

Testing of pilot study tools to investigate challenges presented to lakeside communities at
Lake Atitlán by deteriorating water quality: Analysis of feasibility of interventions
employing a mixed methods approach

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Abstract

Since the first major cyanobacterial bloom in October 2009, the social, cultural, political, and economic wellbeing of communities around Lake Atitlán has been increasingly jeopardized. While it is evident that cyanobacterial blooms have impacted and continue to impact the twelve towns surrounding the lake, this report aims to specifically present the challenges that local residents face in the town of San Pedro La Laguna. In order to do so, a combination of surveys and interviews regarding water quality and treatment, health, cyanobacterial blooms, fisheries, and the use of aquatic plants were conducted with local fishermen, household members, and community leaders. Furthermore, a focus group composed of key leaders from various organizations in the community was also held to discuss all of these topics and challenges. Overall, this study aims to better understand how to improve social study techniques to evaluate the challenges that the local, indigenous population in San Pedro La Laguna faces due to declining water quality and increasing presence of cyanobacterial blooms.

Keywords: cyanobacterial blooms, water quality, treatment, health, social study techniques

Introduction

Located in the western highlands of Guatemala, San Pedro La Laguna is one of the twelve towns of Lake Atitlán. Furthermore, San Pedro la Laguna is one of the five indigenous Tz'utujil communities surrounding Lake Atitlán and there are approximately 13,000 people who reside in the small town. Similar to that of other towns across the lake, there has been a surge in tourism across the town of San Pedro La Laguna over the past decade.



Along with an increase in tourism, water pollution and contamination has become a major issue at Lake Atitlán. More specifically, problems pertaining to unregulated fertilizer use, the dumping of waste, and other chemicals have sparked an onslaught of cyanobacterial blooms. In October 2008, the first major cyanobacterial bloom occurred in the lake (Rejmankova et al. 2011). Shortly after, the lake experienced the “worst algal bloom recorded” in December

2009 (Servir Global, 2015).

Although a few years went by without any significant blooms, there was yet another cyanobacterial outbreak in August 2015. Over the decade, the economic, social, and political wellbeing of the twelve towns around the lake has been increasingly jeopardized as a result of these cyanobacterial blooms.

Last summer, I had the opportunity to participate in the UC Davis Ecological & Social Issues at Lake Atitlán Summer Abroad Program. Throughout the duration of the program, I specifically learned about the multiple, synergistic factors that have led to the emergence of harmful cyanobacterial blooms and declining water quality. Furthermore, I have learned about the ways in which communities and local organizations around the lake are working to solve these issues. This specifically contradicts the type of ideology that reinforces the idea that there is a lack of respect for the lake and its ecosystem among local, indigenous people.

During the month that I stayed in Santa Catarina, I heard a number of people state that the various actions of indigenous people have caused the lake to decline in its health. This type of ideology ignores the fact that tourism and globalization are the main factors which contributed and continue to contribute to the cyanobacterial blooms and overall degradation of the lake. Similar to that of many other cases around the world, it is evident that indigenous communities have been historically ignored and left unrecognized.

Along with the lack of acknowledging the indigenous environmental movement, the multiple challenges that indigenous communities face is often left disregarded. While

studies on water quality have been conducted across the towns of Lake Atitlán over the past decade, the majority do not consider or analyze the challenges that local communities face in regards to cyanobacterial blooms, health, fisheries, water quality and accessibility.

This particular study aims to highlight local, indigenous perspectives of these particular challenges in San Pedro La Laguna. Furthermore, the surveys and household surveys will be utilized to determine whether there are gaps in information regarding the causes of cyanobacterial blooms, decline in water quality, and status of local fisheries. Additionally, another objective of the study is to delve into the past, present, and future actions that local communities, organizations, and municipalities in the town. Ultimately, it is imperative that all measures and programs centered around Lake Atitlán primarily recognize the local, indigenous population as well as the work that is being done at the local scale to alleviate these challenges.

Methodology

In order to conduct the surveys of fishermen and households along with the key informant interviews, I worked with El Centro de Investigacion Cientifica y Cultural or The Center for Scientific and Cultural Research (CICC), a local non-profit organization in San Pedro la Laguna. CICC was established in 2014 by Dr. Domingo the Yojcom Rocché in order to continue to preserve and further develop art, science and culture at the local and national level.

The surveys and interviews took place from July 6 to July 7, 2016. A total of five fishermen and a total of four household members were surveyed throughout the town of San Pedro la Laguna over this time period. Each survey ranged from 20-30 minutes and the total 8 surveys were conducted in Tz'utujil, the native language in the town of San Pedro. The survey was then translated into Spanish and English. The four informant interviews were conducted in Spanish.

In order to better understand the challenges that community leaders face in terms of water quality, accessibility, health, and fisheries, we also held a focus group. The group composed of four men and two women leaders in the community of San Pedro La Laguna was held on July 8, 2016 for two hours.

Fishermen Survey Results

The following fishermen were surveyed:

1. Juan Samol Ratzman
2. Celestino Chipir Ajcac

3. Antonio Sol Ajcot
4. Francisco Aurelio Ixtetelá Quiacaín
5. José María Peneleu Tuch

Basic information

According to surveys with the five fishermen, there are approximately 55-60 fishermen currently working in the town of San Pedro. The majority of the surveyed fishermen started fishing in their teenage years and have at least 40 years of experience fishing in Lake Atitlán.

Fishing participation

According to their responses, all of the fishermen fish in their specific locations due to the division or allocation of fishing space among fishermen. All fishermen work at least 6 days a week (two of the fishermen fish all seven days of the week). In terms of fishing as an occupation, the majority of fishermen have reported that there has been an increase in the number of fishermen in the town over the years. Based on all of the fishermen's responses, there are currently no regulations on fishing activities.

Changes in fish and fisheries

All of the fishermen have noticed cyanobacterial blooms before the first major bloom that occurred in 2009. Additionally, there was general consensus among the fishermen that both the number of fish and quality of water has declined and that fisheries have changed in Lake Atitlán over the years. More specifically, in terms of the number and size of fish in the lake, the majority of the surveyed fishermen reported that there has been a decrease in both the abundance and size of fish, but an increase in different species of fish. Only one out of the five fishermen reported that the number and size of fish has not changed over time.

When asked what factors have led to changes in fisheries (out of fishing technology, the number of fishermen, unregulated fishing activities, and lake pollution), all of the five fishermen believe that lake pollution has contributed to changes in fisheries.

In terms of climate change, three out of the five fishermen do not believe that the process has an impact on fisheries in the lake.

Lake Health

Although there was some variation in answers regarding the causes of algal blooms, contamination was considered to be one of the primary factors of cyanobacterial blooms among all of the fishermen that were surveyed. Out of natural causes, pollution, rain, fish, water hyacinth, high / low temperatures, and fertilizers, all of the surveyed fishermen believe that natural factors cause the blooms. Furthermore, four out of the five fishermen stated that fertilizers are among the main factors of the blooms.

All of the fishermen reported that the water quality and the smell of the lake has changed. Three out of the five fishermen believe that there is an abundance of fish in the lake and all have reported that different species of fish have emerged in the lake over the years. All of the fishermen have reported an abundance of plants in the lake; more specifically, three of the fishermen described that there are four different types of plants in the lake and that new species of plants have emerged over the years.

As for the future of fishing, two of fishermen explicitly stated that do not believe that future generations will fish due to changing times and technology. The other three fishermen believe that it would be possible for future generations to fish, but that it will be more challenging if fish populations continue to decrease at their current rates. One fishermen stated that, "yes, it is possible for future generations to survive through fishing, but keep in mind that being a fisherman is lucky. Some many know all of the techniques, but if they do not catch any fish, it is useless.

Household Survey Results

The following four household members were surveyed:

1. Cecilia Bixcul Chavajay
2. Rosa Baram Rodriguez
3. Flora Virginia Samol González
4. Micaela Zacarías Rosales

Basic Information

Each of the households have 4 to 9 people in their homes and all of the interviewees were female. The main sources of income for the four families come from selling fruits and vegetables, construction, or working in grocery stores or tiendas.

Water Collection and Source(s)

Based on all of the responses, each of the four households use water from Lake Atitlán for household use. More specifically, the household members reported that part of their water comes from Lake Atitlán and the other comes from the town of San Marcos.

In terms of water quantity, three out of the four of the households refill their water storage tanks three times a week and only one household refills twice a week. This is mostly due to family and tank size. For example, the household with the least number of family members refills their tank twice a week. All families store their water in either tanks, barrels, or cisterns and each of the tanks range from 6 -10 tons (two families have 10 ton tanks).

Throughout the week, three out of the four households wash their clothes and collect water from the same location. The other household collects water from a different location from where they wash clothes. Furthermore, none of the families collect water from the same location everyday. When asked about using other water sources, all of the families responded that they would collect water from another source and/or location if it was of better quality.

Water Treatment

Two families use a cloth filter as their water treatment method, one filters their water themselves, and the other only purchases water for drinking.

Concerns relating to water

Three of the household leaders stated that one of their biggest concerns is water scarcity or a lack of sufficient water. When asked to elaborate more about this concern, Micaela Zacarias Ramos stated, “my biggest concern is that there won’t be water. I feel that I am one of the causes that caused the shortage of daily water use. There are so many unconscious people that let their sewage water run into the lake when it rains.” Similarly, Flora Virginia Samol González said that, “water is vital in our lives. If we did not have it, how would we wash our things? Hopefully, people will have the same concern to value water.”

Although three of the households reported that they sufficient water for necessities, one household member said that they do not always have enough water for daily use and that it depends on when their storage tanks were last filled.

Plant Collection

All four household members extract hydrilla (also locally known as pashte) from the lake, but do not sell the plant. One household leader collects the hydrilla with her church along with a foundation she works with.

Fish, Crabs, and Snails

In all of the surveyed households, there are no females in the family that fish. According to four households, tilapia and mojarras are the most commonly sold fish. Two households also reported that tiger fish are sometimes sold in the markets as well. All households stated that the majority of people who buy fish are from the town, however, there are other people from neighboring towns that come to purchase fish as well.

There is only one household leader, Micaela, that sometimes collects crabs. When she collects crabs, she generally collects eight at a time. In addition to crabs, she collects snails as a source of food. Micaela explained that she finds the snails on rocks and usually collects up to 10 at a time.

Interview Results

The following four key informants and organizations were interviewed:

1. Manuel Chavajay, Research Unit of the Public Ministry
2. Agapito Cortez Sequec, Manclalaguna
3. Wendy Hilda Petronila Navichoc Zepeda, Jab'el Ya'
4. Francisco Sánchez, Asociación Vivamos Mejor

Basic Information

1. Research Unit of the Public Ministry
 - it is composed of the prosecution, civil court and indigenous communities , and communities organized COCODES or Community Development Councils.
 - it serves 19 municipalities , including those that are off the coast mouth.
 - actively works on research and documenting the problem through photographs , records , videos and drawings
 - 50 % of male and 50% female
2. Vivamos Mejor
 - 26 years working with the Solola Department
 - there are 25% of women and 75 % men and executed projects have been mostly implemented by men

- some executed projects include: improvement of life in Santa Catarina and Tzununá (two local towns), programs for children ages 4 and up in Nahualá and Ixtahuacán (towns in the Solola Department)

3. Manclalaguna

- exists in 4 municipalities around the lake
- in San Pedro, its directors made up of 40 people, the board consists of 9 people, there is existing technical staff of 14 people and 4 secretaries
- 60 % of the technical and political performance management is handled by women

4. Jab'el Ya'

- 6 members on the Board of Directors
- has a shop for members of different crafts
- includes a school for children for lessons in ecology and classroom work
- current goal is to work with the women's network of the municipality
- there are more women than men in the organization (about 90% are women)

Water Sources

Based on all of the informant interviews, there are 2 wells in San Pedro la Laguna and a total of 3 water sources in the town. However, according to Agapito Cortez Sequec one of the wells is no longer working. Two of the key informants explained that the other source of water comes from the nearby town of San Marcos.

One of the key informants shared that other alternative sources of water come from rain harvesting, snow cover, groundwater, and the trapping of fog.

Treatment

Three of the key informants explained that the community's water is treated through a chlorination system. One of the key informants stated that a treatment process does not exist because the treatment process is governed by the nearby villages that distribute their water.

Water Management and Fishery Recommendations

There was a wide range of recommendations in terms of addressing water quality and related issues that the key informants proposed:

1. Manuel Chavajay proposes the construction of a water treatment plant to ensure that all water is drinkable
2. In order to effectively manage water and fisheries, Francisco Sanchez proposed that the lake's micro basins work in soil conservation, organic agricultural practices, developing a basinwide fertilizer formulation program, and properly using solid waste.
3. Agapito Cortez Sequec stated that overall, one of the most important actions is to care for the lake to ensure that elements like mercury and other metals no longer exist within its waters.
4. Wendy Hilda Petronila Navichoc Zepeda stated that what is most important for the community, in general, is to verify the most important work. For fisheries, more private fishing could be a strategy, but it is important to determine whether this could realistically work. In order to do so, Wendy recommends hiring a person to evaluate by zones and according to those results should verify that could provide these fishermen.

Plant Use

When asked about plant use, collection, and removal in the lake, all key informants stated that hydrilla has been regularly removed from the lake. For example, two years ago, Manclalguna was involved in removing hydrilla each month. However, according to Agapito Cortez Sequec, it was very time intensive and costly; with the changes of the COCODES, these clean-ups are only done when requested.

Manuel Chavajay explained that there are many are engaged in the planting of tul and it has been promoted in some cases; however, it is not monitored. In terms of cleaning events, they generally take place 1 or 2 times a year. Chavajay believes that it is peculiar because those that participate have the intention to clean but there is a lack of support from government and departmental organizations.

Along with the municipal clean-up events, Wendy Hilda Petronila Navichoc Zepeda explained that Jab'el Ya' has already supported the fishermen to clean the lake. Since the end of 2013 and the last two years alone, the organization has been involved in developing environmental policies as well.

Organizations & Collaboration

According to all key informants, there are not any serious organizations tackling water quality and access issues. Manuel stated that “many [organizations] have had good intentions but have not exercised good deeds. For example, AMSCLAE (the governmental body that monitors the lake) has worked on projects and funds along with municipalities, but the first thing they do is take money and not execution.”

Similarly, Agapito Cortez Sequec explained, “there is not one serious organization in the village does not exist. We are the organization (Manclalaguna) that is working on the issue of water but it is costing us our budget. We have contemplated building drainage system.”

Although it was agreed that there is not an organization that tackles issues pertaining to water, the body responsible for ensuring water use is the Public Ministry. According to Francisco Sanchez, there is no water law in Lake Atitlán. One was previously developed, but it was rejected by the population.

Furthermore, all key informants stated that there is not much funding for this issue. Wendy Hilda Petronila Navichoc Zepeda said that “the issue of water quality has not been worked on yet. There is a lack of funds and the only ones who have funds are Manclalaguna and they have done some research.”

Community Challenges in Water Usage & Community

1. Manuel Chavajay stated that one of the great challenges in water quality and usage is ensuring that everyone receives a good education. “Having the knowledge that water is very essential in the community because many people do not give rational use and are not aware of use and management,” said Chavajay. “The interest of our authorities is very poor in the importance of water as they depend on water but we are unaware of use, as chemical elements used.”
2. Agapito Cortez believes that in order to ensure quality and quantity, the public must pay for the service that is demanded.
3. Wendy Hilda Petronila Navichoc Zepeda believes that the municipalities need to join and fight for international funds to address these issues and challenges.
4. Francisco Sanchez concluded that the participation of municipal and government authorities need to ensure that the drinking water for all communities is of drinking quality.

Community Challenges in Fisheries

One of the primary challenges that Manuel Chavajay reported in fisheries is that fishermen usually only care about the fish in their area and not about whether other areas are clean.

Both Francisco Sanchez and Agapito Cortez Sequec agreed that one of the biggest problems is caused by human pollution along with the use of chemicals and fertilizers. Sanchez explained that the type of soap that people use (which contains phosphorous) for cars and clothing kills fish populations. Additionally, solid waste harms the health of the fish. Sequec discussed that the consumption of fish has major implications on human health. When people consume the fish, they can accumulate contaminants such as zinc, lead, and mercury in their bodies.

In regards to actual fish populations, Wendy Hilda Petronila Navichoc Zepeda explained that there is much needed research and information about fish. Furthermore, she proposed that the parameters need to evaluate the secondary and tertiary side effects on the various fish species within the lake.

Recommendations

Based on the key informant's responses, the following recommendations were made in regards to water quality and accessibility:

1. Build a treatment plant to have an acceptable ration water; the water should be regulated by the authorities and it is with the knowledge of the population to give an application.
2. More funding and investment in addressing the problems.
3. Water treatment through chlorination, boiling, training, investing in awareness, along with community-wide participation
4. Join in society and ask for information as well as funds to fight everything that is harming the lake. The entity that should regulate is the Municipal Development Council (COMUDE) and the Municipality should administer programs, etc.

Focus Group Results

The following community leaders were at the focus group:

- Pedro Chavajay, Artista y socio del Centro de Investigación Científica y Cultural
- Rubén González, FEDEPMA (FEDEPMA ASOCIACIÓN FEDERACIÓN DE PUEBLOS MAYAS)
- Agapito Cortez, Manclalaguna
- Nicolás Tumax, San Pedro la Laguna Asociación de Pescadores (San Pedro La Laguna Association of Fishermen)
- Wendy Navichoc, Jab'el ya'
- Juan Manuel Chavajay, Taa' Pit Korteas
- Berta Cotuc, Grupo Ecologico Teixchel

The following people were the moderators, note takers, and observers:

- Domingo Yojcom Rocché, (Director general del Centro de Investigación Científica y Cultural), moderator
- Mynor Israel Ajcac, (Centro de Investigación Científica y Cultural), observer
- Biegler Rolando Cotuc, (Centro de Investigación Científica y Cultural), notetaker
- Salvado Elías Quiacaín, (Centro de Investigación Científica y Cultural), observer
- Verónica Maribel Yojcom, (Centro de Investigación Científica y Cultural), notetaker

Throughout the two hours of the focus group, the participants were asked a number of questions pertaining to water quality, fisheries, health, cyanobacterial blooms, and management and policy recommendations. The answers that participants provided for each of the topics are listed below:

Water Quality

1. How would you define water quality?

The focus group has multiple definitions of what water quality is. For example, one member explained that it is when water is free from metals, microorganisms that cause gastrointestinal problems and is free of radiation. Another participant explained that water is free of chemical and it is also important to ask how the water quality is evaluated. Similarly, another participant explained that it is when there are no chemical preservatives and the water is natural and odorless. Furthermore, others explained that it is a vital fluid that should benefit the body, not harm it.

2. What are the important considerations when assessing water quality for your community and your family?

The group agreed that it is important that the water is crystalline, transparent, and free of bad odor and taste; however, that does not indicate that it is free of bacteria. Since there are two types of water, surface and groundwater, it is important that it is free of physical and chemical contamination.

3. How would you describe the water quality in your community?

The majority of the focus group agreed that the water quality in San Pedro does not fit within their definitions of good water quality. Two focus group members discussed that water quality in the town is average and that water quality is good in the Bella Vista sector of the town.

4. How does it compare to other communities of the lake? The Solola Department? Guatemala in general?

All participants agreed that the quality of water from other municipalities is better than that of the water sources of San Pedro. Similarly, they agreed that the quality of water from the Solola Department is better than the town as well. However, compared to Guatemala, in general, they believe that water quality in San Pedro is better than other municipalities and the capital. They explained that the water in San Pedro is more free from direct pollutants. Additionally, they agreed that other municipalities may have better water quality than Guatemala City because they have more streams or springs.

5. What are the main challenges for water quality in your community?

- The use of chemicals
- The need to create route to attain water quality
- The need to change the prejudices we have
- The need to change our practices (laundry, trash bin)
- Social and municipal Responsibility
- The need to restructure the water distribution system
- Trying to control the direct pollutants
- The need to create water treatment plants
- The need to create batteries with a size suitable for clothing like jackets and large clothes

6. How has water changed over time in the town?

If it has changed over time, it has changed in both smell and taste.

7. *Have you noticed the factors that influence water quality ?*

- The 65 year old system
- Use of detergents
- Chemical contaminants

8. *Does everyone share the same water source? If not, can you describe variable sources and differences in those sources?*

- Yes, everyone shares the same water source because a part of the water comes from the town of San Marcos and the rest comes from the lake, which is then distributed to the entire population.

9. *What are the most important questions concerning the quality of water?*

- How free of contaminants is this water?
- Should I drink it or not take it?
- Will it cause any disease?

10. *What are your main concerns about water quality ?*

- Pollution
- Sooner or later, one can not take water from the lake
- The proper use of water

11. *What information would you like to find out about water quality ?*

- Its origin
- Contaminant levels
- How clean the water is
- How pipelines are maintained

Fisheries

1. *How has changed the fishing area in your community throughout his life ? In the last 5-10 years?*

- Destruction of fish from Hurricane Stan
- Decreased fish sales in 2010 due to cyanobacteria; this affected the

economy in the home of fishermen. Fish and crabs are sensitive about what they eat or consume.

- The fish are healthy, but now the fish are more alert because of more traps
- The fish died within a given time not because of pollution or because they were sick, but because of the whirlpool
- Extinction of some species of fish
- The fishing zone has changed because people have constructed buildings and houses very close to the water

2. *What are the main challenges facing the fishing area in your community?*

- Chemical contaminants
- If fish adapts, man also must adapt
- The conservation of fish
- Creating fish habitat
- Fishermen have no strict control of fish or the sizes they should have

3. *What could you do to overcome these challenges?*

- Raise awareness among fishermen to fish with specific measures
- The municipality needs to regulate fishing

4. *How are these challenges compared to other communities / villages around Lake Atitlan?*

Department of Solola? Guatemala?

- The challenges are quite different due to the different perspectives we have of each community.
- Our challenges should be very similar and so we need to change and improve in these areas

5. *What are the main obstacles to overcome these challenges ?*

- The negativity of people in regards to these circumstances
- One of the biggest obstacles is the vice for the money, because often send international organizations support our communities and people are governed by their own good, not for the common good

6. *What are the main unknowns and uncertainties related to the fishing area in your community?*

- How to survive when there is shortage of fishermen?
- What are the most common strategies used to fish?

7. *What kind of information will help you to reduce / minimize these uncertainties ?*

- Stories
- Research and documents on these unknowns and uncertainties

Health

1. *How would you define health?*

- when a person has a healthy physical, mental, and psychological state
- "health" is being well

2. *What are the main principal factors that influence the health of families?*

- personal hygiene
- the type of water that is consumed
- the way in which water is prepared
- good nutrition

3. *Children? Elderly? ¿Community in general? How does this compare with other communities around the lake? How about the Department of Solola? In Guatemala? How has it changed over time?*

- It is stable compared to other municipalities.
- People are dying at an early age
- Many preservatives and chemicals

4. *What are the most common diseases in the region? For children? How does this compare with other parts of the Department of Solola? Do other departments of Guatemala? How have they changed over time?*

- Mosquitos that carry diseases

- Bacteria that is directly in the water and resistant to chlorine
- Intestinal infections
- Pylori bacteria: generate gastritis
- Ecoli: treatment is very difficult, need to medicate all the time to kill the bacteria.
- AMSCLAE states that no person has been sick from drinking water. However, there are cases of disease and the municipality has 2 latent cases.
- Allergies, skin diseases
- San Pedro must have an organizational office that tests the water and does not generalize damage. This generates panic within the community.
- How many cases of pylori exist? The health center takes a direct record year and compares ages and parameters that determine pre-existing conditions in the lake. We need to get accurate information
- Allergy, temperature and rainfall could determine disease rates.
- Here in San Pedro there are less diseases than in other municipalities because there is more control
- It has changed over time; children now have vaccines, but another issue is now in the health centers do not have enough drugs

5. How is the health of your family's health compared to another family? Do you discuss other health issues in their community and canton? What kind of problems discussed with others in your community?

- The health of my family with another is not very different because all suffer from the same diseases.
- There is not much to compare because we are all accustomed to this

3. Have you noticed any health problems that have arisen in relation to drinking water? In connection with the work of the fishing area? In relation to recreation or bathing or washing with water from the lake?

- Allergies
- Gastrointestinal diseases based on use of detergents or chemical contaminants.

6. What are the most important questions or uncertainties you have in relation to the health of your community? What information would you like regarding the health of your community?

- Arguing the diseases that occur
- When the health center reports on all diseases, it creates panic in the town
- The lack of drugs relative to disease

Cyanobacterial Blooms & Interventions

1. How would you describe cyanobacterial blooms in the lake? How they have changed in recent years? What are the challenges facing their community related to bloom? Confronted by families? How these challenges are faced in other lake communities Compare?

- The cyanobacteria bloom spreads because energy and higher temperatures speeds up the process of germination and flowering. There are no blooms in the months of March, April, and May. The intensity of the light enters these months and after this cycle, the cyanobacteria blooms and germinates
- Studies by the Universidad del Valle de Guatemala (UVG) have presented the results and the population does not understand. The temperature change has changed.

2. Can you describe some benefit from the spread of cyanobacteria?

- Employment generation
- Fertilizer or fertilizer for crops
- It was a tragedy, it was hard to see the lake.
- Water has been fundamental to our customs and traditions as a people
- The lake is part of our experience
- We have lost respect for nature
- The cause of the cyanobacteria bloom is improper use of chemical fertilizer and poor garbage deposit.
- Take back our practices and healthy values to be in harmony with Mother Nature.
- Control and use of fertilizers, chemicals, detergents

3. What are your questions related to the spread / blooms of cyanobacteria?

- How to avoid the spread of cyanobacteria?
- How to make people aware of the basin regarding this phenomenon?
- How we inform about these illnesses that can cause cyanobacteria?

4. What would be useful information for you regarding the spread? Do you see the spread / bloom as inevitable or something potentially controllable? How do you think your opinion differs from other communities?

- It is made possible to clean, but there are other communities that do not
- Sometimes people from other communities do not care if the lake is clean or not
- We are all interested in the welfare of our natural resources

5. Have you noticed any change that reduces the severity and / or duration of blooms? Or any noticed abnormality or effects of the bloom? Have you noticed anything that reduces potential health risks from the cyanobacterial blooms?

- There is not a change that reduces the severity, rather the severity is reduced with time
- In a few people, you noticed the types of allergies.

6. What has been the impact of Blooms Water Quality? Local fishing?

- The negative impact was temporary
- The people stopped using crabs and fish

7. Have you tried any interventions or strategies to change those impacts at the community level or in your household?

- Trying to change people's negative thinking about these issues

8. How Do You Feel About The Different Strategies Interventions or Household Level or community?

- Now it is very peaceful and this happens when there aren't cyanobacterial blooms; but there is an alarm whenever it reemerges.

Conclusion

Ultimately, my goal with this project was to better determine what is needed at the local level in the town of San Pedro La Laguna to effectively confront and solve challenges related to water quality, accessibility, fisheries, health, and cyanobacterial blooms. Furthermore, my hope is that this also guides future actions in the nearby towns of Lake Atitlán. The local, indigenous voices of the community and other towns of the lake are often ignored and it is vital that all future policies and programs primarily consider the recommendations, concerns, and challenges of the local people.

Based on the household and fishermen surveys along with the focus group, it is evident that the clarity and smell of the lake has changed over the years. Although it is understood that factors like pollution, unregulated fertilizer and chemical use, and other natural processes are contributing to the emergence of cyanobacterial blooms, there are many uncertainties that still remain in regards to water quality. In the majority of cases, local people do not necessarily know whether their water is of drinking quality. In terms of the focus group, participants shared that they would like to know more about impacts on fishery, diseases and illnesses, and human health. While a few studies have been conducted in relation to these topics, they are often not accessible to local people or the general people; and it is vital that all reports, studies, and other findings are easily accessible.

Although studies are incredibly important, this project has also helped me to think about the ways in which studies need to develop and lead to concrete actions that work to make change. For example, when, Agapito Cortez Sequec of Manclalaguna was asked what needs to be done to face these challenges, he stated, "No more studies. We all know the problem and we need more investment to address the problem of water."

Future Improvements in Project Methodology

After conducting the interviews, surveys, and focus group, I spoke with one of the CICC translators, Veronica Yojcom, about ways to improve the interviewing process. The following are suggestions that Veronica recommended:

1. Revise some of the questions that are more broad to make more specific
2. Reduce number of questions asked in the focus group due to time

Since the results of the surveys are not representative of the whole population of San Pedro, it would have also been more effective to have a larger sampling size.

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Key Terms & Organization Information

AMSCLAE:

Autoridad para el Manejo Sustentable de la Cuenca del Lago de Atitlán y su Entorno (Spanish: Authority for the Sustainable Management of Lake Atitlan Basin and Its Environment; Guatemala);

COCODES:

Community Development Council

FEDEPMA:

A non-governmental organization based in San Pedro La Laguna with the goal to provide a cumulative means of support to local associations, cooperatives and farmers in the department of Sololá (Guatemala). Legalized under the institutional name of “Federación de Pueblos Mayas” – FEDEPMA fulfills its mission by offering efficient development services that allow its recipients the pursue of competitive and sustainable production endeavors.

Nowadays consisting of three associations (ADENISA, AMO and Mi Soya) as well as one cooperative (Apícola Atitlán) the organization targets different areas of sustainable market-led product creation – organic coffee and lombricompost fertilizer (ADENISA), organic honey and pollen (Apícola Atitlán) and on a (much) smaller scale respectively only demand driven textiles (AMO) as well as soya products (Mi Soya). These projects provide work to total of 290 people and cover 14 different municipalities along the shorelines of Lake Atitlán.

Grupo Ecologico Teixchel:

A Tz'utujil women's collective that sells fair-trade woven goods and offers weaving classes

Manclalaguna:

MANCLALAGUNA La Laguna, is composed of four municipalities of Solola: San Pedro La Laguna, San Juan La Laguna, San Marcos La Laguna and San Pablo La Laguna. It is a non-

profit organization focused on development at the municipal level. It specifically works to carry out non-religious, and non-partisan obligations between the municipalities that conform to the common formulation of inter municipal public policies, plans, public law, along with programs and projects. The main goals of the organization include maintaining solidarity between its peoples, achieving comprehensive development of the region with comprehensive planning and institutional strengthening, with emphasis on the areas of environment, health, education, agriculture, housing, public safety based on strengthening Tzutujil culture and gender equity.

Asociación Vivamos Mejor Guatemala:

An organization that works on the improvement of the living conditions of the local population as well as the conservation of nature through sustainable development in the lake region and in the district of Sololá.

Taa' Pit Korteos or the Center for Intercultural Learning:

This non-governmental organization was founded in honor of Taa' Pit Korteos, one of the first professionals and teachers of San Pedro la Laguna, who worked for 33 years in the bilingual education of children. The Taa' Pit Korteos organization works to reintroduce and restore Mayan culture back to local children and families. It offers programs and classes for young children in technology and environmental education.

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