FINAL REPORT: FIELD EXPERIENCE IN SUSTAINABLE DEVELOPMENT AND HEALTH CARE IN ECUADOR; UNIVERSITY OF COLORADO DENVER WINTER FIELD METHODS COURSE, December, 2006-January, 2007

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View of Napo River from above Mondaña
INTRODUCTION

This project began with the basic question: How do local populations retain the strength of their culture and preserve their environment, yet create viable economic opportunities within an increasingly impoverished country? Questions of sustainability, whether of development, livelihoods, agriculture, health or natural resources, are topics of major importance generating concern and receiving attention from many sectors internationally. This report derives from a three-week field-based course in which students engaged directly with issues of sustainability in the classroom and in the rainforest community of Mondaña, Ecuador from December 18th, 2006 to January 12th, 2007.

The research was based at the Foundation for Integrated Education and Development (FUNEDESIN, hereafter Yachana Foundation) project on the upper Napo River in the Northern Ecuadorian Amazon basin. The Yachana Foundation utilizes an innovative development model in partnership with over 10,000 regional inhabitants including several indigenous and immigrant groups to create development and income generating activities that provide employment while being sensitive to local ecological conditions. Through a variety of development projects over its 15 year history, the Yachana Foundation has focused on education, and basic medical and dental services while working toward ecologically sound, sustainable livelihoods. More on the Yachana Foundation can be found at www.yachana.org. Sustainable livelihoods are those in which human capabilities (knowledge, skills and energy), social and material assets and activities required for making a living are sufficient such that individuals and populations can withstand and recover from natural, environmental, and physical stresses while enhancing opportunities for future development without damage to the available natural and social resource base (derived from a definition created by Chambers and Conway 1991). We will develop this basic definition as it applies to this particular setting in greater detail below.

One of the central long term projects of the Yachana Foundation is the Colegio Técnico Yachana (Yachana technical high school, hereafter Colegio or CTY). The Colegio is a technical high school (vs. college preparatory) with four areas of study specifically oriented toward creating sustainable livelihoods in the rainforest: Ecotourism, Microenterprise Development, Sustainable Agriculture, and Animal Husbandry. In a traditional Ecuadorian Colegio, students would enter a single occupational track in which they specialize with the bulk of their time devoted to didactic classroom instruction. Given the dynamic nature of making a living in a rainforest environment, Colegio Yachana has adopted a different model of education based on direct experience and integration across all four subject areas. Students study all four tracks on a continuous weekly rotation so they leave school with a broad, integrated base of skills and knowledge upon which to draw. In addition, students “live their education,” spending their mornings engaged in the broad range of activities central to the track within which they are currently assigned (practicing), followed by afternoon classes concentrating on the academic concepts and skills pertaining to each track. Although English and the basic academic subjects (math, history, Spanish language) normally covered in a high school curriculum are included, as much of the classroom work as possible is tied to the content of the experiential curriculum. English learning is geared first toward the specifics necessary to interact with tourists, engage in business or understand and communicate agriculture to outsiders. Math is based in the primary needs of making a living: for example, calculating the volume of a fish pond to generate a targeted harvest of tilapia. This
combination of practical and theoretical skills and concepts results in an integrated understanding of a wide range of opportunities and processes within the local environment.

**RESEARCH PROCESS**

This field course was organized and guided by three central concepts and principles:

1. **Sustainability** provided the central focus for the course, whether considering the role of community health as a central factor in a population’s ability to engage in sustainable lifestyles, or sustainable agriculture as an emerging approach to survival in a rain forest environment in a globalizing economy.

2. **Rapid Assessment Processes** (Beebe 2002) provided the core structure to the research enterprise, and:

3. **A Collaborative Research model** defined the approach to conducting the research as outsiders entering into several different but overlapping “communities” (the Yachana lodge, the town of Mondaña, and the learning community represented by the Colegio students and teachers). Having a central research focus, a defined methodological approach and a proven framework for community research allowed us to enter the community and complete two projects to the point that results could be presented back to the community before leaving the field. This report is developed out of this initial field-level analysis, the resulting presentation and community feedback and on more detailed, in-depth analysis of data collected upon return to the US.

The central organizing concept for this research was that by using a **Rapid Assessment Process (RAP)** and collaborative research framework it would be possible for university students to learn research methods, experience field work, and conduct meaningful, important research. The course used an integrated combination of intensive, pre-trip classroom work and field research through which students and faculty used a rapid ethnographic assessment approach (Beebe 1995; Handwerker 2001) to explore the dynamics of community health and sustainable agriculture. To ensure the collaborative process and outcomes, we committed to present the findings from our research before leaving the community. This substantive deadline required a steady engagement with the research process, the community, the data, its ongoing analysis, and the emerging findings.

In consultation with FUDEDESIN and the director of the Colegio Técnico Yachana, two projects were identified that could reasonably be completed in two weeks of intensive, team-based research: 1) A review of health infrastructure and local perceptions of health in Mondaña, Ecuador (see page 34), and 2) An exploration of the dynamics of the sustainable agriculture system being created by the students and teachers of the Colegio Técnico Yachana, also in Mondaña (see page 16). These broad questions provided the framework for classroom work before our departure for Ecuador. The intent of class work was to gain an understanding of the various issues around sustainability, health and research with a specific focus on refining research questions and identifying possible methods. The in-class and Blackboard-based interactions and activities allowed students and faculty to become acquainted with one another, and begin to comprehend the various themes, concepts, and issues with which we would be engaged during the field research.
While there are many definitions and conceptions of sustainability, one of the first things we needed to do upon entering our collaboration with the Colegio was to create a working definition for sustainability in the Ecuadorian rainforest context. In our discussions among ourselves and with the director and students of the Colegio Técnico Yachana, we developed a working definition of sustainability that considers in equal measure economics, place, and people, recognizing that each component must be attended to in order to move toward sustainability. In sustainable business circles this is sometimes referred to as the “triple bottom line” in that a failure to pay attention to the “bottom line” in any one of these three areas necessarily compromises sustainability because of their interacting and overlapping nature (Rogers, Jalal and Boyd 2006). Economics is an essential component for the simple reason that if people’s basic needs, along with some degree of satisfying aspirations and wants, are not met then all other efforts will have limited impact. Thus, the economic aspect of sustainability considers elements of livelihood, diet and nutrition, and income generation over and above basic needs. The failure of sufficient economic development and growth pushes populations into subsistence level activities that derive basic needs directly from local environmental resources. In the presence of rapidly enlarging and highly mobile populations acute local environmental impact can ensue.

The role of place, or environment, is basic in that the local geographic conditions define to a large degree what opportunities can be created and the environmental, social and economic constraints within which any development can take place. The role of people is considered in terms of population size, education level and opportunities, interests and desires, all of which strongly influence the possibilities of striving for sustainability. This working definition provided a guiding framework that aided in data collection, analysis and interpretation. These concepts are broadly captured in what is often called the “sustainable livelihoods” approach (see Carney 2002).

The expectation of completing two research projects before leaving the field site required careful attention to the research process to ensure adequate, appropriate, and accurate data collection. We followed a basic schedule of work each day informed by the RAP perspective: Data collection in the mornings, data analysis and consolidation, and planning for the next day’s activities in the afternoons, and reflecting upon and annotating field notes in the evenings. As will be detailed in the findings sections for the two projects, each of the research teams was further divided into task-oriented groups that collected specific subsets of data. In the afternoon data analysis and consolidation sessions, an important aspect of the process was for members of each task team to present that day’s findings to their fellow team members who had been working on other tasks. Every three to four days the entire group of 16 students met so that each team (community health, sustainable agriculture) could present their emerging findings to the other group for critique and discussion. These reporting sessions served a number of valuable roles: The need to create a daily report on one’s activities required steady analysis and careful consideration of what each team had indeed done and learned each day. It contributed to building the model to be presented back to the community before departure, and provided valuable opportunities for critique and reflection on both findings and process. These presentations required that each team be very clear on what they were learning, what more needed to be done, and what problems needed to be resolved. Because it required that analysis be as complete as possible and that constant attention be paid to research process and progress toward established daily goals, these larger group meetings emerged as an essential component of the overall process. This process enabled us to complete the first round of analysis and
generate conclusions to present to the community before leaving the field. Another important aspect of these daily reporting of findings were opportunities to engage findings and data in collaboration with the Colegio students and members of the community to ensure that our emerging interpretations reflected their understanding of the situation. Being able to collectively examine, discuss, and critique emerging findings became a powerful tool that permitted the reporting of much more robust findings than if we had not had those opportunities.

Afternoon data analysis session, Agriculture team

As is the case in all ethnographically oriented and collaborative research, all plans were necessarily provisional and often changed as conditions in the field changed. Because in most field situations there are many factors over which researchers have little or no control, a great deal of flexibility around the central question and process is necessary. Someone unexpectedly shows up at an interview, someone expected fails to show, unanticipated findings emerge, rain prevents travel, any of which can result in serendipitous changes in the process. Similarly, as each day’s findings are analyzed and organized, carefully developed plans may need reorienting to develop a particular point in greater depth, or to explore a new topic, or because the selected method doesn’t capture the data as expected. Adopting a collaborative approach within a rapid assessment framework often necessitated compromise and change because many more people’s schedules needed to be considered in conducting the research.

Using a collaborative approach within an overall rapid assessment framework requires a focused question, team-based research, and constant analysis and triangulation of data to facilitate efficient data acquisition, analysis and report writing. The very limited time and resources of a field school do not permit the collection of the kind or depth of data necessary to address complex or multi-faceted questions; thus focused research questions are essential. Given short research periods, triangulation becomes an important tool to enhance data quality. Because of its central importance, the nature and types of triangulation should be articulated as clearly as possible at the outset to ensure that data collected are of the highest quality. Triangulation in this project was approached in three ways. 1) The “standard approach” of using multiple methods and sources of data: Methods are carefully chosen to collect very specific data that can serve as a check on other methods and that complement one another toward building the answer to the question(s) (Patton 2002). 2) Multiple Skills: The team-based approach means that team members bring diverse skills, knowledge, and experiences to the research. The teams for these two projects comprised one faculty person, UCD^V students from a variety of fields and backgrounds, and Colegio students who in turn brought an equally diverse range of experience
and training to the teams (Beebe 2002). 3) Multiple Perspectives: Having team members from the local community and from the US provided an important insider/outsider frame through which to collect and analyze data. The opportunity for Colegio students to ask questions about and explain their local setting to US team members allowed them to perhaps explore their local setting in ways not generally possible or necessary, yielding a deeper understanding of the setting and their place in it. The US team members’ continual probing and questioning trying to reach an adequate understanding of the local systems resulted in discussions that ranged far beyond any simple interview process.

In the two following section reports we will detail the methods and procedures specific to each project; however, the overall process and approach was similar for each. The first several days were spent touring the grounds of the Yachana Lodge, the community of Mondaña and the Colegio Técnico Yachana with the director of the Yachana Foundation, Yachana Lodge guides, and students from the Colegio. This provided the broad context for the relationships among the three entities, their physical relationship to one another and how infrastructure is distributed through the area. It also provided an important period for the UCD team to get to know one another under very different living conditions and to become acquainted with some of the students with whom we would be working with over the next two weeks.

**Orientation to Rainforest Environment by Yachana Lodge guide**

These early days were also devoted to orientation to the local conditions and included walking tours of all the facilities and projects under the auspices of the Yachana Foundation, the town of Mondaña, Yachana Lodge and the Colegio, exploration of the biological reserve being developed by the foundation and meetings with students and faculty of the Colegio.

**Jean Scandlyn working with several Colegio students**

A major portion of this introductory period involved developing an explanation of our role and purpose to CTY students and faculty who had not been involved in our abundant discussions and with the Yachana foundation prior to coming to the field. Two issues emerged: While the students had been exposed to other groups of
students, all of whom had come in some capacity of “service-learning” (medical students, alternative spring break), and many groups of Lodge tourists, our role and expectations as researchers was novel in their experience (and ours in this context). While, the UCD students had spent several full days together in the in-class activities focused on the core concepts of sustainability, participatory research and rapid assessment models these were largely unknown concepts to the CTY students. These two factors created challenges finding common ground in expectations and scheduling. Participatory projects are necessarily based in “process” but time taken up in process is time slowing the completion of tasks within a rapid assessment framework. Given that there were a number of unavoidable compromises to the participatory aspect brought on by Colegio student commitments and therefore inability to participate to the degree we had envisioned or they desired, we elected to focus on the research aspect to ensure we had a product at the end of the 2 weeks of field work. Nevertheless, there emerged a genuine sense of partnership across the two groups of students but the relative contributions by each group was lopsided by virtue of the CTY students having to “squeeze” their participation into an already full agenda.

One unanticipated limitation of the field work was the conflict between the Colegio student’s participation on the research teams and their very considerable existing duties and complex schedule. This was felt at two levels: Because students rotate through various segments of the curriculum each week and have specific chores for which they are responsible within that segment of the curriculum, individual students generally could not stay on the research team for more than a day or two. As a consequence, none of the Colegio students could become as immersed in the research process as we had originally envisioned. On the other hand, many more Colegio students had the opportunity to participate, and the large number of students passing through the teams provided a wider range of perspectives than we would otherwise have had.

The final two days of the field stay were spent on more detailed data analysis and preparation of materials to display the findings for presentation to the community and Colegio on the evening before our departure. This emerged as an immensely meaningful experience for students from each school, faculty, community members, and staff of the lodge. Being able to realize this initial field school goal strongly reinforced our decision to focus on three concepts and principles of sustainability, RAP and community-based research. It demonstrated that bi-national student research teams could conduct meaningful, data-driven research in a community setting with sufficient rigor that they could report the useful findings within a very constrained research time frame. A distinctive outcome of this approach is that the RAP framework can be made to accommodate a community based orientation; something that it has not been designed to do. While RAP has nearly always incorporated local people as research team-members based on particular expertise, it is less common that it does so with an explicit community-based participatory perspective. The distinction is important in that the community driven framework privileges local perspectives and needs as much, or more than those of the outsiders. Still, the limitations noted above constrained full participation on the part of many of the Ecuadorian team members.
Upon return to the US, we engaged in a more intensive phase of data analysis that allowed us to systematically examine our findings in the field against these more detailed analyses. Through group meetings and email discussions we built a more robust coding scheme and more detailed code book than had been possible in the field. Once we had agreed to a central coding structure, each student then coded their field notes using that format. We then combined everyone’s coded notes into a central set of notes, organized according to the agreed upon codes. These were then read independently by several individuals who looked for inconsistencies in the data and created detailed narrative summaries. A single summary statement was created for each code that collectively represented the central findings of the study, as reported here, on the project website, and in our various public presentations. The strength of this process lay in the fact that with 18 people collecting data, all of which are coded through a common set of codes allows us to make definitive statements on the two questions of interest. The final data set consisted of nearly 250 pages of single spaced coded notes and 35 pages of summaries.

FIELD SITE
Ecuador is located in northwestern South America. At 283,560 sq. km. (including the mainland, the Galapagos Islands and territorial waters); it is a relatively small country, roughly the size of the US state of Nevada, and contains 22 provinces divided between costal, mountain and tropical zones.

Newly arrived group of tourists at Yachana Lodge

It is bordered by the Pacific Ocean on the west, Peru on the south and east, and Colombia on the north. The equator runs directly through the country, just north of Quito, the capital city.
Yachana Lodge and the Colegio Técnico Yachana are
located in the rural Amazonian community of Mondaña, Napo Province in northeastern Ecuador, roughly 160 km. NW of Quito, and 70 km. south of the Columbian border. Its geographic coordinates are 00°52.460S 077°15.464W and an average 302 meters (994 feet) above sea level. At 79,139 the Napo Province population represents only .6% of the Ecuadorian population.

Ecuador is ranked 29th (www.nationmaster.com) in petroleum production with an average production of 493,200 barrels per day, 60% of which is exported, representing roughly 40% of Ecuador’s export income. Ecuador's biggest oil fields are in the Amazon basin, creating strife because oil exploration and development has displaced traditional peoples from their lands. Other export products include bananas, coffee, cacao, and smaller amounts of other agricultural products, balsa wood; fish, shrimp, textiles, wood products, and chemicals (www.cia.gov).

Resulting from this friction, one of the first projects that the Yachana Foundation undertook was the purchase of land on which Mondaña stands so the community would have clear title to it meaning the local community maintains control over the local resources and development. To date, the Yachana Foundation has purchased 325 hectares of land around the lodge and Mondaña including 100 hectares on the north side of the Napo River. The foundation plans to buy additional tracts as they are made available by community members and other entities. Additional information on the Yachana Foundation’s conservation efforts can be found at the foundation’s website: www.yachana.com.

Although there was some debate, the general consensus is that town of Mondaña includes the central village with its residential areas, an area on the opposite side of the Rio Napo adjacent to the market of Agua Santa, with 4 related households, plus farmlands and surrounding land from the river uphill. At Mondaña, the Rio Napo runs SW to NE. The town is measured away from the river in geographical lines or lineas. Each linea is spaced at a distance of 1000 m.

Approaching Mondaña from the Rio Napo

Mondaña, therefore, is said to go to the segunda linea, or second line (2000 m.) on the south side of the river and the primera linea, first line (1000 m.) on the north side of the river.

During the course of our interviews with key informants, the community survey and our informal conversations with residents, we obtained conflicting reports of the total number of residents in the village, ranging from 60 to 380 individuals or from 12 to 80 families.
Figure A: Map showing approximate location of field site at Mondaña, Ecuador (red star)
Because of long distances between the communities from where students come and long travel times, CTY is designed as a boarding school to accommodate students from surrounding communities, some as far away a full day’s travel. All students, including those from the immediate region stay at the school. Students work on a roughly 12 hour per day, 6 day per week schedule beginning early in the morning into the evening. Mornings are occupied with the “practical”, or technical, aspects of their education actively working in whichever of the four curriculum areas through which they rotated each week. Afternoons are spent in the classroom engaging the more academic aspects of an education (language [especially English], mathematics, history, etc.) and evenings are for homework. Sunday mornings are dedicated to the “minga”, group projects that require large amounts of labor from a large number of people to make much progress. The project occupying most Sundays during the 2006-07 field season was the construction of the Tilapia ponds (see below). These are four large, diked ponds and affiliated drainage systems designed to produce up to 1500 saleable Tilapia each month. Given that each pond was roughly 15 meters on a side and 3-4 meters deep, there is obviously a great deal of heavy, wet tropical clay to be moved, keeping students busy for months. Sunday afternoons were free time. Note: By US or European standards, these are very long hours but are in line with what the students would work if they were working in the subsistence economy typical of the region. It also satisfies the number of educational contact hours necessary for accreditation as a private school.

Part of the innovation of the Colegio is a schedule designed to accommodate as many students as possible within the available infrastructure. Where the campus has the capacity to house around 60 students and teachers, the demand and need is much greater. In order to accommodate larger number of students over time, students come for 28 blocks during which time they are essentially in school full time from early morning until late in the evening Monday-Saturday. In this way, it is possible for students to meet the required number of “contact hours” required of Ecuadorian education policy and the school can accommodate the larger demand. Students then have a “break” of 28 days when they return home and the alternate group begins their 28 day stay. This 28 day “break” had emerged as something of a problem during our stay because for many students, they either didn’t have anything academic to do, or didn’t do anything, thus losing ground for the month they were away from school. To address this, a new approach was being developed that would require students to design and execute projects in their home communities around the topics they were studying.
while in school. Proposed projects ranged from the straight-forward like creating a composting program, to the more socially and practically complex like trying to introduce some sustainable farming practices into their community. This approach was designed to reinforce learning by calling on skills and knowledge from the school as they developed their local projects and give students a chance to begin exercising leadership as they worked to develop their projects.

ECONOMIC DEVELOPMENT

The history of economic development in this region demonstrates the importance of considering economics, place and people simultaneously in emerging models of sustainability. This is an area of major oil exploration and development with the town of Coca, about three hours down river, being a major oil services center in the region. While some people work for the various oil and gas firms, the majority of the population is involved in tropical cash agriculture with the two largest crops being coffee and increasingly cacao. Beginning in the 1970s the Ecuadorian government adopted what is arguably the “standard model” in the American tropics of dividing up large tracts of state-owned rainforest lands in the Amazon basin into 250 x 2000 meter (five hectare) “homestead” parcels that were granted to landless peasants and urban dwellers to settle these newly opened regions (McMeekin, pers. comm.).

The primary crop promoted in the 1980s was coffee because the international price arrangement that guaranteed a certain minimum price for coffee producers made this an attractive development option (International Coffee Organization). This international policy encouraged world wide increases in coffee plantings because the international agreement partially protected producers from wide price swings. With the expiration of the international agreement in 1989 and the overall failure to renegotiate a new agreement before 1994, prices plummeted in the early 1990s. In many areas people responded to falling prices by further increasing planting seeking to make up for lost income through increased production. The international supply quickly swamped demand, eventually pushing prices below production costs.

These processes hit subsistence producers hardest because often their sole source of income was their coffee harvest. In many cases they had planted the maximum available land in light of earlier rising prices and in attempts to make up for falling prices. While on the one hand income was reduced, they also often had little available land for subsistence food crops.

This model of economic development had short term benefits in that it provided land and economic opportunities to large numbers of relatively economically inactive people and provided hard currency income to the country through exports of primary agricultural products. In the longer term, these efforts had limited value. Five hectare plots were sufficient to provide a subsistence living but little else. Furthermore, having a regional economy based largely on a single crop subject to wide price fluctuations makes it difficult to engage in long term development at the individual or regional level. It was this situation that in part motivated the establishment of the Yachana Foundation. One of the early projects was the introduction of cacao in an effort to make up for lost income from coffee and over time to even out income by having a mixed-cropping system.
As will be detailed below current efforts are focused not only on increasing economic opportunities but with considerations of sustainability in mind. Thinking of sustainability in terms of economics, people and place, the Venn diagrams below can be used to explore the various relationships among these three broad sets of factors in this setting. All are hypothetical and highly simplified, serving as illustrations of general concepts rather than empirically derived depictions of the actual situation. Additional detail will be explored below in the section on sustainable agriculture efforts being conducted by the CTY.

Diagram A represents initial colonization efforts where the primary concern was to provide people with economic opportunities (and by extension, add to the country’s export earnings). Little attention was paid to “place”—the rainforest; it was an available resource to be exploited to provide income generating activities. The development of extensive (vs. intensive) agriculture resulted in the clearing of vast tracts of rainforest for marginal economic gain. Primary agricultural products like coffee are sensitive to a host of international economic forces that can dramatically impact prices, in the absence of international agreements, over which individual producers and producing countries have little control. The result of these approaches is that economic sustainability, peoples’ ability to generate a livelihood over the long term and the rainforest environment are all at risk resulting in small overlap among the three sets of factors and limited “sustainability”. Thus, while there is some overlap, at least initially between “economics” and “people”, there is little that is sustainable about these early development schemes.

Diagram B shows some of the current thinking where attention is paid to each of the three elements of sustainability in this region, to one degree or another. Economics is still based in primary agricultural products but through the use of mixed cropping, especially with coffee and cacao, the risk of economic shocks can be moderated somewhat because each is produced under different regimes, and sold and traded in different markets. Furthermore, as fair trade efforts increase with increasing emphasis on organic and/or premium products, there are additional opportunities for value-added efforts at the local level. An emphasis on people results in technical assistance toward realizing the mixed cropping program, education on the value of value-added efforts (organic, superior quality products) and work toward developing food production techniques that can be incorporated into existing cropping patterns. Finally, the considerations of place explicitly acknowledge the opportunities and limitations of the tropical environment and attempt to develop systems that seek to maximize output while maintaining attention to long term needs and potential. The intensification of agriculture can result, over the long term, in less land usage for the same income and therefore less forest land need be cleared.
The goal of integrated development efforts bringing the circles “closer together” thus increasing the area of the overlap that constitutes “sustainability”

One of the central operating assumptions of the CTY is that knowledge (through education) = power; economic power through having a set of “marketable skills” and knowledge-in-place—an education that is based not only on “theory” but theory applied in the context of local conditions; an education that links the full range of skills and knowledge to the realities and opportunities of work in rural, tropical Ecuador. A long term goal is the development of a core of educated young people who can make a living in the local context, provide leadership on economic development and over the longer term create viable, sustainable livelihoods. This may be summed up through a phrase that emerged during the research: Living your Education. A number of components make up the longer process of living ones education:

a) A strong focus on practice, or theory-in-place as opposed studying “theory, theory, theory” as one of the CTY students framed it, as is common in most secondary schools in Ecuador whether college preparatory or technical. The Colegio has developed this concept in some important ways. Not only do the students receive training in the four complementary tracks described above but these are strongly linked to basic skills whether in math, language, history or biology.

b) An emerging approach (in early 2007) to reinforce and build on students’ education is the requirement that they develop sustainability projects in their home communities. The goal here was two-fold: 1) Because students were out of classes for 28 days every other month, they often “lost ground” academically during this break away from the intensive academic environment characteristic of the CTY. Having students engaged in designing and executing projects was seen as a way to reinforce and integrate their knowledge. 2) By developing projects in their home communities their focus on sustainability in its many forms could be diffused throughout the region, increasing the impact of their education beyond the classroom and beginning the long, complex process of creating sustainable livelihoods.

c) A third important goal is to develop professionals in the various fields who can find meaningful work in the region, reducing the need for many to emigrate to the cities, too often to wind up in unskilled labor positions. (This of course remains to be seen.) Having acquired skills and knowledge in several concentrations provides flexibility in seeking meaningful employment regionally as well as providing the basis for further education for those with the intellectual and financial resources.

d) Finally, the educational approach taken by the CTY is a major departure from the more strictly didactic approach typical of Ecuadorian secondary education. Where most schools treat students as “empty vessels” to be filled with knowledge by their teachers (the theory, theory, theory approach noted above), the heavy emphasis on integrating practice with theory
LIVING YOUR EDUCATION: THEORY AND PRACTICE IN ECUADORIAN RAINFOREST SUSTAINABLE AGRICULTURE

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The focus of the project conducted by the “Agricultural Team” was to understand, to the degree possible in the time available, the dynamics of the experimental sustainable agriculture project being developed by students and faculty at the Colegio Técnico Yachana (CTY). The larger research question guiding the field course was: “How do local populations retain the strength of their culture and preserve their environment, yet create viable economic opportunities within an increasingly impoverished country?” Within this broad question, a major set of questions arises around making a living and daily subsistence. As the regional population has changed over the last 50 years through in-migration and shifted from subsistence food production to producing market-oriented crops for sale in international markets (primarily coffee and cacao), and wage labor (e.g., working in oil exploration and production) there has been a notable decline in the diversity of diets (Modesto Yumbo, pers. comm.), increasing reliance on non-local foodstuffs, and perhaps a decrease in the overall quality of the diets. It is against this background that the broader CTY educational program, and the sustainable agriculture focus within it, has been designed. A primary focus of the curriculum is development, through practice, of integrated agricultural systems that meet a number of curricular, economic, and social needs.

1. The development of these agriculture systems is designed to cut across the four core areas of study in that the development and practice of the agriculture system addresses central pedagogical components across the curriculum.
   a. Ecotourism: Tourists staying at Yachana Lodge are given tours of the agricultural fields and introduced to the concepts involved by student guides, permitting practice in interpretation using English;
   b. Microenterprise Development: Many of the products being produced and planned for production (Tilapia, chicken, hearts of palm, tomatoes) are to be sold to the Lodge and in the regional economy;
   c. Sustainable Agriculture: Identifying crops and cropping systems that permit the greatest use of local resources, minimizing inputs from the larger economy while maximizing the results of labor inputs and increasing yields under harsh local conditions;
   d. Animal Husbandry: Seeks to identify animals and animal production systems that can accommodate to local conditions. A major new initiative is to develop production systems for local wild animals both for food production and reintroduction into regional forest environments.
2. An emerging requirement of students in the program is demonstrating to local populations that they can grow much more of their food without major additional investments of time, energy or resources, thus allowing use of scarce cash resources for other household needs. As noted above, the class cycle of the school is designed to accommodate the maximum number of students with available resources. While this appears to be a good system to maximize the number of students given available resources, a recognized downside to this schedule is students become “disengaged” in each of their month long study hiatuses, losing ground academically. In an effort to diffuse knowledge gained by students in their course work throughout the region and to maintain engagement and reinforce student learning, students are required to create demonstration projects on sustainable agriculture during their home visits.

3. This intensification and reintroduction of traditional agricultural practices and products is designed to provide food for Colegio students and faculty.

4. Generate cash income for school through sale of agricultural products (e.g., tilapia, tomatoes, heart-of-palm) to lodge and through local markets.

Commercial production of tomatoes and melons

**APPROACH/METHODS**

Using the team-based rapid assessment approach discussed above, UCD students were paired with CTY students in several task-based teams, the membership of which varied from day to day depending on the Colegio students’ other commitments and the tasks at hand. Broadly, there were two teams within the agricultural project focused on two overlapping tasks: 1) mapping (understanding place) and 2) seeking to understand the social and economic aspects of the project through interviews and observation. The bulk of data collection occurred in the mornings when the Colegio students had more flexibility in their schedules and generally before the afternoon rains. After lunch, each team consolidated their findings from the morning, then discussed and explained what they had done and learned to the other team(s). This daily analysis and review cycle served to identify areas of complement, things that needed to be explored by the other team and added to the emerging model. Every few days, we would spend the first part of the morning data collection period reviewing emerging findings with the CTY collaborators who could not be involved in the daily data analysis and model building. This allowed the UCD team to ensure that we were “getting it right” and the Ecuadorian students a broader opportunity to participate in data analysis and model building given their scheduling conflicts that prevented their participation in afternoon data analysis. Similarly, every three days the agricultural research team graphically represented emerging findings for presentation to the “Health Team” who in turn presented their ideas. These twice weekly presentations to the other research team
served to focus and specify findings, and identify gaps to be filled. The result of this overall process was that by the end of the research period, the majority of findings had been consolidated and draft graphics prepared leaving us the last day to prepare final versions of findings for presentation to the community before our departure.

This approach allowed us to produce a detailed, annotated map of the farm indicating use areas, unique farming practices and ecological dynamics of each and a series of diagrams depicting the established, emerging and proposed ecological and social interactions.

Methods
In our efforts to understand the dynamics of the emerging sustainable agriculture system we used a combination of participatory mapping, interviews and observation.

One team walked the property repeatedly and the surrounding region to gain a broad understanding of the size of the agricultural areas, their relationships to other Colegio facilities, neighboring properties and the lodge and town. In the first several days, we produced a rough sketch map and discussed each locale in the detail with Colegio collaborators. All important points, property corners, buildings and other facilities (e.g., nursery, compost station, and trash pit), different fields, were geographically located using handheld GPS unit. Similarly, rough measurements were taken to understand basic spatial relationships of the parts to the whole. All facilities, fields and processes were photographed and many activities and places were videotaped. Every afternoon during data reduction and analysis we reviewed the emerging map with the whole group and revised it based on that day’s knowledge. At several points during the ten day research process, the UCD and Colegio students reviewed the map together to explore relationships, verify accuracy and compare interpretations. These review sessions revealed a number of important insights that would not otherwise have appeared without the interaction among people who know the landscape intimately but had never thought of it in terms of “mapping” and those trying to see and understand it for the first time.

In addition to the map construction process and review sessions we conducted several types of interviews to comprehend the human relations to the land and agricultural processes: A daily time use analysis allowed us to understand the time relationships of agricultural activities relative to classroom and other activities. We developed an annual calendar of agricultural activities through interviews to understand planting, harvesting and maintenance cycles. In this context we developed a list of all the crops planted which we used in a pile sorting activity (Weller and Romney 1988) to elicit the basis upon which plants are related in students’ minds. (Note: we conducted this first among UCD students, then among Colegio students, with very different, but not surprising difference between the two groups). Throughout all we had detailed discussions between UCD and Colegio students on all aspects of Colegio educational and agricultural activities.

At various points throughout the process we conducted key informant interviews to fill in gaps and better understand underlying vision:

- Agronomy teacher, Modesto Yumbo
- Animal husbandry teacher, Mariano Diaz
- School director, Miguel Murrillo
• The Yachana Foundation’s founder, Douglas McMeekin
• Cooks at the Colegio
  - How much produce do they buy vs. use from the farm
  - Nutrition—how are menus defined/decided upon

We built in an active participant-observation component that ran through the whole process. While active translation between English and Spanish was done to enhance inclusiveness, those with limited Spanish skills took on an explicit role of “observers” often discovering things not noted by those involved in interviews. To the degree possible, in and around data collection and analysis, UCD students participated in daily activities with the students, having meals at the Colegio, or working on the Sunday “minga” or community work day. UCD and Colegio students mixed socially outside the context of daily research.
Participant Observation—tasting sugar cane for the first time

Reviewing draft map
RESEARCH OUTCOMES

The encouragement by the Ecuadorian government of colonization through dividing state lands into 2000 x 250 meter parcels to foment cash cropping, especially coffee in the 1970s and subsequent colonization and production of coffee for external markets led to a substantial erosion of traditional subsistence knowledge and practices (McMeekin, Yumbo, pers. comm.) which has in turn resulted in people buying the bulk of their food from local markets, with the exception of easily grown staples like yuca/manioc. A combination of high prices for coffee through the 1980s followed by a dramatic drop in coffee prices beginning in the late 1980s resulted in extensive planting of essentially mono-crop coffee, initially to take advantage of high international prices, later to try making up for dramatically lower prices after international agreement collapsed. Ultimately people had an insufficiency of land to earn anything more than a minimum subsistence living. Among various options, some turned to wild-cat logging to make additional money, extracting high value trees from surrounding rain forest areas, including Mahogany (Swietenia macrophylla) and Ecuadorian Laurel (Cordia alliadora). In addition to the environmental damage caused by this type of illegal logging, it is highly exploitive of harvesters who were paid very little relative to the value of the logs they were selling (e.g., they may be paid US $10 for a log that would have a value of thousands of dollars as finished lumber). Others turned to wage labor or migrated to the cities.

FUNDEDESIN, now the Yachana Foundation, was created in 1991 with a community-oriented approach of reforesting and search for alternative development efforts. One of their early efforts was to refocus agricultural production on cacao as a replacement for coffee. It is a native crop
that grows better and easier, yields higher prices for less labor with higher return for producers. (See the Yachana Foundation website for more details: http://www.yachana.org.ec/)

**LIVING YOUR EDUCATION**
As detailed above, a central operating assumption of the Colegio Técnico Yachana is the concept of knowledge = power; knowledge-in-place has the potential to increase economic power. This is realized through sustainability as praxis, or living your education. While sustainable agriculture in the tropics has been widely researched and implemented in a variety of situations (e.g., in Colombia where the faculty received their training), the CTY program is among the first, if not the first, to integrate both the development and teaching of sustainable agriculture in a secondary school. This creates an important dynamic not easily realized in other settings. The simple fact of more than 120 students, many highly motivated, working to both create and understand this system leads to a lot of questioning and experimentation. Where a more scientifically driven enterprise might seek to test various methods one against another, a situation like CTY is one of rampant empiricism. Rather than carefully controlled experiments there is an attitude of “let’s try this and see if it works”, which serves to test and refine previously developed concepts and approaches in the local context under local conditions. Over time this will result in a series of refinements and systems well adapted to local ecological, social and cultural conditions.

A second innovation is this program is the intent of making the school as food self-sufficient as possible. Food is a huge expense and the degree to which food can be produced as part of the educational experience reduces costs and allows development funds to be used elsewhere. Similarly, if one of the goals of the school is creating sustainable agricultural systems applicable to the local environment and work patterns, it is important that the school demonstrate the viability of the concept at an institutional level. Although we did not examine it in detail, it appears that for vegetables and perhaps protein, it may be possible to satisfy basic requirements. This is more difficult for staples like rice that are consumed in very large quantities and require large tracts of land to produce the necessary amount. As will be discussed in more detail below, there may also be some conflict between producing for the school’s needs and producing for the external market, including the lodge, in that it may not be possible to produce as much as is necessary to satisfy both demands of feeding the school population and generating income by selling produce to the lodge or in the larger economy. There may need to be decisions about allocation of limited resources.

**LOOPS**
The central finding of this study is an emerging system of what we called “loops” (the term was initially coined by Julie North), meaning systems of management that seek to minimize outside inputs, maximizing recycling and reuse of available resources, and “loops within loops”—a macro-system with a number of “subsystems” within larger system. What this entails is the deliberate, thoughtful development of systems that, to the degree possible, mimic local ecological processes. Adopting this framework means thinking of the entire agricultural area, the people within it and desired yields as a single system. It means understanding inputs in relation to outputs and working to identify points where recycling, reuse and internal production of inputs for other parts of the system can be realized. In a globalized economy, it is not possible to expect complete self-sustaining agricultural systems; rather, the goal is to not think of
agricultural production in a linear fashion where inputs come from outside, are processed through local agriculture to create crops that are then exported. Instead the goal is to acknowledge that some outside inputs are necessary (hybrid seeds, some fertilizer and pesticides, animal feed) but that much more could be produced internally thus decreasing expensive inputs while maximizing income producing outputs and higher quality diets at the household level.

Figure B is a map of the primary agricultural lands and activities. Several points not easily observed on a static map need to be explored. In an effort toward sustainability as defined above—taking into account people, place, and economics—a key feature is the intensification of production in time and space. One of the central limitations of tropical agriculture is the relative nutritional paucity of tropical soils. Most nutrients are “tied up” in existing vegetation. In the common form of tropical swidden agriculture (“slash and burn”), an area of forest is cleared, the vegetation allowed to dry, then burned. In his process requisite nutrients are released and made available for agriculture. Because relatively few nutrients are released in this process and heavy rainfall that leaches available nutrients from the soil, most plots can only be used for one or two years before they must be allowed to return to forest in order to replenish available nutrients, a process that can take from 15-30 years, depending on climate, soil structure, use patterns, and other factors. New plots are cleared and the cycle continues. In areas of non-commercial agriculture and low population density, this is a system that functions well, but change either of these two factors and this form of extensive agriculture quickly becomes unsustainable. Tree crops like coffee and cacao are less susceptible to these limitations because they can be incorporated into a semi-forest environment that takes advantage of natural cycles.

The challenge then is developing systems of intensification within the context of the limited resources available in the tropical environment. Furthermore, an effort is being made to develop largely organic systems thus limiting chemical inputs in the form of inorganic fertilizers and pesticides. This effort is important on several levels: While considerations of health and well-being of the agricultural system (soils, water) and of the population who work in the fields and consume the food are of high importance an equally important component from the standpoint of sustainability is limiting artificial, outside inputs. Chemical fertilizers and pesticides are expensive, toxic and do not contribute to a sustainable system.
Figure B: Map of Intensive Agricultural Zone, Colegio Técnico Yachana (map drawn by Cristella Valdez)
Several of the intensification methods will be explained in detail through Figures C and D, but a couple of broad processes need to be discussed in greater detail. Intensification can be generally conducted in time and/or space. In both cases the goal is to create combinations of crops complementary in time and/or space, each using different resources within the agricultural system. Intensification in space involves planting more than one crop on a plot of land; each “using” space differently in terms of size, length of growing season and harvest time. A good example can be seen in the NE quadrant of the agricultural plot in Figure B where a variety of crops are planted together. For example, corn, yuca (manioc) and plantains (starchy bananas) are all planted at roughly the same time. Corn, an annual crop that requires nearly full sun to produce well, grows much more rapidly than the yuca or plantains and is harvesting in about 6 months before the other plants provide too much shade. Yuca which is harvested between 8-18 months is more shade tolerant so although the plantains quickly cover the entire area in shade, the yuca still produces a full crop. Plantains are long lived perennials and continue producing over many years in the same place. If space permits, the plantains can be more widely spaced and the area between rows can be repeatedly planted with other crops. While this basic approach is not new, it is in essence a reintroduction in this area where a more or less mono-crop system of coffee and/or cacao had become the norm. There is also a great deal of experimentation to expand the kinds of crop combinations that can be grown together.

**Corn, manioc and plantains in co-planting**

The second major approach to intensification is through time where different annual crops are planted in succession on the same plot of land. A primary goal here is the maintenance of soil fertility over time; plants are chosen that use nutrients in different ways. No matter the combinations, there is always a nitrogen fixing plant in the mix—beans, peanuts, soybeans. In the SW quadrant is a field midway through this process. This area was planted in rice, with a third planted in peanuts (nitrogen fixing) and two thirds planted in watermelon and cantaloupe. Following the cycle through time, after the watermelon and cantaloupe are harvested, those plots would ordinarily be planted with a legume of some sort while the area currently planted in peanuts would be ready for another more nitrogen demanding crop.

An area of particular interest can be seen in the SE quadrant of the main plot where a major experimental effort towards intensification is taking place. In this area the focus is on experiments in commercial production (tomatoes and cucumbers, melons to be sold to the lodge
and through local markets) and on the cultivation of vegetable crops that are essential but often lacking components of the diet. The basic argument is that these should be fairly easy to incorporate into a household garden, do not require complex, time consuming management and can make a very important contribution to the daily diet addressing several common nutritional deficiencies (e.g., Iron, Vitamin A). It is in this context that work will begin on the reintroduction of a number of important native “vegetables” that had long been consumed but were no longer much collected or known. These are generally “green leafy vegetables” that grow as “weeds” in cultivated areas or wild in the forest environment. This is an important initiative because these plants are fully adapted to the region and should grow with minimal effort and can be readily incorporated into other planting and cropping arrangements. Those found in agricultural plots are well adapted to human activity thus requiring minimal cultivation or attention while those growing primarily in forest environments may require more sustained experimentation to identify the best cultivation techniques. An excellent example of this is the wild nettle, “hortiga,” that grows vigorously in this area. The young leaves can be harvested and used in a variety of cooked salads or as an ingredient in soup, and make an excellent food for pigs thus satisfying three important needs in an integrated agricultural system: human food, animal food, and easy cultivation. Researching these plants provides students the opportunity to explore their botanical, culinary and medicinal plant heritage as they engage elders in the process of identifying, cataloging and understanding the uses of specific plants. Over a period of several years it should be possible to develop a body of knowledge-in-place about plants appropriate to the goals of introduction, reintroduction, and reincorporation of introduced and native plants. A parallel process is planned for medicinal plants with the goal of cataloging medicinal plants, their uses, preparations and cultivation or habitat needs.

One important consideration in these efforts toward intensive production of edible greens is two important inputs: Raised beds in a variety of forms and the use of compost to maintain soil structure and fertility. The design of the raised beds is focused on the use of local materials for construction of the raised beds (porta-banda), especially bamboo which is widely available, fairly easy to work with and rapidly renewed. The circular raised beds (called mandalas because of their shape) are constructed in place by digging paths and piling that dirt onto the intervening beds and incorporating compost. This simple system requires no construction (though a fence may be important to keep out foraging animals) and increases soil drainage thus broadening the range of potential plants that could be grown. The regular addition of compost, rice hulls (which break down slowly thus slowing soil compaction) and regular crop rotation, intercropping and temporal planting can produce near constant harvest, and reduces risk of major insect and disease outbreaks.

Intensive planting, mandalas and raised beds

Herein lie potential limitations: In
the context of the Colegio program labor to design and build the raised beds can be allocated according to the educational program. In this case the raised beds were an end of year project/experiment by the first year students. Thus, considerable labor could be mobilized to build, plant, and maintain the various designs as well as produce the large quantities of compost necessary for ideal production. Labor is notoriously scarce in campesino households so the benefits of labor intensive gardening techniques will have to be demonstrated to and adapted by households.

Compost is an essential component of nearly any intensive agricultural or horticultural effort and is especially important in tropical environments where high temperatures and high rates of rainfall quickly break down available organic matter and leach essential nutrients from the soil. This relative lack of organic matter and associated nutrients requires regular additions of some form of organic matter, often in the form of compost. The Colegio demonstration compost program appears to yield substantial quantities of high quality compost for use in the raised beds and other locations. Two issues arise relative to the diffusion of these approaches to the household level: 1) the labor required to create and maintain a compost system is, as noted above, an additional burden on already labor constrained households. 2) While the Colegio with 70 or more people creates a large quantity of compostable organic matter (egg shells, vegetable peelings, fruit rinds, chicken feathers, etc.) and receives large quantities of compostable material from the Yachana lodge, this could arise as a limitation at the household level where they simply do not generate that much organic waste. As these efforts proceed at the Colegio some attention should be directed to identifying easily compostable materials that do not substantially add labor to campesino households.

Mixing compost

Figure C displays the concept of “loops” at the macro level. Students attending CTY come from a variety of communities throughout the region but as a collective body of students participating in the CTY program, they are very much at the center of this emerging system. It is through the innovation of this educational approach and the interest, hard work and dedication of the students, teachers and administrators that a dense network of relationships develops (see Figure D). The approach of “living their education” links them closely to four broad spheres of the local, indeed regional, economy and environment: community, markets, the Yachana Lodge, and the surrounding natural environment. It is through these linkages and relationships that they become educated and influence the broader region. Through the development of the CTY concept and student involvement in its evolution, students emerged as the center of this social-ecological system. Students receive benefits from and provide benefits to the regional “community” through their education and community based efforts in which they engage; they potentially enhance local markets by producing unique products (e.g., Tilapia) or producing products at a lower rate than can more distant producers.
Their various micro-enterprises provide important services—ecological and economic—to local communities through the production and distribution of water filters for schools, or LED light bulbs that greatly extend battery life for flashlights thus reducing solid waste and cost of discarded and frequently replaced batteries. Through efforts at intensification, they can arguably be said to be protecting rain forest and enhancing regional biodiversity. The relations to the Yachana lodge and foundation are both remote and immediate: Remote in that the funding received through the foundation and lodge profits are essential to the development and functioning of the Colegio but not as obvious as daily interactions with tourists.

Figure C: Macro Level View of “Loops” (drawn by Andy Duvall)

Figure D details many of the existing and emerging loops as we were able to define them through the research. This network of relationships emerged through the data collection and analysis process as the best way to capture the breadth and depth of the sustainable agriculture efforts at the Colegio. Through walking all of the agricultural lands, discussing what was going on in each with Colegio students, and the mapping exercise we were able to capture in broad strokes the existing, emerging and planned activities. An important point to note: Most of what had been developed when we arrived had been done within the first 15 months of the school’s operation, exhibiting very ambitious plans and a tremendous amount of work. Broadly, the base goal of this integrated system of market and subsistence crops is to provide as much of the school’s basic food necessities as possible and generate income to defray school expenses through sale of farm products to the lodge and into the larger regional economy. While it is not possible to explore all the various relationships, a number can be explained as illustrative of the broader range of activities.
Figure D: Detailed View of Existing and Emerging Loops (drawn by Andy Duvall). Solid lines indicate existing relationships; dashed lines indicate proposed or emerging relationships.

A large number of potential and actual linkages and relationships can be seen on the left side where a link between pigs and crops is shown.

1) Pigs are fed azola (a high protein aquatic fern, easily produced in freshwater ponds), quiebra barriga (a local vegetable green), chonta (a palm), yuca (manioc), platanos (starchy plantain bananas), soy and sugar cane much of which can be produced locally.

2) Meat from the pigs can be eaten by the students, sold on the local market and/or converted into a variety of preserved meat products (bacon, sausage) and sold as value-added items.

3) The waste produced by the pigs goes directly into the biodigester. Biodigestion is an ancient technique of anaerobic composting that converts high nitrogen waste (manure) into methane gas and high quality liquid fertilizer (“bioabono”). The bio-digester is a closed system, sealed at each end by closed water tanks which prevents the escape of the noxious gases produced by anaerobic digestion. The methane is piped to the first of several stages of the chicken production facility where the newly hatched chicks spend their first couple of weeks. Young chickens are extremely susceptible to cold, even in a tropical environment where the nighttime temperatures stay fairly high. When the chicks feel cold they huddle closer and closer together, to the point that those in the center can be suffocated. The methane produced by the biodigester is used to fuel a small burner that provides the slight additional warmth needed by the chicks. At the end of the digestion process, a very high grade fertilizer emerges that can be diluted as much as 50:1 and applied either as a foliar spray or to the soil. Because anaerobic decomposition occurs at high temperatures, the exposure to disease causing organisms is much reduced vs. using the raw manure or incorporating it into some other composting program.
Pond for production of Azolla

This creates a number of closed loops within the larger system of loops: Where pig manure is a highly concentrated, odiferous waste product, daily flushing into the biodigester greatly reduces odor and converts a waste into several useful products. The resulting methane removes the need to supply fuel to heat the chicken pen, and the resulting fertilizer replaces some portion of the soil nutrition needed to produce feed for the pigs (and humans). The resulting pork and chicken meat obviously make an important contribution to the health and well being of the local population—tourist and student.

The Yachana Lodge is the economic engine that drives much of the rest of the process. As a well run, widely recognized ecolodge, it provides through its profits, many of the funds for the development and operation of the CTY (see www.yachana.com for more detail on the lodge, its mission and awards). In addition to income the lodge and visitors are linked into the school and its activities in a number of obvious and not-so-obvious ways:

1) The lodge kitchen generates a tremendous amount of organic waste which goes into the composting program.
2) The four curriculum areas are linked in some way to the lodge and guests.
   a. Ecotourism: All students rotate through the lodge learning the core skills necessary to work in and run a complex, multifaceted business enterprise. In each successive year, they work themselves deeper into the working structure beginning with the most basic requirements: waiting tables, cooking and cleaning, through managing the bar, gift store, accounting, supply ordering, etc.
   b. Microenterprise development: Many of the products produced through the sustainable agriculture, animal husbandry and craft production are sold to the lodge to be consumed by tourists. Craft products are also sold through the lodge gift shop providing additional revenue to the school.
   c. Sustainable agriculture and animal husbandry: As a consequence of commercial production efforts students gain an appreciation for the demands and complexity of commercial production. Likewise, by selling to the ecolodge at market prices, the school generates necessary operating capital.
3) As students provide tours and serve as guides, their English language skills and understanding on how to relate to foreigners and clueless tourists improve.

A number of planned programs provide further extending the nature of “loops” at the school. One such proposed cycle is that involving increasing the numbers and kinds of animals raised.
In the 2006-07 field season, a huge effort was being devoted to the construction of a series of ponds that were to serve as a Tilapia raising area. Tilapia is a tropical fish of African origin that grows quite rapidly and produces a mild white flesh usable in a number of ways (baked whole, as filets).

Tilapia ponds under construction

As an omnivore, tilapia can consume a range of foods from kitchen scraps to azola and other vegetable materials, to commercial feed, reaching harvestable size within about 8 months, depending on the quality of food and other environmental factors (e.g., temperature, water quality). The ponds are designed to take advantage of existing streams creating a flow-through system that maintains high water quality and requiring minimal costly infrastructure. Once up and operational the series of ponds will permit a nearly continuous harvest for sale to the larger community, to the lodge and for consumption at the school. Projections are that as many as 1500 can be harvested per cycle producing up to three thousand pounds of edible meat. Bones, skin and other scraps all become part of the composting system. The overall goal is to produce large quantities of high quality protein using as much local feed as possible while generating income and recycling wastes into other parts of the system.

DISCUSSION

This section will highlight the vision and accomplishments of the CTY Sustainable Agriculture program to date and outline some potential problems that emerged through the course of the research; problems that will need addressing should they emerge to maintain the goals and strong growth of the program. There can be little doubt that what we encountered represents a very promising start: What is arising in the rainforests of northern Ecuador is a visionary program that has demonstrated tremendous accomplishments to date, only 15 months after its initiation. Potential impact can be seen at several levels.

- Local and regional impact is most dramatic through direct benefits derived by students through high quality education not easily accessible in poor tropical regions. Educating students using alternative models provides both direct skills development for job seeking in an increasingly dynamic regional economy as well as important basic skills (math, reading, language) that potentially provides access to wider opportunities. The concept of “living their education”; of gaining skills and knowledge with which students can define their future is a powerful, indeed radical, approach to education in this part of the world A regional impact over time is likely through direct student engagement and intervention in their communities as they gain the broader perspective that comes with education and importantly through their required projects they are to conduct in their respective communities.
• It could be argued there is a broader, global, impact through regular contact with and education of tourists, visiting students and researchers who write articles and teach. In a sense, Colegio students are participating in global discussions on sustainable development through the living of their education.

The central organizing principle of this section on the sustainable agriculture program of the CTY is that of “loops”—these emerging systems designed to create a set of viable alternatives to the long standing practices of extensive agriculture: Systems that can possibly improve income, and health and nutrition of the population if they are demonstrated viable and widely adopted in the region. While the program is visionary in its goals and remarkable in its accomplishments to date, some potential vulnerability emerged through our research.

• Potential vulnerabilities
  o Limits on labor: Many of the concepts being developed and activities being pursued are tremendously labor intensive. In the context of the Colegio, a large labor pool can be mobilized to build raised beds, create and maintain a composting system, or tend large plots of vegetables. A question that will need addressing as these ideas are diffused into the broader community is how realistic they are in light of chronic labor shortages typical of campesino households. In a sense, it becomes something of a “cost-benefit analysis” at the household level. While there may be unquestioned benefits derived from adopting some of these techniques, a central question faced by individual households will be “do these benefits justify the work required”? Framed another way, many of these ideas may be interesting and attractive at the household level but may be perceived as unworkable or too costly to be adopted.

  o In a similar vein, there emerged a clear conflict between labor demands of developing the various programs and classroom activities (basic education). Labor always wins; if projects demanded labor input, classroom time appeared to have been sacrificed in most cases. In the short term, this shouldn’t be a problem, but over time it could represent a compromise in a very important part of students’ overall education. One of the central strengths of CTY model is the delicate balance between practical skills and the equally important skills of reading, writing, math, history and language. There is no denying the importance of finishing construction and other essential projects, but consistently placing the priority on this aspect of their educational efforts will likely dilute the proposed strengths of the combined approach.

  o Another concern mentioned a number of times was the high drop out rate, especially among first year students (up to 50% of the class). The primary “cause” noted was the “hard work” involved in being a student at the CTY. Given the tremendous amount of work involved in establishing a program of this nature, it is easy to see why attrition rates would be high. A consistently high dropout rate should call for a review of the program to understand the causes and identify potential solutions. Each dropout represents a lost investment on the part of the CTY and lost opportunities on the part of students and communities.

  o A problem that may arise when the school begins to market products in the larger economy (e.g., tilapia) will be a potential for conflict with local vendors who are selling the same or similar products. To maintain good will with the local community, it may be advisable to not sell in competition with local vendors, i.e.,
retail in local markets. Rather, it may make more sense to sell in competition with outside suppliers (“wholesale”), offering higher quality (e.g., fresher fish) and/or lower price materials.

- Potential conflict in goals. There are apparently three primary goals embedded within this system:
  1. Providing a solid education that will yield well trained and educated students who will be competitive in the local and regional marketplace;
  2. Produce as much meat and produce as possible in support of the food and nutritional needs of the school population;
  3. Generate surpluses that can be sold to the Yachana Lodge and in local markets generating income in support of the school programs.

- It is the second and third of these that may be in conflict in that it appears that it may not be possible with available labor and other resources to produce both for the market and for the school. Some clarification of the priorities may be useful to avoid possible difficulties in the future. There was a sense that students were working at their maximum in terms of available time and labor but it was not clear where their efforts were directed. The tension we could envision was one where the school could become relatively food self-sufficient but there would insufficient time and resources to enter into major market production. The opposite scenario holds that it might be possible to produce large quantities of specialty products for the local markets (e.g., tilapia, chicken, tomatoes) but not have the time or labor resources to produce high quality food for the school.

- A major unknown and one well worth examining closely as the first group of students graduate and head into the larger economy is: Can they compete for and secure jobs in a country of increasing poverty? This is of course the ultimate test of visionary educational experiments: Does it realize its stated goals? Can students find meaningful employment that derives from their superior education at CTY? Tracking student success can identify unknown weaknesses and provide a basis for fund raising should the successes as envisioned be realized.
SUSTAINABILITY AND COMMUNITY HEALTH IN TROPICAL ECUADOR

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INTRODUCTION
The health of human communities is an essential component of sustainable development. Human energy, in the form of socially organized labor, represents an important resource or input into agriculture, forestry, and animal husbandry. If health is conceived broadly, i.e., as the optimal development of body and mind, then a healthy community is not only a good in itself, but comprises individuals able to respond creatively and thoughtfully to the natural environment, creating systems that generate food and other products necessary for human life but that also conserve the natural environment. Research on health transitions in human history demonstrate that economic development in the form of increased income, education, and improvements in sanitation (water and sewage systems), especially when distributed equitably within a society, are the primary determinants of improved health and increased longevity in contemporary societies (Caldwell 1993; Frenk et al. 1994; Gutierrez, Zielinski, and Kendall 2000; McKeown 1998).

Dunn and Janes (1986) note that human interactions with the environment can be assessed in four patterns: those that are deliberately designed and undertaken to affect health positively or negatively and those that are not deliberately designed or undertaken to affect health but nonetheless have positive or negative effects. Examples of each are presented in the following table.

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<tbody>
<tr>
<td>Healthful</td>
<td>Build a closed water system.</td>
</tr>
<tr>
<td>Harmful</td>
<td>Market sales of tobacco to young people.</td>
</tr>
</tbody>
</table>

Few activities are undertaken to deliberately harm health: dams are built to generate electricity, store water, and control flooding, all goals that have the potential to improve health. Nonetheless, this same intervention may harm health because it removes land from agricultural activity and thus diminish the supply of locally available food, decreases yields from fishing, or creates environments where fresh water snails can breed and increases the incidence of schistosomiasis, a debilitating waterborne parasitic infection (Desowitz 1976). Ideally, the
negative and positive effects of such projects are considered and weighed before they are implemented so that the overall effect on health is positive.

This model provides a useful framework for assessing changes in health status that result from human interventions with a wide variety of stated goals, from market-driven cash-cropping to building a clinic. Thus an important factor in answering the larger research question of the course, “How do local populations retain the strength of their culture and preserve their environment, yet create viable economic opportunities within an increasingly impoverished country?,” demands an understanding of how a community’s actions and responses affect their health status, their health needs and members’ perceptions of their relationship to regional and national health care systems and the efforts of NGOs such as Yachana.

In Mondaña and the surrounding area, the recent shift from subsistence food production to market-oriented crops and wage labor that often requires migration of family members has had profound effects on local diets and health practices. For example, we observed a mother waiting to make a decision about a child’s serious injury until her husband returned from the oil field. Students at the Colegio reported that discarded batteries were a major source of trash and pollution in their rural villages. In 1995, Yachana responded to local needs for improved access to health care services by building and staffing a primary health clinic with a radio so that individuals in more isolated villages could call the doctors and community health workers in Mondaña for advice and assistance.

THE PROJECT
The focus of the project conducted by the “Health Team” was twofold: to assess the health status and health care resources of the community of Mondaña and the Colegio and to provide a preliminary evaluation of a micro enterprise project of the Colegio to distribute water filters to elementary schools in the area (hereafter the filter project). The primary objective of both research efforts was to provide a baseline study from which suggestions for improving the community’s health and the filter project could be made and for measuring change over time.

The filter project was selected as one focus of our work because it was a specific intervention designed both to provide the Colegio students with a microenterprise to support the school and for them to learn basic skills and knowledge about small entrepreneurial businesses and to improve the health of local communities by providing a convenient and reliable source of clean water. UCD students would learn the evaluation concepts and skills necessary to provide a preliminary assessment of this project. By working with the Colegio students, they too would learn the principles of building evaluation into intervention projects and help develop tools for continuing the evaluation through the duration of the project.

We chose the community health assessment project to provide a baseline assessment for future research in the community of Mondaña and to offer preliminary suggestions for improving the community’s health. UCD and Colegio students would learn the skills of community assessment including interviews with key informants, community survey, and observation of the physical environment and health-related behavior.
Using the working definition of sustainability developed during the orientation phase of our fieldwork (see page 4), we determined that assessment of the community’s health, evaluation of the filter project and any suggestions for change must consider the relationship between economics, place, and people (see diagrams on pages 13-14). As was illustrated in the case of a small child’s injury mentioned previously, the decision to seek professional treatment depends upon balancing economic resources, proximity to health care facilities, and the social relationships within the family and the community.

Although the Colegio’s curriculum focused primarily on the economic activities described in the previous section on agriculture, messages about health suffused the student’s activities and were the topic of much discussion among students and between students and faculty. Students’ behaviors that affect health were definitely changing, and they were encouraged to take these changes back to their home communities. For example, in the Colegio’s kitchen, where students were actively involved in meal planning and preparation, they learned the elements of a balanced diet using a majority of foods that were locally produced; how to prepare, serve, and store food safely; and effective hand washing. Because the Colegio is a boarding school, students cared for their personal hygiene at set times and in close proximity to one another, thus sharing practices and developing norms. The Colegio has a closed water system, and students are actively discouraged from drinking water from streams and the river. Faculty were also alert to the emotional and social needs of students who were separated from their families for long periods of time.

One of the Colegio’s core curriculum areas was the development of micro enterprise projects through which students could achieve a variety of related objectives including:

- Learn the basic skills for setting up and running a small business including development of a business plan, creation and manufacture of products, marketing and sales, pricing and accounting
- Learn skills related to a particular project, e.g., silk screening T-shirts, assembling water filters, or creating a method for teaching children why and how to use water filters
- Create projects that will provide sources of revenue for the Colegio, e.g., the sale of handmade crafts and silk-screened T-shirts at the lodge’s gift shop, the sale of water filters to local households.

One of the students’ first projects, which we were fortunate to observe and participate in from its initial phases, was the assembly and distribution of water filters to elementary schools in the area (see page 40 for a detailed description of the project and its objectives).

**APPROACHES**

One of the advantages of RAP is the flexibility of its team-based approach that allows team members to go to different sites at the same time. Everyone on the “health team” participated in the evaluation of the filter project, taking turns accompanying the CTY students as they delivered and installed the filters in various surrounding communities. This was such an important project that brought together objectives of the school curriculum (micro enterprise) with the provision of service and education to local communities, and the dissemination of behaviors to improve health, that every UCD student participated in at least one installation visit.
Following the general orientation to the area with the entire group (see page 6), to evaluate the health status of Mondaña and the Colegio, the health team was further divided into two smaller teams, based primarily on students’ language skills, but also on specific skills such as facility with mapping. One group concentrated on surveying and observing the physical environment as it pertained to health, detailed below, while the other group concentrated on developing an interview schedule to assess community members’ health-related attitudes and practices and their perceptions of the available health services and their health needs. Students on both teams participated in interviews with key informants whenever possible.

Students in each group worked closely with CTY students throughout the research period. Because of our limited time in the field, CTY and UCD students developed a conceptual map defining the boundaries of Mondaña, developed the interview schedule and translated it into colloquial Spanish, interviewing each other about health practices in the US and in Ecuador, identified key leaders in Mondaña who would provide entrée to the community and whose sanction would be essential to doing observations and interviews and would serve as key informants about health. The local knowledge of the CTY students was essential to the UCD students’ correctly identifying structures and other key features of the landscape and to serving as translators. In turn, this process helped the CTY students to see aspects of Mondaña that they had previously not “seen” before or had taken for granted.

METHODS
To assess the health status and needs of Mondaña and to evaluate the filter project, consistent with the principle of RAP that requires the use of multiple sources of data (triangulation) to understand a given phenomenon in a short period of time, we employed a combination of participatory mapping, systematic observation, interviews with key informants and community members, and participation in the filter project.

The Filter Project
We began with an orientation to the project given by the Yachana Foundation’s director, Douglas McMeekin and followed this with participant observation of the assembly of the initial production of water filters (see results below). UCD and CTY students worked side by side, creating an organized production system with quality control. Members of the health team observed the puppet show created by the CTY students to teach about the filters, offering suggestions for improvement. The health team then developed a short form, linked to an Excel spreadsheet, to collect information at each delivery site to use as a baseline for evaluating the project’s success (see Appendix A). Two students from UCD accompanied CTY students at each visit to a surrounding community where they observed the delivery and installation of the water filters, the puppet show, and completed the data collection form, and spoke with community members and elementary school students about the project. Quantitative data, recorded by hand on printed forms was transferred at the end of the day to the Excel file for later analysis. Qualitative data were recorded in field notes and analyzed in team meetings each afternoon.
In addition to the data collected directly related to the filter project, these visits to outlying communities provided both teams with valuable information on the context in which the Colegio operated, including dominant agricultural practices, transportation and settlement patterns, social patterns, and a chance to speak with Colegio students who were on their breaks from school and living in these communities.

Delivering water filters to rural community

Community Health Assessment/Survey of the Physical Environment
After working closely with the CTY students to establish the boundaries of Mondaña, the team working on the physical survey created a detailed observation checklist and form for recording the physical characteristics of the village, concentrating on those related directly to health, e.g., water, sewage, trash disposal, physical hazards, shelter, electric power, and communications (see Appendix B). Because one of the students had skills in building survey and mapping, she created a sketch map of the community noting all the major building and physical features. The team then proceeded to fill in the details of the map, noting and identifying all structures and physical features, measuring the dimensions of buildings and their distances to one another and to physical features of the landscape, e.g., streams and paths. Notes on sights, smells, and behavioral observations were also recorded on the forms. The details of the map were then shared with the CTY students to verify their accuracy before a final map was created. This map was linked to data about each feature that was recorded in an Excel spreadsheet and analyzed to assess the types and numbers of physical structures, their condition, and their relationship to various services such as water, sewage, and trash disposal.

Community Health Assessment/Survey of Health Status and Needs
Together the health team, in collaboration with the CTY students, generated a list of key informants to interview about health status in the community including the full-time community health promoter at the clinic, teachers at the Colegio, the principal of the local elementary school, village leaders, and staff members of the Yachana Foundation and the lodge (see Appendix C). These interviews were held whenever it was possible and convenient for the interviewees and the interview notes were collected into a Word document that was subsequently coded during afternoon analytical sessions. In addition, this part of the health team worked with CTY students to create a simple survey of basic questions concerning health status and perceived needs. This survey was translated into colloquial Spanish. The president of the village (elected) was approached to secure his permission and support for the survey, and he and his wife helped to recruit participants from the community through a convenience sample. UCD students also tried to interview as wide a range of village residents as possible by age, gender, and occupation. Although we reached saturation of themes in this sample (no new themes emerged in the final
interviews), the survey’s results were necessarily limited by not being administered to a more systematic sample and by not being able to identify the characteristics of non-respondents to determine if they were significantly different from those who were interviewed. The results of the interviews were collected into a Word document and coded in the field.

Throughout the research, CTY and UCD students used their conversations with one another both to build rapport and teamwork, but also to learn a great deal about their respective views and assumptions about health and illness including such things as local remedies, common illnesses, vaccination rates, and desired (and actual) family size.

The map of Mondaña, the preliminary results of the survey, and our initial evaluation of the filter project were presented in Spanish and in English to the Colegio and community members on our final night in Mondaña.

RESEARCH OUTCOMES

The Filter Project
The central findings of this aspect of the health team’s research were 1) a detailed description of the process involved from selection of the project to its first phase of implementation, 2) tools to evaluate the project, and 3) identification of significant factors that might affect the success of the project (initial evaluation).

Providing clean water in a rural, tropical environment: The filter project arises from the efforts of the Yachana Foundation to provide alternative models of social and economic development to local communities from those being promoted by large commercial enterprises such as lumber and oil extraction. Their focus is on experimenting to find appropriate technology and appropriate institutions for adopting and disseminating that technology. A major cause of illness and death in children under 5 and of illness at all ages in Napo province are waterborne diseases. Although some villages have closed water systems that provide reliable potable water, many villages either lack any system or are unable to adequately clean and maintain their systems. Most adults we spoke with knew that rainwater, collected in a clean covered container was a good source of potable water in a tropical environment, only some households do this on a consistent basis. We were unable to ascertain whether this resulted from insufficient rainfall, insufficient storage capacity or other factors of convenience (a topic that bears future study). Thus groundwater in the form of streams and the Napo River are major sources of water for all purposes from washing dishes and clothing to carrying away human waste to drinking and food preparation. For example, in Mondaña we observed a young woman washing dishes in a small, slowly flowing stream downhill from a residence while humans, chickens, and pigs crossed it upstream. An assessment of patient visits to the clinic in Mondaña conducted in 2001 showed that almost half (42.9%) of the visits for children under the age of five were to treat waterborne gastrointestinal illnesses, i.e., parasites (29.9%) and diarrhea (13.0%) (Samaan et al. 2001).

According to interviews with community leaders, the region receives little support from the central government for installing and maintaining potable water systems and many communities lack the resources (time, energy, accountable personnel) to maintain centralized systems or
households and work sites are simply too dispersed in rough terrain for centralized systems to be feasible. Consequently, appropriate interventions to provide potable water need to be inexpensive, easy to maintain, durable, and simple to use (Sobsey 2002).

At the Colegio, one priority is to ensure students’ health by preventing the spread of infectious diseases, the most common being respiratory infections and waterborne diseases. The Colegio has a closed water system that is fed from a spring above the school, collected in a concrete cistern, disinfected with chlorine, and piped to the kitchen and bathrooms. Immediately outside the row of flush toilets are sinks where students can wash their hands after eliminating waste and another outside the kitchen and dining hall where they can wash their hands prior to handling food. Dishes are washed using potable water and allowed to air dry. Although students may occasionally drink from streams or the river while working in the fields, they are discouraged from doing so, and they carry water and other beverages with them to the fields. In their sciences classes, students learn about the parasites, viruses, and bacteria that cause diarrhea and how they infect human hosts by drinking water contaminated by infected human waste. The water filter project is thus a logical extension of health behaviors promoted at the Colegio.

Description of the process: Given the need for potable water in this region and the desire to provide simple, small filter systems that a household or school could easily use, the Colegio decided to invest in a portable water filter project as one of its micro enterprises. The goals of the filter project include:

1) Supply the means to bring potable water to elementary schools in the area;
2) Disseminate knowledge about waterborne diseases and how to prevent their spread;
3) Facilitate the adoption of simple, appropriate, and sustainable water filter technology, and;
4) Create a market for the water filters whose sale will eventually generate income for the Colegio.

Douglas McMeekin approached politicians from three surrounding provinces to secure their cooperation and support in installing systems in 7,500 elementary schools in the area, the majority of which are one-room schools with no potable water. To start the project, the Yachana Foundation received a grant of $45,000 from Oleoducto de Crudo Pesado (OPC, Heavy Oil Pipeline Association) to place five filters in each of 200 schools at a cost of $200/system plus $75 for educational materials.

Figure E: Water Filtration System (drawn by Amanda Israel)

The water filters are based on known technology using relatively inexpensive materials. The most important components of the device are two carbon colloidal silver ceramic filters made in Brazil. The ceramic portion has pores one micron in diameter that filters sediment and microbes and parasites. The silver is effective in killing microbes and parasites and the activated carbon removes
odors and tastes. Assembly is easy and takes approximately five minutes per unit including rinsing and drying the plastic buckets. The filter systems consist of two clear plastic 22 L (5 gallon) buckets with lids, also manufactured in Brazil, that are placed one on top of the other. See Figure E for a schematic representation of the filters.

It is important to use clear plastic, even though it is more expensive and fragile, because it is virgin and does not contain the potentially harmful chemicals that colored plastic, which is recycled, may contain. The filters yield 2L/hour of purified water, so it takes approximately 10 hours to completely filter an entire 20 L of water. Filtered water is 99.9% free of bacteria, amoebas and parasites. The filters should be cleaned periodically (gauged by the flow of water through the system) with a toothbrush and water. The recommended life of the filters is six months; however, at Yachana Lodge the filters, if maintained, have shown to have a life of 12-18 months. The price of a filter system for schools is $31.25 and for individuals it is $35.00. The Colegio plans to disseminate filters to 7,500 elementary schools in the Napo Province. Each school will receive five filters to serve an average school population of 25 students. It costs $200 to install five filters in a school (includes the costs of the filters plus the cost of transportation and basic education in their use).

In addition to assembling the filters, the Colegio students are responsible for creating and delivering a presentation about the filters, their care, use, and purpose, suitable for school age children, teachers, and members of the community. Unfortunately, the labels that were initially purchased for the filters that contain the name and address of the Colegio and its website did not adhere well to the plastic buckets. Fortunately, this means that the Colegio students, when the new labels arrive, will need to return to the communities to deliver the new labels, creating the opportunity for them to evaluate the use of the filter systems.
Assembling the filters before inserting into buckets

Assembled filter systems read for delivery

Explaining the Importance of Clean Water

Demonstrating Operation of the Systems

Demonstrating Operation of the Systems

Clean Water
The preliminary evaluation of this project suggests this is a relatively simple and appropriate technology for schools in this region; however, it also raised several concerns about its sustainability including cost, maintenance and convenience. We concluded this preliminary evaluation by developing a tool for collecting data regarding the use and maintenance of the devices. Further research will conclude whether this tool proved effective.

The cycle of contamination

Drinking dirty or contaminated water

Handling food and drinks with dirty hands

Fecal contamination of the water supply

Diarrhea & Parasites

Touching Feces

Washing Hands

Filtration system

Figure F: The Cycle of Contamination and points of intervention

Summary of key findings related to the water filter project:

- Clearly fills a need;
- Initial enthusiasm in the communities and among the Colegio students.
- Need for careful follow-up and support shortly after installation – are enough resources built into the plan to achieve this?
- Viability of long-term use given cost of replacement filters and time to collect and filter water, clean filters, etc.;
- Need for more rigorous evaluation design for future phases of the project;

Community Health Assessment
The key findings of the community health assessment provide a baseline picture of health status, resources, and needs in the village of Mondaña.
Any research into a particular community’s health must take into careful consideration the hygiene, sanitation, access to water and quality of water of that particular community. Through an analysis of the community, the Yachana lodge and the Colegio Técnico Yachana, through interviews, surveys of the physical environment, and participant observation the community health team was able to develop an overall understanding of the infrastructure of these three separate entities. While these three entities are linked economically, politically and culturally they face slightly different circumstances in regards to hygiene, sanitation and water.

During the course of our interviews with key informants, the community survey, and our informal conversations with residents, we obtain conflicting reports of the total number of residents in the village, ranging from 60 to 380 individuals or from 12 to 80 families. The household health survey that had recently been completed by the national Ministry of Health, which included a household census that would provide more accurate information on the community’s population, was not available for consultation at the time of our field study. As part of our community mapping exercise, we had an extended conversation with students at CTY who were also residents of Mondaña to define the physical boundaries of the village. The general consensus was that Mondaña included the central village with its residential area, an area on the opposite side of the Rio Napo adjacent to the market area of Agua Santa, where several related households reside and farm, and surrounding land from the river uphill to the “Segunda linea,” a line that runs parallel to the river two kilometers from its banks. One of the first projects that Yachana undertook was to purchase the land on which the village stands so that the villagers would have clear title to it.

The majority of residents in the village is engaged in a mix of cultivating cash crops, primarily cacao, for sale in local markets, and wage labor at Yachana Lodge or for oil companies operating in the region. There is a small cluster of buildings that form the core of the village (see building survey and map). Another major development project of Yachana was the building of a clinic in the village that opened in 1997. This project responded to a combination of factors including the health needs of the local community, their desire for better access to health care services, and from the need to provide emergency health care services and communication for the tourists staying at the ecolodge. Yachana initially fully funded the construction of the clinic facility, stocked it with equipment and supplies, and employed a full-time health care auxiliary (the equivalent of an RN in the US) and a full-time physician supplemented by physicians from other nations who served for shorter periods as volunteers. In 2004, the clinic’s management and primary funding, which had become a financial burden on Yachana, was turned over to the Ministry of Health. Yachana continues to pay the salary of a full-time health auxiliary who is a long-time resident of Mondaña.

As community interviews show, poverty and health are the most prevalent of concerns. At the core of these issues lay a need for clean water, medical attention, trash removal and functioning bathrooms. The water collection/purification procedures and trash removal in Mondaña are handled separately from the same procedures at the lodge and Colegio. Clean water is supposed to be accessible in Mondaña with maintenance carried out by a citizen of Mondaña and an individual from upriver. Water comes from a stream to a small reservoir to a system of pipes propelled by gravity and then to Mondaña. The water is accessible through six spigots scattered throughout the community. While this system could be highly effective, there seems to be a lack
of accountability on the part of the individuals who are supposed to maintain it. Surveys of the physical environment show that there are broken pipes and it appears to be very little maintenance in order to correct the problem. Community interviews reveal that the water tank does not receive proper maintenance and while chlorine is supposed to be added monthly there is no chlorine in the tanks. In addition, the six spigots which ultimately supply the supposed clean water to the citizens leaked contributing to a great amount of clean water waste.

This apparent disconnect with the water system and those who are responsible to maintain it prompts many individuals to resort to alternative methods of water collection and purification. Some boil their water while others drink, cook, do laundry, and bathe directly from the stream. This contributes to various health problems with common complaints including diarrhea, parasites and overall stomach problems.

The primary school located within Mondaña shares a water supply with Mondaña but teachers at the school are very consciousness to boil the water that the students drink. The government provides students of the primary school with bathrooms. These bathrooms are locked to ensure they are used only by students. This leaves the residents of Mondaña with only one bathroom located next to the community store has only one toilet, flushes properly and has a trash can, yet it is typically dirty since, as with the water system, there is no one with primary responsibility to maintain it. Both of the bathrooms for the primary school and the community are connected to septic systems which then drain to the river. There are no outhouses and community interviews along with a physical survey of the land show the jungle as the primary location for relief.

Trash is the responsibility of the municipality. However once again there is a lack of overall maintenance leaving individuals to use more traditional methods. Families in Mondaña individually compost. Trash is moved away from the homes and burned. In addition there is a landfill for inorganic trash. At the time of research, the landfill was full.

As community interviews, participant observations and the survey of the physical land show hygiene, sanitation and water is a growing concern. Many would like better hygiene for their children, but this is a difficult task: Chickens roam throughout the village; children do not wear shoes and often wear the same clothes day after day. There is generally no practical way to wash hands since few people have soap most of the time.

One of the central dilemmas in sustainable development is finding an appropriate balance between local initiative, participation, and responsibility and that of outside organizations, primarily NGOs but also local and national government, whose resources may be essential to keep a project running. Ideally, a community should, over time, be able to generate the revenues necessary to support a health care facility or a potable water or sewage system. In rural areas, because populations are so dispersed, this is often beyond the means small communities even in wealthy nations like the US. Given the realities of central governments that often do not place a high priority on rural health care, in this context sustainability often depends upon access to external resources. At this point, the residents of Mondaña and Yachana are working to negotiate an acceptable balance between internal and external resources and health infrastructure.
**Map of Mondaña**
The map of Mondaña was completed over a two-week period of measurements and systematic inventory of buildings with observation, when it could be done unobtrusively, of their use.

![Map of Mondaña](image)

**Figure G: Map of Mondaña (drawn by Cathy Covey and Tirshana Sharma)**

Common themes included:
- A need for additional bathrooms;
- Garbage management;
- Access to clean water;
- More medical staff;
- Increased food security.

Current strengths in the community included:
- Basic awareness of health and nutrition needs;
- Ability to come together as a community to achieve shared goals.

Based on our rapid assessment observations and interviews we have concluded that Mondaña would benefit from a full assessment of the current water system, additional sources of water (e.g., rainwater and water from rivers and streams) that are used for a variety of tasks including drinking, food preparation, washing dishes, and laundry, and how water is used in the community. This project would include systematic inventory and inspection of all water sources including water quality (e.g., bacterial levels and heavy metals), interviews about water use and sanitation practices, and observations of water use. Who collects water, how water is stored, who uses it and how, how water sources are classified by local residents, and how water is given to and used by infants and children would be key aspects of this assessment. A comprehensive assessment of sanitary systems and their maintenance, both human waste and trash, and community resources to install and maintain public toilets would be a useful second priority identified by residents of Mondaña.
A critical element of this assessment would be identifying the administrative structure, both formal and informal, in the community to determine the most feasible approaches to improving water, sanitation, and trash disposal. For example, the household water filtration initiative begun by the colegio could begin to address the need for potable water in a community and region with little government support.

Although not identified as a priority by residents of Mondaña, they would also benefit from basic first-aid education that is provided to the colegio and its students.

Finally, the UCD students suggested that a community garden could help fight hunger while bringing together members of the local community and students at the technical high school.

Yachana Lodge and Colegio Técnico Yachana

While Mondaña, Yachana lodge and the Colegio face many of the same issues when it comes to hygiene, sanitation and water there are also stark differences. First, guests, employees and residents of the lodge have access to purified water as do students at the Colegio. At the Colegio one of the goals is to teach the students proper hygiene, sanitation and the value of clean water hence there is community action in regards to these issues at the Colegio. First, Colegio students are trained on how to compost, proper washing techniques and the importance of purified water as shown by involvement in the water purification project.

The students learn how to use small landfills to dispose of inorganic material. They dig small holes and throw everything (except glass and cans) that cannot be composted into this hole. Once the hole is full they burn everything. They cover the material with palms and bury it to avoid contamination. Every six months the location of the landfill is changed. The concept and practice of composting is one that is very important at the Colegio.

In regards to washing, the students at the Colegio were very well groomed. Some showered two to three times per day. The Colegio itself was also very clean with strict standards enforced by administrator, and adhered to by the students.
Appendix A: Assessment Form for Baldes Project

PROYECTO DE LOS SISTEMAS DE FILTRACIÓN DE AGUA
DATOS BASICOS
Colegio de Yachana

Nombre de la Comunidad: _______________________________________________________

Nombre de la Escuela: _______________________________________________________

<table>
<thead>
<tr>
<th></th>
<th>Instalación</th>
<th>Visita 1</th>
<th>Visita 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nombre de investigador/a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fecha y hora</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Numero de alumnos</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Numero de maestro/as</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>¿Cuántos sistemas tiene ahora en la escuela?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>¿Cuántos sistemas funcionan ahora?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>¿Cuántos sistemas están limpios?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>¿Cuántos sistemas contienen agua filtrada?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>¿Hay un cepillo para limpiar los filtros?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>¿Cuáles son las piezas que les faltan los sistemas?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presentación – títeres o repaso</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notas (es muy importante de notar cuando personas en la comunidad compran filtros nuevos o sistemas nuevos para la escuela o para uso particular. Note la fecha y la cantidad de filtros o sistemas comprados.

Sugerencias

Encuesta:
1. ¿Quién está encargado/a de mantener los filtros?
2. ¿Cuántas veces cada día llenar el sistema?
3. ¿Cuántos de estos sistemas son usados?
4. ¿Es la cantidad de agua filtrada suficiente?
5. ¿Cómo funciona el trabajo de los filtros?
6. ¿Necesita respuestas nuevas?
7. ¿Necesita algunos sistemas nuevos?
8. ¿Hay otras sugerencias?
Appendix B: Building Inventory Form

Community Health Assessment Observation Checklist
Mondaña, Ecuador
January , 2007

<table>
<thead>
<tr>
<th>Item</th>
<th>Item of Observation</th>
<th>Building #</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Odors? Describe</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Battery</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Generator</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Gas (Propane) Tank</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Antenna</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Electrical line</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Visible Out House/ Latrine</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Visible Sewage Line</td>
<td></td>
</tr>
<tr>
<td>9</td>
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<td>12</td>
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<td>Collection Point</td>
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<td>Garden Vegetable</td>
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<td>Building Function Home</td>
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<td>Other, Describe</td>
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<td>Building Location GPS</td>
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<td>Structure A (Size)</td>
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<td>25</td>
<td>Structure B (Size)</td>
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<td>26</td>
<td>Structure C (Size)</td>
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<td>27</td>
<td>Pictures #</td>
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<td>Other Observations</td>
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Appendix B: Health Survey Questions
La Encuesta de Salud

Salud
1. ¿Cuáles son las preocupaciones de la salud en la comunidad de Mondaña?.
2. ¿Qué hace usted cuando está enfermo?
3. ¿Sus hijos son vacunados?
4. ¿Qué hace usted para mantenerse saludable?
5. ¿Cuándo veces visita la clínica?
6. ¿Qué cosas necesitan en la comunidad para mejorar la salud?

Agua
1. ¿Tiene usted agua intubado o purificado en su casa?
2. ¿Qué agua usa para lavar las frutas y vegetales y para cocinar?

Alimentación
1. ¿Cuál es su alimentación diaria?
2. ¿Usted produce su alimentación o cómprala?
3. ¿Sus hijos, que prefieren beber? Gaseosas o jugos naturales?
4. ¿La dieta de hoy es igual que la de antes?
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i At the time of the field school, the university was named the University of Colorado at Denver and Health Sciences Center following a consolidation of the University of Colorado at Denver campus with the Health Sciences Center. As of October, 2007, the consolidated entity is known as University of Colorado Denver.

ii In 2007 FUNDESESIN changed its name to Yachana Foundation.

iii The question of the ethnic composition, historical origins, and identity, both imposed and self-defined, of the population in this region is complex and beyond the scope of this report.

iv A severe winter storm prevented the class from meeting two of the five planned days; part of that lost time was made up in the field.

v There was one student from the Metropolitan State College of Denver (MSCD) and one student from the University of Colorado at Colorado Springs (UCCS) on the team; in the interest of brevity, UCD will be used to include all students and faculty.

vi The cycle of the school is designed to accommodate the maximum number of students with available resources. Students are resident at the school for 28 day blocks of time and in class 6 out of 7 days of the week, though Sunday is often a work day for community projects. In alternate 28 day cycles, one group of students returns home while a new group comes arrives. This intensive contact meets the “contact hour” requirement for national certification while permitting a larger number of students over the course of the academic year.

vii The only exception to the water problem in Mondaña is the clinic. The clinic originally funded and managed by the Yachana Foundation is now financed and managed by the ministry of health. The clinic has its own water system.