One Health Nicaragua Field Report
Summer 2014
University of California, Davis
Students of the School of Veterinary Medicine
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I. Introduction

In early 2012, the UC Davis School of Veterinary Medicine established a partnership with the UC Davis School of Medicine and Public Health Sciences, and began a collaboration to develop a One Health project in Sabana Grande, Nicaragua. The overarching objective of this project is to foster a One Health approach to international outreach by establishing an evidence based, interdisciplinary community health project and research platform. Acknowledging that human, animal, and environmental health overlap and interconnect, One Health seeks to promote, improve, and defend the health and well-being of humans and animals by enhancing cooperation and collaboration between physicians, veterinarians, environmental specialists and public health practitioners. The specific project goals are: to bring sustainable, interdisciplinary healthcare and economic development to the people and animals of Sabana Grande; to create a model for sustainable health practices that will be applicable worldwide; and to provide an educational and cultural experience for the students of UC Davis, in turn fostering global health leaders of the future.

Project Overview

The community of Sabana Grande is located in the mountainous northern region of Nicaragua, in the municipality of Totogalpa. For the past decade, it has been the site of an array of local and foreign partnerships that have resulted in the creation of a community that is empowered to improve their lives. Empowerment groups have formed that foster renewable energy, reforestation and local job creation.

In June 2012, our team investigated the overall health of Sabana Grande by conducting a needs assessment of human, animal, and environmental health conditions and gathered information about the existing health infrastructure in the community, and in the country at large. This pilot investigation provided us with demographic data, an understanding of the human and animal health issues present within the community, and a number of Nicaraguan partnerships that have allowed us to lay the groundwork for a lasting and sustainable One Health collaborative project.

Upon completion of our team’s needs assessment, we found that the greatest potential for sustainable change in Sabana Grande lay in improving access to human and animal health care services and the need for improved community health worker training and education. Minimal animal or human health services are available, with the majority of the health care burden falling on volunteer community health workers, who do not feel adequately prepared to address the greater health needs of their community. Furthermore, surveys identified that livestock and poultry play an important role in household livelihoods as valuable food sources and supplemental sources of income. However, nutritional deficiencies and a high disease burden in cattle and poultry limit milk and egg production. In addition, the human population of the region is afflicted with conditions common to impoverished areas such as diarrheal disease, respiratory illness, malnutrition, and tropical disease. The burdens of illness and limited access to health services place both health and financial strains on the community. With effective preventative care and education, it is our belief that these conditions can be sustainably improved, and can have a sizeable impact on the economic growth and health of the community.
Given the receptivity of the community and the existing framework for empowerment groups, our team saw the potential to create a community-based health cooperation that would bring together animal and human health workers within Sabana Grande, providing them with a platform to tackle health concerns from a more holistic standpoint. Alongside our public health partner, we assisted in the formation of a Health and Welfare Cooperation (Cooperation) in January 2013. The members included government trained human health volunteers (brigadistas) and animal health volunteers (veterinary promoters). This cooperation is a locally-driven group that will serve the community in a stand-alone format while simultaneously providing a framework for a longitudinal study and platform for UCD involvement.

In June 2013, our team returned to Sabana Grande to conduct educational workshops aimed to promote the connection between poultry and livestock health and community welfare, and to provide information about communicable disease identification and prevention and food safety. These workshops were facilitated by UC Davis graduate and professional students and overseen by UC Davis faculty members. Participants included the Cooperation, local teachers and community leaders. Preliminary surveillances were conducted regarding the health of livestock and poultry through household surveys and physical exams. These community conversations suggest that cattle and poultry have nutritionally poor diets and are highly susceptible to easily preventable diseases. Secondly, there appears to be some community confusion regarding the distinctions between different classes of pharmaceuticals, such as vaccines, antibiotics and vitamins.

2014 Objectives:
In 2014, community interventions and field research continued to focus on poultry and livestock health. In addition, a major aim was to develop transdisciplinary collaborations within the community and in Davis. The specific 2014 objectives are outlined below.

i. Multidisciplinary Outreach: further develop the transdisciplinary, collaborative focus of this One Health project, by recruiting graduate student researchers and faculty members from outside the veterinary health sciences.

ii. Information Exchange: improve community and student understanding and use of basic preventative veterinary medicine measures through educational workshops

iii. Research: conduct a community-wide poultry and livestock health assessment to gather baseline data regarding poultry and livestock health needs and community access to poultry and cattle veterinary care.

II. Overall Project Design
We propose a model for community outreach that addresses the need-based concerns of the community through informational modules and clinical workshops for human and animal community health workers, local leaders and other local stakeholders. This project is designed to be asset-based and evidence-based, utilizing locally available resources and limiting interventions to community identified areas of need. Interventions are planned based on thorough investigations and in conjunction with community support and agreement. This model, which utilizes bi-directional information exchange and actively engages the community at every step of the development process, provides the project and the community with a sustainable method of regional information dissemination and enhances the cultural and educational
experiences of the community members as well as those of the students. The goal is to not only improve health and welfare but also ensure continual communication, collaboration and cross-disciplinary learning.

III. Multidisciplinary Outreach

*Methodology*

During the fall of 2013 students in One Health Nicaragua reached out to graduate students in the International Agricultural Development program at UC Davis and the UC Davis Medical School to recruit other students to the project. Emails were sent to contact people in each department and a presentation was made to medical students. Emails were sent to UCD Medical School, the UCD Forestry department, the UCD College of Agriculture and Environmental Science, UCD Masters of Public Health program and the UCD Masters of Preventative Medicine program. In the summer of 2014, while in Nicaragua, students met with the dean of the medical school in Leon and the assistant dean of the veterinary school to discuss future involvement in the project.

*Outcomes*

In Fall 2013 two international agricultural development (IAD) students joined the project, focusing on land-use assessment and improving cattle nutrition. They are now involved in recruiting new IAD students to the project for the 2014-2015 season.

In June 2014 progress was made to establish collaborations with the University of Leon. Three members of One Health Nicaragua met with administrators of the Veterinary and Medical School at U Leon. Details of the meeting are discussed within the “In-country Field Work” section. Key points of the meeting were:

1. Nicaraguan veterinary students must complete a field practicum as a graduation requirement.
2. The Nicaraguan administrators are interested in developing a joint research project with UCD.

As a result of the meeting in Leon, students received the contact information for the Assistant Dean of the veterinary school. Future aspirations are to have Nicaraguan veterinary students engaged in the project to develop project sustainability, but follow up communication with the veterinary school is needed.

IV. Workshops

*Methodology:*

*Topic Selection*

Workshop topics were decided based on the educational needs or knowledge gaps within the community. These needs were identified during previous surveys and by members of the Cooperation. Once the specific topics for the summer 2014 workshops were chosen by students at UC Davis, they were presented to the Cooperation for further feedback. The topics this year were all deemed agreeable and students from the UC Davis Veterinary School and the International Agriculture Development program worked throughout the 2013 and 2014 school year on workshop design.
Topics chosen for 2014 were:
1. Train the Trainer
2. Poultry disease prevention: Biosecurity and vaccination
3. Introduction to pharmaceutical classes
4. Tick disease and prevention

**Structure**
The workshops were designed to engage adult learning and enhance memory. Based on resources compiled, clear learning objectives that are repeated throughout the session improve retention. Therefore, each workshop highlighted several main points for a two hour session. These points were repeated throughout the session, on written materials and verbally at the conclusion of the presentation.

To improve audience participation, we incorporated many small group activities, such as designing a vaccination schedule based on when disease symptoms tend to appear locally. The small groups were also encouraged to present their results to the whole group. This method improves both presentation skills and knowledge exchange between members of the community and ourselves.

**Learning objectives for each workshop:**

1. **Train the Trainer**
   1.1. What a goal is and how to set one for a presentation
   1.2. The importance of explaining to an audience why they are at the presentation
   1.3. The importance of understanding your audience
   1.4. Possible audience motivations in the community
   1.5. How to appeal to your audience through logic, emotions and values
   1.6. Individuals of different backgrounds/gender/ roles in the community with different learning styles
   1.7. Types of different learning styles (given in a list) and examples (activities, actions, materials) on how to appeal to those different learning styles

2. **Poultry disease prevention: Biosecurity and vaccination**
   2.1. Become aware of Newcastle disease
   2.2. Understand negative impacts of Newcastle disease
   2.3. Recognize the 3 major clinical signs of Newcastle
   2.4. Understand that Newcastle disease kills many birds quickly
   2.5. Understand transmission of Newcastle
   2.6. Recognize potential biosecurity strategies
   2.7. Introduction to vaccines & how chickens fight disease
   2.8. Important principles of vaccinating poultry for Newcastle Disease
   2.9. How to use vaccinations as an effective tool of disease prevention

3. **Introduction to pharmaceutical classes**
   3.1. By the end of the workshop participants will have a basic understanding of what the
following are and what their purpose is:

3.1.1. Vaccines function to **prevent** disease, each vaccine prevents a different disease
3.1.2. Antibiotics function to **treat** disease, specifically disease caused by bacteria
3.1.3. Antiparasitics function to **prevent/treat** parasites
3.1.4. Vitamins + supplements

3.2. Participants will receive and know why and how to use a health record card

4. Tick disease and prevention
   4.1. Audience will understand why understanding ticks and their diseases is important
   4.2. Audience will understand basic tick biology
   4.3. Audience will be able to recognize common clinical signs/symptoms of prevalent tick-borne diseases in humans and domestic animals
   4.4. Audience will learn how to properly remove ticks
   4.5. Audience will know basic strategies for minimizing tick exposure
   4.6. Health workers will be able to share information with broader community

**Materials:**
All workshop materials (both oral and written) were checked by faculty mentors for factual correctness and comprehensiveness. All translations were checked by native Spanish speakers. This summer we utilized a local translator during our oral presentations.

**Evaluation:**
Workshops evaluations were completed attendees immediately after the event. These evaluations asked a few skill testing questions to see if the main learning objectives had been conveyed. There was also space provided for general comments on the structure and content of the workshops. Evaluations were also left in Sabana Grande to be completed in September to assess retention of the concepts we discussed. These surveys will be collected during the stakeholder meeting in Sabana Grande in December 2014 and then assessed.

**Outcomes:**
From this summer’s workshops we found the following work well:
- Small groups work very well, everyone is eager to be engaged and participate so having small groups discuss and present was very successful.
- We offered tea and snacks for half day sessions and lunch for full day sessions, these provided much need refreshment for everyone.
- Skits, specimens and microscope slide readings garnered a positive reaction.
- Short presentations kept participants more engaged. Presentations lasting two hours with a tea break in between the hours seemed to go best.
- Engaging local knowledge was very useful. For the pharmaceutical workshop we had a local nursing student explain how a vaccine card works. This sparked interest in other attendants that suggested we design these for the animals - which is what our hope was!
At each workshop attendees were asked to fill out a quick evaluation. One evaluation question had raters select a face that matched how they felt about the workshop. There were six faces from very happy (6/6 happy) to very sad (1/6 happy). We also noted down some successes and challenges from each workshop. Attendance and details for each workshop were:

1. **Train the Trainer**
   1.1. Attendance: 4 people
   1.2. Rating: 3 rated the workshop 6/6 happy, 1 unrated
   1.3. Challenges: lack of attendance, much of the material presented seemed to be too abstract, learners were not fully engaged. We think this workshop could be repeated with a larger crowd that allows for more small group work and immediate use of topics discussed.
   1.4. Successes: Following the workshop Hilario, a veterinary promoter, hosted his own workshop on poultry vaccinations.

2. **Poultry disease prevention: Biosecurity and vaccination**
   2.1. Attendance: ~14 people
   2.2. Rating: 13 people were 6/6 happy with the workshop, 1 unrated
   2.3. Challenges: Though this workshop was written and designed by students, Dr. Gallardo (a poultry veterinarian) was the primary speaker during the workshop. We hope to have the workshop be more student run next time. Future workshops could be more engaging by having a chicken present to demonstrate vaccinations.
   2.4. Successes: Audience was very engaged throughout the presentation and asked lots of questions. Audience was eager to work through a vaccination plan for the town of Sabana Grande.

3. **Introduction to pharmaceutical classes**
   3.1. Attendance: ~19 people
   3.2. Rating: 16 people were 6/6 happy, 1 person was 5/6 happy, 2 unrated
   3.3. Challenges: This workshop was very long (approximately three hours in length). While a lot of information was covered, participants seemed more distracted for the last hour.

![Example of a vaccine plan from one of the workshop attendees.](image)
3.4. Successes: During the workshop the audience had a light bulb moment when they realized what a vaccination was. This will help clarify language and survey questions/answers in the future.

4. Tick disease and prevention
   4.1. Attendance: ~17 people
   4.2. Rating: 12 were 6/6 happy, 2 people were 5/6 happy, 3 unrated
   4.3. Challenges: This workshop was geared towards children, but only a few showed up. This workshop occurred after a long and challenging workshop on pharmaceuticals, so both participants and leaders were tired.
   4.4. Successes: This workshop used a lot of games and skits that were popular with everyone, but especially younger audience members. It was easily adapted for a school class.

V. Surveys

Methodology:

Subject Matter
Survey questions were designed to fall into seven main categories: General information on poultry production, General information about chicken management/husbandry, Information about poultry health, Newcastle specific information, General information on livestock production, Information about livestock health, veterinary pharmaceutical use, and basic demographics. We hope to use data on poultry and livestock production as baseline data from which we can measure impacts of various projects. Poultry and livestock health questions provide baseline data, but also shed light on current health concerns we could design workshops to address. Newcastle specific questions were asked to gather information on awareness of the disease before workshops so we can compare to after workshops. Basic demographic data allows us to have a better understanding of the make-up of the community.

Question Design
Questions were a mix of close ended, coded questions and open-ended questions on animal health and concerns. These questions were designed with assistance of faculty mentors experienced in surveying. We consulted Dr. Martin Smith and Dr. David Bunn to aid in question design. Carolina Vicario and Blanca Camacho (members of One Health Nicaragua) translated the questions. After questions were designed they were submitted to the Institutional Review Board (IRB) for approval. This approval is needed if the results are to be published. The 2014 surveys were determined to be IRB exempt.

Study Area and Participants
50 households with chickens and/or cattle were surveyed in Sabana Grande (46) and Santo Domingo (4), Nicaragua. Four sub-communities were surveyed within the larger community of Sabana Grande: Twenty-four households in Fraile, thirteen households in La Palmera, three households in Tinajilla and two households in Sabana Grande (a subcommunity of Sabana Grande proper). A convenience sample was used in which survey candidates were found by going door-to-door and requesting an interview. A disclaimer explaining the purpose of the survey, the anonymity of the survey, and how the survey was voluntary was read to each participant.
Outcomes:

Community Demographic Data Survey Results
Of the fifty households surveyed 96% had chickens, 48% had cattle, and 36% had pigs. 28% of the households reported being surveyed last year in 2013.

34% of households were part of Bono Productivo, a national government-sponsored program to provide food animals to low-income women. 18% of households were part of Solar Women, a community-based women’s empowerment group in Sabana Grande.

14% of those surveyed reported having no formal education. 50% had a primary school level of education and 24% had a secondary school level of education. 4% had university level education and 2% had nursing school education. 6% did not report.

Poultry Survey Results

Demography
Forty-eight (96%) of surveyed homes owned poultry. On average, families owned 17.41 ± 13.7 chickens.

12 homes (25%) buy chicks to raise, eight of which buy from neighbors. Fifteen homes (31.3%) buy adult chickens to raise, thirteen of which buy from neighbors. No homes reported buying chickens or chicks from chicken traders or bird markets. Further inquiry revealed that chicken traders and bird markets do not exist in the region.

Husbandry
Most households reported that their chickens sleep in trees and bushes around the home (52%) or in a coop (39.6%). 89.5% of households reported changing the water for their chickens at least once a day.

Production
The average number of eggs collected in the week prior to the interview was 14.01 ± 13.3 (n=47). On average households sold 9.4 ± 18.38 eggs last month (n=48).

Households sold an average of 12.3 ± 43 (n=48, range 0-288) and consumed 8.1 ± 6.6 of their chickens last year (n=44).
Disease Occurrence in 2013 and 2014

An average of $5.01 \pm 7.68$ (n=41, range 0 to 36) chickens per household were lost or died this year. An average of $9.62 \pm 14.87$ (n=46, range 0-78) chickens per household were lost or died last year.

Illness was the most commonly reported reason for chicken losses in 2013, with 74.2% of households reporting illness as a factor (n=31). 48.39% of households specifically self-reported that they believed “murina” to be the cause of losses in 2013. Illness, predation and theft were all commonly reported as reasons for losses in 2014 (n=24). Only 4.1% of households specifically reported “murina” as contributing factor to losses in 2014.

65% of households (n=43) reported that they had sick birds in 2013, while 36% of households (n=36) reported sick birds in 2014.
96% of households reported deaths due to illness in 2013, while 67% of households reported deaths due to illness in 2014. In 2013, 82% of households with dead chickens reported deaths of chicks. In 2014, 0% of houses reported deaths of chicks due to illness.

Newcastle Awareness & Prevention
Thirty-five (70%) of households were not aware of Newcastle disease, while thirteen (26%) were aware of Newcastle disease. Of those households familiar with the disease, five (38%) reported having witnessed the disease in their home or at the home of a neighbor, while 8 (62%) reported no experience with the disease. It is important to note that many people in the community are familiar with the term “murina,” which is used to describe severe disease in animals including poultry, and likely encompasses Newcastle disease. When surveyed about Newcastle awareness, interview subjects were specifically asked about their familiarity with the term “Newcastle.”

Twenty-four (48%) of households did not vaccinate for the disease last year. Eighteen (36%) reported vaccinating for the disease last year, however, this may be a liberal estimate as some poultry owner’s may have administered injections or vaccines for other diseases. Of those which reported vaccinating last year, eight (44%) vaccinated once and 50% vaccinated twice. No household reported vaccinated more than three times a year for the disease.

Discussion of Poultry Data
The results of the survey indicate that poultry are an important and popular food animal species in the communities of Sabana Grande and Santo Domingo. They are raised for both meat and egg production for
personal or familial consumption and for sale. Birds are typically acquired locally. Chickens are generally kept in or around the home. Fresh water and supplemental feed are provided regularly by most families.

Losses of chickens are regularly reported and are most often due to disease, theft or predation. Many people reported losing chickens to domestic cats, domestic dogs and wild cats. Many households reported losing chickens to disease in 2013 and described clinical scenarios consistent with a highly pathogenic disease that killed most of the flock within a matter of days. Clinical signs consistent with Newcastle disease, such as sudden death, green diarrhea and twisted neck, were also inconsistently reported. By June 2014 when the interviews were conducted, people reported significantly fewer losses of poultry to disease for the current year. This may be associated with persistent drought conditions experienced in 2014 but causation can be determined.

The term “Newcastle” is not widely known in the community. Vaccination for the disease is also reportedly uncommon and no members of the community reported vaccinating more than twice for the disease during the last year.

**Cattle Survey Results:**

**Demography and Production Goals**

Twenty-four (48%) of surveyed homes owned cattle. On average families owned 4.5 ± 4.8 female cows with a range of 0-19, an average of 0.7 ±0.9 bulls or steers with a range of 0 - 2, and an average of 1.7± 2.4 calves with a range of 0 -11. Fifty percent of the families obtained their cows within Sabana Grande or the neighboring community of Santo Domingo. Another 23% of families obtained their cows from the government program, Bono Production. The rest of the families got their cows from relatives, raised calves from their own herd, or purchased the cows from one of the nearby towns. A subset of these families (n=6) were asked about their production goals for their cows and milk production predominated over meat production. All six families produced milk for home consumption. Three of the families also sold excess milk when they had it. Only one family raised cows for meat consumption.

**Husbandry/Nutrition**

Most families (83%) provide their cows with well water placed in a tank. All surveyed families changed this water at least every two days, and 91% changed the water every day. The majority of families (61%) had their cows on pasture or fed their cows food they grew themselves. Only 9% of families only purchased food, and 30% of families used some combination of pasture and purchased food depending on the time of year. Commonly feed was purchased in the dry season and pasture was used in the wet season. When specifically asked if they purchased food for their cows, 80% of families indicated they purchased feed for at least part of the year. Sixty-four percent of families owned the pasture on which their cows grazed, while 23% rented land, and 9% both owned and rented land.

**Production**

This summer cows were producing on average 3.9 +/- 3.8 liters of milk/per cow/per day. The typical change in milk production between the wet and dry seasons was hard to quantify based on the answers provided. A frequent response was about a 50% drop in milk production during the dry season, however,
answers were highly variable and a complete cessation of milk production in the dry season was also a common answer.

**Health/Pharmaceutical Use**

When a cow gets sick 68% of families contact a vet in one of the nearby towns (Ocotal, Totagalpa, Somoto). Fourteen percent of families treated their cows themselves. No families indicated they contacted a veterinary promoter. Every family indicated they give their cows some sort of medication when sick. The types of pharmaceuticals used are listed below.

*Percentage of Families Using Different Types of Drugs on their cows (n=22)*

- **Vaccines (32%)**
  - Blackleg (32%)
  - Anthrax (32%)
- **Antibiotics (27%)**
  - Oxytetracycline (18%)
  - Others mentioned:
    - Dipron
    - Trimethoprim sulfa: 1
- **Antiparasitics (82%)**
  - Unspecified (45%)
  - Ivermectin (45%)
  - Others mentioned:
    - Diclovan
    - Albendazole
    - Tristesan
    - Fumigation
    - Levamisol
- **Vitamins (73%)**
  - Unspecified (41%)
  - Some type of B vitamin (36%)
    - Hetofor B12
    - B complex vitamins
  - Combination of A, D, and E (14%)
    - Silvermec ADE
    - Vigoravit A D3 E
  - Others
    - Formula ganadera
    - Extracto do higado vitamindo
    - Coloidal (D and B12)
    - Ataxar
- **Minerals (5%)**
- **Hormones (9%)**
Interestingly, when specifically asked about vaccines for blackleg and anthrax, 90% of families indicated their cows had received those vaccines. Eighty-three percent of families indicated their cows received the vaccines once a year and 17% indicated this occurred twice a year. Nearly 50% of families purchase these vaccines in a nearby town while 32% receive these vaccines from Bono Productivo. For those who purchased vaccines, 80% gave the vaccine within the same day and 100% indicated they transported vaccines on ice.

Most families (74%) had seen ticks on their cows, but only 53% indicated their cows appeared sick when they had ticks. All families surveyed treated their cows for ticks. Most families use multiple treatments for ticks including Ivermectin, oxytetracycline, fumigation, and unspecified antiparasitics.

Fifty-nine percent of families obtain their pharmaceuticals from a veterinarian in Ocotal, 18% from a vet in Somoto, and 9% from the Bono Productivo technico. No one indicated that they got their drugs solely from a veterinary promoter. A majority of families (62%) administer drugs to their cows themselves. Fourteen percent of families have a technico administer drugs. Fourteen percent of families indicated it was a combination of themselves, a vet, technico, or a vet promoter who administered drugs.
**Additional questions:**
Towards the end of conducting surveys, with the input of Dr. Maier, a systems check was added to the survey with some additional questions about production goals, nutritional supplementation, source of feed, and reproduction. The following results were only collected from seven families.

**Production Goals**
All families produced milk for personal consumption (n=6) and half the families (n=3) said they sold milk when production was high. Only one family raised cattle for personal meat consumption and for sale.

**Husbandry**
Eighty-three percent (n=6) of families provide some sort of nutritional supplement regularly to their cows. Two-thirds (n=6) of families used silage, which ranged in contents from a combination of mineral, molasses, and grass to corn. Half of families (n=6) cut hay to feed later. Grass cut to make hay or silage is always cut when it is dry and not when green.

**Reproduction**
All families said their cows gave birth somewhere between every one to two years. Two thirds of families (n=6) first bred their heifers when they were 3-4 years of age. Sixty percent (n=6) of households currently had pregnant cows. Fifty percent (n=6) of households reported difficult births in their cows. Two of those families called a vet when this occurred and at the other household they handled the birth themselves. Fifty percent (n=6) of households also reported having had abortions amongst their cows. Bulls selected for breeding belonged to the household (2), belonged to a neighbor (2), were rented (1) or artificial insemination was used (1). Eighty percent (n=5) of families did not castrate their bull calves. One family explained that they only castrated bull calves they planned to keep.

**Systems Check**

Results of a series of systems check questions for seven cattle-owning families are presented below.

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**Systems Check for Cattle**

![Bar chart showing systems check results for cattle]
Discussion of Cattle data:
While we have previously heard anecdotally that most families within Sabana Grande were given their cows by the Bono Productivo program, in actuality half of surveyed households say they’ve obtained their cows from within the Sabana Grande and Santa Domingo communities. Bono Productivo has still provided cows to a substantial portion (23%) of interviewed families. However, we need to consider that only about a quarter of cattle owners in the community may have access to resources provided by the Bono Productivo program. Other families may not be willing to seek out or may not be able to obtain help from a veterinary promoter or bono producto tecnico.

Questions about production goals were added on at the suggestion of Dr. Maier towards the end of our surveying. While the preliminary results from six families confirm that milk production is a primary goal, this is a valuable question to ask of more cattle owners in future surveys. Three families mentioned that they sold milk when extra was available, suggesting that future work to improve milk production may help to increase household income. This is a valuable survey question and should be asked of more cattle owners in the future. Changes in milk production between wet and dry season were challenging to quantify based on the answers provided. Responses seemed to range from a 50% to 100% reduction in milk production, but if such information is sought in the future more specific questions are needed to obtain the desired information.

Surprisingly cattle owners are not contacting veterinary promoters when their animals are sick or when they are in need of medications for their cows. The majority of cattle owners contact veterinarians when their cattle are sick or they need to purchase medications. This may be because families that own cattle have more disposable income available and thus can seek advice from a veterinarian. As we move forward in supporting cattle owners we need to be aware that veterinary promoters are not their primary contact and thus educating veterinary promoters may not be the best way of disseminating knowledge to cattle owners.

While we were able to compile the start of a list of pharmaceuticals used by cattle owners this summer the responses varied from general products (e.g. vitamins) to getting very specific information from the bottles directly (e.g. Hetofor B12). When asking broadly what medications are used, some medications are likely to be left out. This may simply be because they are forgotten or because what they consider a medication is not what we consider a medication. For example, when asked what medications they gave their cows only 32% (n=22) of households mentioned vaccines for blackleg and anthrax. However, when specifically asked whether their cows had received vaccines for blackleg and anthrax 90% (n=22) of households confirmed that they had. This demonstrates the need for more focused, less open-ended questions.

Two areas stood out where cattle owners seem quite knowledgeable: vaccine use and need for fresh water. As mentioned above 90% (n=22) of households own cattle that have been vaccinated against anthrax and blackleg. Additionally vaccination is occurring at least once a year in 100% of those being vaccinated and twice a year in 83%. If this area is to be pursued further, we should examine how often these specific vaccines need to be given to be effective. All cattle-owning households who purchased
vaccines in a local town expressed an understanding of the importance of the cold chain and said they carried vaccines on ice until administered. All cattle owners regularly changed water containers, suggesting they understand the importance of freshwater for their animals. The systems check added at Dr. Maier’s suggestion is a much better way of gathering information on cattle health than simply asking if their cattle have had any health problems in the last year. This allows us to determine which body systems are causing the most problems and are need of better care. While only seven households were asked system check questions this year, reproductive health and lameness seem like potential avenues for future workshops.

**VI: In Country Field Work:**
Between June 2 and June 28, the One Health Nicaragua team was in the community of Sabana Grande. The team consisted of 6 UCD veterinary students, 3 UC IAD students, and 2 UCD faculty mentors.

*Week 1: June 2 – June 5*
The main accomplishments of the first week in Sabana Grande were choosing the dates for educational activities that would happen over the next 2 weeks, reconnecting with community contacts (Susan Kinne, Dr. Freddy, Hilario), conducting the ‘Train the Trainer’ workshop, and initiating household surveys. Additionally, the team held the first community-wide meeting with the objective to introduce new team members to the community, promote the upcoming educational workshops, and discuss the concept of One Health as it applies to life within Sabana Grande. Meeting details and important outcomes are outlined below.

*June 2 – Organizational Meeting with Susan Kinne & Brief Introductory Meeting with Cooperacion representatives:*
Throughout the year, Susan Kinne is our main contact within the community because she has the most reliable access to the internet and her relationship with the community has been very important in developing our partnership with the community. In the afternoon, we meet with community representatives to confirm the workshop dates and discussed the best way to advertise attendance. The community representatives were the Solar Mountain interns: Meyling, a nursing student, Yeiling, a literature student and intern in childhood education, and Diana, a sociology student and intern in childhood development in community, Hilario (veterinary promoter), and Mayra (brigadista). We also learned about a new youth group (of 7th and 8th graders) in the community called San Sun: Seguridad de Ailementario y Nutricion, which focuses on food security and sovereignty. The group is coordinated by Susan Kinne with Nicaraguan government and EU sponsorship, Plan Nicaragua and INSOFP.

*June 4 – Salud Integral en Sabana Grande*
This meeting was organized by Susan and run by the veterinary team. In attendance were the: SanSun members and government representative, the brigadistas, the veterinary promoters, and the solar agro-ecological promoters (adult solar mountain group). The medical students part of the UC Davis MEDICOS program were also able to attend this One Health meeting. The meeting began with introductions and a brief overview about the concept of One Health and the interconnectedness of the health of humans,
animals, and the environment. In order to engage the audience in thinking about how One Health applies to life in Sabana Grande, the audience was divided into small groups and had each small group brainstorm the top 3 health concerns for humans, animals and the environment. Then, all together, we discussed what each small group had come up with. The topics are outlined below. Interestingly, there was a lot of overlap between the groups.

<table>
<thead>
<tr>
<th><strong>Animal Health Concerns:</strong></th>
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<tbody>
<tr>
<td>- Morena in the chickens x 3</td>
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<tr>
<td>- Pox (buba) in the chickens x 2</td>
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<tr>
<td>- Respiratory problems (mosquillos) x 2</td>
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<td>- Hunting by wild cats</td>
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<td>- Hunger in the dry season (la sequilla) x 2</td>
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<td>- Cattle nutrition x 2</td>
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<tr>
<td>- Ticks</td>
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<td>- Flu in dogs (morena in dogs)</td>
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<td>- Lack of treatments and vaccines for animal health</td>
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<tr>
<th><strong>Human Health Concerns:</strong></th>
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<tr>
<td>- Illness with the changing seasons (los cambios climaticos) x 2</td>
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<tr>
<td>- Chronic illness</td>
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<tr>
<td>- Environmental contamination</td>
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<tr>
<td>- Pneumonia x 2</td>
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<td>- In the summer there are many people that suffer from ‘the pressure’</td>
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<tr>
<td>- Pneumonia – light or serious</td>
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<td>- Especially in the children and old people</td>
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<tr>
<td>- Diarrhea x 3</td>
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<td>- Dengue x2</td>
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<tr>
<td>- Intestinal infections</td>
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<tr>
<td>- Cough</td>
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<tr>
<td>- Flu x 2</td>
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<tr>
<td>- Hygiene around the house</td>
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<tr>
<td>- Virus</td>
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<th><strong>Environmental Health Concerns:</strong></th>
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<tr>
<td>- Water contamination x 2</td>
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<tr>
<td>- Burning (la quema) x 4</td>
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<td>- Forest fires</td>
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<tr>
<td>- Deforestation x 4</td>
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<tr>
<td>- Trash and litter</td>
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<tr>
<td>- Extinction of animals</td>
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As a follow-up question, we asked each group in attendance to share how they are addressing these concerns, what successes they are most proud of, the biggest challenges they foresee, and how the UC Davis team can work in partnership with the community to overcome these challenges. Unfortunately, due to time limitations, we were unable to hear from all the participants, but we did hear from a representative from the brigadistas (Mayra) and the veterinary promoters (Hilario). The brigadistas work a lot in improving infant and maternal health and are proud of improving nutrition (like through programs promoting the use of natural pesticides). Also, they weigh children every month (and follow up with those that do not show up) and proactively making sure children get vaccines (involving mothers in the vaccine plan). They can refer those who are malnourished and those with pregnancy problems to clinic. Hilario spoke about his role helping exchanges with UC Davis and sharing what we are studying and relating to what is happening in the community. He has challenges with vaccinations because of cost, the difficulty of collecting the chickens, and general lack of participation. He voiced that we can help him promote chicken health through the interviews and talking to households about chicken health.

Other important outcomes of the meeting included an overview of the SanSun from Pedro Reyes and the connection of the UC Davis medical students and the brigadistas. Pedro took a moment to discuss the SanSun and the groups objectives for food security, water and soil conservation, and nutrition.

**June 4 - Interview with Hilario**

On June 4th Sam and Laura interviewed Hilario. He feels the biggest health concerns for poultry in the community is flu or death when the season changes. For cows the biggest concerns are ticks, torsalo, and nutrition in the dry season. Two pigs died of a respiratory problem, but there were no other major problems for pigs. Hilario is mostly contained for cattle problems. Most people want him to give a prescription because he’ll do it for free and vets are too expensive. Vaccination programs do exist for blackleg and anthrax. The vaccines are not free and the technicians come around twice a year to give them. Bono Productivo meets every month. Hilario feels the community is most in need of a veterinary pharmacy and that people need education on what feeds to give their cows during the dry season.

**June 5 - Interview with Juan Jose**

On June 5th Laura and Hannah interviewed Juan Jose, another veterinary promoter. He agreed with Hilario that the major health concerns for chickens were pox and flu when seasons changed, dry season nutrition for cattle, and the respiratory problem for the pigs. People ask him for help when seeking a prescription. He explained the three stages of Bono Productivo. First people receive a cow, then a pig and chickens, and then goats and sheep. He said most people sell these animals right away. He also agreed that the community most needed a veterinary pharmacy.

**Week 2: June 9 - 13**

On June 9, half of the team traveled to Leon to meet Dr. Gallardo and Dr. Michael Wilkes at the University of Leon, Medical School for a meeting with the deans and administrators of the Medical School and the Veterinary School. The meeting was organized by Dr. Wilkes, with the objective to work towards a more formalized ‘One Health’ partnership between UC Davis and the University of Leon. The meeting was attended by three UC Davis veterinary students, two UC Davis medical students, two
University of Leon medical students. Dr. Wilkes introduced how UC Davis approaches One Health and the ways it is incorporated into the different curriculums. Dr. Gallardo shared the progress that the One Health Nicaragua project has made in Sabana Grande, especially in regards to poultry health and vaccinations. After the meeting the group toured the veterinary facilities. There appeared to be a lot of enthusiasm to pursue a potential partnership with the University and to possibly organize the incorporation of Nicaraguan veterinary students in the project. The rest of the week was focused on completing the planned educational workshops on Poultry Health and Vaccination, Pharmaceuticals, and Tick-Borne Diseases.

**Week 3: June 14 - 20**

On June 14, the veterinary team and Dr. Maier went to Ocotal to interview Dr. Freddy. There was discussion of a variety of topics concerning cattle health. Dr. Freddy emphasized that ivermectin is used ubiquitously and that there is resistance to it. He noted that he never sees anthrax in the region and that papillomatosis is a common problem in livestock and that it is practice to administer an intramuscular injection of blood from another animal as treatment. Nutrition is a significant problem.

On the morning of June 16, the IAD and veterinary team met with veterinary promoters Hilario and Romberto, and Dr. Freddy at the Natural classroom for several hours to discuss cattle nutrition. It was generally agreed that nutrition is the basis of most cattle health problems, including reproduction. Dr. Freddy suggested that an appropriate formula for a nutrition block is 40% melaza, 5% salt minerals, 10% calcium, 10% urea, 35% Maiz, sorgo and semolina. He also emphasized that a lack of nitrogen is the key nutritional problem. The afternoon was spent surveying cattle producers.

June 17th was devoted to surveys. On June 18, Hilario led a poultry health and Newcastle workshop. The content of this workshop was similar to the earlier poultry workshop, however, attendance was considerably lower. Surveys were completed on June 19. On June 20, IAD and veterinary teams led interactive tick classes with elementary school students.

**VII: Future Work**

*Poultry*

Newcastle disease is a major cause of chicken mortality. We want to support current community efforts to vaccinate for Newcastle disease by hosting more poultry disease workshops and providing information to all interested parties even those unable to make it to workshops.

To further support poultry efforts we are hoping to work with Nicaraguan veterinary students. These students might be able to monitor the community for Newcastle outbreaks during the time when UC Davis students are out of the country. They could also work to support vaccine efforts throughout the year.

*Cattle*

Cattle nutrition during the dry season still appears the biggest concern for cattle health and production. We will continue to work with current and future International Agricultural Development students to determine forage and and silage options that may be beneficial during the dry season. Related to nutritional challenges is reproductive health. There are indications cattle owners are seeing issues with abortion and difficult births in their cows. We are interested in discussing these issues further with cattle
owners and developing a workshop on cow reproductive health and how this relates to milk production.

**Partnerships**

We are still interested in developing the human health aspect of this project. We are working with Dr. Wilkes, director of the UC Davis Medical School’s Medicos Program, to find medical students who wish to partner with us. This year we also have a Public Health masters student as part of our team who can help take the lead in developing the human health side of our project. We are also working hard to continue communication with the University of Leon’s medical and veterinary schools. Though communication has proven difficult thus far, we hope to get Nicaraguan students actively involved in our work with the community.

**VIII: Acknowledgments:**

Thank you all our host families for making us feel very welcome in Sabana Grande. Thank you to the numerous community members of Sabana Grande who were willing to be surveyed and who attended our workshops. Their participation is vital to our project’s annual work.

A huge thank you to Susan Kinne, our primary community contact, whose help is integral to making this project an on-going success. Thank you also to the brigadistas and veterinary promoters, particularly Hilario, for all their time and continued support that make our workshops a success. Another huge thank you to Osman, our translator. Without him our surveys and workshops would not have been possible.

Thank you to our faculty mentors who continue to offer valuable advice and guidance each year. Thank you to the other faculty and staff who offered input on our workshop content and structure.

Thank you to the following sources for funding the summer 2014 trip: University Outreach and International Programs, UC Davis Blum Center, UC Davis SVM International Programs Summer Externship Fund, UC Davis Hemispheric Institute on the Americas, UC Davis Internship and Career Center.

**IX: References**