

# ECOLOGICAL ENTREPRENEURSHIP AS A STRATEGY TO MANAGE COMPLEXITY

## Case Study:
## Green Solutions Laboratory – Chingaza Paramo (Guavio Province)

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# Keywords

Chingaza Paramo, Sustainable Entrepreneurship, Complexity, Green Businesses.


# Abstract


The Paramo ecosystem is one of the most important in the production of the hydric resource. This neo tropical ecosystem is located in the northern part of the Andean and Central American mountain chain at an elevation higher than 3,000 meters above sea level.
Complex evolutionary processes that have occurred in this place have given place to a unique Andean tropical forest. Paramos are characterized for having a low annual temperature, 12 degrees Celsius at noon, with small variations during the day (at night they can reach temperatures under the freezing point). The annual precipitation is high, ranging between 1000 and 3000 millimeters with seasonal variations. Thanks to the complex evolutionary processes, Paramos present a unique and distinctive flora which is home to more than 3399 plants, the great majority of which are endemic making this ecosystem a biodiversity hyper hotspot (Londoño, Cleef, & Madriñán, 2014). Paramos are especially important for being sophisticated water storing systems with a high capacity to produce and regulate water. In addition, the rivers that come from Paramos have a constant flow throughout the year (Ríos-Sánchez, 2009).

Due to global warming that foresees a rise in the temperature of this characteristically cold ecosystem, there will be changes in the ecosystem's soil's characteristics and in its total extension contributing to a reduction in the production and water regulation (Ríos-Sánchez, 2009).

The second symptom of global warming is the reduction in precipitation; this will lead to a rise of forest fires that will change the type of vegetation and the water cycle's components, especially, the transpiration process. Also the total pass-through time will be less as a sign of melting glaciers which implies a more frequent water supply to the system (Ríos-Sánchez, 2009).

Both impacts of global warming over Paramos will have mainly two consequences: in the first place, water production in Paramos will be reduced. In second place, a there will be a rise of human activities such as agriculture, grazing, pine tree planting and tourism, all altering the hydrological behavior of Paramos. Both consequences will affect the water supply of major cities which will have a strong repercussion in economic terms because, going back to the Colombian case and the Guavio province, between 85% and 95% of potable water for the 8.000.000 Bogotá residents comes from their local Paramos (Ríos-Sánchez, 2009).

Although the Guavio province possesses such natural richness, the majority of its population belongs to the lower income segment and 27.2% of its residents have their basic needs unmet. Moreover, 75% of the business there are micro and family based which prevents the generation of employment opportunities. In addition, their main economic activities depend on traditional agriculture techniques and marketing where the producers receive a relatively low pay by middlemen (Cámara de Comercio, 2006). All these activities, as were mentioned, threaten the nearby Paramo Ecosystem's –Chingaza- biodiversity.

In this context, the Engineers Without Borders Colombia - ISFCOL (Ingenieros Sin Fronteras Colombia), made up by two Colombian universities, Universidad de los Andes and Corporación Universitaria Minuto de Dios, has identified along the local community, opportunities to generate an environment of sustainable entrepreneurship revolving around the projection of sustainable green businesses.

A green business refers to a specific business that is made with a good or service through processes and materials with the following characteristics: a. They are green processes meaning they minimize the use of energy and water, they impede environmental pollution (soil, air and water) and they minimize the generation of residues and b. they are green materials, which in other words means they are made or obtained from nature through green processes (Pacheco, J., González, M., Ramírez, M. 2013).

This article identifies an articulation model between the region's different entrepreneurs, through the construction of a proposed sustainable system that a. will keep in mind the needs of the systems actors, b. will tap into green business models that will conserve the environment's impact and c. will generate complexity managing mechanisms that will support development and the region's conservation.

# Introduction

The more the economic benefits that come from environmental services are evident and widely known, there will be more, in the same measure, interest to prioritize, protect and repair that ecosystem. In the specific case for the Chingaza Paramo ecosystem, located in the Guavio region in Colombia, their environmental services come in the form of clean water supply and electricity generation via hydroelectric plants. These environmental services are consumed by Bogota city, the nearby provinces and 17% of the country if it is taken into account that the Orinoco River is born in the Chingaza Paramo. Thanks to these facts there has been an interest awakening to protect this ecosystem through its responsible administration.

This document presents a model to articulate different Guavio region entrepreneurs, through which, the construction of a collection of ecologic productive opportunities connected throughout the region is proposed that will a) take into account the needs of the system's actors, b) develop ecological entrepreneurship and c) generate complexity management mechanisms to produce the conservation and conservation of the Paramo ecosystem.

In the first section, context, the case study's essential actors are described and the place where it takes place. The second section, conceptual framework, talks about the concepts on which the article is based upon. The third section, introduced the case study and how the Green Solutions Laboratory was developed. In the fourth section, the results obtained during the event are presented. In the fifth and last section, the conclusions are presented in relation to the event's results.

# 1. Context

## Guavio Region

The Guavio Region is comprised of 8 municipios that form part of the Cundinamarca department and it is a region of importance because it possesses 4 big strategic ecosystems. The natural region offers, through the Chingaza Paramo ecosystem, approximately 72% of Bogota's water supply; at the same time, the production of the Guavio hydroelectric corresponds to 9.88% of the national total. This means that the development of around 15% of the country's population, situated in Bogotá and it's outskirts, depends upon the sustainability of the Guavio Region's environmental offer (Cámara de Comercio, 2006).

Despite its regional importance, the Guavio Region's population has low economic income and 27.2% of its inhabitants have their basic needs unmet in part due to the fact that 75% of the local enterprises are very small sized or family-sized productive units (Cámara de Comercio, 2006). From another point of view, the main economic activities are dependent on processes of territory use and occupation, where traditional commerce schemes based on agriculture and animal rearing are implemented. Here the producer receives a low pay on behalf of the middleman and the biodiversity and sustainability of the ecosystem is threatened. Finally, it is important to highlight that the working opportunities for young people are limited and nearsighted. The most frequent jobs are as assistants in flower cultivations, in private farms and in some tourism establishments. This shows a lack of culture around entrepreneurship that generates a working force migration from the smaller municipios to the bigger municipios and cities (Ingenieros Sin Fronteras Colombia, 2013).

## Paramo Ecosystem

The Paramo is a tropical ecosystem endemic to mountains and unique for the environmental services it provides. The most known services are the regulation and conservation of water. In Paramos, a great number of small and medium sized rivers are born. Colombia possesses 49% of the world's Paramos. In the American continent, the majority of Paramos are located on the Andes mountain chain (Greenpeace, 2012).

Paramos are characterized for having a low annual average temperature, 12 degrees Celsius at noon, with small variations throughout the day. At night below-freezing point temperatures can be reached. Annual precipitation is high, between 1000 to 3000 millimeters, with seasonal variations. Paramos present a unique and distinct flora, home to more than 3399 species of plants, the great majority endemic making this ecosystem a hyper biodiversity hotspot (Londoño, Cleef, & Madriñán, 2014).

The Paramo's behavior is not disconnected from what happens throughout the rest of the region. Paramos, "with environmental conditions sustained by low temperatures, climate extremes and slow metabolic rates, present a high vulnerability to perturbations (herding

and local fires), which is responsible for the low response rates of these ecosystems." (Andrade, Sandino, & Aldana-Dominguez, 2011).

With frequent disturbances, biological biodiversity is lost and so, the system has a less response capacity (Andrade, Sandino, & Aldana-Dominguez, 2011).

## Chingaza Paramo

This article's study case is located in the important Chingaza Paramo ecosystem. "It is located in the country's center, between the Cundinamarca and Meta departments. These paramos are distributed in 19 municipios mainly in Fómeque, Guasca, Junín, San Juanito, la Calera, Guatavita y el Calvario. This región contains the Chingaza, Gachalá, Guasca, Guatavita, Las Barajas, Las Burras, El Atravesado y San Salvador Paramos, and the localities of Altos del Gorro, Tunjaque, Cerro Granizo, among others." (Vásquez & Buitrago, 2011).

The Chingaza Paramo "reaches 19 municipios, 64.500 square meters, between 3,150 y 3,950 meters above sea level. Its importance made it deserving of being declared a Natural National Park in 1977. As an additional fact, it shares the hydrographic areas of Magdalena-Cauca and Orinoco for rivers Bogota, Teusaca and Siecha. There are 40 lakes of glacier origin in the Chingaza Paramo and of this great hydrological abundance, 80% of Bogota's water is supplied." (Vásquez & Buitrago, 2011).

## Engineers Without Borders Colombia – ISFCOL

Engineers Without Borders Colombia, abbreviated as ISFCOL, is an academic alliance between Universidad de los Andes and the Corporación Universitaria Minuto de Dios, "that through managing community projects and academic upbringing, seeks to promote people with strong capacities and with the most potential for social change for generating regional development based on equity and social, economic and environmental sustainability." (Duarte Gómez, 2013).

It has two sets of primary activities: in the first place, academic development and upbringing shown through the course Intermediate Project ISFCOL, the international course ISFCOL, the international seminar ISFCOL, the investigation group ISFCOL and ISFCOL dissertations (Duarte Gómez, 2013).

In second place, it manages community projects, and at the time of the publication of this article, it is currently executing a) Strengthening of Community Management of Water through reducing the amount of water consumed using Information and Communication Technologies; b) Quality of Water: Vereda Santa Isabel de Potosí, Guasca - Cundinamarca; c) Strengthening of Community Green Business in the Guavio Province; d) Center for Social Innovation in Guasca - Cundinamarca (Duarte Gómez, 2013).

Finally, it also develops as part of supporting activities, gaining visibility though awards along with publications as it gains institutional strengthening and formation of alliances. (Duarte Gómez, 2013).

## Green Businesses Project

Engineers Without Borders Colombia managed to identify, in conjunction with the local community, the opportunities to generate and environment around sustainable entrepreneurship through the projection of sustainable green business in the Guavio Region. Such opportunities were explored formally and this is how the “Strengthening of Community Green Business in the Guavio Province” project was born. A project formulated by Engineer Without Borders Colombia – ISFCOL and approved by the Sistema Nacional de Regalías through the Gobernación de Cundinamarca and its Secretaría de Ciencia, Tecnología e Innovación.

This project has as its objective the construction of a network that merged 35 or more productive units, meaning, already established enterprises o businesses, located in the Gachetá, Junín and Guasca municipio (municipios all part of the Guavio region). In addition to seeking to build or create ties between the existing productive units, the project wanted to strengthen the green profile of these productive units and awaken interest for entrepreneurship among the young people in the region. For this reason, the project used 350 Tenth and Eleventh grade students from the three municipios, along with university level students from Universidad de los Andes and the Corporación Universitaria Minuto de Dios through the courses offered by Engineers Without Borders Colombia in both institutions.

The project was constituted by workshops, events, data collecting and its announcing. Among all this, the essential was to generate democratically 10 green solutions. They, if implemented, would be the great innovations that would allow the construction and integration of the Green Business network amongst the 35 productive units in the project. In the section that talks about the study case, these mentioned green solutions will be explained.

# 2. Conceptual Framework

## Ecological Entrepreneurship

We will start with the description of what will be understood as entrepreneurship throughout this article to then afterwards encompass the term ‘green’. There are articles solely devoted to categorize the different types of existing entrepreneurs. Therefore, we will now mention a set of cases that have been registered in literature as types of entrepreneurship. Schaltegger (2002) manages to select his favorite authors and gathers the following five phenomena. I) Entrepreneurship as the process of creating and establishing a new business. II) Entrepreneurship as constantly seeking out knowledge. III) Entrepreneurship as a social or environmental movement with its beginnings anchored to a community. IV) Entrepreneurship as the successful introduction of innovations into the market. V) Entrepreneurship as the set of characteristics associated with leadership: ambition, commitment and the capacity to build good work team practices.

With that stated, ecological entrepreneurship, being the union of two words, is the case where the entrepreneurship characteristics are channeled towards environmental reparation and conservation. Then, we define, the ecological entrepreneur as that who leads an enterprise which is not only economically viable, but that seeks to incorporate responsible environmental practices.

Finally, it is important to highlight, which are, generally, the motivations of the ecological entrepreneur (Schaltegger, 2002):

- Respect legislation: he or she seeks to venture through government sanctions and incentives.
- Market access: he or she seeks to venture to obtain the market’s positive incentives.
- Acting on moral conviction: he or she seeks to venture to change the relationship of the consumer with the envirionment.

It is important to mention that these motivations are not mutually excluding.

## Strategic Ecosystems

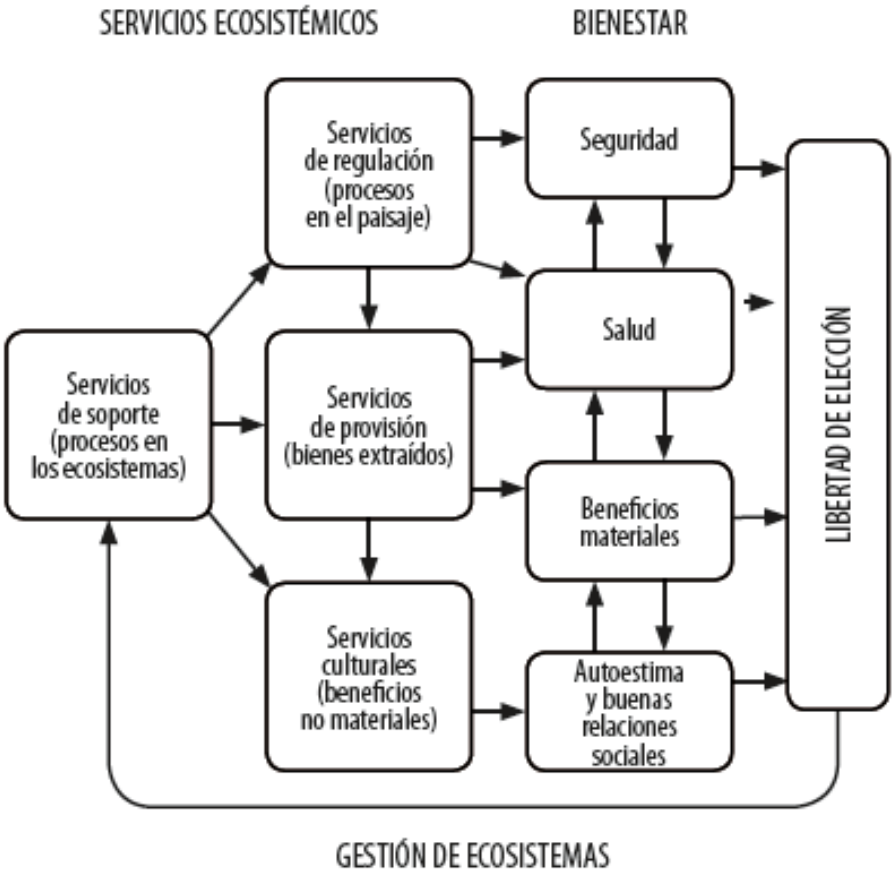
Strategic ecosystems are “those areas inside the territory that thanks to their biological composition, physical, structural characteristics and ecological processes, provide environmental goods and services necessary and irreplaceable for sustainable and harmonic development (Vega, 2005).

The Paramo is defined as strategic ecosystem in El gran libro de los paramos published by the Instituto Alexander Von Humboldt. In this document, the most important environmental services that this ecosystem provides is the production of sweet water, “the hydrological balance in high mountain zones and the importance of these ecosystems in the conformation of hydrographic birthplaces [in Colombia].” (Vásquez & Buitrago, 2011).

In that order of ideas, it is important to examine what are the environmental services: “provide society with services that support, regulate, provision and cultural values that determine human well-being.” (Andrade, Sandino, & Aldana-Dominguez, 2011).

To understand this fundamental concept, we included a graphic representation shown next that exemplifies the relationship between humans and biodiversity contained in strategic ecosystems as we already have named the Paramo.

**1. ECOSYSTEMIC SERVICES AND HUMAN WELLBEING**




**SOURCE: (ANDRADE, SANDINO, & ALDANA-DOMINGUEZ, 2011)**

This graph very well explains how the freedom of choice that society possesses, comes from the responsible managing of ecosystems. This liberty comes from the different processes that exist within each ecosystem. Then, as consequences of these processes, come the so-called services humans obtain. They comprise a range that society has known how to take advantage of: visually and for the aesthetic enjoyment of flora and fauna (cultural services); commercially for industrial development (provision services); need supply without damaging the landscape (regulation services). The benefits are multiple and different in the long and short term: security, health, material wealth created by men and self-esteem and good social relationships.

Applying the previously stated to the ecosystem where the study case takes place: the Chingaza Paramo, the support services that occur are the production and hydrological regulation. This happens based on certain organisms, for example the endemic species, frailejones. Its aesthetic enjoyment, as the one that comes from the contemplation of a picture of these landscapes, o when one visits in the company of a guide, is a cultural service. This contributes to our self-image as a biodiverse and beautiful country. This hydrological regulation also supplies 17% of the country, 70% of Bogotá and also is a hydroelectric energy provider. This forms part of the regulation services. Finally, through the extraction of minerals valued commercially in the market such as coal, the provision services are manifested.

Sadly, although society is so closely tied to strategic ecosystems, in particular the one that is here talked about the Paramo ecosystem, there is not a consequent behavior with this reality. “The Paramo is one of the most altered ecosystems in the continent, the climatic conditions of the Andean mountain range are favorable for the establishing of a great deal of population, causing the progressive diminishing of these natural scenarios.” (Chaparro Barrera & Chaparro Barrera, 2012).

More worrying is the Paramo damaging that occurs directly and indirectly. The direct affectation, already mentioned, includes the agricultural activities such as potato growing and animal farming. The indirect affectation includes the climate change manifestations.

Due to global warming, that projects an increase on the temperature of this characteristically cold ecosystem, there will be changes in the characteristics of soil and of its total extension contribution to a reduction in the production and regulation of water (Ríos-Sánchez, 2009).

Also due to this same phenomena created by human activity since the final part of the 20$^{th}$ century, a reduction in precipitation will lead to a rise in forest fires that will change the type of vegetation and the components of the water cycle, specially the process of transpiration. Furthermore, the time that water takes to push through the system will be less as a sign of glacial melting which implies a more frequent entry to the system (Ríos-Sánchez, 2009).

And so, everything previously stated allows us to conclude that the Paramo ecosystem is extremely fragile but at the same time a great provider of essential environmental services,

therefore, undoubtedly its protection and responsible management must be a national priority (Miranda, 2014).

## Green Businesses

A green business refers to a specific business that is made with a product or services that is made or derived from processes and input that have the following characteristics: a) they are green processes: they minimize the use of energy and water, they prevent environmental contamination (soil, air and water) and minimize the generation of residue; b) they are green input, manufactured or obtained from nature through green processes (Pacheco, J., González, M., Ramírez, M. 2013).

## System Complexity

All the variables that have been taken into consideration generate a complex system that requires re-thinking to generate regional entrepreneurship. Complexity will be understood as the great quantity of systems/institutions related with the need to generate social regional sustainable entrepreneurship. Normally, such system's resources are fragmented (Espejo, 2007). Scenarios where each system seeks to respond to their own reality and point of view (without always taking into account other contexts) are generated. Therefore, how to accomplish autonomous closed systems in the creation, regulation and production of their own politics and norms?

A viable system that contains the following is proposed (Espejo, 2007):

- Norms for their own actions.
- Characteristics of an autonomous existence in their relevant surroundings.
- And a place where knowlegdge is to be generated.

Taking into account that the several systems interrelate, mechanisms that can manage such variety have to be taken into account to generated a system for autonomous entrepreneurship and generator of solutions.

# 3. Case Study: Green Solutions Laboratory

To handle the complexity just exposed, there is a quest to design a model that articulates the different actors of the Guavio Region's green administration. Such model is part of the macro project named "Community Green Business Strengthening in the Guavio Province" Business. The central phase of the project is the Green Solutions laboratory. This section seeks to describe the circumstances in which the event happened and in the next section the results obtained are shown.

## Green Solutions Laboratory Objective

To build 30 ecological entrepreneurship ideas and to select democratically the best 10 ideas with relevant actors in the Guavio Region's conservation.

## Methodological Proposal

### Dynamics

During the Green Solutions Laboratory, 30 work teams were formed which individual members were already preselected. Each team was made up by at least one university-level student and a high school student. The great majority of the teams also had a productive unit.

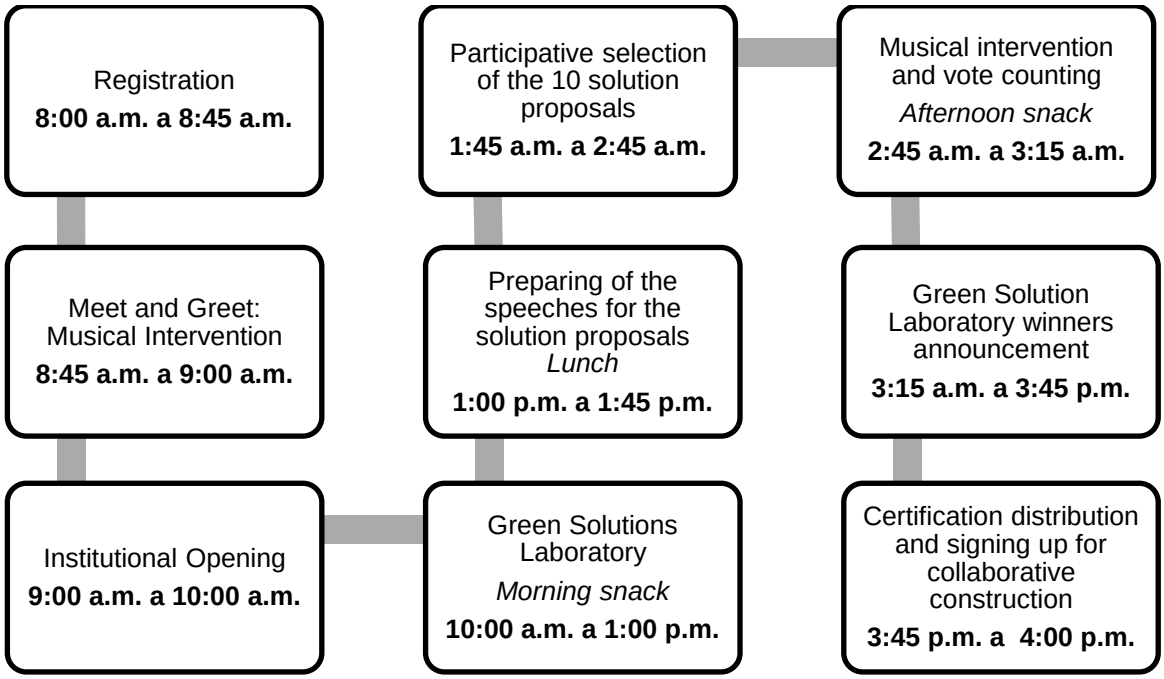
Each one of these 30 teams was divided in one of the three possible categories: tourism, services or agro-fisheries, according to the social reason of the assigned productive unit. The teams that did not have a productive unit were randomly assigned between the three possible sections.

To each team it was announced that their mission was to build between all members a business idea that was also green.

### Day Processes

The Green Solutions Laboratory took place during just one day along an 8 hour session. The following table shows a time distribution during the event:

**2. DAY PROCESSES – GREEN SOLUTIONS LABORATORY**




**SOURCE: RESULTS REPORT FOR THE GREEN SOLUTIONS LABORATORY (PROYECTO DE NEGOCIOS VERDES, 2014)**

## Participants

To the event the work team that belonged to the bigger team was called to action and it is represented in the following graphic.

**3. GREEN BUSINESS PROJECT TEAM**


**SOURCE: OWN CONSTRUCTION**

## Material Resources

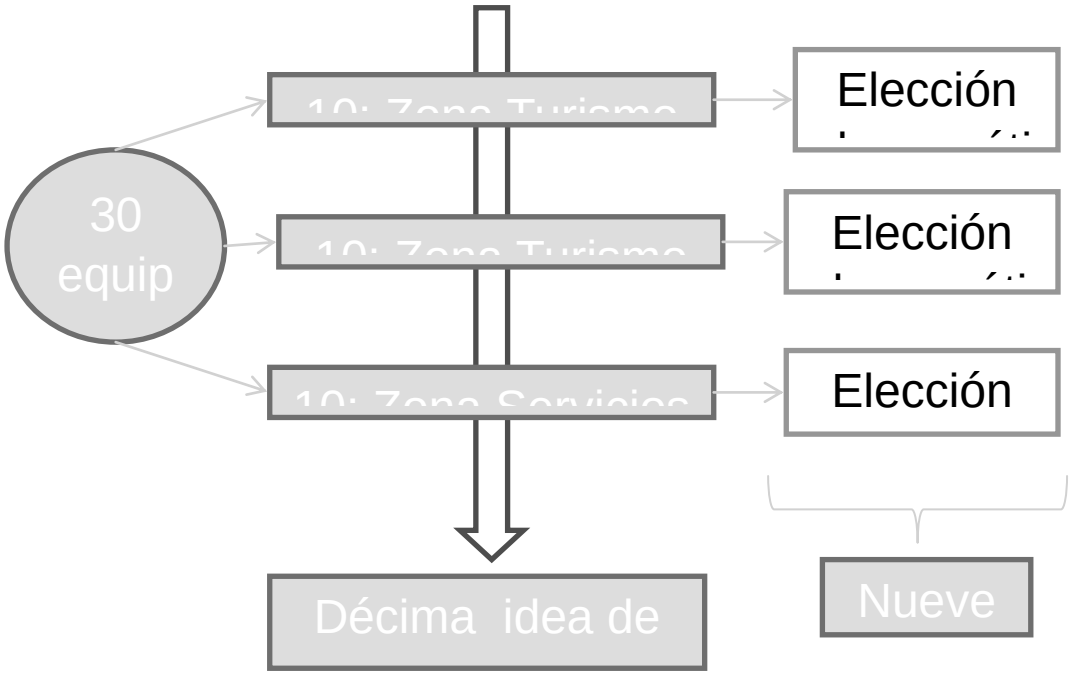
As resources, the team members had only some few stationary materials such as cardboards and markers that would allow them to share at the end of their day their idea and like that, convince the other participants to vote for their projects.

## Process for selecting the 10 winning ideas

The instructions given to the participants were to develop an idea for a green business that had to be green and besides that, also had to be in the interest of the greatest number of competing teams because the winning ideas would be selected in a democratic fashion by the participants of all of the teams. This implies that each team should vote for an idea that was not their own.

The following graphic shows the described voting process:

**4: WINNING IDEAS SELECTING PROCESS**




**SOURCE: RESULTS REPORT FOR THE GREEN SOLUTIONS LABORATORY (PROYECTO DE NEGOCIOS VERDES, 2014)**

## Incentives

According to the role that the participant had, their incentive to win was different. The following table sums up the participant's incentive according to the category they belonged to.

## 5. PARTICIPANT CATEGORY AND THEIR INCENTIVE

| CATEGORY | INCENTIVE OR MEANING FOR THE EVENT |
|---|---|
| **HIGH SCHOOL STUDENT** | Green Business Laboratory as part of the program in Science, Technology and Innovation where a representative of the 60 student teams (15 high school teams) practice what they've learnt during the Innovation-Action workshop to support the generation of an idea that can benefit the Guavio Province productive units. If a student manages to be one of the 10 winning solutions, his or her team will receive an incentive to participate in the "nearby expedition" weekend where they will learn from the productive units, practical concepts for businesses from the Guavio Province. |
| **UNIVERSITY STUDENT** | Green Business Laboratory as part of the Engineers Without Borders Colombia – ISFCOL subject taught simultaneously both in Universidad de los Andes (as a summer session) and in Corporación Universitaria Minuto de Dios (as a term for the academic period 2014-10). |
| **PRODUCTIVE UNIT REPRESENTATIVE** | Green Business Laboratory as an event that will allow them to propose an idea that will benefit in a participative way both their productive unit as well as the others. In addition to proposing, they are also offered the opportunity to be part of the 10 winning solutions that will be formulated during the month of August within the project framework. |

**SOURCE: RESULTS REPORT FOR THE GREEN SOLUTIONS LABORATORY (PROYECTO DE NEGOCIOS VERDES, 2014)**

# 4. Results

The 10 winning solutions are now presented in the following table explained by name and premise:

**6. 10 WINNING IDEAS FOR THE GREEN BUSINESS LABORATORY**

| Idea | Name | Premise |
|---|---|---|
| 1 | Smartphone application for the Guavio Province | Smartphone application that will allow showing the Guavio province's information and that of the productive units that have a ecological purpose. |
| 2 | Green Business Network: A Healthy Path | A Green Businesses network that provides a tangible education experience on ecological practices for visitors. |
| 3 | Development plan: Quinoa from All for All | Territorial brand to establish the Guasca municipio as the global quinoa capital through the progressive introduction of this crop in child nutrition. |
| 4 | Honey derived proposals | Honey-centered products pushing: a thematic restaurant, healing parks, high technology laboratory, honey caramels. |
| 5 | Bettering communication through technology | Learning through the use of interactive technologies in the Guavio region, mainly in its rural areas. |
| 6 | Green farm for responsible learning | Touristic and pedagogic model that allows the development of ecotourism activities in a natural environment that integrates teachers, farmers, tourism experts and fun activities. |
| 7 | Technological center for recycling | Museum with recyclable objects using bottles to build the external structure. |
| 8 | Agrotourism farm | Creation of a Agrotouristic farm in the Junín municipio with the purpose of educating and strengthening the biodiversity potential of the Guavio province. |
| 9 | Center for promoting tourism in the Guavio Province | Tourism in the Guavio province that promotes local and responsible activities. The places it should consider of upmost importance are the Guavio dam, La Bolsa, Cerro Redondo and Tembladores. |
| 10 | Self-sustaining biofarms | Expansion for a milk distribution center and dairy processing station that currently has 24 associates in different points of action. |

**SOURCE: OWN CONSTRUCTION**

# 5. Conclusions

a) Within the Green Solutions Laboratory, 8 of the 10 winning solutions clearly manifest the importance of ecological entrepreneurship. Only two solutions, number 1 and number 5, do not explicitly mention responsible environmental managing.

b) 80% of the winning solutions revolve around ecotourism, responsible resource administration and sustainability. That fact states that within the community there is a high level of awareness about the place where they live and how they have to incorporate environmental responsibility within their entrepreneurships.

c) It could be said that in the Guavio region there exists a collective spirit of ecological entrepreneurship which was evidenced within the Green Solutions Laboratory.

d) The Guavio region requires economic investment and technical support to develop the latent potential that clearly exists.

e) The Green Solutions Laboratory participants have it clear that ecotourism is a very important alternative to generate economic revenue through the protection of the Paramo ecosystem.

f) Although in none of the winning solutions it is explicit the Paramo ecosystem management, 80% tries to push environmentally responsible practices leaving ideas of mining, extracting and exploitation aside.

g) The regional educational institutions have managed to leave in their students a preoccupation for the environment. This is explicit in all of the winning solutions as they do well know the basic concepts for green businesses.

h) Although the winning solutions, directly or indirectly, incorporate within their description the intention of implementing environmentally responsible practices, there is no guarantee that if they’re executed, they will in fact be developed in such fashion.

i) It is important to highlight that, being the Green Solutions Laboratory a system of co-construction and real participation, it has become a system that allows that all points of view interrelate to create projects or ideas that benefit the whole region. All of these solutions where developed by beneficiaries or actors that participate in the development of the Paramo ecosystem. Therefore, who better than them to build viable, autonomous and cohesive solutions that build towards entrepreneurship and towards the non-destruction of the Paramo ecosystem. This was the greatest challenge of this participation model.

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# Acknowledgments

The authors of this article would like to thank the Green Business team and all its participants in the Guasca, Gachetá and Junín municipios. The Parque Científico de Innovación Social is specially thanked. Thanks to the university-level students at Universidad de los Andes and Corporación Universitaria Minuto de Dios. Finally, a special thank you to the Secretaría de Ciencia, Tecnología e Innovación de la Gobernación de Cundinamarca.