Ecotourism in the Equatorial Andes

Research & Design for the development of an ecotouristic project proposal for a site on the north-western slopes of El Corazón

Graduation Report for Explorelab + TiSD
Terms of reference

This report was written as part of my graduation thesis project at Explorelab. The main goal of the report is to present the knowledge that was gathered and produced during the graduation project in a structured manner so that it can be reviewed by my graduation Research and Design tutors; and, just as importantly, to make the information available to anyone who may be interested.

About the author:
Nicolas van Drunen
Student nr 1362224

Graduation studio:
Explorelab #17 + TiSD

Mentors
Architecture: Ir. R.J. Nottrot
Research & TiSD: Ir. R.J. Geldermans
Technology: Ir. J.A. van de Voort
Abstract

This graduation thesis project was concerned with the definition of the need; and the design of appropriate facilities to enable the use of a given site for ecotouristic purposes. The site is located on the slopes of the occidental Equatorial Andes at an altitude surrounding the 3500masl. Participative Backcasting was used as a general methodological framework; a broad study of the context was carried out which lead to the identification of needs and opportunities; at the same time it produced insights related to the site and its conservation purpose and potentials. A desirable future vision was then produced were Ecotourism and Cradle to Cradle principles were used in order to define normative demands. After this a Backcasting analysis was done in order to define a path for the development of the site and give input for the design of the facilities. The Backcasting analysis ran parallel with the design process and informed choices between alternatives.

In practical terms, the main goal of the research was to orientate and define the program of requirements for a given development purpose (Ecotourism) in a given site (El Corazon). The project then followed a transition from research to design development which ended with the plan presented at the end of this report.

Keywords: Ecotourism, Ecuador, Andes, Páramo, Cloud Forest, Sustainable Construction, Minga, Backcasting, Cradle to Cradle

About the design

During the study the minga was identified as a cultural manifestation which plays a central role in the proposed plan. The consideration of cycles within the project was addressed in many levels: building life cycle, maintenance, water and waste management.

The proposed project is phased in order to allow for adjustments and reduce risks. Sustainable building knowledge was applied, involving: life-cycle planning, self-sufficiency, low-impact materials and structures.

The design aims to promote involvement in a rising green building sector. Materialization plays an important role in the strategy. Materials, processes and techniques were selected considering Cradle to Cradle and Ecotourism principles.

Bamboo and other low-impact materials are applied in a way that is innovative for this region. While the use of other materials such as stone, ceramics and earth relies on existing local traditions.

Vernacular architecture was a source of insights for the developed design. The experience of nature was an important consideration. How to give people a constructive role in this natural landscape?
Table of Contents

Introduction
  Educational context & strategic approach [7]
  Research question [7]
  Methodology [9]
  Report structure [12]

Step 1 | Strategic problem orientation

  Introduction [14]

  Context [15]
    Site characteristics [17]
    Cultural Landscape [23]
    Natural Landscape [46]

  Ecotourism [56]
    Definition and principles [56]
    Historical development [57]
    Trends [59]
    Relation between tourism and protected areas [61]
    Relation between local communities and ecotourism [61]
    Guidelines for planning [63]
    Ecotourism in Ecuador [64]

  Ecotourism Cases [65]
    Pasochoa case [67]
    Bomboli case [75]
    Papallacta case [83]

  Sustainable building theory and practice [90]
    Cradle to Cradle [90]
    Life cycle [93]
    Architecture and energy [95]
    Passive design [97]
    Low impact construction materials and techniques [97]
    Ecologdes [99]
    Eco-minimalism [99]
    Practices in Ecuador [101]

  Closure [106]
    Site diagnostic [107]
    Programmatic recipe [108]
    Insights for the design [109]
    Design objectives [109]

Step 2 | Future vision [110]

Step 3 | Backcasting and design development [118]

Step 4 | Design [120]
Project proposal is based on a broad context study for a specific site.

The site borders an Ecological Reserve. The question is whether this site could be developed to support eco-touristic activities which could bring both social and environmental benefits. (Sustainable development)

Taking the site as a departure point relevant themes to be researched are identified.

The themes form a framework from which to look at the conditions and possibilities of the site and in this way inform the design.

The development plan and design are developed supported and conditioned by the gathered knowledge.

Design loops produce alternative architectural solutions to the specified requirements. This process then leads to a final design which performs in harmony with the local ecosystems.

An evaluation of the design process & product will be done, this will lead to conclusions and recommendations applicable to similar sites.

Fig.1 Strategic approach diagram
Introduction

Educational context & strategic approach

The trajectory of the graduation project is represented in this report. The graduation project was done in the Explorelab graduation studio which has a strong Research & Design orientation. In this case the project is also done with the aim of applying for a specialization on Technology in Sustainable Development (TiSD); this is reflected on the focus for both research and design. The starting point for graduation projects in this studio is often marked by particular fascinations which can be researched in relation to architecture; this thesis is not an exception. The fascinations which lead to the development of this graduation project are characterized by the following keywords: vernacular, tropical architecture, critical regionalism, ecotourism, sustainable building. While they may clarify the field of interest they remain vague and don’t directly lead to a project. So, in order to get started with the project a site was intuitively selected which showed potential in its capacity to be related to the mentioned fascinations and also to provide a real context for the project. In this initial stage a strategy on how the project could be approached was defined and is described in the strategic approach diagram (Fig.1). From the diagram it becomes clear that the site is used as a focal point to develop the project, and that at the end generic insights can be used in similar projects developed in similar contexts. After defining the strategic approach the research questions were defined which in turn led to the methodological approach taken.

Research question

*How can the implementation of eco-touristic facilities in the damping areas surrounding the Ilinizas Ecological Reserve bring environmental and social benefits?*

Sub questions

1. What is ecotourism? And, what are its environmental and social implications?
2. What is the context for the project?
3. Which ecotourism related activities can be performed in the given context?
4. Which facilities are needed for those activities?
5. How can the activities-facilities be designed if they are to contribute to Sustainable Development?
6. Which principles and criteria can be used to support choices and give direction in the design process?
Fig. 2 Future vision types by Quist (2007)
Fig. 3 Backcasting concept diagram based on diagram by Quist
Fig. 4 Participatory Backcasting Methodological Framework by Quist (2013)
Methodology

The approach taken was to structure the research using the Participative Backcasting methodological framework which is provided in the course *Engineering for Sustainable Development* at the TU Delft (Quist, Rammelt, Overschie, & de Werk, 2006). One of the coordinators of the course; Jaco Quist (2013) argues that “the strong future orientation of sustainable development is exactly why future studies, scenarios, scenario assessment, and backcasting are highly relevant for systems innovations and transitions to sustainability.” He explains that normative demands to reduce our environmental burden do not only require technological changes, but also cultural, organizational, structural and institutional changes. The term socio-technical system is used to refer to the larger societal systems which contain both social and technological components. It is at this level that issues are framed, and transition strategies towards sustainability are studied (Quist, 2007, p. 9). He distinguishes between three types of scenarios related to likely, possible, and desirable futures (Fig.2). The backcasting methodology works with the last type, which is also referred to as normative scenarios, or future visions. In addition to the definition of desirable future visions, backcasting focuses on the definition of pathways and milestones to direct actions towards the achievement of desirable future scenarios (Fig.3). A multi-trans-inter-disciplinary approach is distinctive for the participative backcasting methodological framework. The methodological framework contains the following 3 key elements: Use of future visions, Stakeholder participation, and the use of a wide set of methods to address process, participation, analysis, and design (Quist, 2013). The methodological framework of Participatory Backcasting describes 5 steps and the outline of a toolkit (Fig.4); in the education variant, because of time and other constraints, usually only the first 4 are carried out:

- Step 1: Strategic problem orientation
- Step 2: Future vision and normative demands
- Step 3: Backcasting analysis and design development
- Step 4: Plan and implementation

The Participative Backcasting Framework is applicable to a wide range of topics, and able to produce informative outcomes for various goals; because of this it is defined in a general way and needs to be supported by a fitting set of strategies, methods and tools. In this case it is complemented by *Cradle to Cradle* and *Ecotourism* guidelines and principles for the definition of the normative demands for the future vision. It is worth mentioning that all three Backcasting, Cradle to Cradle and Ecotourism are frameworks used in planning which divert from *business as usual* approaches and focus on desirable futures.
Ecotourism

Future vision

Fullfilment of needs

Normative demands

Needs

Programmatic recipe

Design objectives

Design insights

Backcasting analysis

Program of requirements

Design development

Project milestones

Plan and Implementation

Step 1

Research

Site context

Cradle to Cradle

Building technologies

Regional Landscape

Project Cases

Step 2

Design Brief

Future vision

Fullfilment of needs

Normative demands

Step 3

Step 4

Design

Architecture & BT Tutoring

Expert Feedback Interviews

Plan and Implementation

Fig. 5 The graduation project in relation to Backcasting Methodological Framework Steps 1-4
Here follows a short description of how elements from the complementary cradle to cradle and ecotourism frameworks have been integrated. **Ecotourism**, defined as “Environmentally responsible travel to natural areas, in order to enjoy and appreciate nature (and accompanying cultural features, both past and present) that promote conservation, have a low visitor impact and provide for beneficially active socio-economic involvement of local peoples.” (2015, From TNC website; IUCN definition), is here considered as one of the main pieces of the puzzle to contribute to sustainable development in the given context; it should in theory lead to a desirable future. The principles by which ecotourism is defined have been implemented into planning guidelines by TNC. Those guidelines and principles are used in this thesis as an aid to define normative demands related to conservation, touristic and other activities defined in the future scenario.

Although other similar frameworks able to provide criteria exist (van Dijk, 2012); the Cradle to Cradle framework has been selected because of its focus on actively beneficial activities, its comprehensiveness, and its growing presence in the building industry. **Cradle to Cradle** defines principles to steer the development of a sustainable built environment in the following way: “A Cradle to Cradle building contains defined elements that add value and celebrate innovation and enjoyment by: measurably enhancing the quality of materials, biodiversity, air, and water; using current solar income; being deconstructable and recyclable, and performing diverse practical and life-enhancing functions for its stakeholders.” (Mullhall & Braungart, 2010). Cradle to Cradle principles are used in this thesis as an aid to define normative demands related to the facilities which would be needed in the desirable future scenario.

In practical terms the steps that have been taken are based on the Participatory Backcasting methodological framework discussed above. Only steps 1-4 have been carried out in the context of the graduation project. The research is mainly concentrated in Steps 1-2; while Steps 3-4 correspond to the development and presentation of the plan (Fig.5).

The methods and tools that were applied during Steps 1-2 Strategic problem orientation and Future vision were:
- **Information Gathering:** Literature study, Selection of cases, Interviews, Site visits and field documentation through photography and written observations.
- **Analysis:** Strategic problem orientation, Socio-technical system definition, Stakeholder analysis, Case studies, Trends, Unsustainabilities, Programmatic studies, Multilayer Site analysis.
- **Synthesis:** Desirable future scenario elaboration.
- **Presentation:** Structuring of information so that it’s presented in a way that makes it accessible to contribute to other people working in a similar context.

In the transition from research (Steps 1-2) to design development (Steps 3-4) the following methods and tools were used: Identifying the needs and resources, defining and refining the programme of requirements, defining principles and criteria for the assessment of design alternatives, development of design alternatives, defining a phased development plan using backcasting analysis, implementation of feedback from mentors and experts, consolidation of the final plan.
Remarks

Even though the process was not linear; it is the aim of the report to present the findings in a logical and structured manner. Many times literature was consulted to fill gaps in data and knowledge.

Also other activities were carried out in order to familiarize myself with program elements e.g. nursery management. I have now a small avocado forest in my room, with 2 pineapple plants, all of it from better “waste” management.

A good amount of time was spent reading on topics which are in some way related to the research but don’t directly come back in this report. I am sure however that those studies have positively influenced the way I think, and I see this as an investment in specializing myself. This might be just as important as the thesis, in relation to the specialization on sustainable development.

Report structure

The report is divided into four sections analogous to the steps taken during the project. In the first section STEP 1 is presented. It deals with the strategic problem orientation and includes literature studies, field studies and case studies, which were done as part of the research component of the project. The conclusions from the studies form a bridge to the next section.

The second section STEP 2 presents the project proposal as a desirable future scenario. A recipe for the development of the site is complemented by normative demands based on values and principles derived from the first section.

In the third section STEP 3 the design process is described. By performing a backcasting analysis the design is defined both in terms of the physical design, and development phases and milestones. This section contains a reflection on the design process and the input from mentors and external advisors.

The fourth section STEP 4 presents the final plan which includes the architectural design for the facilities and the development plan for the site.
Bibliography


STEP 1 | Strategic Problem Orientation

Introduction

The studies carried out in relation to the strategic problem orientation depart from an initial definition of the sociotechnical system with which the project will be involved. The system has been (loosely) defined by the type of productive activity, in this case ecotourism; and its spatial setting, in this case rural areas bordering protected natural areas. Through the studies the definition of the sociotechnical system is further defined to include specific activities and stakeholders. This section deals with the literature, case, and field studies carried out within the strategic problem orientation. The main purpose of the studies was to gain an understanding of what ecotourism is, and what kind of an ecotouristic project proposal could be suitably implemented in the given context. The content of the section is divided into the following three thematic parts: Context, Ecotourism, and Sustainable building (Fig.6).
The study of the context was divided into the following subsections: Site characteristics, Natural Landscape, Cultural landscape.

Vernacular architecture types were selected which have developed in and are representative of the region, or the circumstances. Vernacular types from the Equatorial Andes region were analyzed in terms of purpose and use, materialization, and climate strategies. They provide knowledge of traditional inhabitation of the landscape, and the traditional way of life of local cultures. The A-frame type has been included because of its relation to leisure and its characteristics as a widely disseminated self-build structure.

The thematic part dealing with Ecotourism presents a definition and supporting principles derived from the literature. It presents important considerations that need to be taken into account when planning for ecotourism.

In addition, three ecotourism project cases were selected which have been developed within similar contexts and which are considered representative ecotouristic projects: Pasochoa wildlife Refuge, Bomboli Ecological Reserve, and Termas de Papallacta. They serve as precedents of the implementation of ecotouristic projects in similar conditions. Analyses of the touristic and conservation activities and the program of existing facilities were done in order to orientate the definition of the project proposal. The mixture of activities and supporting facilities is termed the programmatic recipe in this report. The programmatic recipe describes the projects at an abstraction level in which the materialization of physical buildings remains undefined. Leading questions in the project case studies were: What activities are done? And, which facilities support those activities? Are they sustainable?

Lastly, information is presented in relation to the third thematic part; studies about sustainable building theory and practice are presented here in order to provide answers to the following question; when the desired activities have been defined in terms of needs, which (if any) facilities can support their fulfilment in a sustainable way? The insights gathered in this part are applicable to the design of the facilities and the phased planning of the project. STEP1 forms a bridge to STEP 2 in the following way; it closes with identification of needs, it provides a programmatic recipe, insights, and objectives for the design. In Section 2 the proposal is described as a desirable future in which the needs are fulfilled in a sustainable manner. The conclusions from the studies are summarized as insights which will be used as input in the design of the needed facilities in Step 3.

**Context**

The following texts present the context in which the project is to be developed. It has been divided into subsections which present the following themes: Site characteristics, Cultural Landscape, and Natural Landscape. The texts cover a broad range of topics within those defined themes. The objective is to provide the context in a way that can contribute to the strategic problem orientation which is the main objective in STEP 1.
Fig. 7 Location of the property on El Corazón
Fig. 8 Access to the site from the center of Quito
Site characteristics

The site selected for the project is located on El Corazon, an extinct volcano in the Occidental Equatorial Andes. It is at a linear distance of around 50km from Quito, the capital city of Ecuador. It can be accessed from the center of Quito through the national highway network (41km) and secondary rural access roads (16km) (Fig.7-8). The size of the property where the project is to be developed is 66 hectares.

The precise location is: Latitude -0.49°; Longitude -78.68°; Altitude 3300-3600 masl. The geomorphology of El Corazon is similar to that of surrounding mountains (Atacaso, Pasochoa, and Rumiñahui); it is a stratovolcano with an eroded west facing crater. The property lies on the north-western slopes which have an average inclination angle of the 20°. It mainly receives warm air currents coming from the western humid ecosystems on the lower slopes (Fig.9).

The terrain has been shaped by climate and geological processes which have produced geomorphologic features such as ravines with small streams and waterfalls. In parts of the ravines the soil has been completely eroded leaving the bedrock exposed. The accumulation of organic matter and the abundant presence of water are characteristic of the soil’s top layer. The soil under those layers is locally known as cangahua. This type of soil can be seen exposed on the edge of the rural roads; it was traditionally used in earth construction.

The climate is characterized by a rainy (feb-apr) and a dry season (jun-aug); the average temperature is around 8°C varying from 0-16°C; and the average yearly rainfall is approximately 2000mm. The sky usually is clear during the morning and then misty throughout the day with occasional heavy rains. Because of the nearness to the equator and high altitude, solar irradiation at the location is very high (especially with a clear sky), the daily average is around the 4.5 KWh/m².

In the majority of the property the native vegetation of the primary forest has been preserved (Fig.12). Around 15% of the property (10 hectares) was adapted for cattle farming and raising horses. The well-preserved area contains vegetation which is characteristic of the Páramo (3 hectares) and Cloud forest (53 hectares) ecosystems. The area with primary forests was presumably better preserved because of its more difficult accessibility and steeper slopes. The areas adapted for cattle farming were presumably cleared by cutting and burning the forest; after that, grass was planted. In the last 5-10 years productive activities on the property have stopped and the vegetation has started to recover. The primary forest on the property forms a habitat for a large diversity of wildlife and plants; including many bird and orchid species.

Historically the property has legally changed ownership at least 3 times in 1992, 2002, and 2012. When the property was registered in the municipality of Mejia in 1992 the areas located above the 3600masl were designated as a protected area and thus were no longer included in the property. Currently the property limits with the Ilinizas Ecological Reserve (RELI) towards the south and west borders, and with two private properties towards the north and east borders respectively. On the western border there is a steep ravine with exposed rock faces. The southern border is characterized by the Páramo vegetation. The eastern border is marked by a ravine with a small stream.
Fig. 9 Site features and access, from a rhino model based on Google Earth geometry & images
Fig. 10 Impression of access road during the summer months
Fig. 11 (Opposite) Helecho arbustivo, it has a growth rate of 1m in height every 10 years!
There is practically no built infrastructure on the property, other than small paths. On the neighboring properties there are wooden houses, built with local wood by previous owners, which were not being inhabited at the time of visit. The access roads near the property are made of earth and are not well maintained; they become very slippery in the rainy season (Fig.10). As a result of this the property is currently not accessible by car. However, there are plans to extend the road stone covering up to the property. Historically there was a water diversion structure which canalized the water and carried it eastward from the property towards properties with an agricultural use on the northern slopes.

The local community consists mainly of farmers. The rural neighborhood is called El Pongo and consists of dispersed buildings in plots dedicated mainly to agriculture and cattle farming. The nearest populated center is Aloag, it is situated next to highway.
Fig. 12 Three panoramic views showing the vegetation on the site: Paramo (Top), Cleared areas in recuperation (Middle), Cloud Forest (Bottom)
Fig. 13 Aloag, ADELCA, and the highway, adapted from Google Earth
Fig. 14 Alpachaca Ibarra 1969, bahareque houses with thatched roofs,
From: http://www.taringa.net/posts/imagenes/14806177
Cultural landscape

The human settlements neighboring the site are mainly rural neighborhoods surrounding the town of Aloag. The town is the center of the parish of the same name; it is situated next to one of the main highways between the Pacific coast and the Andes. In the rural area, dwellings are dispersed on plots dedicated mainly to agriculture and livestock; forming a dispersed community. They form a rural neighborhood called El Pongo. The name Pongo; meaning door (Punku in the Quechua language) has its origin on the presence of ravines and streams in the area. There are also large properties that are used for production and are not inhabited. An example of this is a large area on the eastern skirts of El Corazón which is owned by the military. The town of Aloag is marked by the presence of the highway and large industrial halls (Fig.13). ADELCA is a large steel recycling and product manufacturing company that has been based in Aloag since 1963.

Demographics

The following demographic information was collected from the development plan for Aloag 2012-2025. The parish of Aloag had 9237 registered inhabitants in 2010. The population identify themselves as belonging to the ethnicities: Kichwa of the Andes 42%, Panzaleo 9%, Puruhá 8%, and others/none 41%. In terms of self-identity most identify themselves as: mestizo 86% and indigenous 7%. More than 60% of the population lives in poverty. The main economic-productive occupations in the population are: agriculture and cattle farming 23%, manufacture industries 14%, commerce 13%, transport and storage 12%, construction 5%, public administration 4%, education 4%, accommodation and restaurants 3% and others. (Narváez, Rodriguez, & Ortiz, 2012)

History

The historic inhabitation of indigenous cultures in the areas surrounding the site was gathered from a literature study (Mejia, 2015a, 2015b). The equatorial Andes region was inhabited by many cultures. The Panzaleo culture inhabited the area to the south of the location before the conquest by the Incas; this culture was famous for its ceramic works. There are still indigenous groups who identify themselves as Panzaleo in the neighboring province of Cotopaxi. Towards the north, in the area that now correspond to the city of Quito, was formerly the territory of the Quitu culture; they are known to have inhabited areas around the town of Aloag (Villarroel, 2007). The Quitus worshiped the sun and the moon and built temples in stone. They are known to have used the bahareque technique for constructing houses, combining it with thatched roofs made of locally available grasses (Fig.14). Around El Corazón there are remains of presumably military structures called Pucaras. The structures are located at places which offer a panoramic view of the surrounding territories. Specific studies about the origin and function of the structures near the site have not been found. The Spanish arrived at the end of the fifteenth century, relatively shortly after the Inca expansion into Ecuador. The Spanish conquest followed by colonization lead to changes in the social structures and productive activities held by the previous
Fig. 15 The Chagra, From: chagraecuatoriano.blogspot.nl
Fig. 16 Peasants working on the land, From: http://agronegioscandoador.ning.com/notes/Reforma_Agraria
indigenous peoples. Characteristic of this is the developed latifundio - minifundio structure which consisted of large properties in orders of size surrounding the five hundred hectares owned by Spanish descendants (Bifani, 1998). The large properties (latifundio) were dedicated to agricultural production, and small properties with surfaces under the five hectares (minifundio) were given to indigenous peasants in exchange of their labor. The minifundios, also known as huasipungos in Ecuador, were situated in marginalized territories and usually contained a hut constructed with local materials such as earth wood and straw; the land was worked by the peasants for self-subsistence. Although the structure of land ownership was changed after the agricultural reform in 1964 (Ramón, Báez, & Ospina, 2004, p. 85); the use of the land for agricultural and livestock purposes remained and is still recognizable in recent satellite images. Next to the site there are a number of small properties, presumably remnants from the minifundio structure.

Cultural Identities

The cultural identity is quickly sketched here because of the scope of this report. Study of cultural identities and linked activities is a complex matter. Local communities are an important stakeholder and potential partner for the project and because of this a notion of their cultural identity is critical. Two cultural identities related to the rural landscape were identified in the literature: The Chagra, and the Farming Peasant. The Chagra is an important individual cultural identity related to a typical way of life closely related to the landscape in the region (Corral, 1993). The Chagra may be characterized as someone who knows his way around in the Páramo landscape (Fig.15). Horseback riding is his main means of transport. His role is similar to that of a cowboy taking care of livestock in the open landscape; where he spends most of the time. The use of a horse makes it easy to cover large distances and maneuver through the irregular mountain paths. The farming peasants represent another typical identity (Martínez, 2004). They work their plot of land and manage livestock both for self-subsistence and as a source of income (Gondard, 1984). They can be characterized as stationary since they mostly focus on their own plot. They have a broad knowledge of the plants found in the surrounding landscape, and also poses knowledge of the implications of inhabiting the mountain slopes (Fig.16). They understand the natural cycles involved in agriculture practice. For more information on the cultural characteristics of the Equatorial Andes see (León, 2011).

Izko (2001) points out that indigenous people in the equatorial Andes view their relation towards the environment as a reciprocal one; they take care of nature and nature will take care of them. The common rural development model were the agricultural overproduction of plots, driven by the need for incomes, has led to a cognitive dissonance for rural communities; they don’t want to damage the environment, however, their participation in a market driven economy and need for income leads them to overburden their lands. This ultimately leads to an increase in poverty as the local ecosystems are degraded and production is no longer possible. Izko (2001) has identified a number of alternative productive activities which can be carried out by communities situated next to mountain ecosystems without exerting detrimental pressures. They are: ecotourism, non-timber production, fisheries, and
Fig.17 Exterior (Top) and Interior (Bottom) of the house in the neighboring property
reforestation. Those two identities are linked to the landscape and are involved in productive activities; this means that they have developed a way of managing the landscape for their subsistence and inhabitation. Their activities and related practical knowledge form an important set of valuable capacities that need to be considered during the development of the project. This is important because it may ease their involvement since possible collaborations can be discussed. It is also important to note that while their current activities may be detrimental to the protected landscapes; their knowledge and capacities are valuable. An adaptation of their activities relying on the same capacities may in turn be used to restore the damaged ecosystems. A key question for them, in particular the farming peasant is: how to work and make a living without damaging the environment, even supporting the recovery of ecosystems? This demarcates the need for an alternative or complementary productive activity. The answer would ideally come from the definition of alternative and supplementary activities based on their existing capacities e.g. horseback riding, knowledge of native vegetation and agricultural production.

Vernacular architecture

Here a number of cases of vernacular architecture are presented which are considered to contain valuable lessons that can be applied in the design. The sample is varied; a constant is that the selected cases are set in either rural and/or natural areas. In Ecuador many traditional earth construction techniques have been applied throughout history, they have been described by Sutter (1985): Chamba, Pared de mano, Cangahua, Tapial, Adobe, Bahareque. Only the last two building techniques are represented in the selected cases.

House built next to the property

This house was used as a shelter to spend the night during the field visit (Fig.17). The house is built of tropical hardwood collected from the site. The slope has been leveled creating a sunken step in the hill where the house is placed at a distance of approximately 1m from the exposed earth (cangahua) back wall; by doing this the house is sheltered from the wind. The structure is raised 1m from the ground with wooden piles to prevent moisture damage. The house has a rectangular configuration with the kitchen at the front, a corridor in the middle which connects to rooms on both flanks, and a living room at the back. The roof covering is made of profiled steel sheets. The wall construction was adapted at some point to prevent air infiltration between the boards. Since the house was abandoned for a number of years it has deteriorated, specially the roof. The wood has aged and doesn’t show signs of rot. The surrounding areas consist of (now) overgrown gardens and a small wooden fence which was formerly used to station horses.
Fig.18 Traditional hut (Top), From: http://3maanden.reismee.nl/fotos
Fig.19 Change and contemporary hybrid constructions
Buildings in Pastocalle, Cotopaxi

During the field study the area surrounding the town of Pastocalle was visited. The main reason to visit this area was to find various types of buildings: traditional huts, contemporary dwellings, and traditional adobe and stone construction. Pastocalle is at a similar height as the site 3300masl, it lies in the south-eastern skirts of the Ilinizas volcano 25km south-east of the site. The indigenous communities are of the Panzaleo ethnicity.

The huts are the most primitive, they consist of a pit with levelled ground and an adobe (nowadays also concrete block) wall on one side and a mound shaped surrounding cover structure constructed with branches and covered with native grasses from the Páramo (Fig.18-19, 21). The shape is useful to shelter from the cold winds. The grass covering provides thermal insulation to the interior while serving as a barrier for rain and mist. According to locals, traditionally these huts were built on the slopes of the mountains to shelter while taking care of livestock. When people had to spend the night in the shelter they would either take small animals inside to help produce heat or lay on a layer of heated coals covered with green branches. The internal space is undivided, and there is only one straight wall in which the door is placed. The interior is dark and humid because of the lack of windows and ventilation.

Contemporary houses constructed mainly in concrete are nowadays found next to the huts (Fig.22). This is a general trend that has been described in the literature (Gondard, 1984, p. 41). They provide a feeling of safety to their inhabitants, both from criminality and natural events. The use of industrial materials enables the incorporation of windows and secure doors. The spaces are usually divided into two, the kitchen and the living-sleeping area. The use of concrete blocks for the walls and corrugated cement sheet for the roof offer less thermal insulation than the traditional huts. This may be compensated by the use of concrete floors and windows which work together to store heat gains from the incoming sunlight. In general, the houses are not considered warm at night; on the other hand they may overheat during the day because the roof can act as a radiator when heated by the sun.

Near the center of Pastocalle a house was visited which is considered to be the last one standing in the area built in a combination of stone, wood and adobe (Fig.20). The house is damaged and currently not inhabited. The damage is mostly to the top floor which is built with wooden frames filled with adobe bricks. The lower level mainly constructed in stone is currently used to keep small animals and tools, the damage to this level is not significant. The reason for the damage is that the area has been subdued to a number of earthquakes; the one from September 15 1944 is said to have completely destroyed the town of Pastocalle, even producing cracks in the ground (Arguello, 1997). The construction used in this house was the way most of the town houses were built in the past. The collapse of the houses led people to distrust the safety of this type of construction, especially adobe, and consequently to build mainly with concrete blocks (Fig.23-25). The structure can potentially have a better thermal performance than the contemporary concrete construction type. At the top level the adobe walls help reduce temperature swings and the roof has a thicker covering of ceramic roof pans set with mud on a wooden structure, which offers better insulation than the contemporary corrugated cement sheet.
Fig. 20 Stone+wood+adobe house exterior and interior (oposite top and bottom)
Fig. 21 A group of huts 4200m above sea level From: (Dudley, Field, & Jordán, 1988)

Fig. 22 The three construction types referred to in the text; straw huts, concrete houses, stone + wood + adobe
Fig. 23 Miduvi social housing for rural areas. Interior of a house under construction in Lloa.
Fig. 24 Exterior of the same house (Opposite top)
Fig. 25 House built with concrete blocks and steelsheet roofing in Pastocalle (Opposite bottom)
Fig. 26 Saraguro house with Galluchaqui technique (Top) and Bahareque Parado technique (Bottom), From: (Calderón, 1985)
Saraguro houses

Saraguro is a different ethnicity than the local Panzaleo. The book Saraguro Huasi (Calderón, 1985) presents the way of inhabitation of this ethnicity in the Southern Equatorial Andes. Although it is focused on a specific vernacular building type it describes very well the larger context (cultural historical), and brings many sustainability issues into attention such as: the change in construction materials due to depletion and changes in landscape, the role of reciprocity and minga in the building process, the roles of people in the community in general, the effects of the introduction industrialized materials. It also discusses the cultural changes in indigenous lifestyles and cultural values due to increased exchange with westernized cultures.

The study presents the Saraguro house as the result of an assimilation process containing various internal and external influences in which the characteristic way of building was defined. This process of cultural assimilation has also been described as a general feature of the architecture in rural indigenous communities in the northern Andes by Castillo (2011, p. 202). The construction types discussed in the book are Bahareque Parado and Galluchaqui; the second one being an adaptation of the first one to the warmer and more humid climate, and other circumstances characteristic of territories in the Amazon where the Saraguro have expanded to (Fig.26).

The book presents in detail the use and origin of materials, seasonal planning, and the building process which is organized around mingas with various purposes such as: selection and collection of materials, timber cutting, leveling ground work, structural construction and weaving of walls, covering of walls with mud, roof construction. For every minga the owner of the future house provides food and drinks. A loss of the traditional minga in the construction of houses can be discerned followed by exchange of goods and finally paid labor. This is parallel to the individualization characteristic of modern western society.

The house consists of three internal spaces organized around a semi enclosed space or corridor which usually faces west. All of the spaces are contained under the total volume of the house and covered by the roof. The orientation of the corridor towards the west can be mainly explained by the use of this space for drying grains and as a space for rest in the afternoon when it is exposed to the sun. The internal spaces are all accessed from the corridor; they usually contain small windows, if any, which are most commonly placed on the western walls. Another important factor in the determination of the orientation of the Saraguro house is the protection from wind often accompanied by mist. The main reason for not having windows is the protection against the cold winds.

The measurements for the house are based on a system which uses the human body as unit of reference; the units are: the Vara, from the fingertips to the center of the chest approx. 80cm; and the Cuarta, with an extended hand from the tip of the thumb to the tip of the little finger approx. 20cm. The tupa is a stick used to fix the dimensions for construction purposes.
Fig. 27 Elevations section and plan of a house made with bamboo
Fig. 28 Rendering of the kitchen and potted plants in the balcony
Both From: (Nurnberg, Ycaza, and Holm, 1982)
Bamboo construction from the coast

The book Arquitectura vernacula en el Litoral by Nurnberg, Ycaza, and Holm (1982) presents a broad study of the vernacular architecture in the coast of Ecuador. Common to the types described is the use of bamboo, locally known as caña guadua, in the construction of the indigenous houses (Fig.27). In the study the authors distinguish four zones based on environmental differences and prehistoric occupation, they are: Esmeraldas, Manabí, Península de Santa Elena, and Cuenca del Guayas. The zone of Cuenca del Guayas borders the western slopes of the occidental Andes and because of this was selected as a reference to be studied. Characteristic of the vernacular of this zone are: rectangular and linearly expandable plan, raised structure on pilotes, roof structure with two eaves, a gradual transition from outside to inside with a significant area of the front wall left open for ventilation, the use of hammocks as beds, the roof cover is made of palm, grass or other vegetal material, the use of bamboo and wood for the structure. The authors also describe the commonalities between all houses in all the studied zones, they include: the use of vegetation for shading and the creation of a fresh microclimate to counteract the humid tropical climate, natural cross ventilation, extended eaves with an inclination of forty-five degrees to protect from the sun and rain, the division walls are constructed with flattened bamboo mats which are permeable (20%) to wind and light, the roof covering acts as a thermal insulator and because of its open configuration dissipates heated air, interior division walls are lower than the roof height to facilitate air movement, the illumination of the interior is mainly through the filtered light producing an homogenous illumination, the circulation is organized towards the middle of the spaces and objects are placed next to the walls which often have integrated shelves, the space under the house is used for keeping livestock, the kitchen fireplace is set near the a corner but separated from the walls and consists of a wooden box filled with clay where the coals are set and a grill on top, the kitchen sink releases the used water directly to the lower level where it is reused for the animals, bamboo is used for ornamental elements which are combined with small potted plants (Fig.28), the measurements are based on the human body, the house forms an harmonious whole with the natural surroundings.
Why an A-frame goes up so fast

**SIMPLE FOUNDATION:** requires only a few main beams supported on concrete-block piers. The blocks, usually two side by side, rest on concrete footings that go below the frost line.

**A-FRAMES CAN BE PREFABRICATED** on the ground unless very heavy beams are used. Each completed frame then serves as a pattern to insure fast and accurate alignment of next one.

**END GABLES** can also be pre-assembled, complete with siding and door and window openings. This makes it easy to frame openings accurately without climbing around in mid-air.

**FRAME ARE HOISTED UP** one at a time and held temporarily in place by diagonal braces. Two persons with a third helper pulling on a line can raise all but the heaviest A-frames.

**TWO FAST WAYS** to get strong, interlocking joints: At left, single wall beams are straddled by doubled floor beams. At right, doubled wall beams straddle a single floor beam.

**WITH FRAMES IN PLACE,** exterior panels or siding are nailed on to complete the shell in as little as six hours. Temporary cleats nailed to roof let you walk up the steep sides.

---

Fig. 29 A-frame informative illustration
Fig. 30 Construction of an A-frame house in 2002
Both From: (Randl, 2004)
A-frame

The A-Frame was studied as a case of a recent vernacular which developed in parallel to recreation culture in natural areas in the US. The book A-frame presents a historical review discussing its antecedents, its development in the US related to the surrounding cultural and economic aspects (Randl, 2004). The principles behind this type of building are interesting because of the wide enthusiasm that was linked to it; the underlying forces that lead to its success and later decline provide relevant insights and cues for design. In the book it is described as “the right shape at the right time” as it was introduced after the war when the economic growth lead people to purchase a “second everything” including houses. In distinction to log cabins and cottages on one end and glass boxes on the other; Randl (2004, p. 10) describes the A-frame as an alternative way to build recreational houses in wilderness settings characterized as “innovative and exciting, modern yet warm, a place wholly suited to the informality of the new recreation lifestyle”; further stating that “perhaps its greatest appeal was that it was different, an expression of individuality that meant relaxation and escape from the everyday” and also that “by the early 1960’s, the A-frame became a cultural icon, a geometric representation of the good life”. He explains that the appeal of the A-frame to the general public was partly based on that it appeared as a simple unimposing self-build structure.

Most commonly an A-frame is a triangular wooden structure composed of a series of rafters joined at the peak, which outwardly descend to the floor level meeting the floor beams at a sixty degree angle (Fig.29-30). The series of rafters joined with floor beams form triangular frames which in turn are joined by wooden boards ensuring the stability of the structure. A covering of wooden or mineral shingles or steel sheets is usually applied to the wooden roof boards. In this way the wall and the roof functions are fulfilled by the same element. The openings at the gable ends are closed by vertical walls usually containing large windows. The gable end walls only support themselves and thus can be very light and open. The whole structure is usually raised of the ground and sits on concrete or steel supports to prevent moisture related damage to the structure. This is a general description of what an A-frame is, without a doubt a large number of variations can be found and many are presented in the book

In the conclusion Randl (2004, p. 163) describes the decline of the A-frame starting on the 1970’s as it went out of fashion. By that time the triangular shape had become ubiquitous as it was adopted not only by recreation home builders but also for churches, restaurants, motels and many others. Its influence however remains in the design of recreational houses as it is linked to the popular conception of leisure and the good life. That is why the American landscape is dotted by thousands of this type of houses which are still being built today.
Fig. 31 General view of the Sinchaguasin Center showing the native plants nursery and more...

Fig. 32 (Opposite) L shaped rammed earth formwork (Top left), pivoting door (Top right), demonstration house (Bottom), All from: (Dudley, Field, & Jordán, 1988)
Sinchaguasin Center
The Sinchaguasin Center was part of a project for rural development, involved in improving rural housing and reforestation with native plants, through capacity building in rural communities (Fig. 31-32). Their work will be not discussed in detail but is worth mentioning as they provided insightful information of their experience into how to approach such development programs with rural communities. They have also identified practical innovations which can be applied to rural houses and describe the way those technologies have been dispersed (Dudley, Field, & Jordán, 1988).
Fig. 33 Reference to the minga as community work, From: (Dudley, Field, & Jordán, 1988)
Fig. 34 "Zumbahua en minga por el TURISMO"
Fig. 35 Weaving of the grass bridge by members of the community, From: www.cultura.gob.pe
The Minga

The minga can be broadly described as collaborative work for the common good. Today it is a widespread concept in the Equatorial Andes region; it is often used to organize activities in rural communities, as well as schools and other institutions. It is safe to assume that the concept is known by most of the population; and if it’s not understood it can be easily explained. It has been referred to various times in the studied literature (Fig.33). It has its origins in the traditional way of life of indigenous communities as they are community oriented (as opposed to individual oriented). It was used by the Incas in the maintenance of civil works; a great example of this is the yearly cyclical rebuilding of the grass bridge over the Apurimac River in Q'eswachaka (Fig.35).

Summarizing Table

The identified needs can be alternatively fulfilled by the recipe which can be implemented in a way informed by the insights.

<table>
<thead>
<tr>
<th>Needs</th>
<th>Recipe</th>
<th>Insight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income</td>
<td>Horseback riding services</td>
<td>Stables and design of paths</td>
</tr>
<tr>
<td></td>
<td>Production of non-timber products</td>
<td>The site contains a biodiversity bank</td>
</tr>
<tr>
<td></td>
<td>Reforestation</td>
<td></td>
</tr>
<tr>
<td>Knowledge</td>
<td>Workshops given by local community and experts</td>
<td>Valuable knowledge of native plants and their uses can be exchanged at a workshop space at the site</td>
</tr>
<tr>
<td>Ecosystem services</td>
<td>Native plants nursery and gardens</td>
<td>A place to study and produce native plants by visitors, local communities, schools</td>
</tr>
<tr>
<td></td>
<td>Reforestation programs</td>
<td></td>
</tr>
<tr>
<td>Shelter</td>
<td>Rural House</td>
<td>Use of locally available materials in construction and climate strategies</td>
</tr>
</tbody>
</table>
The Páramo and the Cloud forest are the natural ecosystems found at the site. There is a clear transition in vegetation from the lower area which is characterized by cloud forest vegetation from 3300-3500masl, dominated by large trees up to 30m in height covered in epiphytes and abundant presence of mosses; an intermediate area with plants of decreasing size, mainly shrubs 3500-3600 masl; and an area with small vegetation which characterizes the Páramo ecosystem 3600masl and above.

A literature study was done to get familiarized with the Páramo and Cloud forest ecosystems in the context of Ecuador. Here follows a description of those ecosystems, sustainability issues related to land use and climate change, management and governance of the ecosystems and observations about their study and management.

Fig. 36 Holdridge Lifezone classification scheme + Páramo & Cloud forest indication
Description of the ecosystems

In the studied literature the Cloud forest is characterized in terms of the environmental conditions and endemic vegetation (Fig.36). The ecosystem has been identified from the literature (Baquero et al., 2004). In the occidental central and northern Andes the *Bosque siempre verde montano alto* (Bsvma) is defined by the following characteristics: it includes the transitional forests bordering the Páramo, abundant moss ground covering and a large amount of epiphytes, the vegetation selected to identify this ecosystem has a collective altitudinal range of 1000-4000masl, the median altitude is 2925, slopes surrounding the 11°, 4 dry months, a minimum annual temperature of 6°C, and maximum annual temperature of 17°C, 922mm annual precipitation, and 882mm evapotranspiration potential. The presence of mist and horizontal precipitation is an important factor in the hydrological performance of the cloud forest. They contribute considerably to the total volume of water which is captured by the vegetation; also, the mist prevents evapotranspiration from taking place reducing the loss of moisture at the canopy (Tobón, 2009).

The Páramo in the occidental central and northern Andes is defined as Páramo Herbáceo (Ph). This ecosystem is characterized by: its extended straw fields mixed with shrubs vegetation; the chuquiragua is a characteristic flower of this landscape, it borders the previously described cloud forest at lower altitudes and the Super Páramo at higher altitudes, the altitudinal range of its characteristic vegetation is 2500-4500masl, median altitude is 3662masl, slopes surrounding the 9°, 4 dry months, a minimum annual temperature of 4°C, and maximum annual temperature of 13°C, 722 annual precipitation, and 820 mm evapotranspiration potential. For more information on the vegetation of the Páramo and the Cloud forest and its distribution see (Beltrán, 2009; Reynel, 2009; Suárez, 2011).

The tree line marks the end of the cloud forest and the beginning of the Páramo. There are many views on how this border dynamic or transition has been defined. Some views place more emphasis on the climatic characteristics as the temperature gradients in the Andes are generally characterized by a 0,6 °C per 100 meter height difference; although the temperature is also largely influenced by wind currents and proximity to glaciers (Baquero et al., 2004). Recent studies suggest that the past and present anthropogenic influence on the tropical cloud forest mountain landscapes may have played an important role in shaping them (Sarmiento & Frolich, 2002). Many studies have been done within both the Páramo and the Cloud forests. Some publications have gathered the dispersed knowledge, especially in relation to the Páramo (Hofstede, 2014; Vásconez et al., 2011). This report is not the place to discuss them in detail, although it is important to point out that it is often mentioned in the literature that more studies are needed into for instance soil composition, hydrology, biodiversity, productive activities among others.
Fig. 37 FONAG fund and contributors from: www.fonag.org.ec
Fig. 38 Working scheme Socio Bosque from: www.sociobosque.ambiente.gob.ec
Sustainability issues

The Páramo and Cloud forests are of both economic and ecological value because of their biodiversity and their water resources. (Célleri & Feyen, 2009) The stages of deterioration of the cloud by anthropogenic actions forest start with the extraction of timber products, when there is no more construction quality wood it usually precedes with the use of other vegetation for the production of coal, in the last step the forest is completely cleared for agricultural use or livestock farming. Changes in vegetation to grass affect the capacity to catch water and to maintain water on the ground, it is also often linked to soil compaction, this leads to higher runoff and less hydrological regulation. The effects of climate change need to be studied further, however some scenarios and their consequences have been discussed in the studied literature; for example in case the cloud cover would diminish, there would be more evapotranspiration at the canopy ultimately reducing the quantity of water released to lower streams (Tobón, 2009). In relation to the biodiversity a link can be made between the deterioration of the ecosystems and biodiversity loss. The potential effects of climate change on mountain ecosystems are still uncertain and need to be studied further (Hofstede, 2014). The uncertainty is mainly due to the unpredictable changes in precipitation patterns.

Management of Andean ecosystems

Bièvre (2011) presents an overview of the various aspects of the management of Páramo ecosystems in relation to their diversity, paradigm shifts, conservation and management mechanisms in the face of current adversities which threaten them. The diversity both in types of Páramos and within Páramos is pointed out as something that needs to be considered; not only biodiversity but also cultural diversity. The diversity in management practices is a direct reflection of this reality; he explains that a universal solution doesn’t exist for the challenges that Páramos face. An optimal solution strategy would be in function of the local characteristics of each zone. The Páramo is the best represented Andean ecosystem in the National Protected areas system; around 40% is found within protected areas destined for conservation. Although its biodiversity is a good reason for its conservation the main reason is the need for the hydrological services it provides. Projects for the conservation of the Andean ecosystems are being financed by water funds. FONAG, the water fund for Quito, is one of the best examples of such a fund. It is founded by various actors including hydroelectric plants, industries, tap water enterprise and ONG’s (Fig.37). They organize and promote environmental education programs, monitoring programs, and conservation management programs. Another more recent financing instrument is the Socio Bosque; a Government run program which offers financial incentives to private owners or communities for the conservation of primary forests (Fig.38). The most commonly applied mechanism for conservation is conservation through local agreements; this accounts for 60%, while the other 40% is covered by the National Protected Areas system. The main threats identified by Bièvre (2011) are: the advances in agricultural frontier expansion, bad management practices such as the forestation of the Páramo with exotic species, mining practices, big infrastructure projects, and climate change.
Technical alternatives for the sustainable management of Native Andean forests have been presented in a publication by DFC (1997). They present alternatives for management both within the forest and in surrounding damping areas.

The proposed activities within the forest are:

- Non-timber forest products: ornamental orchids, medicinal plants, fibers from small bamboo plants, fruits based products.
- Services: forest protection in relation to biodiversity and water resources, ecotourism.
- Timber products: enrichment of degraded forests, use of “fine” wood in artisanal products, selective timber use and regeneration management.
- Change of use: native forest based agriculture, pastures -forest for livestock purposes.

The proposed activities in the damping areas are:

- Paddock management: use of existing paddocks (either developing them as forest clearings, or implementing living fences), recuperation of degraded areas, soil conservation, and agroforestry.

**Governance of ecosystem services**

The relation of Ecuador to its natural resources is contextualized and presented in the publication Governance of ecosystem services (Greiber & Schiele, 2011). Ecuador is considered among the most biodiverse countries in the world; it contains more than 16 000 plant species of which 25% are endemic to its territory. However, at least 3000 of the 4000 endemic species are endangered. Ecuador’s natural resources have been declining gradually under the high rate of economic development since the 1990’s which has outpaced natural rates of resource regeneration. The country has one of the highest annual deforestation rates in the Americas; 1.7% percent per year between 2000 and 2005 which amounts to a loss of 198000 hectares per year. Of the total 28 million hectares of national territory, forests and woodlands cover 39% and the páramos about 4%. Primary forests in the sierra region (or the Andes) have virtually disappeared as a consequence of a combination of wood extraction for fuel, grazing, and clearing for farmland. Ecuador’s economy has been based on agriculture since the colonial era. During the 1970’s oil and oil products became the main source of income through exports; it is nowadays followed by bananas and shrimp exports. Although the country has developed policies and regulatory frameworks for forest management, their enforcement has been limited. That, in combination with a weak institutional structure has led to high rates of forest exploitation and illegal logging; which are considered the main causes of the rapid loss of native forests. The loss of the native forests is linked to a chain of effects such as: loss of biodiversity, degraded quantity and quality of water resources, an upset climatic equilibrium, and a decline in the quality of human life. Access to land has been made difficult for poor farmers by legal barriers, the cost of land, migrations due to the agrarian reform, and land ownership concentration among the largest owners; forcing them to move to higher
less fertile lands. More than 500 000 people, most of them belonging to the Kichwa indigenous community, live in the vicinity of páramos. Their use of land often involves highly productive agriculture.

**Ecosystem services of the páramo**

Within the Ecuadorian territory; the páramo is a severely threatened ecosystem which provides specific ecosystem services:

- The regulation of nationwide hydrological processes; being the only source of water for the population of the upper and lower parts of the Andes. The páramo is a delicate ecosystem; when its soil dries up it becomes hydrophobic losing its capacity to absorb water, this in turn produces an uncontrolled flow of water down the mountain slopes.
- Carbon sequestration: páramo soils can store more carbon than that of the rain forest.
- Recreational and aesthetic: the páramos offer a potential for recreation and tourism because of their attractive features such as views of snow-capped mountains, lakes, ponds, hayfields, high-Andean forests, and relative accessibility.

**Laws and policies**

The new Constitution of the Republic of Ecuador approved in 2008 reflects a change of paradigm in the relation between society and nature. It is the first national constitution in the world to recognize legally the rights of nature as ecosystem rights. It recognizes nature as an entity instead of an object to be exploited by people. The state then plays an important role in regulating the production, provision, use, and exploitation of ecosystem services.

The National biodiversity strategy is an important national instrument which proclaims biodiversity as a strategic resource in Ecuador.

Ecuador has a National System of Protected Areas (SNAP) which includes areas which are protected as national heritage. The Forestry act defines two categories for such areas:

- State-owned Natural Heritage areas including national parks, ecological reserves, wildlife refuges, and marine reserves. Their scientific, landscape, educational, touristic, and recreational values are recognized. Also they are valued for their flora and fauna, and their contribution to the environmental balance.
- National Forestry Heritage which regulates the tenure, management, and commercialization of forest resources.
Observations

The productive alternatives that can be implemented should avoid the further degradation characteristic of bad practices. In order to select appropriate activities it is important to make an inventory of the biodiversity at the site. By doing this and experimenting new activities could be identified. It is important to remember that areas containing primary forest need to be conserved and studied and because of this their use would be mainly directed to conservation. The recovering areas and agricultural areas, which form the damping areas surrounding the protected areas, are the main areas to focus on for the development of productive activities. One of such activities can be reforestation with native species which can be produced in a local nursery which has access to the biodiversity banks of the protected areas.

A need for studies related to tropical mountain ecosystems is frequently mentioned in the literature (Tobón, 2009, p. 9). This forms a link to the definition of the program for the project in the sense that the project can support: the implementation of measurement equipment (weather and hydrology), lodging and facilities for researchers to stay and study (diversity inventory, hydrology, impacts of land use and climate change), the accessibility of the natural landscapes, the definition of strict conservation areas to be studied, enabling the surveillance of the landscape to prevent man related deterioration.

Based on the presented information, the role local communities can play in the conservation of the discussed ecosystems is considered a central one. In this thesis the development model being studied is based on the principles of ecotourism. The relevance and value of an ecotouristic project as an alternative for development is considered in the following way; in such a project local communities would ideally be: Involved in the conservation of the Páramo and Cloud-forest ecosystems; and, involved in the study and production of products and services derived from sustainably managed local resources.
Bibliografía


ec/index.php/mejia/historia


Ecotourism

Definition and principles

Various definitions for ecotourism have been given along its development by organizations such as The Nature Conservancy (TNC), The International Ecotourism Society (TIES), The United Nations World Tourism Organization (UNWTO) and The International Union for Conservation of Nature (IUCN). The definition adopted in this thesis is the one provided by IUCN; it has been agreed on by a number of organizations in 1996 (Drumm & Moore, 2005, p. 15). Following this definition Ecotourism is:

“Environmentally responsible travel to natural areas, in order to enjoy and appreciate nature (and accompanying cultural features, both past and present) that promote conservation, have a low visitor impact and provide for beneficially active socio-economic involvement of local peoples.” (TNC, 2015, from website; Definition by IUCN)

Other definitions circle around the concept of ecotourism providing different accents, depending on the organizations focus and area of expertise (Fig.39). (Ceballos-Lascurain, 1996; Drumm & Moore, 2005; TIES, 2015; TNC, 2015; UNWTO, 2002) They are often accompanied by a set of principles and/or conditions. The principles and conditions described in the reviewed definitions roughly fall under the following categories:

a) Minimizing undesirable Environmental & Cultural impacts
b) Promoting Environmental & Cultural education and awareness
c) Developing sensitivity and respect for local cultures, traditions and biodiversity
d) Involving the collaborative participation of stakeholders (including local communities) in planning and implementation
e) Generating profits (and other benefits) for conservation and community development
f) Providing a positive experience for visitors and hosts
g) Developing and managing a sustainable built environment

The last principle was added in the most recent definition by TIES from January 2015 (TIES, 2015). This last theme directly shows the growing awareness of the relevance of the design and management of sustainable facilities for ecotouristic projects. The way the facilities are designed, built and managed is directly related to the implementation of most of the described principles.
An important distinction must be made between nature based tourism and ecotourism. As its name suggests nature based tourism is a modality of tourism in which nature enables the development of an attraction. Ecotourism is a specific kind of nature based tourism which applies sustainable development principles. Its general goal is to bring social and environmental benefits to protected areas and communities while providing profits to the businesses involved. Also, a distinction is made between Sustainable nature tourism and Ecotourism; although the line between them is very subtle. The distinction is that a project must meet all of the necessary criteria (listed as principles above) in order to be accurately defined as ecotourism. (Ceballos-Lascuráin, 1996, Ch.2; Drumm & Moore, 2005, p. 18)

In the publication Tourism, ecotourism, and protected areas; edited by Hector Ceballos-Lascuráin (an architect from Mexico who introduced the term ecotourism in 1983) some observations based on collected worldwide experiences are presented. An observation is that while visitors may learn from, and appreciate the natural environment of the place visited, the knowledge and appreciation does not necessarily help the place, and thus cannot be considered ecotourism. Another observation is that while the touristic activity may bring economic and material benefits, it can go paired with “loss of traditional employment systems, acculturation, and social disruption.” It is then also not considered to be ecotourism. According to Ceballos-Lascuráin ecotourism “provides its greatest benefits (especially if applied at local level) through pursuit of a widespread but controlled ‘small is beautiful’ philosophy.” There is also a reminder that the term ecotourism is “used to describe tourism only when an additional, normative characterization is intended – tourism that helps society achieve sustainable development”. (Ceballos-Lascuráin, 1996, Ch.2)

Historical development

Ceballos-Lascuráin (1996,Ch.1) provides an outline of the historical development of tourism; this has been summarized here in order to provide some historical context. Referring to accounts of travels in the 5th century B.C. he argues that tourism has been around for a long time; in those accounts, Greek travelers described their experiences in visiting foreign places. During the middle ages pilgrimages were common for religious people, often travelling by foot around Europe. According to him it was not only until the Renaissance that people started travelling in greater numbers for educational and recreational purposes; and, later during the 18th and 19th centuries, he explains , the Grand Tour became common under European aristocrats. During the industrial revolution incomes increased and started to include paid holidays; that in combination with new affordable means of transportation meant that tourism was increasingly becoming accessible to the general public. For people living in industrializing countries the will to travel was stimulated by the idea of new exotic places beyond their known world; mainly promoted by the views depicted in seducing photographs; which served as an objective proof of the existence of foreign marbles. After 1945 the growing availability of commercial flights and automobiles gave a
new impulse to the development of travel; and by 1950’s and 1960’s those means of transportation became widespread enabling the growth of global tourism. The growth of tourism into larger scales meant there was higher pressure on host sites, and when this went combined with lack of planning it often led to negative impacts. A growth in the public concern about the environment and the negative impacts of mass tourism therein led to a reexamination of the notion of tourism as a panacea for the problems of developing countries. While this happened, conservation organizations were formed to lobby governments to set land aside with the aim of preserving the natural integrity of natural ecosystems.

In a different text Ceballos-Lascuráin (1996, Ch. 2) sketches the evolution of ecotourism. Again he refers to ancient times to explain the origins of nature travel. Interestingly he refers to explorers such as Alexander von Humboldt, Charles de la Condamine, and Charles Darwin; all of who visited Ecuador. According to him, their travels can be characterized as travels with a fundamental purpose of discovering, studying and describing natural and cultural features. Analogous to the described development of tourism, he explains that the popularity of nature travel cannot be considered to have truly developed until the late 19th Century, following advances in mass travel. At that time the main motivation behind travel was the quest for spectacular and unique scenery; and it was also at that time that the national park concept was created. The national parks were meant for the protection of the environment, although they didn’t necessarily have the economic resources to finance this goal; it was through the involvement of tourism that profits could be made and invested in protection programs. The birth of the ecotourist is placed in the 1970; when conservation organizations were formed mainly with the goal of promoting the reservation of land at a governmental level in order to protect the integrity of whole ecosystems. The experience of the threatened places by visitors increased their support for conservation.

Drumm and Moore (2005, p. 15) describe the emergence of ecotourism in a similar way; based on the involvement of three players namely: conservationists, local communities, and the travel industry; as they “…witnessed a boom in nature tourism and realized their mutual interest in directing its growth.” According to them “…ecotourism has brought the promise of achieving conservation goals, improving the well-being of local communities and generating new business ---promising a rare win-win-win situation.”

Ceballos-Lascuráin talks about the irony that increased interest in nature and nature travel can lead to problems of overuse and disruption. He describes the following often cited drawbacks of ecotourism: “degradation of the environment, loss of economic benefits due to damage to the resource or the local community, and disruption of local cultures and/or values.” Finally, he concludes with the following remark: “…if tourism is damaging a natural resource (whether it is a species or a protected area), then it is not ecotourism. True ecotourism can in fact be one of the most powerful tools for protecting the environment.”
Trends

“There is currently no global initiative for the gathering of ecotourism data. However, certain indicators show us how the larger nature tourism market, of which ecotourism is a segment, is growing at a rate faster than that for tourism as a whole, particularly in the tropics.”
(Drumm & Moore, 2005, p. 17)

“The UNWTO data also reveal a tourism shift that has occurred in the last 20 years that favors developing countries. Namely, those countries with the most diverse flora, fauna and ecosystems, and therefore the greatest potential for ecotourism, are increasingly preferred by tourists. This trend is likely to continue and those regions which are politically stable will benefit most.”
(Ceballos-Lascurain, 1996, Ch.2)

Trends described in the literature (Ceballos-Lascurain, 1996; Drumm & Moore, 2005) include:

- Continued growth of tourism
- Increased interest in travelling to more natural settings and less disturbed areas
- A global increase in interest in the environment
- Travelers seeking more remote destinations
- Travelers becoming activists
- Travelers interest in environmental education
- Travelers willingness to contribute to conservation and sustainable development and placing increasing demands for the “greening” of the tourism industry
- Emergence of companies dedicated solely to nature travel
Fig. 40 Ecotourism as an opportunity, and tourism as a threat

Fig. 41 Potential impacts of Tourism in Communities

All from: (Drumm & Moore, 2005)
Relation between tourism and protected areas

Budowski (1976) describes three possible types of relationship between nature travelers and conservationists operating in the same area, namely: conflict, coexistence, and symbiosis. The first describes a scenario in which tourism is detrimental to nature, thus creating a conflict between conservationists and tourists. The second one is described as a temporary stage in which conservationists and tourists are unaware of each other’s actions and effects, this would usually be the case in the initial stages of development and can later develop into either a conflict or a symbiotic relationship. The last one describes such a symbiotic relationship as a scenario which is mutually beneficial for conservationists and tourists.

Ecotourism and protected areas have a mutually beneficial relationship. Ecotourism promotes conservation and environmental education, and provides revenues; protected areas conserve natural ecosystems which form the main attraction for tourists. Appropriate management is crucial for both in order to prevent adverse impacts (Ceballos-Lascurain, 1996,Ch.2). Drumm & Moore (2005,Ch.3) present the opportunities and threats of ecotourism at protected areas (Fig.40). They are described as a mix; ecotourism seeks to increase opportunities and reduce threats. They also explain that the entire spectrum of opportunities and threats does not apply for every protected area.

While the focus of ecotourism is on enabling both tourism and conservation; the touristic activities can produce negative impacts in the protected area where the activities take place. Ceballos-Lascuráin (1996,Ch.4) provides an overview of the direct impacts of touristic activities on the natural environment at a local level in protected areas. The direct impacts are divided into the following categories:

- Impacts on geological exposures, minerals and fossils
- Impacts on soils
- Impacts on water resources
- Impacts on vegetation
- Impacts on animal life
- Impacts on sanitation
- Aesthetic impacts on the landscape

The possible negative impacts have to be considered during planning; they should be minimized and outweighed by positive impacts if the project is to succeed.

Relation between local communities and ecotourism

The crucial role of rural communities in the conservation of biodiversity has been recognized by conservationists. Because of this, protected area managers have adopted mechanisms to incorporate those communities as stakeholders into the planning and management process (Fig.41). Also, local communities are sometimes directly involved in touristic activities; when for example tourists travel to experience their culture. According to Drumm & Moore “one of ecotourism greatest contributions
Fig. 42 Stakeholders in ecotourism, and the role of site managers
Fig. 43 Planning phases, the most relevant for the design are highlighted
All from: (Drumm & Moore, 2005)
to conservation is the degree to which it can shift community activities from ‘threats’ category to that of ‘opportunities’, i.e., those activities which contribute to sustainable development and the achievement of an area’s conservation goals.” (2005, Ch. 4) The potential impacts of tourism in communities are described in the following table:

### Stakeholders

Stakeholders (or participants) in ecotourism have been classified by Drumm and Moore (2005, Ch. 2.) into two groups: Core decision makers and supporting players. In the first group they place core decision makers, local communities, Government officials, NGO’s (Fig. 42). They emphasize the role of the protected area (or site) managers as a central one; they must be able to guide conflicting interests of all other stakeholders for the benefit of the protected area. The second group contains Funders, Academics and Travelers. They play a supporting role by providing economic incentives for the development of projects, being critical and providing input to the project, and participating in touristic activities. Travelers are highlighted as vital participants in the industry as they provide funds and are part of the motivation for the development of projects; they are however usually not involved in the planning process.

### Guidelines for Planning

Both IUCN and TNC have developed guidelines which support the planning and management processes. TNC has produced a comprehensive manual in two volumes explaining planning, implementation and management of ecotourism projects (Drumm & Moore, 2004; 2005). This manual has been consulted as the main guide (Fig. 43). (It has also been translated into Spanish and is available for free online). Other publications by IUCN were consulted for complementary study on more specific topics of conservation and infrastructure design. The publication edited by Ceballos-Lascuráin (1996) contains a lot of insightful information, even though it was made almost two decades ago. More recently a series of manuals were published by IUCN presenting principles for the implementation of good practices, illustrated with state of the art cases (Cooper & Renard, 2012; Sweeting, 2008).
Ecotourism in Ecuador

The publications Ecoturismo en el Ecuador (Izko, 1995), and Turismo y desarrollo sostenible (Fernandez, 2002) were the main sources of insight to how ecotourism has developed in Ecuador. The first publication (1995) was produced in a collaboration between IUCN and Intercooperation (Swiss NGO, active in Ecuador); it presents a collection and comparison of experiences from selected ecotourism cases linked to the perspective of either communities, tour operators, or NGO’s. From the cases presented in the publication the Paschohoa case has been selected to be studied further. It is relatively near the site and contains the same ecosystem types; it is also presented as a successful project. At the end, general recommendations are presented; the ones that are considered relevant at the level of the project are the following:

- Involve local communities
- Aim for a maximal participative integration of locals from the very start
- Promote dialogue
- Promote the manifestation of the wishes which represent the community as a whole (not only the leader)
- Ecotourism should be complemented by other productive activities to diversify incomes and reduce risks (ecotourism stability is dependent on external factors)
- Promote conservation as a base strategy for ecotourism development
- Area managers need to be capacitated to be receptive of the needs and way of life of the local community
- Promote reciprocity contracts (join venture) between tourism operators and local communities
- Actors should be aware of their role and relation to others roles, and collaborate to create a quality product
- Incentivize authentic cultural exchanges which enrich the appreciation of nature
- Exchange knowledge about experiences and internal and external interests
- Incorporate the traditional knowledge of local communities in area management
- Promote the self-organizational strength of local communities
- Appropriate technical means should be used (Use of solar energy, waste management, use of local means in the architectural design)
The second, more recent publication (Fernandez, 2002) by the Ministry of tourism of Ecuador includes agreements, policies, norms, and strategies; it also provides a reflection about how they see the way, and are planning towards sustainable tourism in Ecuador.

In the reflection at the end of the publication Ecuador is described as an ideal setting for the development of tourism; with its many, cultural and natural, attractive features. Ecuador is one of the 17 most biodiverse countries in the world, largely due to its geographic and climatological configuration. It contains four distinctive natural regions: The pacific coast, the Andes mountain range, the Amazon, and the Archipelago of Galapagos; Each region containing various ecosystems. The occidental slope of the Andes (where the property is situated) is characterized by its protected natural areas, cloud forests and high mountains such as the Chimborazo (6310masl).

The text describes how, in line with the international context, the Ecuadorian Government has incorporated a normative framework which encourages sustainability, sector modernization, infrastructure creation, investments uptake, inter-institutional coordination, competitive tourism products generation, promotion of technological development, technical and professional capacity building, and an impulse towards a decentralization which delegates responsibilities to local and community instances.

One of the goals they aim for is an equitable distribution of the multiple benefits brought by tourism. The role of local municipalities is seen as key to strengthen civic participation and act as a coordinator between the National Government, civilians, and businesses in important aspects to enable sustainable development. The Ministry of tourism of Ecuador recognizes the potential of ecotourism and seeks to promote it and regulate it.

**Ecotourism cases**

The following cases serve as examples of approaches which place different accents in the way they have developed ecotouristic projects. They differ in their: scale, types of ownership, types of touristic activities and facilities, and relation to conservation. By presenting these cases I hope to sketch the diverse identities of ecotouristic projects in the natural context of the cloud forest and páramo ecosystems in the Equatorial Andes. The three cases being presented are Paschooa, Bomboli and Papallacta.
Fig. 44 School students on one of the trails
Fig. 45 School students at the camping area
From: (Endara, 2010)
Pasochoa case

Reference name: El Bosque Protector Pasochoa (Refugio de vida Silvestre Pasochoa)
Sources: (Jijón, 1990), (Izko, 1995), (Endara, 2010)
Figures: (Fig.44-47)

Description of the project

In 1982, 320 hectares of the hacienda Pilopata de Monjas, property of the Ministry of Health, were designated a protected natural area by the Ministry of Agriculture. That same year the Ecuadorian NGO Fundación Natura was given a contract for the management and conservation of the area. The area was later extended to include 500 hectares. The area was identified as one of the last remnants of well-preserved inter Andean forest in the Equatorial Andes; which have been largely changed by human influence through extensive agriculture use and the introduction of exotic forestry species such as the Pine and Eucalyptus trees that currently dominate the landscape. The main reason why the area of the project has remained well-preserved is the characteristic geomorphology characterized by strong slopes and ravines which difficult the development of agriculture.

From its conception the Pasochoa project has put a large emphasis on environmental education and conservation of wild fauna and flora; those are its main objectives (Fig.44). During the first years of development the project focused on the improvement of access roads, capacitation of personnel, and the construction of basic and interpretative infrastructure needed to facilitate the management of the protected area which involves: protection of the natural landscape, education, investigation and recreation.

Biophysical characteristics

There was an eruption of the Pasochoa around 100000 years ago leading to the current condition; a collapsed semicircular crater with an occidental opening. The lava and ashes were transformed by physical and biological processes into a fertile ground. A multitude of plant species populated the area leading, after a number of centuries, to the creation of the current forest. The primary forest is a representative remnant of the native forests which previously covered the inter-Andean corridor. It contains three highly threatened native species: Palma de ramos (Ceroxilon sp.), Podocarpus sp., Polylepis reticulate.

The area of the project contains the following life zones according to the life zones described in the Holdridge system: lower montane moist forest, montane wet forest,
subalpine pluvial páramo.

Conservation

Due to the large demand in the educational, scientific, and recreational services the project provides; its planning and zoning are crucial in order to fulfill the objective of conservation. The management plan(s) developed for the Pasochoa project (1990) has the role of integrating all the activities in order to prevent conflicts which can arise from its diverse objectives. The project aims to offer visitors an authentic positive experience which stimulates a change of attitude with respect to the human-nature relation.

The following programs are carried out by the project:

- Environmental management: Protection (surveillance by personnel), investigation (by external scientists).
- Public use: Interpretation and environmental education (mainly by students), tourism and recreation, public relations.
- Operations: project management, maintenance.

The main threats to the conservation of the protected area are the extractive practices by the surrounding communities. The main extractive activities have been identified as: collection of fire wood, hunting of wild animals (birds, pumas, rabbits, and antelopes), collection of plants (Palm leaves, epiphytes, and mosses). Those activities have been reduced thanks to the surveillance activities of the project and the precise definition of zones.

The zoning of the project was implemented with the following types of zones:

- Intensive use zone
- Extensive use zone
- Intangible zone
- Recuperation zone

Tourism

There are around 30000 annual visitors; 60% of which are children from schools from Quito and surroundings; 38% national tourists; 2% foreign tourists. This makes Pasochoa one of the main environmental education and ecotouristic interest centers in continental Ecuador. (Even though it hasn’t yet been considered an natural attraction of importance)

The success is attributed to the natural setting’s graciousness, the created infrastructure, the capacity building of the personnel, and the proximity to the capital city of Quito.

Natural Touristic attractions of the area include: Sambache ravine, Santa Ana ravine, Pucuneros hill, Crater of the volcano, Pasochoa River, Páramo, lower montane moist forest, montane wet forest, Patacorona, Pasochoa Mountain.
Facilities and services

Basic infrastructure

- Road: The area is located 45km from Quito, 38km are first order highways, 7km local ways. Travelling time is around 1 hour from Quito. 90% of the visitors arrive by public & private road transport, 10% arrives walking from the neighboring town Amaguaña.
- Radio communications with a system based in Quito, and accessible to all forest keepers.
- Access to national electricity grid.
- All water used in the facilities comes from higher areas of the reserve. There are 20 sanitary batteries and 3 non potable water sources distributed in strategic points within the area: Recreation area, Environmental Education Centre, Information Points.

Touristic infrastructure

- Interpretative trails: Created based on the protected area management plan, 6 trails, 3 self-guided, 3 require a guide, and duration ranges from 30 min to 8 hours.
- Ecologic lodge with capacity for 20 people. Consists of two big rooms positioned in the attic of the Environmental Education Centre, Toilets and common use showers, and a kitchen/eating area.
- Camping sites: zoned into different areas for camping, water sources, toilets, waste collection, recreation area with tables, grills, roofs.
- Environmental Education Centre: Conferences & projection room, exhibition room, biologists department, toilets.
- Administrative area which includes the following services: Radio central, First aid, Forest keeper home, toilets, storage, lockers.
- Forest nursery: With a production capacity of 5000 native plants per month. It provides an income and is an important educational instrument. It consists of 2 greenhouses, a seed drying room, and a composter.
- Waste management: A waste collection system has been designed within the administrative and recreation areas; based on a separation of organics and inorganics. Organics are used in the forest nursery, and inorganics are either sold to recycling or, if that’s not possible, sent to the municipal waste collection of Mejia.
- Information posts: with maps showing trails and facilities.
- Signaling: Sings serve for regulation, information and interpretation and are designed in a harmonizing way with nature (?). Sings are in Spanish and English.
Fig. 46 Trail (Top), information sign (Bottom), Organic and Inorganic waste bins (Opposite), All from: (Endara, 2010)
Services needed for touristic exploitation

- Ecological Store: All products sold here come from the surrounding communities. The products include souvenirs and ecological products.
- Guide services: The Park has trained a team of 30 naturalist guides. In weekends and holidays there are 5 guides present, each is able to lead a group of 15 people.
- Restaurant service: Only typical food is offered and it’s only open in the weekends and holidays.
- Park ranges (forest keepers): The team includes 4 park rangers which work on turns and work every weekday. Their activities include vigilance, providing information, maintenance of trails, and charging for entrances in weekdays, working at the forest nursery, and attention to the public.
- Parking: 1000m² of parking space.
Fig. 47 Environmental education center (Top), Covered eating area (Bottom), Toilets (Opposite top), Storage (Opposite bottom) All from: (Endara, 2010)
Fig. 48 Fireplace in the shared living room
Fig. 49 Trail into the protected area
Bomboli case

Reference name: Reserva natural privada Bomboli
Sources: (Ecuador), (Bomboli, 2014), Visit documentation
Figures: (Fig.48-53)

Description of the project

The Bomboli Private Natural Reserve is located 4km northeast from the site of the project; it can be accesses at the 20th km of the Aloag-Santo Domingo highway. Oswaldo Haro is the owner of the property. He is an ecologist (just like his grandfather and his great-grandfather) who has dedicated more than 35 years of his life to the conservation, study, and restoration of the ecosystems within his 204 hectare property.

In their web site they explain the philosophy behind their actions:

“Bomboli Cloud Forest is committed to a sustainable approach for tourism grounded in the proper use of the natural landscape and the support of its local economy, offering the traveler a unique and localized experience. The house and infrastructure are completely made from wood that comes from renewable forest plantations of the region to prevent the harvesting of primary forests. Water comes from the natural creeks and springs that flow through the forest. Ninety percent of the energy the Ecolodge uses comes from clean sources; however, propane is needed for hot water showers because of the lack of energy.

Most of the food offered is grown and processed in their organic farm. In the past development agencies promoted the plantation of foreign tree species, as can be seen along the road that comes into the house. We are currently committed to the restoration of cloud forest ecosystems through the planting of native trees and other natural vegetation that is important for local wildlife and for our neutral carbon commitment.

The makeup of the ecosystem continues to change and enrich itself with the interactions of the natural vegetation with local wildlife. This modification combined with our expertise in forest ecology and agro forestry systems, and our philosophy of life, to live simply and in harmony with nature, is continuously shaping our approach to how we manage the reserve on a daily basis, and give the visitor a truly unique experience that integrates all the necessary elements.”

Life Philosophy (http://bombolicloudforest.com/)
Biophysical characteristics

The reserve lies in the west facing slopes of the occidental Equatorial Andes; with an altitude range of 2700-3450masl and an average temperature of 13°C in winter and 25°C in summer. The preserved native forests contain a large diversity of flora and fauna; especially diversity of epiphytes and mosses is characteristic for this area. Also the reserve constitutes an important source of water recharge for the Pilatón watershed; providing fresh water to communities and properties located downstream. The native vegetation found on the reserve is dominated by the following trees: aliso (Alnus sp.), pumamaqui (Oreopanax sp.), and podocarpus (Podocarpus sp.). The most representative fauna includes: pava de monte (Penelope Montaigne), puma (Felis Concolor), and cervicabra (Pudus Mefistofeles).

The area of the project contains the following life zones according to the life zones described in the Holdridge system: lower montane wet forest, montane wet forest.

Conservation

The reserve only receives relatively small groups of visitors. This approach ensures that the owner can manage the visits, sometimes with help of an external guide. In this way threats to the site from visitor’s activities are minimized and visitors have the opportunity to exchange knowledge with the guides and experience the place in a more personal way.

The project has been involved in the following activities in relation to conservation:

- Reforestation with native tree and woody plant species
- Forest Protection: conservation easements to give long term protection to restored and vulnerable forests
- Assembly of “university hospitals”, they are small nurseries made of locally available materials where orchids are placed to be rescued and studied.
- Implementation of living fences
- Agro ecology Work-Study Scholarships
- sustainable cattle farming in (recovered) forest-pastures
- Agriculture: Improving production and soil fertility on existing crop land, Promoting and improving fruit tree production, processing , adding value to, and marketing organic food and handmade products

The following zoning has been implemented in the 204 hectares reserve: 108 hectares are well preserved native forests which are strictly conserved, 27 hectares are recovering forests which are supported by forestry management, and 70 hectares are used as paddocks with living fences.
Tourism

They offer a varied set of attractions and activities, which they have classified as:

- **Adventure:** Waterfalls, Hiking By Night, Hiking By Day, Horseback Riding.
- **Gastronomy:** Sweetened Condensed Milk, Marmalades, Cheese, Healthy Food.
- **Good Life Visits:** Orchids Trail, Organic Garden, Orchids Hospital, Ferns Forest, Handicrafts.
- Activities in surrounding areas such as horseback riding and rafting are also arranged.

Facilities and services

Basic infrastructure

- Second order access roads
- There is no electricity
- Poor mobile phone signal
- Dwelling with a large kitchen for the elaboration of organic products
- The heating is done by burning wood in a fireplace
- Sanitation treatment on site
- Fresh water from the site

Touristic infrastructure

- 11 km of Trails
- 4 rooms with adaptable furniture, private bathroom with hot water, and a total capacity of 16 people
- The beds are preheated with hot water bottles before they are used
- A living room and kitchen which are shared with the dwelling

Services

Complementary economic-productive activities include the production of cheese, condensed milk, jams. They are an important contribution to the financing needed for running the reserve’s conservation program and giving maintenance to the facilities.
Fig. 50 Panoramic view towards the north-east from a paddock in Bomboli (notice the grown living fences)
Fig. 51 Some detail pictures of the native vegetation
Fig. 52 Oswaldo Haro helping the reproduction of an orchid (Top), University Hospital (Bottom)
Fig. 53 Forest canopy (Opposite top), White mortiño berry (Opposite bottom)
Fig.54 Papallacta river (Left), Hot springs Pool and natural environment (Right)
Papallacta case

Termas de Papallacta
Sources:(Papallacta, 2015), (Poats, Ulfelder , Recharte, & Scurrah-Ehrhart, 2000), (Climate-Data.org, 2015)
Figures: (Fig.54-57)

Description of the project

Papallacta lies on the oriental range of the northern Equatorial Andes, at a linear distance of approximately 50km north-east of Quito. Papallacta has long been an important attraction for national and international tourists, who go there especially for the thermal baths. The visitors experience is enhanced by the natural environment and breathtaking views of mountain landscapes including the imposing Antisana snowcapped volcano (Fig.54). In Ecuador there is a long tradition of use of thermal water for medicinal and recreation purposes. Thermal baths can be found in many places, Papallacta is the nearest one to Quito. The Papallacta hot springs started to develop in the 1970 with the construction of a road which connected Quito to the oriental amazon territories. In the beginning it attracted only locals and national tourists who paid low entrance fees. The touristic infrastructure in the beginning was very basic, consisting mainly of a couple small pools built with concrete. In 1994 a property of 260 hectares, which included the pools and the surroundings of the thermal springs was acquired by a Private society from Quito. After this, the place was developed for tourism purposes. Termas de Papallacta is today widely recognized as one of the best thermal baths/ spas in the country. Its attractiveness relies on the services it provides and the design of its facilities which has employed a rustic stile combining it with elements from colonial haciendas and which harmonizes with the natural surroundings of the cloud forest and páramo. Because of its attractiveness and its nearness to Quito, it manages to attract up to 3000 tourists per day during the weekends. Although all the tourism provides significant incomes, the owners have mentioned that most of it has been invested back into the project which is planned to keep expanding; always in a way which is in harmony with nature.

Small restaurants have been established by individuals from the local community next to the road that leads to the Termas de Papallacta. The lack of integral plans to develop tourism in the area has as a consequence that the design and materialization of those small establishments are not representative for ecotourism; forming a strong contrasts with the aesthetics promoted by the Termas de Papallacta. The involvement of individuals from the community of Papallacta in the project is strictly as labor force; they are not involved in decision making within the project. A stronger relation between the local community and Termas de Papallacta would be desirable as it could promote the implementation of good practices in for instance construction and waste management. Particularly worrying is the future development of the town with the perspective of increasing touristic activities.
Biophysical characteristics

The area of the project is set at an altitude of 3300masl. The geomorphology of the area is characterized by steep ridges. The project is in the middle of a canyon through which a small river flows. As the area lies in the oriental range of the equatorial Andes; it receives warm air currents from the amazon region to the east. The upper areas consist of extensive páramos which are the main source of water to the city of Quito. The average mean temperature is 10°C. The minimum average is 5°C and the maximum average is 15°C. The climate is not marked by a dry season. The average annual precipitation is 1281mm.

The area of the project contains the following life zones according to the life zones described in the Holdridge system: montane wet forest, subalpine pluvial páramo.

Conservation

The Termas de Papallacta borders the RECAy (Reserva Ecológica Cayambe-Coca). The reserve was established in 1971 and ten years later the first management plan was made. The reserve existed on paper, however, in reality there was little contact and communication between the planners/workers and the local communities about the reserve and the management plan. The reserve was established to protect water resources and biodiversity contained in the area. Currently the participatory conservation of the reserve has been greatly improved. People from the local community have been trained as park rangers.

The spatial position of the property belonging to the reserve is strategically valuable as it forms the entrance to the RECAy. The property of the Termas de Papallacta can be categorized as a damping area for the RECAy.

The thermal baths represent a type of use of the land which is generally not considered detrimental to the environment, and compatible with conservation objectives. According to tests carried out by third parties, the quality of the water leaving the touristic complex is not contaminated and shouldn’t form a threat to local or downstream ecosystems.

The Termas de Papallacta is a Private business and as such one of its main purposes is generating profits. Because Termas de Papallacta relies directly on ecosystem services provided by the area protected by the RECAy; there is a direct interest in the conservation of those ecosystems. They do this mainly by supporting environmental education programs and employing sustainability driven design for their infrastructure. The design of the facilities has been done in a way that is sensitive to the existing vegetation and type of soil. This can be seen in the choice of wood and natural stone as the main building materials; the buildings are lifted from the ground, and the paths are durable and let the water lifter through. Also, the use of native plants in the landscape design is worth mentioning as a good example of implementation of conservation considerations in the design.

It is also important to point out that the owners of Termas de Papallacta have an influential network of contacts operating on the economy and politics; because of this they can play an important role in the protection of the reserve.
Tourism

The distinctive attraction is the hot springs with a temperature range of 28-70°C, which is complemented by the natural environment and the spa & resort services and infrastructure provided by the project. The main natural attractions other than the hot springs are the native forest and páramo vegetation and wildlife, and the views of the Antisana volcano.

The activities include: Bathing, going to the Spa, walking on trails, eating at the restaurant and lodging. Most people just come to visit the large thermal baths accounting for around the 3000 visits per day during the weekend and holidays.

They have defined a clear zoning for different types of visits with a varying range of access to the facilities: Open use zone, restricted use zone, Spa zone.

Facilities and services

Basic infrastructure

- Access road and parking
- Water systems which rely on local water resources
- Sanitation and waste collection
- Electricity

Touristic infrastructure

- 9 thermal baths and 3 cold water pools in the Open use zone
- Lodging: 7 two story family cabins, 7 rooms and 7 suites, 32 rooms with private bathroom. The lodging areas contain smaller baths for restricted use
- Restaurant
- Spa
- Convention center with two meeting rooms

Services

- Preparation of food with a national and international menu
- Spa: Massages and other types of treatment
- Medical consults related to the use of the thermal baths are free
- Guided tours in the paths
- Store with self-care products and clothing
Fig. 55 Impressions of the pools, stone surfaces, and wooden (eucaliptus) cabins for lodging
Fig. 56 Local food production for the restaurant, living fences, wooden bridge on the trail (Opposite)
Fig. 57 Native plants are used in the gardens
Bibliography


Cooper, G., & Renard, Y. (2012). Siting and Design of Hotels and Resorts; Principles and Case Studies for Biodiversity Conservation


Sustainable Building theory and practice

In the following text references are made to sustainable building theory and practice. Nowadays the term sustainable is used so often that it has come to mean everything and nothing. This text addresses aspects of sustainability which are related to the built environment with the aim of specifying what sustainability implies for the design of buildings in the given context. For this, both literature studies and field studies have been carried out. The topics addressed are: Cradle to Cradle, Lifecycle approach to buildings, Architecture and Energy, Passive design, Low impact construction materials and techniques, Ecolodges, and Practices in Ecuador.

Cradle to cradle

The book Cradle to Cradle: Remaking the way we make things, written by McDonough and Braungart (2010) presents an approach to design in which the concept of waste is replaced by the idea that everything is a nutrient for something else. Applying this idea as a principle can lead to more thoughtful and desirable designs which could bring benefits on many levels other than that of the designed object itself i.e. at a system level.

In the text they point out that the most common approach when dealing with environmental issues has been to be “less bad” instead of aiming for a positive impact. The first approach which focuses on efficiency, they explain, doesn’t stop depletion of resources, it only slows it down. Eco-effectiveness is then presented as a more worthwhile objective:

“Eco-effective designers expand their vision from the primary purpose of a product or system and consider the whole. What are its goals and potential effects, both immediate and wide-ranging, with respect to both time and place? What is the entire system – cultural, commercial, ecological - of which this made thing, and way of making things, will be a part?” (McDonough & Braungart, 2010, p. 82)

![Cradle to Cradle philosophy](http://www.bluehair.co/2009/12/cradle-to-cradle-hype-or-hope/)
Design considerations about the natural and cultural landscapes are not always present in the growth of urban areas; as they expand they eradicate the living environment in the process (McDonough & Braungart, 2010, p. 33). This issue is also relevant from the perspective of rural landscapes which at some point may become urbanized. The rural landscapes could be developed as areas in which both nature and culture are not in opposition but rather are simultaneously present and can coexist in a symbiotic way. Becoming native to the planet we inhabit is seen as a key objective. This doesn’t mean quitting on technology and returning a pre-technological state. On the contrary, they recognize the human capacity to incorporate appropriate technologies and culture into civilized places which reflect an innovative view in which the places of societies are integrated with their ecosystems in ways that are mutually enriching (McDonough & Braungart, 2010, p. 87).

This view is further expressed in the following quote:

“We can design systems that regulate themselves. Instead of using nature as a mere tool for human purposes, we can strive to become tools of nature who serve its agenda too.” (McDonough & Braungart, 2010, p. 156)

Another concept which is needed to support the basic idea behind Cradle to Cradle is that of material flows (Fig. 58). They distinguish between two material flows based on the origin of the materials:

“From our perspective, these two kinds of material flows on the planet are just biological and technical nutrients. Biological nutrients are useful for the biosphere, while the technical nutrients are useful for what we call the technosphere, the systems of industrial processes. Yet somehow we have evolved an industrial infrastructure that ignores the existence of nutrients of either kind.” (McDonough & Braungart, 2010, p. 93)

Diversity is present as one of the principles promoted by Cradle to Cradle theory. The role and scope of diversity in their theory is clarified in the following quote:

“Against this tide of sameness we advance the principle ‘respect diversity.’ By this we mean to include not only biodiversity but also diversity of place and of culture, of desire and need, the uniquely human element.” (McDonough & Braungart, 2010, p. 119)

In the text the importance of considering the appropriateness of technologies is hinted at in the following quote which refers to a project in which McDonough was involved:

“The question that helped to guide the team’s work at every level was: What is the right thing for this place? Not prefabricated elements, or mastery of the landscape with a universal modern style, they concluded. They hoped their plan would enhance that particular community in several ways: the homes were built from local materials that were biologically and technically reusable…. Enlisting local craftsmen to train
Fig. 59 Material and energy flows during the life cycle of a building
Fig. 60 Principles of design for durability and reverse engineering
Both from: (Kohler, König, Kreissig, & Lützkendorf, 2010)
young people in the use of local materials and techniques would encourage an intergenerational connection.” (McDonough & Braungart, 2010, pp. 124-125)

They also mention the use of future visions as tools to define desirable futures, which is the same approach taken in this thesis:

“We can consult “feedforward,” asking ourselves not only what has worked in the past and present, but what will work in the future. What kind of world do we intend, and how might we design things in keeping with that vision?” (McDonough & Braungart, 2010, p. 145)

The article Cradle to Cradle for the built environment presents in a more direct way the implications of a Cradle to Cradle approach in practice. It presents a definition in which the basic principles of Cradle to Cradle are integrated. The basic principles are:

**Waste equals Food:** *Everything is a nutrient for something else.*

**Use current solar income:** *Energy that can be renewed as it is used.*

**Celebrate diversity:** *Species, Cultural and Innovation diversity.*

Definition of a cradle to cradle building:

“A Cradle to Cradle building contains defined elements that add value and celebrate innovation and enjoyment by: measurably enhancing the quality of materials, biodiversity, air, and water; using current solar income; being deconstructable and recyclable, and performing diverse practical and life-enhancing functions for its stakeholders.” (Mullhall & Braungart, 2010)

The article also defines criteria for the implementation of cradle to cradle in practice. A summary of the criteria is presented as an annex.

It is worth mentioning that the objective of the project is not to fulfill Cradle to Cradle criteria. The relation of Cradle to Cradle theory to the project is that it provides principles which are used in the definition of normative demands for the future vision which is presented in STEP 2 in the next section.

**Life cycle**

The following texts have been consulted to get a better understanding about life cycle planning and design.

The first book, *A life cycle approach to buildings* (Kohler, König, Kreissig, & Lützkendorf, 2010), presents considerations about the planning from a project life cycle approach and discusses this mainly from a European context (Fig.59-60).

The second book, *The ecology of building materials* (Berge, 2009), deals more specifically with the material cycles involved in building explaining the various flows and processes it involves. The two books will serve as a source of reference providing insights needed to take decisions the development of the design (Fig.61-62).
Fig. 61 The cycle of materials
Fig. 62 The main layers of a building (Original source is Brand 1994)
Both from: (Berge, 2009)
Architecture and energy

The book Fire and Memory (Fernández-Galiano & Cariño, 2000) presents a historical-theoretical view of the development and the relation between architecture and energy. In the book he explores the relation between the scientific theory of thermodynamics and the philosophy behind the architecture being produced. The concept of entropy becomes of central importance in his narrative. He observes that the formulation that life does not feed on mere matter and energy, but on entropy relates very well to “…architecture, which can survive with a continuous supply of low entropy…” (Fernández-Galiano & Cariño, 2000, p. 87) He describes three types of architecture in relation to the principles of thermodynamics. The architecture of the first principle (the conservation of energy) is termed heliotechnical mechanicism and is characterized as active. The architectures of the second principle (increase in entropy) are termed bioclimatism and rehabilitation. Bioclimatism is characterized as passive and representative of the optimistic side of entropy, while rehabilitative architecture is characterized as being “as attentive to the dissipation of energy as it is to the degradation of matter and information” (Fernández-Galiano & Cariño, 2000, p. 124) constituting the pessimistic side of entropy. This report is not the place to go into further detail; the point is that the book gives important thoughts to take into consideration in relation to the design approach. Those thoughts are an aid on how to interpret the relation between architecture and energy. Also it is clear that this is a topic of importance in relation to sustainability.
Fig. 63 Impressions of the Shorsighted Symposium, From: http://www.shorsightedarchitecture.com/
Passive design

The book 101 Rules of thumb for low energy architecture Heywood (2012) presents a series of principles for the design of passive buildings. While his book is aimed at European climates there are some principles which are applicable in the context of the project. The following 20 tips have been derived and adapted from his list to fit the context of the project:

1. Using plants as wind barriers
2. Orientating the building mass to the sun (with a consideration of the sun path)
3. Shelter from rain; it can rain very hard
4. Orient the building mass to allow for ventilation while also providing sheltered areas
5. Think about climate (average) vs weather (snapshot) when looking at climate information; also consider climate change and its possible effects
6. Study vernacular shelter strategies
7. Map potential solar gains; they are mainly on the East and West facades and the Roof
8. Organize servant and served spaces in an advantageous way; for example by creating a buffer
9. The more compact the building; the less area with heat losses
10. The thermal mass of the building can be used to dampen the strong thermal variations outside
11. In rooms that need to heat up quickly, a lightweight structure is preferred
12. The last two can be present and combined in a compartmented plan
13. Use thermal mass in climates with a diurnal temperature difference larger than 6°C or in cool cold climates; the site has a 16°C difference
14. In a cool climate a high insulation and internal thermal mass is desirable
15. Consider comfort in relation to the users behavior
16. Earth sheltering provides a stable thermal environment; but keep in mind that at the site the ground is a sponge filled with water
17. Shutters improve the insulation performance of glass; also it could be possible to implement movable walls as they could offer better insulation than glass
18. Using water as a thermal mass; water can store more heat than concrete
19. Recover and reuse valuable heat; this is possible by using a heat exchanger
20. Skylights capture more light than windows do, especially at the equator

Low impact construction materials and techniques

Literature on low-impact building materials has been collected and will be used as a source of reference during the design process. The main materials for which the literature study and collection was done are: Bamboo, Earth, Wood, Straw, Natural stone (Elizabeth & Adams, 2000; Minke, 2012a, 2012b; Minke & Mahlke, 2005; Velez, 2000). Also during the graduation I participated on a small symposium organized by students from the faculty; the shortsighted architecture symposium offered lectures and hands on workshops (Fig.63). The workshops were a good way to get in contact with the materials and get some insights into the possibilities of working with them. The choice of materials involves important design considerations.
Fig. 64 Use of local materials in: Touristic office in the páramo at Quilotoa (Top), a wooden house in the cloud forest near Lloa (Middle), Stone surfaces in the entrance to a house near Lloa (Bottom)
Ecolodges

The book Authentic Ecolodges by Mehta (2010) presents state of the art Ecolodges from around the world while providing a system of criteria for their qualification. He provides the following definition:

“An ecolodge is a two- to seventy-five room, low-impact, nature-based, financially sustainable accommodation facility that helps protect sensitive neighboring areas; involves and helps benefit local communities; offers tourists an interpretative and interactive participatory experience; provides a spiritual communion with nature and culture; and is planned, designed, constructed, and operated in an environmentally and socially sensitive manner.” (Mehta, 2010, p. 10)

In his view authentic ecolodges must embody the three main principles of ecotourism: 1) Nature must be protected and conserved, 2) through community outreach and education programs, local community must benefit 3) interpretative programs must be offered to educate both tourists and employees about the surrounding natural and cultural environments. In addition they must satisfy 2 additional criteria from the following list in order to be considered an authentic ecolodge:

1. Use alternative sustainable means of water acquisition and at the same time reduce overall water consumption.
2. Meet its energy needs through passive design and renewable sources.
3. Provide for careful handling (reduce, refuse, recycle, reuse) and disposal of solid waste.
4. Use environmentally friendly sewage treatment systems.
5. Fit into its specific physical and cultural contexts through careful attention to form, landscaping, and color as well as through the use of vernacular architecture.
7. Have minimal impact on the natural surroundings and utilize traditional building techniques during construction.
8. Endeavor to work with the local community, including community members, whenever possible, in the initial physical planning and design stages of construction.

Eco-minimalism

In general an approach focused on sustainability doesn’t lead to a particular universal solution for building; on the contrary, it probably leads to a wide variety of buildings which perform well in their specific contexts. In other words, and quite obvious, it leads to is sustainable buildings. However, distinct approaches do exist when designing with sustainability in mind; some of them focusing on topics which relate to specific quantifiable aspect of sustainability e.g. energetic self-sufficiency, CO2 balance, Passive climate etc. An approach which I have found helpful is the one described in the book Eco-Minimalism by Liddel (2013). There he describes a holistic approach based on the use of principles related the elements fire, air, earth, and water. Practical solutions or technologies based on those principles are organized into two categories: Eco-bling and Eco-minimalism. The second one being the preferable solution which can be supported by the first one if needed.
Fig. 65 Fausto Acosta explaining the construction types during the visit to a project.

Fig. 66 Impressions from the construction process of a bahareque house, From: Fausto Acosta.
Practices in Ecuador

Barro Viejo

During the field study I visited some projects of Barro Viejo; an architectural office that has been active for many years mainly applying earth based construction techniques (Fig.65-68). Their choice of materials and techniques influences the compositions they develop, which are often characterized by thick walls which enclose spaces organically laid out in clusters resembling little towns.

In an interview with Fausto Acosta, one of the partners from Barro Viejo, we discussed their way of working and the implications of their approach on the designs they develop. An important observation made during the talk was that some types of space have evolved together with construction technologies that are employed to build them. Examples of this are the external spaces that are formed under the extended eaves of the roof, of which the main purpose is to protect the earthen walls. Those spaces are in-between spaces which define the dynamic border between inside and outside; they are external spaces which are sheltered from the rain and high sun. They produce a micro climate which is often perceived as comfortable and is valuable in the context of adaptive comfort. When contrasting rural houses build with earth with those built with concrete blocks something becomes clear; the use of concrete blocks in construction produces walls which can withstand the elements and thus no longer need to be protected by eaves. In the construction of rural houses economic considerations will dictate that those spaces are no longer made as they are no longer technically necessary. This leads to a loss in the inhabitation quality of the concrete houses since they offer only the option to be either inside or outside. In other words there is a loss of traditional types such as porches and verandahs. And to this it can be added that the concrete houses may perform poorly in terms of thermal regulation in cases where comfort is not considered as a significant parameter of design.

Another observation, which is also implied in much of the studied literature, is that the construction of houses using earth is characterized by the use of local means, both in terms of materials and labor. And that the type labor used is often linked to the minga. This means that knowledge can be maintained through exchanges within the community and produced through experimentation during the building process. Also, in this way social bonds in the community are strengthened. Organizing the building process around mingas also means that labor costs are reduced, although there is a symbolic reciprocity in the exchange of food and drinks for helping hands.

Fausto mentioned that they have also worked on various ecotourism related projects such as Papallacta and Napo Wildlife center. He explained how the consideration of the visitor experience is very important in the design of such projects. The project is there to make nature and culture accessible to visitors.
Fig. 67 Impressions from the construction process of a bahareque house
Fig. 68 Napo Wildlife Center, ecotouristic lodging in the amazone designed by Barro Viejo (Opposite)
From: Fausto Acosta
Fig. 69 Axonometric diagram and photographs of Pendimento house by Al Borde
The design employs modular concrete blocks as a modular element with many uses
From: http://www.albordearq.com/
Al Borde Practice

This is a practice run by young architects which has recently gained international attention with their projects. This is due to their approach which combines a clear definition of objectives based on needs and which pays special attention to spatial configuration, materialization and detail. One can see them as representative of a new generation of architects which is aware of current issues, implements both modern and traditional means in the development of their designs, and which shows commitment to deliver the quality envisioned in their designs, which is something that cannot be taken for granted in the context of construction in Ecuador (Fig.69).

Bibliography

Mullhall, D., & Braungart, M. (2010). *Cradle to cradle criteria for the built environment K. Hansen (Ed.)*
Closure

The information needed for STEP 1 (strategic problem orientation) was presented in this section. That was done in the subsections: context, ecotourism, and sustainable building theory and practice.

Based on the presented information, the assumption is made that an ecotouristic project is a desirable alternative for the sustainable development of the site because of the environmental, social and economic benefits it can bring. The major environmental and socio-economic pressures/issues in the given context were identified in the literature. Also, the programmatic recipe was defined, Insights were gathered, and a clear set of goals were defined for the design of the project. These goals are in line with the principles of ecotourism, and reflect the challenges of the context in which the project is to be developed.
Site diagnostic

From the studies carried out the following statements can be made about the site:

- It borders the RELI (Ilinizas ecological reserve) which has been designated as an area of national strategic importance because of its biodiversity and hydrologic resources. This reserve is relatively new and there is no vigilance implemented yet in the area surrounding the site.
- The site contains areas with well-preserved primary cloud forest and páramo, and areas which have been cleared and are now in recuperation. The well-preserved areas can be conserved by implementing a clear zoning for the site.
- The soils at the site are very humid and act as a sponge. The role they play in the natural hydrological system is essential. They are also delicate and take a long time to form.
- The vegetation in the cloud forest is high (up to 30m) and dense; in the páramo it is small.
- The area is known as a hotspot of orchids, ferns, and mosses biodiversity. Also, many bird species can be seen in the forests.
- The site has a height difference of 300m, a slope of approximately 20°, and has an area of 66 hectares.
- The average mean temperature is 8°C, and has a daily range of 0-16°C.
- The climate is very humid and is often misty; the average yearly rainfall is approximately 2000mm.
- Solar irradiation is high, approximately 4,5KWh/m².
- In terms of infrastructure the site only has a couple of old paths that are currently overgrown.
- There are natural features such as small ravines with waterfalls and streams which can help illustrate the hydrological performance of the local ecosystems.
- The rural community of el Pongo near the site either lives in poor conditions, or has abandoned the land.
- The main productive activities in the surrounding plots are agriculture and cattle farming.
- The main threats to the local ecosystems are: illegal extractive practices of both flora and fauna, extension of agriculture and cattle farming into the páramo and cloud forest, fires, and others related to climate change.
- Alternative uses of the forest have been described; some of them could be implemented at the site.
Programmatic recipe

Activities:
- Conservation of the forest through zoning and vigilance
- Study of native plants and local ecosystems
- Production of native plants
- Experience of local ecosystem’s flora and fauna
- Environmental education
- Workshops (alternative construction, sustainable uses of the forest, yoga, capoeira etc...)
- Lodging
- Recreation and wellness
- Horseback riding and mountain biking

Facilities:
- Zoning (signs and warnings)
- Plant nursery (semi shaded spaces, recreation of micro climates found in the forest)
- Seed collection and study rooms (with storage shelves)
- Gardens (for study and recreation)
- Interpretative paths through forest (various technical solutions depending on the soil and vegetation type)
- Meeting room
- Residents house
- Amphitheater (outside, semi covered space for workshops)
- Visitor center
- Shelters (lodging in the forest)
- Sauna and natural cold water pools
- Stalls for horses and bike parking places

Services
- Vigilance of the protected areas
- Research opportunities in collaboration with universities
- Native plants store for reforestation and gardens (only produced plants and seeds)
- Wellness services
Insights for the design

**Minga**
The minga can play a central role in the development of ecotourism projects in the Andes region. It involves the community working together for the common good. It is cyclical and can be integrated into the upkeep of the built environment. This allows for the implementation of maintenance practices which in their turn can be a way to transfer and develop knowledge on building techniques with a low environmental impact. It is clear that the facilities have to be designed with this in mind, allowing for maintenance (not making it difficult) and be accessible for reproduction and improvement.

**Materialization**
The choice of materials for building should be considered in terms of necessity fulfillment and performance, environmental impact, supporting local or national economies, availability, lifespan/ease to maintain, ease of construction, cost, and potential esthetics of construction technique.

**Climate strategy**
The climate strategy has as a goal the design of passive building integrated solutions. The studies on the local vernacular types provide insights into the main climatic challenges to be tackled in order to provide a comfortable interior climate. It is important to consider the value of variation of spatial climate zones in and around the building in relation to experience, and adaptive comfort. The in-between spaces are crucial to achieving a diversity of micro climates in and around the buildings.

**Experience**
The experience of the visitors and the hosts is a central consideration for the design. The facilities are implemented to make nature accessible, provide shelter for visitors and hosts, support recreational, academic and observation activities, and define boundaries within the site to ensure conservation. Keeping in mind that the visitors come to experience the various natural and environmental characteristics of the site at specific places; the definition of the qualities of the places is crucial in order to design suitable solutions. Descriptive documentation (photography) of those qualities was collected and will be used in the design process.

**Design objectives**
Translation of the programmatic recipe into suitable facility designs based on ecotourism and cradle to cradle principles, which will enable the development of the site. Produce an architectural solution which contains generic strategies which may be replicable in similar contexts. The strategies are abstracted by looking at the plan through the following thematic filters: phasing, climate design, spatial composition, construction process, materialization, reliable integrated solutions.
STEP2 | Future Vision

Fig. 70 Diagram showing the native plant nursery as a central project component
Main issues to be addressed

The deterioration of the Páramo & Cloud forest landscapes poses a threat to the provision of fresh water to urban areas and hydroelectric plants. The natural landscapes need active conservation efforts.

The eradication of native vegetation ultimately leads to a loss of biodiversity. High biodiversity is desirable for adaption to climate change. Native species need to be protected.

The creation of Protected Areas poses restrictions on the use of land. This affects the local communities. Projects exploring alternative land-uses are needed.

Maintaining minga as a social structure (by integration in design and planning) which works well with capacity building and knowledge exchange in communities.

Desirable future vision

The site is developed as an ecotouristic project which promotes the conservation of the natural landscapes in which it is embedded and brings benefits to local communities contributing to sustainable development.

The site contains a bank of biodiversity which needs to be conserved. It may be studied and there may be productive activities related to the conserved area; although they may not be extractive or detrimental to the ecosystem.

In order to achieve this, the project is developed with a focus on the following topics:

- Experience of the natural landscapes for visitors
- Conservation and reforestation with native species Agroforestry in recuperating areas
- Community involvement though mingas
- Opportunities for research on Andean Forests
- Sustainable construction with regionally available materials
- Closing cycles (Water, Materials, Food, Energy)

Design Brief

The assignment consists of the design and planning of the facilities needed for a phased development of the site.

The facilities are needed to activate the site for ecotouristic purposes and in this way provide an alternative to land uses which pose a threat to the protected area.

The project is centered on the conservation of biodiversity of native plant species; it provides the setting for environmental education programs and is aimed to make the experience of the local ecosystems accessible to visitors.
Design decisions for the facilities should be supported by the conditions of the site. For example in the choice of materials both the availability of local resources and the consequences of using them should be considered. The selection of materials may also depend on the type of building and location.

Phases
Phase 0: Study/evaluation of site and design
Phase 1: Residence, Nursery, Trails
Phase 2: Visitor center, Gardens
Phase 3: Cabins, Sauna, Trails

Native plants nursery:
The area dedicated to the nursery will act as a buffer between the biodiversity bank and the outside world (neighbors, visitors, reforestation programs etc.). In the nursery the vegetation is studied and produced. Only experts are allowed to enter the strictly conserved areas.
Seed collection and drying, Lab/Office, Greenhouse, Composting area/waste management, Open air area in garden [collected plants reception]. (~500m2)

Residence:
Living space, Sleeping space, services (toilet and kitchen). Privacy is an important consideration, at the same time it should be strategically positioned for vigilance purposes. (~100m2)

Visitor center:
Program: Reception, Workshop area, Projection room, Eating area, Storage room, Toilets. (~400m2)

Gardens:
They consist of areas surrounding the buildings and defining transitions within the site. They are managed natural areas to gradually replace introduced pastures as the project develops, with designed landscapes using local vegetation. (~7hec)

Trails:
Connect points of interest (views, places for meditation), cross areas of interest (forest, gardens), follow a storyline/theme (e.g. water cycle); give access to the cottages in natural areas. (~5km)

Bridges and Platforms:
Bridge at the Entrance, raised paths in sensible areas, viewing platform(s) at strategic point near the trail.

Cabins:
The cabins are meant for visitors as a resting place which enhances the experience of nature. It’s important to consider views, natural elements, shelter function, place in nature, interaction/conversation building & site. (~100m2 each)
Zoning

The following zoning is to be applied to the site and surrounding areas. This is done in order to describe areas with defined boundaries in relation to the development objective of the project.

![Diagram of the various zones](image-url)

### External zones

<table>
<thead>
<tr>
<th>Name: Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General objective:</strong></td>
</tr>
<tr>
<td><strong>Description:</strong></td>
</tr>
<tr>
<td><strong>Boundaries:</strong></td>
</tr>
<tr>
<td><strong>Rules, regulations and policies:</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name: Páramo (National Protected Areas)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General objective:</strong></td>
</tr>
<tr>
<td><strong>Description:</strong></td>
</tr>
<tr>
<td><strong>Boundaries:</strong></td>
</tr>
<tr>
<td><strong>Rules, regulations and policies:</strong></td>
</tr>
</tbody>
</table>

Fig.71 Diagram of the various zones
Project site

Native plants production, trails, lodging, research in the forest

Surrounding sites

Current landuse: Intensive agriculture and cattle farming

Improved dwelling

Sustainable cattle farming in forestal pastures, lodging

Sustainable cattle farming and lodging and trails in recovered forest

Fig. 72 Diagram of the proposed use of the project site, and the proposed transition in landuse for surrounding sites
### Name: Cloud forest (National Protected Areas)

**General objective:**
Conservation of the cloud forest

**Description:**
The cloud forest provides hydrological services at a national level. It also contains a characteristic fauna and flora which is directly linked to its ecosystem services. The biodiversity contained in the cloud forest is very high and seen as a strategic resource. The main threats to its conservation are agricultural frontier advances, excessive extractive practices (Timber, flora, fauna, mining), and climate change. Some level of use of resources from the forest is possible within certain boundaries.

**Boundaries:**
Under 3600masl, same as the border of RELI

**Rules, regulations and policies:**
- Clarity about ownership and property borders
- Vigilance for extractive practices
- RELI management plan

### Name: Extensive use (National Protected Areas)

**General objective:**
Accessibility of natural resources for study and experience of the ecosystem.

**Description:**
This includes mainly areas with trails and resting points. It consists of linear spaces for movement crossing through other zones.

**Boundaries:**
Defined by the breadth of the use area for trails and resting points

**Rules, regulations and policies:**
- Appropriate design of paths and other infrastructure

### Internal zones

#### Name: Primary Cloud forest (Private Reserve)

**General objective:**
Conservation of the cloud forest, research, tourism

**Description:**
The cloud forest provides hydrological services at a national level. It also contains a characteristic fauna and flora which is linked to its ecosystem services. The biodiversity contained in the cloud forest is very high and seen as a strategic resource. It contains many plants with medicinal and ornamental qualities.

**Boundaries:**
Primary cloud forest within the property dedicated to conservation

**Rules, regulations and policies:**
- Access restrictions (Study activities allowed)
- Vigilance for extractive practices

#### Name: Páramo (Private Reserve)

**General objective:**
Conservation of the páramo ecosystem, research, tourism
### Páramo within the property

**Description:**
The páramo provides hydrological services at a national level. It also contains a characteristic fauna and flora which is directly linked to its ecosystem services. It’s an attractive landscape it provides views to surrounding mountains and a far horizon because of the small vegetation and altitude.

**Boundaries:**
Páramo within the property

**Rules, regulations and policies:**
Vigilance for extractive practices and fires

---

### General objective:

**Forest recovery (Private Reserve)**

Conservation and recovery of the cloud forest

**Description:**
Some areas in the property were cleared to create paddocks to keep and feed cattle and horses. Currently there are no livestock animals being kept in the property and the forest has started to recover. This area can be used to study the natural recovery process of the forest; also it can be intervened to create gardens to study the vegetation.

The type of use in this zone can be moderate. It forms a buffer zone between intensive use zones and the primary forest.

**Boundaries:**
Intervened areas within the property which are in natural or intervened recovery

**Rules, regulations and policies:**
Vigilance for extractive practices and fires
Rules for tourists to reduce impacts

---

### Extensive use (Private Reserve)

**General objective:**
Accessibility of natural resources for study and experience of the ecosystem.

**Description:**
This includes mainly areas with trails and resting points. It consists of linear spaces for movement, connecting intensive use zones, and crossing through other zones (Forest recovery, Primary cloud forest, Páramo)

**Boundaries:**
Defined by the breadth of the use area for trails and resting points

**Rules, regulations and policies:**
Appropriate design of paths and other infrastructure

---

### Intensive use (Private Reserve)

**General objective:**
Demarcation of places

**Description:**
This includes areas around attraction points such as natural features and facilities. The points or places have a higher presence of humans who perform actions of management, study, or recreation.

**Boundaries:**
Defined by the use area around natural features and/or facilities

**Rules, regulations and policies:**
Appropriate facilities
Waste management, Visitor behavior, Maintenance
Step 3 | Backcasting and Design Development

During the design process the design brief was used as a starting point and was further developed/specified in an iterative process. For instance a sauna was added to the original program in order to offer an extra touristic attraction to the site and address the general need for warmth. The sauna also has the capacity to bring people closer to nature by providing a service which works in symbiosis with the characteristics of the local natural landscape.

The backcasting analysis ran parallel with the design process. The backcasting element (pathway for development) is implied in the definition of the design brief and was taken into account during the design. However it wasn’t further specified in terms of defined milestones. As many as possible potentially involved actors would have to be contacted in order to define a realistic widely supported development pathway. Instead the focus was set on the cyclical elements of the project, and example of this can be seen in the analysis of opportunities during the life cycle of the project depicted in Fig.74.

The interviews carried out during the project were an important source of information. The ones carried out during the site visit at the beginning of the project were very helpful in providing orientation about the issues to be addressed by the project. Talks with tutors, specialists and students during the design stage provided the feedback which was necessary for the design development. Unfortunately it was not possible to contact the person who knew most about the site, during the final stages of the project.

The design consists of a site plan, landscape elements, and architectural elements. One of the buildings considered representative of the project was developed further into detail.

Fig.74 Opportunities in the lifecycle of the project
Local communities

The local communities can be involved through the provision of services and products such as: transportation, traditional food production, artisanal products, construction and maintenance of infrastructure, guides, educational programs with schools, reforestation in neighboring sites, community support (surveillance and knowledge exchange).

The development of the project aims to bring the following social benefits:

- Improvement of infrastructure, water, sanitation, access roads
- Access to knowledge about land management, ecological construction
- Economic benefits through access to touristic markets, employment
- Security and safety
- Development of a lively landscape

Stakeholders

The following stakeholders were identified. They should be contacted for a follow up of the project!

- Site and Neighboring site owners
- Local community from Pongo and Aloag (involvement in providing services surrounding the visit to the site)
- Local government of Mejia
- Ministry of tourism
- Ministry of the Environment
- Ilinizas Ecological Reserve (RELI)
- Bomboli Ecological Reserve
- Bamboo producers
- Quarry
- Visitors
- Tour operators
- Transport sector
- FONAG
- Eco-Sciencia
- oachi-Pilaton Hydroelectric Plant
- Schools (reforestation programs, educational programs)
- Research institutes
- Private reserves network (Red de reservas privadas)
- NGO Projects
- IUCN,TNC,TIES
- GTP: grupo de trabajo Páramo
- International funds for conservation?
- Alternative construction sector
- Adelca (Aceria del Ecuador)
Step 4 | Design
Plant Nursery
- Anden terraces: 120m²
- Green house: 35m²
- Office: 10m²
- Seed storage: 30m²

Sauna
- Saunas: 6m²
- WC: 1.4m²
- Changing room: 2m²
- Massage room: 6m²
- Central space: 10m²
- Veranda: 24m²
- Covered terrace: 50m²
Visitor Center
- WC 10m²
- Reception and Storage 10m²
- Kitchen 7m²
- Laundry room 18m²
- Cafe 19m²
- Terrace 50m²
- Expo A 10m²
- Expo B 25m²
- Conversation pit 35m²
- Covered entrance

Residence
- WC 2m²
- Bathroom 6m²
- Storage and Bedroom 14m² + 5m² (2x)
- Central space 35m²
Detailed section
Cabin 6p

Exposed external wall
- 10 mm Shingles (heat treated eucalyptus) 350mmx150mm
- 10/50 mm Counterbattens 150mm centre to centre
- 20/50 mm Battens 600mm centre to centre
- 1mm EPDM watertight membrane
- 10 mm Split guadua bamboo mat
- 90 mm Ventilated cavity
- 100 mm Myco Foam (Ecovative Mushroom insulation)
- 100 mm Guadua bamboo frame with lightweight mineral loam infill (with pumice stone agregate)

Covered external wall
- 100 mm Guadua bamboo frame with lightweight mineral loam infill
- 100 mm Myco Foam (Ecovative Mushroom insulation)
- 100 mm Guadua bamboo frame with lightweight mineral loam infill

Internal wall
- 100 mm Guadua bamboo frame with lightweight mineral loam infill
- 100 mm Cavity (or mycofoam infill)
- 100 mm Guadua bamboo frame with lightweight mineral loam infill

Roof
- 10 mm Shingles (heat treated eucalyptus) 350mmx150mm
- 20/50 mm Counterbattens 150mm centre to centre
- 20/50 mm Battens 600mm centre to centre - cavity
- 1mm EPDM watertight membrane
- 20 mm Split guadua bamboo mat double layer
- 100-350 mm ventilated cavity
- 200 mm Myco Foam between bamboo roof beams
- 10 mm Split guadua bamboo mat + vapour barrier
- Woven mat finishing

Exterior floor
- 25/50 mm wooden flooring planks
- 100 mm Guadua bamboo counter beams 550mm
- 100 mm Guadua bamboo secondary beams

Interior floor
- 50-100 mm loam floor with hydronic pipes
- 50-100 mm Pre-fab bamboo floor element
- 100 mm Myco Foam between bamboo secondary beams
- 10 mm Split guadua bamboo mat

Other
- 1 Concealed perimeter gutter EPDM
- 2 Central gutter zinc
- 3 Bamboo (treated) reinforced concrete ringbeam
- 4 Rain water pipe
- 5 Solar collector made of PE pipe and repurposed PET bottles
- 6 Insects net
- 7 Stainless steel net parapet