic way, in order to identify the best and most profitable aspects, as well as those that must be transformed because they constitute dangers and weak points [117].

In this way, Table 3 offers a SWOT analysis of the current SL experience.

**Table 3:** Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis. Source: Own elaboration.

Strengths	Opportunities
<ul style="list-style-type: none"> <li>• Learning becomes more significant</li> <li>• Practices (field/lab) can be implemented easily</li> <li>• Transversal competences and skills are easily developed, since a context is given.</li> <li>• SDGs share many objectives with these transversal competences in the Degree of Environmental Science.</li> </ul>	<ul style="list-style-type: none"> <li>• University/Education/Academic Knowledge is put directly in relationship with the reality of several aspects of society and citizenship.</li> <li>• Stereotypes of young generations (known as millenials) are deconstructed with regards of education and solidarity action.</li> <li>• SL can be used to demonstrate how to become useful for society.</li> <li>• It responds to the search for new educative models.</li> <li>• Society urgently requires new responses to real needs.</li> </ul>

	<ul style="list-style-type: none"> <li>• SL can be creatively adapted to global challenges.</li> <li>• Communication Technologies allow new ways to work on social problems (such as those presented by the SDGs) in a very effective way.</li> </ul>
Weaknesses	Threats
<ul style="list-style-type: none"> <li>• Some theoretical content can be left behind.</li> <li>• SL forces us to go outside our “comfort circle”.</li> <li>• Official procedures for evaluation are not adapted for individual work with each student.</li> <li>• Society can misunderstand the fact that students are engaging in social services during academic periods.</li> </ul>	<ul style="list-style-type: none"> <li>• The official syllabus is in risk of not being completed.</li> <li>• High-level coordination is required, especially between teachers and social agents.</li> <li>• It requires more teacher dedication (or more teachers).</li> <li>• There is still a large gap between academic issues and profesional/social concerns. This gap must be filled.</li> </ul>

As can be seen, the main concerns about the implementation of a SL experience for promoting SDGs have to do with the fact that it places us a bit far from the exact academic completion of the syllabus; it is also a rather heterodox teaching practice. The challenge is, therefore, to include these experiences in standard teacher planning, as well as its evaluation (internal and external), in order to overcome possible risks.

#### 4.6. Conclusions

Higher education institutions play a very important role in the achievement of SDGs [16]. Transversal competences are probably the most intangible competence, but, at the same time, they are the most required for the current world. SDGs and the paradigms they develop require these soft skills [117].

As in other studies, service-learning is shown to be a perfect resource for teachers to teach about sustainability [16,66,118–121]. Good living (*Sumak Kawsay*) could be an appropriate framework for students to develop competences. From the perspective of Good Living, from a holistic perspective, one cannot separate the nature of the community from its people. The human being is an individual who is part of a community and of nature [45]. Simple living introduces the need for a social ethos of good living, a cultural change that modifies patterns of consumption towards a socially and ecologically sustainable one: to live well within social and ecological limits [45].

The current work presented a specific SL activity, focused on the promotion of sustainability under the prism of SDGs. Analysis of the activity shows many competences, especially those related to global citizenship, and transversal skills (soft skills) were developed. As far as we know, there are few studies with a similar research focus [29,48,59,111,114,120,122].

Finally, this work is an example of how it is possible to integrate SDG and Good Living objectives in higher education. One of the best ways to do this is through the FDDs of environmental sciences. It is then possible to achieve the competences required by UNESCO [20] and by the official

curriculum. It seems necessary for universities to work on sustainability. This help all the individuals and families within society to live healthy and prosperous lives. Social sustainability also deals with different political and religious issues. People from all cultures, religions, values, and ethical backgrounds have a prosperous life in the future [42]. To educate is to introduce a person into the participatory flows of our society; moreover, to educate critically is to participate in a student's transformation [83].

The methodology of SL, through a process of action-reflection-action, collaborates in an efficient and practical solution for the consolidation of the basic competencies that contribute to a successful life and good social functioning in the general framework of universal values: respect for human rights, integral development, and democratic processes [114].

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## Appendix A

**Table A1.** Analysis of the SL project.

Title of the project:
Development of cooperation with an indigenous community of Amazonas (Canelo-Kichwa)
Technical details:
Responsible entity: University of Extremadura
Number of participant students: 1 (FDD Student)
Number of persons to whom the service is addressed: 1200 inhabitants of Pakayaku [48]
Background
The Pakayaku community is an isolated indigenous kichwa population that has little contact with the outside world. The community sites are on the shores of the Bobonaza River (an Amazon tributary) in Pastaza (Ecuador). There is no electricity, no running water, no sewers, no internet, no landline telephones, and no mobile phone coverage. Coexistence is peaceful and access is by canoe and fully regulated by the community. Society divides tasks according to gender.
Ecuador's Ministry of Education has become committed to the most neglected indigenous communities in the Amazon. It proposed to set up schools in the jungle where formal education would be harmonized with their culture of origin.
At the Faculty of Sciences in the University of Extremadura (Spain), a previous study dealing with the ethnobotany of the area was performed. The principal aim of that previous study was adding value to the biodiversity of Pakayaku to serve as a source of innovation for development. Researchers realized that the community's teachers needed didactic material adapted to their socioeconomic conditions. They were informed by teachers and the population about this demand.
Social need aim to serve by the project
Creation of didactic materials for teachers who have to teach biology and earth sciences in rural amazonic contexts.
Fight for the right to universal education
Learning objectives
Acquire a multidisciplinary and global vision of the environmental problem, based on various sectors of knowledge.
Be able to deal with environmental problems with rigour, in accordance with the complexity of their scope, taking into account the rest of the social and economic problems of the society.
To be able to situate oneself in a new context with unique problems, identify those problems, analyse them, and propose methods of action.

<p>Recognize the ethical dimension of problems</p> <p>Evaluate one's own activities and learning process, developing strategies to improve them and undertaking further studies with autonomy;</p> <p>Integrate legal, socio-economic and cultural factors in the treatment of environmental problems.</p> <p>Process, interpret (quantitatively and qualitatively), and present experimental results</p> <p>To design and execute plans and programs for formation, diffusion, and environmental sensitization</p>
<b>Curricular areas involved</b>
Didactic, Botany, Ecology
<b>Service Objectives</b>
<p>To create material for teachers working in the Kichwa communities of Amazonian Ecuador adapted to their spiritual values and beliefs;</p> <p>Preserving the indigenous cosmovision through the cultural use of plants;</p> <p>To promote the conservation of ancestral ethnobotanical practices;</p> <p>To help match the academic formation of the children of the community with those of the rest of the country;</p> <p>To demonstrate that there are many possibilities for research in Amazonian ethnobotany;</p> <p>To facilitate community empowerment through education;</p> <p>To help to the public University of Extremadura (Spain) to comply with the Nagoya Protocol.</p>
<b>Activities to achieve the objective</b>
<p>Deeply study the community, traditions, conditions, social customs, geography, ethnobotanicals;</p> <p>Design 20 educational fact sheets with botanical information of the (20) most important species for the community;</p> <p>Elaboration of a science workbook with activities to help teachers using the official curriculum of Education (Ministry of Ecuador), exploring the contents that they demand students must know;</p> <p>Giving this material to the indigenous community.</p>
<b>Entities involved in the project</b>
<p>University of Extremadura, Spain</p> <p>Originary Community of Pakayaku, Pastaza, Ecuador</p>
<b>Reflection</b>
<p>Engaging in this project makes the FDD student reflect on the impossibilities of achieving sustainable development if we exclude any part of the world's population from opportunities, services, and the chance for a better life.</p> <p>It makes the learner realize the global inequalities affecting us all and that problems and challenges (poverty, climate change) are never just confined to one country or region.</p> <p>It importantly empowers and promote inclusive social and economic growth, while we should also respect that natural landscapes are closely linked to spiritual values and beliefs. From our comfortable Western position, we can work together to improve access to education and health.</p> <p>Indigenous people are important because they maintain and protect a capital of knowledge and biological patrimony. They must to fight against the accelerated loss of their society and culture</p>
<b>Evaluation</b>
<p>The project was developed within the official curriculum of the Degree in Environmental Sciences at the University of Extremadura as a FDD. The final evaluation was made after the public defense of the work before a tribunal composed of three expert doctors (PhDs).</p> <p>Also, during the process, almost every week a common reflection was shared between the teacher and the student to evaluate the project's advances and future lines of work.</p> <p>Concerning the evaluation of self-learning, through this project it was possible to integrate the knowledge and contents of various scientific and social fields but also to attain various competences and develop other types of skills that would not have been possible following a traditional teaching methodology.</p>
<b>Celebration</b>
<p>After the elaboration of the cards and the defense of the FDD, one of the investigators of the previous ethnobotanical research, of Ecuadorian origin, returned to Ecuador and delivered the didactic material to the indigenous community and teachers.</p> <p>They accepted the material we created, but we did not engage in any celebration together.</p>
<b>Diffusion</b>
<p>-April, 5<sup>th</sup> 2018: National Conference III Workshop Studying Sciences "Creating Scientific Vocations" as an oral presentation: Amazonian Kichwa Ethnobotany as a Resource for Awakening Vocations to Plant Biology".</p>

- June, 7<sup>th</sup> and 8<sup>th</sup> 2018 in the IV Ethics and University Conferences as an oral presentation: "A University for Citizenship": "Cooperation from the UEx for educational development in an Amazonian indigenous community".
- March, 9<sup>th</sup> 2019 II National Conference Service Learning-Extremadura as oral presentation: "Cooperation for development in an indigenous community".

#### Calendar

January to September: Elaboration of Final Degree Work  
 September 2016: Public defense of Final Degree Work  
 November 2016: shipping of materials to the Canelo-Kichwa community  
 April 2018–March 2019: Diffusion of SL methodology

#### Human and material resources required

Willingness, motivation [38], Internet, Bibliography, Curricula of Ministry of Ecuador, access permissions to the community.

#### Budget

This activity was performed without external funding.

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