WATER EDUCATION IN PARAGUAY

By

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Water Education in Paraguay

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ABSTRACT

The importance of water as a resource is a foundational concept in environmental science that is taught and understood in different ways. Some countries place a greater emphasis on water education than others. This thesis explores the educational system in Paraguay, with a particular focus on environmental education and water. Coupling my work as a Peace Corps/Paraguay Environmental Education Volunteer and my participation with Project WET, a nonprofit organization that specializes in the development of water education activities, I compiled country specific information on the water resources of Paraguay and used this information to adapt 11 Project WET Mexico activities to the Paraguayan classroom. There were many cultural and social factors that were considered in the adaption process, such as language and allotted time for lessons. These activities were then presented in a series of teacher workshops in three different locations to further promote water education in Paraguay.

This abstract accurately represents the content of the candidate's thesis. I recommend its publication.

Signed _____
Bryan Shao-Chang Wee

DEDICATION

I dedicate this thesis to my parents in gratitude for their support with all my crazy adventures and ideas and also to the people of Paraguay, who opened their homes and hearts to me for over two and a half years.

Dedico esta tesis a mis padres en gratitud de su apoyo con mis aventuras y también para la gente de Paraguay, quien me abrió a mí sus casas y corazones por dos años y medio.

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To the people of Project WET, John Etgen and Julia Nelson for their enthusiasm in this project and the desire to launch Project WET in Paraguay.

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Últimamente, para Sergio Galeano. Sin su consejo, ayuda y apoyo, hubiera sido imposible hacer este. Gracias no es suficiente.

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CHAPTER 1

INTRODUCTION

Water is a renewable resource. Our lives depend on this substance composed solely of hydrogen and oxygen, which covers nearly 70% of Planet Earth. However, of that huge percentage, 97% of the water is in the ocean and unusable while the potable amount of freshwater from lakes, rivers, and other sources of freshwater, is much less and harder to obtain (United States Geological Survey 2009). The actual amount of useable water decreases even more due to contamination, salinization and pathogens.

The most basic use of water in society today is for personal uses, such as hygiene, food preparation, and drinking. Also, water is highly used for irrigation in the agricultural sector, cattle ranching, and industry which includes shipping their products via waterways. These other uses place a heavy demand on the water resources of a country. Contamination levels increase if factories do not regulate wastes produced. Raising cattle in arid places necessitates more water to prevent dehydration. Of course, for our well being and the well being of our crops that we eat, irrigation uses the same water resources too (Jackelen & Gatto 2006).

Paraguay is a small, South American country about the size of the state of California in the United States of America. It is nestled between the two giants of the continent, Brazil and Argentina, and also Bolivia. Even though this country is small, it is very rich in water resources due to its location in the second largest basin in South America and fifth largest in the world, the Cuenca del Plata (Barros 2004).

After spending over two years living with Paraguayans, they, in general, understand the importance of water and drinking uncontaminated water, but not all. Many Paraguayans do not value this resource that their country has because they always have access to water and their wells or water tanks seldom run dry. My Peace Corps experience coupled with my research interests in water and water education led me to focus on this topic in the hope of understanding human-environment relationships in Paraguay from an environmental educator's perspective.

In recent years, the climate has begun to change in Paraguay and less rainfall has been occurring, or been occurring at the wrong times. "*No se puede mirar el calendario más para saber la estación. Hay días que hace calor en el invierno y hace frio en el verano.*"[1] Huge portions of the country, namely a region called the

[1] One is not able to look at the calendar and know the season anymore. There are days when it is hot during the winter and cold during the summer.

Chaco in the northwest, are in a severe drought and the citizens refer to their water as *oro*, or gold. The people who live there actually hide their water supplies, or lock them away in order to prevent others from robbing them of their water. A Peace Corps Volunteer who lives in the Chaco region says that people would rather steal the water first before other objects of value in a house (McClelland, F., personal interview, 2009). Contaminants have entered the small streams, rivers, and groundwater from the large scale use of pesticides in agriculture. Wells in many regions have been known to dry up during the summer months. Some communities do not even have well developed systems to access their groundwater. Wetlands have been drained by improperly built canal systems for agriculture, particularly rice, or cattle ranching. Many times I have heard Paraguayans say *"Antes, había más animales por esta zona, ahora no*[2]*"* or *"Nuestra agua está sucia, ¿pero qué vamos a hacer? Tenemos que usarlo.*[3]*"* These are a few of the problems Paraguay is facing today, which is why water conservation is such an important environmental issue.

In 1977, the United Nations Educational, Scientific and Cultural Organization (UNESCO) held a conference in Tbilisi, Georgia to define environmental education:

> "Environmental education is a process oriented to develop a world population conscious and interested in the environment in its totality and its associated problems that have knowledge, attitudes, motivation, compromise and abilities to work individually and collectively in the solution to the actual problems and in the prevention in the future" (Environmental Education 2007).

When a Paraguayan teacher was asked to define environmental education during a workshop, she stated "*La educación ambiental es formación del hombre y la mujer en el desarrollo de actitudes positivas, hacia el uso adecuado, la apreciación y la valoración de los recursos naturales."*[4]

These are two broad definitions of what environmental education is yet what is common between them is this notion of stewardship; a concern for environmental

[2] Before, there were more animals in this zone now there are not.

[3] Our water is dirty, but what are we going to do? We have to use it.

[4] Environmental education is the formation of the man and woman in the development of positive attitudes towards the appropriate use, the appreciation, and the valuing of natural resources.

health that is grounded in an understanding of natural and anthropogenic interactions. More specifically, in context of water resources in Paraguay, it is not only important to learn about water conservation, but also to understand the why and the how of water education. Why should we conserve the water? How can we do it? What are some strategies that we can implement in the home, the school, and in the community to achieve this goal?

With this in mind, this thesis is along the lines of environmental education with a particular focus on water conservation and education in the Paraguayan school system. As of now, there is little focus placed on this important issue in the Paraguayan schools. This is mainly due to the time constraints for classroom instruction. The school day is only four hours long and the students have to focus on other classes too, not only science.

An international organization called Project WET (Water Education for Teachers) has designed countless manuals for water education (Project WET 2010). For a complete listing of the manuals available and the countries where Project WET operates, see Appendix A. The manuals list different activities that teachers can add to their existing school curriculum to teach about water conservation, the water cycle, etc. In other words, Project WET is not designed to replace the curriculum in schools; rather, these activities are intended to supplement the materials that the teacher uses in the classroom. The manuals that were sent to Peace Corps/Paraguay, with the goal of promoting environmental education and water conservation in schools, were manuals that were published specifically for Project WET Mexico and have activities that deal with hurricanes and the indigenous people of Mexico (Vázquez del Mercado Arribas et al. 2000).

Currently, there are no manuals in Project WET specific to Paraguay. In fact, there are limited resources in Paraguay with a specific focus on water education and even these tend to be very technical. For this reason, it is important to generate a manual that incorporates the local cultures and environments in Paraguay, or at least a collaboration of country specific and basic information on the water of Paraguay, such as rivers, aquifers, lakes, flooding information, etc. that teachers can use in their class and can be easily accessed by students or other teachers. For example, not all teachers teach in Spanish. The majority that live in the *campo*, or rural countryside, use the indigenous language of Guaraní.

Challenges arise in adapting the Project WET Mexico manual for schools in Paraguay, for example, selecting activities that fit into the curriculum, particularly those that are not too material intensive. Most schools in the *campo* do not have resources such as notebooks for the students, pencils, or even chalk. An activity that calls for expensive materials, such as topographic maps, does not make sense to incorporate in these local contexts.

Given the need for a Project WET manual specific to Paraguay and the challenges associated with lesson adaptation, the goal of this thesis is to explore and describe the social, cultural, ecological, and political processes involved in adapting and teaching Project WET lessons in Paraguay. Specifically, the questions this thesis addresses are: 1. What are the processes involved in adapting and teaching Project WET in Paraguay through teacher workshops? 2. What are the implications of these findings for environmental education?

The intent of this thesis is not to focus on the pedagogical aspects of Project WET in schools nor is it about Project WET manuals per se, rather, it is intended to describe my role as a Peace Corps Volunteer in Paraguay in the context of water resource conservation and based on these experiences, to stress the importance of curricula contextualization in environmental education.

CHAPTER 2

PHYSICAL, BIOLOGICAL, CULTURAL AND POLITICAL HISTORY OF PARAGUAY

Geography, Climate, Eco regions and Political History

Paraguay is located between roughly between 23° 00 S and 58° 00 W. It is situated between the two giants of South America, Brazil and Argentina along with Bolivia to the northwest (Figure 1). It is roughly the size of California with 407,000 km^2 (Bao et al. 2002). Paraguay and Bolivia are the only two landlocked countries on the continent, but fortunately for Paraguay, it has two very large and important rivers that flow to the ocean, the Río Paraguay and the Río Paraná (Figure 2). These rivers are very important for the transportation of materials and for places like Bahía Negra, situated at the top most boundary of the country on the river between Bolivia and Brazil, constitute the only reliable method of transportation to the town, along with the floating supermarkets that bring in produce and other goods from Concepción. The Río Paraguay, in particular, has a steady line of boats that haul soy, mercury, zinc and other heavy metals. For that reason, heavy metal contamination levels are fairly high for this river (Facetti 2002). The rivers are also important for tourism (beaches), fishing (dorado, boga, surubi species), hydroelectric energy (the hydroelectric dams Itaipú and Yacyretá), and serve as a drinking water and irrigation source (Entidad Binacional Yacyretá 2009; Jackelen & Gatto 2006; Quirós et al. 2007).

Figure 1: Paraguay In Reference To Other South American Countries

Figure 2: The Country of Paraguay by Departmental[5] Divisions

The temperatures range during the summer (December to February) between 25°C to 43°C with an average of 35°C while the winter months (June to August) are more variable between 6°C to 22°C (Bao et al. 2002). More humid conditions are

[5] There are 17 departments in Paraguay, which can be likened to states or provinces, each with its own capital and governor.

found in the southern half of the country while more arid conditions are found in the north, particularly a region called the Chaco. A trend is noticed with rainfall too. The annual mean rainfall tends to decrease both from north to south and from the east to west (Quirós et al. 2007). In the eastern city of Ciudad del Este on the Brazilian border, the average rainfall for the year is 2,000 mm while in the capital city, Asunción, the average rainfall for the year is 1,500 mm (Bao et al. 2002). This means that people living in different regions will have varying access to water and/or that even slight changes in climate may have significant impacts on water availability.

Paraguay has two very defined regions, the Occidental, or western Chaco and the Oriental. The Río Paraguay more or less splits the country in half. The majority of the six million inhabitants live in the Region Oriental. There are very characteristic eco regions in the country as well.

The Dry Chaco, located to the west of the Río Paraguay, covers the departments of Boquerón, Alto Paraguay, and Presidente Hayes. It is characterized by shrubs and spiny trees which include, samu'u (*Chorisia speciosa*), the endangered palo santo (*Ceiba chodatii)*, and quebracho blanco (*Schinopsis balansae)*, and various species of cactus. The salty lagoons are home to the Chilean Flamingo (*Phoenicopterus chilensis)* and Coscoroba Swan (*Coscoroba coscoroba)*. The name reflects perfectly the water conditions here; there is very little to no precipitation throughout the year.

Transitioning with the Dry Chaco is the Humid Chaco which covers 25% of the Chaco and extends farther south into the departments of Ñeembucú and Misiones down even into Argentina. Species such as the karanda'y *(Copernicia alba)* dot the landscape along with islands of forests of quebracho blanco (*Schinopsis balansae).* Numerous bird species and other aquatic animals make their home here (Peña-Chocarro et al. 2006). The majority of the wetlands are found in this eco region. It is estimated that up to 35% of Paraguay is covered with wetlands (Salas-Dueñas et al. 2004). Paraguay can also stake claim to touch part of the largest freshwater wetland in the world, the Pantanal. It is an intricate system of inundated flood plains that begin in the Brazilian Amazon and is recognized internationally for its ecological importance and for its wildlife (Barros 2004). The Pantanal is also important because it helps to regulate the flooding and flow of the Río Paraguay (Quirós et al. 2007). The jabiru stork (*Jabiru mycteria)* is characteristic to this region along with other herons and wetland birds.

The fact that a good portion of the territory is covered with water, whether it is a wetland or not, indicates that the presence of water education or at least education relating to the importance of the water related eco regions, is needed in the education system. Humans, animals and plants as well as entire ecosystems that

are found here depend on water resources for survival. With contamination and the draining of wetlands caused by human actions, it is important to learn about conservation practices and what we as humans can do to mitigate the effects. The classroom is one place where education efforts, such as Project WET, can make positive changes to environmental health.

Moving east across the country, one encounters the Bosque Atlántico Alto Paraná (Atlantic Forest of Alto Paraná) or BAAPA. The region is characterized by rolling hills and high humidity. Trees in this subtropical rainforest can reach over 30 meters in height, like the national tree, the lapacho (*Tabebuia serratifolia*) or timbo (*Ebterolobium contortisiliquum*) with the national bird of Paraguay, the bare-throated bell bird (*Procnias nudicollis)*, being found in that upper canopy. The BAAPA can be found in the departments of Itapúa, Alto Paraná, Caaguazú, Caazapá and Canindeyú and is situated above one of the largest aquifers in the world, the Guaraní Aquifer. Due to the fertile soil of this eco region, the majority of the large scale agriculture (soy beans, sunflower, yerba mate, wheat) is found in this region too. However, due to increased logging and lack of governmental control and funding, the BAAPA is suffering from a high level of deforestation. Originally the BAAPA covered 85% of the country, but since 1997 is now covers less than 15% (Carolan et al. 2004). Deforestation, ergo, leads to soil erosion, which leads to the contamination of the rivers and streams with sediments. This is another example of why water education should be a focus in the schools.

The original inhabitants of the region known today as Paraguay were the Aché, Guaycurú, and most importantly the Guaraní. They were hunters and gatherers, nomads and also relied on fishing in the rivers (Baos et al. 2002).

The first Spanish explorers came to Paraguay around 1524 looking for gold and silver in the Andes (Baos et al. 2002). The Spaniards founded the first city in South America, Asunción, which would eventually become the capital once Paraguay gained its independence on May 15, 1811, the first South American country to do so. The Spanish conquistadors did an excellent job mixing with the local Guaraníes to the point where Paraguay is 85% homogenous and are considered *mestizos*, or a half and half heritage of Spanish and Guaraní (Boas et al. 2002; Lewis 1982). There are also other cultural groups here too which include Japanese, Germans, and other descendants of Eastern Europe (Boas et al. 2002).

Since the Spanish explorers did not find any metals or resources of any importance, Paraguay was a colony that was overlooked by the Spanish crown, and for that reason, there were more liberties granted to them, which later would prove costly when the Jesuits arrived to the region (Lewis 1982). The Jesuits arrived looking to spread Catholicism and also to teach the native Guaraní people. Their missions covered vast regions of the south of Paraguay and down into what is now

Northern Argentina. They had little success in the northern Chaco, with the Guaycurus, Tobas, and Payaguá tribes. The Payaguá would attack the settlements from their canoes in resistance to the Jesuits. But, due to the gaining power of the Jesuits and fear that the Spanish crown was losing its control, the Jesuits were forced to leave in 1767 (Boas et al. 2002).

It is largely due to this early influence that a majority of the population claims to be Catholic, though only a relatively small population actively practices. If you are asked,"*¿Sos Catholico/a?"*[6] Paraguayans would expect to hear you say, "yes" even if they are not a practicing Catholic or even Catholic themselves. In public schools, which are controlled by the Ministry of Education and Culture (MEC) where religion also falls under that ministry's jurisdiction, the students pray before class and are encouraged to sing songs about and write sayings to decorate their classrooms about God (Cáceres de Rodas & Garcete 1999). The normal response to any invitation for a future event is, "*Si Dios quiere y la Virgen permite.*" [7] Locally, that is translated as "no thanks." In short, Catholicism is integrated into Paraguayan society more as a social (rather than religious) norm. This aspect of the culture was not an influence in the adaptation of the Project WET materials for Paraguay.

Paraguay has almost always been ruled by dictators and with a strong presence of the military and has always had to fight to stay a sovereign country. After Paraguay declared its independence from Spain, the first country in South America to do so, Argentina sent their military up the Río Paraguay to Asunción with the attempt to regain a renegade province; the view of most Argentineans (Lewis 1982). The first dictator reigned from 1814-40. He was a civilian leader, but at the time was one of the only educated men in the country. The people looked to him to lead the country; they voluntarily chose a non democratic model for their government (Sobera, C., personal interview, November 10, 2007). The lawyer, Dr. José Gaspar Rodríguez de Francia served in Paraguay and was given the nickname El Supremo. In order to avoid more conflict with neighboring Argentina and Brazil, he closed the borders to export and trade. He fought for the poor and worked to eradicate the status of the social elite by reclaiming their land and then releasing this land to poor farmers. He also disliked the Catholic Church's influence. He thus closed the monasteries and made the Church completely dependent on state funds. However, since most of the schools in the country were staffed by monks or friars, the state was not prepared to handle a public educational

[6] Are you Catholic?

[7] If God wants it and the Virgin permits it.

system and since the borders were closed and no periodicals or new books were coming into the country, the education level sank to disastrous lows. His reign was one of terror and fear. Torture was not uncommon during this time. However, it can be said that thanks to his rule, Paraguay was able to gain a sense of nationhood and national pride immediately following their independence (Boas et al. 2002; Lewis 1982).

After Dr. Francia's death by natural causes, the López family took control of the country, first with Carlos Antonio López from 1840-62, and then his son, Francisco Solano López from 1862-70. Carlos Antonio recognized the disastrous educational system and during his time more than 400 primary schools were opened, educating over 25,000 students. Scholarships were given widely to those who wished to study in European universities. He worked hard to give Paraguay military strength amassing 28,000 men and another 40,000 in reserves (Boas et al. 2002; Lewis 1982).

Once his father died, Francisco came to power. Called the Napoleon of South America, he is responsible for the war that nearly wiped Paraguay off the map. When the War of the Triple Alliance began in 1865, Paraguay had a population of around 400,000. By the end of the war in 1870, Paraguay not only lost over 150,000 km^2 of their territory, was placed in considerable debt by Argentina and Brazil, but the population was cut in half as well. From the 221,000 survivors, only 28,000 were male but mostly old men and children (Boas et al. 2002; Lewis 1982).

The years following the war were an unstable time for Paraguay. A new constitution was written in 1870 which was based on the United States and Argentinean constitutions. Guaraní was forbidden to be taught in the schools, slavery was abolished and a system to check the power and abuses of the president was instigated. Unfortunately, this constitution never really worked due to the nearly 80 years of dictatorship and the ban on individualistic thinking and education. Between 1870 and 1954 Paraguay saw 44 presidents, and of those, 24 were removed by force (Lewis 1982).

Between 1932 and 1935 Paraguay entered into a conflict with Bolivia. The Chaco War was fought due to undefined territory in the Chaco region and the possibility of the presence of oil; but neither country really has occupants there, and oil was never discovered. Even though the Bolivians were better trained and better equipped than the Paraguayans, the long standing tradition of nationalism spurred them on to win this war against Bolivia and retaining three fourths of the disputed territory (Boas et al. 2002; Lewis 1982).

It was during the time of the Chaco War that Alfredo Stroessner emerged onto the political scene. Stroessner would later go on to become the longest lasting

of all dictatorships in Paraguay. The extreme corruption and a one party rule, the Colorado, or officially the National Republican Association, dominated his nearly 35 years of dictatorship. He ran the country as a military, almost enslaving his citizens and granting extreme powers to the rich and further promoted corruption saying it was for the good of the state. He strived to make a unified country and even stated that class and political conflicts violated the idea of unity (Lambert et al. 2007). Torture was accepted and spies were everywhere, even amongst "friends." It is said that every seven out of ten people were informants for the government. He led genocide against the indigenous Aché, wiping out almost the entire population (Boas et al. 2002). To this day, the indigenous people, who number less than 3% of the population, are looked down upon as the lowest of the classes and are stereotyped as uneducated in Paraguayan society.

Stroessner was responsible for creating an "uneducated" society. He referred to himself as the "interpreter of the heart and the soul of the nation" which meant that he was able "to select and promote history, myth and identity according to political necessity" (Lambert et al. 2007). He did this through the national discourse of the Colorado Party and to be a teacher in the schools, you had to be a member of the party. Also, there was only one book used in the schools and it contained six subjects and even then, the information was not always that accurate (Sobera, C., personal interview, November 10, 2007). Despite everything he did to the nation, the Paraguayans who grew up under his dictatorship say, "*Era mejor cuando Stroessner fue dictador,"* how things were better when he was in power; how there was more order and structure and how you did not have to live in fear of being robbed and you could sleep outside your house without worrying (you just had to live in fear of being tortured).

The Colorado party was in power for 61 years. Then, in the presidential election of 2008, Fernando Lugo from the Tekojoja party won the office of President, thus ending the longest running one party rule in any country. Lugo was a Catholic bishop who renounced his holy orders in order to be president of the nation. He has launched a new campaign, Paraguay, Para Todos y Todas in hopes of bringing new reform to the education system.

CHAPTER 3

PEACE CORPS, PROJECT WET, AND THE PARAGUAYAN SCHOOL SYSTEM

The Peace Corps was founded in 1961 by United States of America President John F. Kennedy. As stated on their website (Peace Corps 2008), the mission of the Peace Corps is three fold:

> "1. Helping the people of interested countries in meeting their need for trained men and women.
> 2. Helping promote a better understanding of Americans on the part of the peoples served.
> 3. Helping promote a better understanding of other peoples on the part of Americans."

Peace Corps is found worldwide in over 70 countries trying to complete the mission in education, health, agricultural development, and youth development just to name a few. Particularly, Peace Corps/Paraguay has nine sectors with roughly 160 Volunteers. As an Environmental Education Volunteer in the Environmental Sector, my role is simply "to contribute to the protection and improvement of Paraguay's environment" (Aquino et al. 2006). The Environmental Education Sector was developed in the 1980s and works closely with the Paraguayan Ministry of Education and Culture (MEC). Volunteers are assigned to schools in communities where they will work and live for two years. Volunteers, like myself, typically work in their assigned schools, but also collaborate with non-governmental organizations (NGO), such as WWF, Guyra Paraguay, and PROCOSARA, especially since in recent years local NGOs have become more established and prominent.

The Peace Corps project plan for the Environmental Sector:

> "seeks to facilitate teachers' increased capacity to achieve integrated lesson planning through direct mentoring and training. Volunteers working with teachers, teacher training institutes, school principals and regional supervisors orient their efforts to reach children and youth" (Aquino et al. 2006 pg 8).

Since 1993, Peace Corps/Paraguay has emphasized the importance of deforestation, water conservation, and waste management (Aquino et al. 2006).

Thus, working with an NGO in water education fits into the project plan for Peace Corps Volunteers in Paraguay.

Peace Corps offers a program called Masters International where one can complete their graduate studies while serving as a Peace Corps Volunteer. The University of Colorado Denver offered this opportunity in the Department of Geography and Environmental Sciences. The core classes are completed the first year of study while the thesis is developed during the time that the student serves as a Peace Corps Volunteer. During my 30 months of service, I was able to learn about the culture of Paraguay and recognize the need for water education in the school system. Through the Peace Corps, I learned about Project WET and this is how this thesis topic presented itself to me.

Project WET, or Water Education for Teachers, is a nonprofit organization that was founded in 1984 by the North Dakota State Water Commission. For five years the program was focused only in North Dakota, then in 1989 Montana State University invited the director of the program to start a pilot program in the states of Montana, Idaho, and Arizona. Funding for this program was through the United States Department of the Interior Bureau of Reclamation. Later, in 2005 Project WET left Montana State University to become its own independent foundation (Project WET 2010).

Its mission is to bring water education to not only teachers, but to students, families, and community members so that they might have a better understanding of the importance of water. This goal is accomplished in four parts; by publishing educational materials in various languages such as Spanish, Japanese, Hungarian, and French to name a few, training workshops for teachers pertaining to specific topics such as wetlands, watersheds, water quality, etc., organizing community events such as Making a Splash with Project WET, and lastly by building a network of educators, professionals and scientists around the world who continue to add their valuable input to this program (Project WET 2010).

Project WET is present in all 50 states and Washington D.C. and also 26 countries around the world (see Appendix A), particularly in the South American countries of Colombia, Argentina, Chile, and Uruguay. The educational materials are effective because they are "interactive, adaptable to any environment or country, relevant, science based, and measurable" (Project WET 2010). In a study conducted in the United States by D'Agostino et al. (2007), 6th grade classes in Arizona were evaluated using hierarchical linear modeling to see if the activities of Project WET made a difference in the level of learning. It was concluded that the program is effective at improving students' understanding of water and water issues even if the teacher is using the material for the first time in the classroom. However, before the lessons were even presented in the classroom, the teachers

who participated underwent training in teacher workshops. The format of these teacher workshops places an emphasis on active participation, much like the teacher workshops I planned and executed in Paraguay.

This study by D'Agostino et al. (2007) is specific to teachers in the United States. However, a study such as this does not exist in a South American country. It is for that reason that this thesis is very important in terms of its contribution to the literature and the impact of Project WET in Paraguay. Project WET Canada had a team create water specific information in an annex as well, but their annex was written with specific highlights for certain activities. The Paraguayan annex is more of a general guide to the water in the country, but the topics were influenced by the 11 selected activities from the Project WET Mexico guide.

The Paraguayan school system is similar to the United States in respect to grade levels (Table 1). It is also obligatory for children to attend school up until *noveno grado* (ninth grade) and it is free for the public schools. The national organization of the system can be seen in Appendix B.

Table 1: Comparison of school grade levels

<table>
<tr><th colspan="2">PARAGUAY</th><th colspan="2">USA</th><th>AGE</th></tr>
<tr><td rowspan="4">Primer Ciclo</td><td>Pre-escolar</td><td rowspan="6">Elementary School</td><td>Kindergarten</td><td>5-6</td></tr>
<tr><td>Primer Grado de Básica</td><td>First Grade</td><td>6-7</td></tr>
<tr><td>Segundo Grado de Básica</td><td>Second Grade</td><td>7-8</td></tr>
<tr><td>Tercer Grado de Básica</td><td>Third Grade</td><td>8-9</td></tr>
<tr><td rowspan="2">Segundo Ciclo</td><td>Cuarto Grado de Básica</td><td>Fourth Grade</td><td>9-10</td></tr>
<tr><td>Quinto Grado de Básica</td><td>Fifth Grade</td><td>10-11</td></tr>
<tr><td rowspan="3">Tercer Ciclo</td><td>Sexto Grado de Básica</td><td rowspan="3">Middle School</td><td>Sixth Grade</td><td>11-12</td></tr>
<tr><td>Séptimo Grado de Básica</td><td>Seventh Grade</td><td>12-13</td></tr>
<tr><td>Octavo Grado de Básica</td><td>Eighth Grade</td><td>13-14</td></tr>
<tr><td rowspan="3">Colegio</td><td>Noveno Grado de Básica</td><td rowspan="3">High School</td><td>Ninth Grade</td><td>14-15</td></tr>
<tr><td>Primero Curso de la Media</td><td>Tenth Grade</td><td>15-16</td></tr>
<tr><td>Segundo Curso de la Media</td><td>Eleventh Grade</td><td>16-17</td></tr>
<tr><td></td><td>Tercer Curso de la Media</td><td>Twelfth Grade</td><td>17-18</td></tr>
</table>

All teachers are required by the MEC to have three years of education beyond high school to be a certified teacher and one extra year if they are to be specialized in a certain area, like math or Guaraní. Also, the teachers must attend teacher workshops throughout the year and accumulate various pedagogic hours to

continue their education, become familiar with new teaching techniques and to also learn about the changes in the MEC (Cáceres de Rodas & Garcete 1999).

Teacher workshops are vital to the exchange of information and other learning methods. Many times though, these teacher workshops are solely based on theory (the theory of classroom management for example) and do not touch on the practice of what was presented in the teacher workshop. In synthesis, teachers are not taught how to teach and especially are not taught how to teach using didactic methods, such as incorporating games, experiments or songs into their lessons. This leaves the teachers who truly do want to learn a new teaching method or learn new information to present to his or her class at a disadvantage. Therefore, teacher workshops planned and executed by Peace Corps Volunteers fill the niche where sometimes the MEC falls a bit short.

One of the biggest changes in the Paraguayan school system is the Educational Reform that took place in 1992. The reform was initiated due to the concern for a lack of science and technology in the curriculum (UNESCO 2003). The basic objective of the schools in relation to the environment state students should "*desarrollar valores que propicien la conservación, defensa, y recuperación del medio ambiente y la cultura"*[8] (Jiménez 2008). It was in 1992 that environmental education was emphasized more, not only in the overall fundamental learning components, but also in the *competencias básicas* (basic competencies) for each grade level. What that means is that environmental education should be integrated into all the subjects of the curriculum at all grade levels. For example, *Segundo Ciclo* students have classes in math, natural science, communication (Guaraní and Castellano[9]), art, physical education, health, social studies, and *trabajo y tecnología* (work and technology) and within those materials teachers must somehow incorporate aspects of the environment, whether it be using leaves from trees to do math problems or painting pictures of the environment, or using recycled materials for art class, or creating and maintaining a *huerta escolar*[10] (Environmental Education 2007). Unlike the U.S. where environmental education is typically incorporated into the life and earth sciences such as biology and geology,

[8] Develop values that favor the conservation, defense, and recuperation of the environment and culture.

[9] Castellano is Spanish, but there are differences in the way it is spoken in the southern cone countries of Paraguay, Argentina, and Uruguay. When asked, a Paraguayan, Argentinean, or Uruguayan will never tell you they speak Spanish. "*Hablo Castellano*" ("I speak Castellano").

[10] School garden particularly referring to vegetables

environmental education in Paraguay is infused throughout different subjects that students take across all grade levels.

In theory, this sounds very easy. The *huerta escolar* can easily be used in all subjects: measurements of the growth of plants for math class, drawing pictures of the plants for art class, actually planting, weeding and watering the garden for *trabajo y tecnología* class, learning about the properties and nutrition of the vegetables for health class, and learning about soil and water filtration and food chains for science class, etc. In reality, however, many teachers still do not know how to incorporate these changes into their curriculum and instructional practices. The *tranquilo* lifestyle[11] on the part of the teacher does little to encourage these changes from being implemented. This *tranquilo* lifestyle is perhaps due to Paraguayans being passive from years of political dictatorship, thereby developing a learned sense of helplessness. They are used to a dictator and his mandates, and thus do not do implement change themselves. It could also be a reflection of teacher training programs and the state of professional development in Paraguay. Nevertheless, this demonstrates the importance of workshops that equip teachers with the knowledge to incorporate environmental education into the school curriculum, especially when using specific educational materials such as Project WET.

With the educational reform of 1992, a large change was seen in the shift in the power to hire teachers and directors for schools. This was switched from Asunción to the interior of the country by creating supervisions. These supervisions are located in major towns in each of the 17 departments (Figure 2). Now, the schools can work with the local governments of the departments more easily, thus enabling funds to be obtained more efficiently than in the past for various projects or renovations for the school. Technically, it is not the responsibility of the local municipality to make the renovations to the schools, it is the responsibility of the MEC, but the *intendentes* (mayors) or *gobernadores* (governors) generally help out anyway if there is money available (Environmental Education 2007).

Another aspect of the educational reform is that schools must choose if they are an all Guaraní school or an all Castellano school. What this means is the students are receiving the majority of their education in either Guaraní or Castellano since both are official languages of Paraguay and roughly 90% of the population speaks both languages fluently (Cáceres de Rodas & Garcete 1999). If the school is a Castellano school, then it is required for the students to write and read Guaraní and

[11] The *tranquilo* lifestyle is one way to describe life in Paraguay. It is easy going, not too much stress, no strong commitments, carefree, lots of time for an afternoon *siesta*, and of course plenty of time to drink mate or tereré (a type of tea infusion, one served hot the other cold) throughout the day

vice versa for Guaraní schools (Environmental Education 2007). Usually Guaraní is spoken more in the *campo* and in the urban areas the teachers use more Castellano.

Lastly, the Educational Reform also states that 3% of the curriculum at all grade levels should be for community projects, which can include a community clean up, making trash cans, planting trees, or any other topic decided by the teacher and approved by the director/a (Environmental Education 2007).

Given how important water is to this country and the efforts of the educational reform to increase science in the school curriculum, it is amazing how little emphasis there is in learning about the water cycle, contamination, or even the states of water. Many older Paraguayans, who completed their schooling before the reform was initiated, recall never learning about the water cycle until they were at the university, and even then it was only because they had an interest in water and enrolled in science classes. In fact, before the reform, the students at every grade level were taught without ever having the opportunity to look for the information nor question whether the information being presented to them was correct. This applied to all subject matters, not just science.

However, these same people state that this was for them the *verdadera educación*[12] and what the system is like today is not as good as what it used to be. In other words, before the reform, students were given the information and expected to memorize it and were expected to write down on the exam exactly what was given to them. The teachers were stricter and there was more order in the classrooms. Today, there is still the same expectation of memorizing the information, but the punishment for acting up in the classroom is less than what it used to be. Before the teachers were permitted to use physical punishment, but after laws were passed to protect the rights for children in the same year as the educational reform, this action ceased.

Every grade level has *competencies básicas* (equivalent to the state/national standards in the US) that the teachers have to cover throughout the school year in order for students to move to the next grade the following year. For example, in the natural sciences class for *Segundo Ciclo*, the material is broken up into four areas: matter and energy, living things, the environment and the universe. The competencies for fourth grade science state that students should be able to:

> *-Valora la importancia de los ecosistemas acuáticos y terrestres.*
> *-Caracteriza por su importancia las relaciones biológicas que se establecen*

[12] True education

en una comunidad.
-Reconoce las cadenas alimentarías en la naturaleza.
-Coopera en acciones que favorecen la utilización racional de los recursos naturales.
-Toma decisiones acerca de las causas y consecuencias de la contaminación acuática.
-Analiza las implicancias ambientales de la Carta de la Tierra, la Cuenca del Plata, y los productos químicos orgánicos clorados persistentes, tóxicos y los de emisión no intencional (Dioxinas y Furanos) (Jiménez 2008).[13]

Unfortunately, these competencies are not well defined and can be hard for the teacher to interpret. For example, valuing the importance of aquatic and terrestrial ecosystems is a difficult concept to grasp. How do you value it? What actions need to be taken? Why should we value what those ecosystems contain? These are the sorts of questions that make environmental education in Paraguay difficult, because the outcomes of learning are not specifically stated.

Another difficulty with this system is the school day. The public schools are broken up into two sessions, or *turnos*; *turno mañana* and *turno tarde*. The morning goes from 7:00 to 11:00 and the afternoon session goes from 13:00 to 17:00. Students are only required to attend one session. It is generous to say that the students are actually in classes and learning for four hours. In my observations of not only my community, but in schools all over the country, schools rarely start on time and when they do start, at least 15-20 minutes are needed to sing the national anthem, pray and listen to any announcements. Then the students spend time sweeping the classrooms and arranging their desks for the day. Finally, after about an hour, their classes can begin. There is also at least 20 minutes set aside for recess and snack time. By the end of the session, the teacher is tired and usually the students are not paying that much attention to whatever class they are in.

The teaching method that almost every single teacher uses is the transmissive pedagogy mode, which is to say that the lesson for the day in a

[13] Value the importance of aquatic and terrestrial ecosystems. Characterize, by its importance, the biological relations that establish a community. Recognize the food chain in nature. Cooperate in actions that favor the rational usage of natural resources. Make decisions near to the causes and consequences of water contamination. Analyze the environmental implications of the land charter, the basin del Plata, the organic chemical products, and non-intentional emissions.

particular class is copied onto the black board and the students are expected to sit in silence and copy the information. This is done for almost every subject with little to no explanation. The students are graded on how well they can copy the information. During exams, the students memorize word for word what they copied in their notebooks and spit it out onto the pages of the exam. If they do not remember, usually their neighbor next to them does and thus cheating is widely accepted in the classrooms.

With this style of teaching and learning, it is important that learning becomes meaningful, fun and interactive so that the students will walk away from the activity having understood the importance of water conservation. This is where the Peace Corps hopes that their efforts with environmental education using Project WET curriculum in Paraguay will have a positive impact on schools, teachers and students. However, there are challenges to this implementation here in Paraguay and in having the teachers actually integrate water education activities into their lessons. This is why this thesis is focused on understanding the processes of adapting and implementing Project WET in classrooms through teacher workshops.

CHAPTER 4

EXAMPLES OF ENVIRONMENTAL EDUCATION IN PARAGUAY

My work as a Peace Corps/Paraguay Environmental Education Volunteer has been primarily in *Segundo Ciclo* (4th- 6th grades). I have worked extensively with the teachers of two grade schools, one public and the other private, in the town of Ayolas, Misiones to develop and implement new teaching techniques, make their classes more didactic, and to promote environmental education.

A typical day for me starts at 7:00, but I generally do not go to the school at this time of day. Given the usual school schedule for the first hour, I generally roll in on my *kavaju piru*[14] (bicycle) around the time of the first recess. It is much easier to talk to the teachers during their recess period since I do not feel like I am interrupting the class. After the *besitos*[15] and *saludos* from the students of "*Hola Profe!"* I usually manage to locate the few teachers that are willing to work with me in the school. We are assigned to the schools based on a written request to Peace Corps from the director/a or the supervisor/a. This means that they want a Peace Corps Volunteer there, but the rest of the teachers may not even know who we are or what we are doing there. Before the school year starts, we present ourselves at the teacher meetings and try to gain an idea of who might want to work with a Peace Corps Volunteer through a simple survey (Appendix C). It is completely voluntary for them to want to work with us. Some choose not to as a matter of pride in their own abilities, distrust of foreigners, or even from simple disinterest in what we are doing in the community. However, others jump at the chance to get to know the new *norte*[16] and hear what we have to offer. I also have the ability to say 'no' to working with certain teachers if all they want from me is to take over teaching their class. This is the main reason our service is for two years. It takes a tremendous amount of time and effort to gain the trust and respect in the community and especially in the professional setting of the school.

On this given day, there is one middle aged *profesora* who, as always, readily jumps as the chance to chat with me and asks me if I can come in and teach

[14] Literally skinny horse (in Guaraní)

[15] Little kisses, the normal greeting between women are kisses on both cheeks. This is also a greeting, or *saludo* between a woman and man. Between men, they shake hands.

[16] Literally means north, but Paraguayans use the word to refer to anyone from the United States.

her students about the types of soils and how water moves through the different substrates. This is a teacher with who I have had many successes, not only in the area of water education. She is always enthusiastic about any new game or song or activity I bring to her class. She is one of those teachers who has been teaching the same thing for years, and actively is searching for new activities to try with her students.

A few days later I arrive to the sixth grade class to find 25 students overjoyed to see me and to spend the next half hour listening to a strange *norte* who speaks Castellano with a funny accent talk about clay, sand and compost and how water particles move through each example of soil and how it filters down to become part of our groundwater. The *charla* (talk) ends with the students pouring water into plastic bottles via funnels filled with each example of soil and timing how quickly the water moves through different substrates. I leave the classroom hearing shouts of "*¿Cuándo vas a volver, Profe?"*[17] Smiling, I use my favorite response, "*Cualquier momento."*[18]

This example of environmental education in the schools of Paraguay is what we as Peace Corps Volunteers are striving to implement here with the teachers in hopes that they will learn a more didactic approach to teaching the same information. An activity such as the one just described is exceedingly uncommon in the normal school day. The activity described was adapted from one of the Project WET activities in the Project WET Mexico manual, called *Visualizando el agua subterránea* (Visualizing the subterraneous water). The activity as written is directed to high school aged students and is much longer than my time allotted with my 6th grade students. Instead, I selected the most important point to explain to my students by drawing the figures of substrate particles on the chalkboard then implemented the hands on part of the activity, but not to the degree as described in the activity as written.

Generally, activities such as going to school, planning a *charla,* or just conversing with teachers (in order to have a sense of what they are currently teaching that week), take up a majority of my time, but then again I do not have a set schedule day to day. I am not a regular teacher in the schools, nor am I a substitute teacher. Every time I enter to teach, the teacher must be present in the room with me. This is not only to ensure that the students behave, but also to show the teachers different teaching techniques, classroom management tips and also potentially teach them something new related to the topic of my *charla*.

[17] When are you going to come back, teacher?

[18] Any moment

One cold July day in 2009, I received Project WET Mexico manuals from my APCD, or Associate Program Country Director, or also known as 'my boss.' It was never clear to me how this manual arrived to Paraguay or even why it was a Project WET Mexico manual instead of a manual from one of the countries closer to Paraguay. My APCD explained to me that it was decided that in order to promote the ideals and principles of the Environmental Sector on water education (as stated in our sector plan), help future Environmental Education Volunteers with easy activities they could do within the first few months in site, and promote water education activities in the school curriculum, I was to select and adapt 10-12 activities from the Project WET manuals. I choose the activities that would be easy to explain to teachers through a series of workshops, which would not require inaccessible materials and would follow the *competencies básicas* for fourth, fifth, and sixth grades.

I selected 11 lessons from these manuals that consist of over hundreds of different activities related to water education (Appendix D). I chose lessons while keeping in mind the ability of the poor rural school teachers to find the materials in their communities since many of the activities are material intensive. I also chose the activities based upon the geography of the country. The amount of wetlands in Paraguay led me to choose a few activities that relate to wetlands and their importance. One activity relates to water usage in a community, and given the diversity of the water resources (lakes, rivers, aquifers, etc) and *campo* versus city, I thought this activity would be important to incorporate as well.

After looking carefully at the Connections and Background sections of each selected activity from the manuals, I determined what information would be the most pertinent for the lessons and also for the Paraguayan classroom. I created an appendix of water specific information relating to the country with the agreement that it would be placed at the end of the Project WET Mexico teacher's guide. Given how instruction in this country is in two languages, I kept the technical, scientific parts in Spanish while more cultural points, such as myths and legends regarding water, I also had translated into Guaraní as well as keeping it in Spanish. I wrote the annex in simple terminology so that the teachers would be able to understand, and thus be able to communicate the information effectively to their students. There are many figures and tables incorporated into the document too. This annex in its true Spanish form can be seen in Appendix E.

Next, I selected three sites: Pilar, Ñeembucú, a large city of roughly 32,000 residents, Ayolas, Misiones, a smaller city of 5,000 people and lastly Valle Apu'a, Paraguarí, a rural town less than 1,000 residents. These three locations all are located by some body of water and retain a Peace Corps Environmental Education Volunteer, to host teacher workshops on how to incorporate water conservation

ideas and activities into their curriculum. Also, these sites represent a variety of different demographic areas. Each site contains a different amount of people. Also, geographically they are not located near to each other. Lastly, there is the difference in a more rural mindset compared to a city. This rural site was very important in this study since it would be a test to see if the activities would be appropriate for the amount of materials available and word choice for the manual's technical information.

Figure 3: Río Paraguay In Pilar

Figure 4: Río Paraná In Ayolas

Figure 5: Valle Apu'a With Peace Corps Volunteers Andrew Smith and Amanda Horvath

Planning for these workshops began about a month ahead of time. Lots of communication had to occur between myself, the two other Peace Corps Volunteers, and the supervisions of each zone in the department where the workshops were to take place. In the past few years more and more places in Paraguay have seen an increase in local cybers. This does not mean that using e-mail is how communication occurs due to the potential lack of knowledge of how to use the internet and e-mail. Almost everyone has a cell phone and thus communication occurs more quickly and effectively by calling or sending a text message. But, nothing ever moves along as quickly as planned on the day you wish it would occur. Someone is always not in their office (*Lo siento Mandi, Pablina no está hoy, pero sí o sí mañana*[19]), without *saldo* (credit) on their phone so they do not return my calls or text messages, or I am directed to someone else since no one knows the answers to my questions. This slow progress is potentially again due to that *tranquilo* lifestyle or just the sense of time that Paraguayans have. They generally do not rush

[19] I'm sorry Mandi, Pablina is not here today, but without fail tomorrow.

nor see the importance of being on time. To them, *otro día,* or *más tarde*[20] are perfectly acceptable responses and allotments of time. In the case of the schools in Ayolas, a fax was sent to all the schools in the area to invite the teachers who were interested to come. For Valle Apu'a, the Peace Corps Volunteer, Andrew Smith, personally went to solicit from the supervisor permission for the workshop and then personally invited the teachers in the one school in his community. In Pilar, the Peace Corps Volunteer, Brian Byrd, sent faxes, made flyers and personally went to all the schools in Pilar to invite teachers to come.

It was finally decided by the Peace Corps Volunteers in each site that the best time to have these teacher workshops was on or around March 22nd in honor of the *Día Internacional del Agua* (International Water Day). Paraguayans are very particular about celebrating these days of remembrance in the school calendar. Teachers remember and celebrate these days better than I remember the days of importance or holidays in the United States. Teachers and students celebrate and remember these days in a variety of ways. For some days the student paint pictures or write poems to commemorate the day or perhaps they will perform a dance or skit for the school. They say that these occasions (the majority are specific to Paraguayan culture) became part of the school calendar when Stroessner was in power. Since his dictatorship was one of cruel and utmost control, he wanted to give something back to the Paraguayans where they could have one day to look forward to and celebrate each month. Other days that are remembered in the school calendar include: *día del animal, día del camino, día de amistad,* or *día del medio ambiente*[21], just to name a few.

Finally with set dates, March 18th in Ayolas, March 19th in Valle Apu'a, and March 22nd in Pilar, preparing the agenda and materials for the workshops could be made with a deadline in mind (Appendix F).

The first workshop in Ayolas was attended by 14 teachers from around the city and even a teacher from a town 30 kilometers to the north. This was an excellent turn out since only nine teachers had sent in an RSVP to the school where I work and where the workshop was going to be held only two days before the event. I only invited teachers via fax who were interested in the topic and who were available to come since they would have to find replacements for their class. The workshop was scheduled to start at 7:00 am, so naturally by 7:40 we were just

[20] Another day or much later. This is a literal translation to the words, but in the context of time, it can mean anywhere from the next day to never.

[21] Day of the animal, day of the road, day of friendship, day of the environment

beginning our first icebreaker. This is what is known as *la hora paraguaya.* Things rarely start on time. The workshop began with an overview of why environmental education is important, and particularly water education. The teachers were eager to speak up and provide what knowledge they already knew about the water situation in Paraguay. *"Estaba mirando la propaganda en la tele y habla mucho sobre la contaminación del Lago Ypoá debido a fosfatos en los detergentes. Tenemos que valorar lo que tenemos acá en Paraguay"*[22] claimed one *profesora*. This led into a discussion on biomagnification led by another *profesora*.

Later the group was split into four groups to do the *suma de las partes* activity. This activity focuses on river contamination and how we all are part of the process of water pollution. This is important in water conservation education because it allows us to think and make the connection of how we are all related and our actions affect those around us. The *profesores* could draw whatever they wished and have whatever they wished for on their land. Some were very environmentally conscious and drew wind turbines and wanted organic farms, while others valued a more traditional Paraguayan lifestyle of agriculture and animal husbandry. Possibly these differences occurred based on their upbringing or on the current trends they see on television or in movies. In three out of the four groups, hotels for tourism were constructed; this could possibly have been influenced by the high amount of tourism located along the Río Paraná and particularly in Ayolas. In the past few years, there has been a big push from the *Secretaria Nacional de Turismo* (National Secretary of Tourism) to develop the areas in Paraguay which are most likely to attract tourists, not only Paraguayan tourists, but international travelers as well. Due to the location along the Río Paraná, its beautiful scenery, and Yacyretá, the hydroelectric dam, Ayolas has seen an increase in tourism in the past few years. All teachers actively participated and enjoyed the activity. When asked, *"¿Quién conoce Encarnación?"*[23] the city that is located upriver from Ayolas, almost everyone raised their hand. This helped them make the connection of how Ayolas is affected by the contamination up river. I related a story to them also to drive home the point of contamination and how we are all connected.

I once was looking at the prices of fish in a supermarket in Encarnación and could not believe how expensive it was compared to the prices in Ayolas. I asked a fisherman friend of mine, "*¿Por qué el pescado en Encarnación está tan caro?"*[24]

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[22] I was watching commercials on the television and it speaks a lot about the contamination of Lake Ypoá due to the phosphates in detergents. We have to value what we have here in Paraguay

[23] Who is familiar with Encarnación?

[24] Why are the fish prices in Encarnación so expensive?

He told me, "*Es porque no se pesca ahí. El agua está sucia.*"[25] I told him that the same water was coming down to Ayolas, and it would still be dirty once it reached our town. He did not have a comment to that. The teachers did not comment either, but I could see from their faces and nodded heads that a few were making some connections.

Figure 6: Teachers From Ayolas Working On Their Drawings

After an unplanned recess of 40 minutes (*la hora paraguaya)*, the group came back to try their hands at teaching one activity which related to the properties of water to the other group. This is important in water education because it starts with the basic properties of water. If one understands the basic properties, such as density, adhesion and cohesion, one can be better equipped to conserve water or understand better how contamination occurs. One group used the *aventuras en la*

[25] It is because you do not fish there. The water is very dirty.

densidad (adventures in density) activity and the other used *olimpiaguas* (water olympics), which focuses on adhesion and cohesion. I worked with the group on density while Jessica Blatt, my follow-up Peace Corps Volunteer, worked with the other group. When I asked my group of seven teachers, one of whom was the *directora* of another school in Ayolas and another a fourth grade teacher, what I thought was a simple question "*¿Qué significa densidad?"*[26] I received no response and blank stares. One *profesora* stated "*No tocamos este tema en segundo ciclo, por lo tanto no estamos seguras que significa."*[27] I quickly defined the term for them and confirmed that was one of the reasons for the workshop; to learn new concepts. I went directly into the experiment after that and went ahead and presented all three parts of the activity, but when it came down to understanding how temperature affects the density of water, they again became uncertain in their responses due to their lack of experience with these topics. They decided to just focus on how salinity affects density since it was a concept they could visualize by using a diagram and presented that to the other group.

When it came time for the groups to present their information, the teacher with whom I have worked many times addressed her colleagues with the same question, and received the same response I received from them. She responded, *"Nosotros usamos otros términos, por ejemplo, enseñamos las cosas como 'peso' y 'volumen' en vez de decir 'densidad.' Miren como enseñan países más adelantados. Y por eso Paraguay está detrás de ellos. Términos científicos no enseñamos correctamente."*[28] This statement was very strong because it made me realize that the teachers do understand that some concepts are missing from their basic water education. However, they did not start their presentation with a single question even when presenting the *olimpiaguas* which is clearly written with opening questions for the students and which Jessica Blatt presented to them. In this case the teachers did not have an inquisitive mindset before starting the presentation even when presented in written form and Jessica's opening demonstration. This could be because all those teachers fall under the old system of education, where they were taught not to ask question and in the same way, they do not expect their students in class to ask questions.

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[26] What does density mean?

[27] We do not touch on this topic in 4th, 5th, and 6th grades, therefore we are not sure what it means.

[28]We use other terminology, for example, weight and volume instead of saying density. Look at how more advanced counties teach. It is for that reason that Paraguay is behind them. We do not teach the scientific terminology correctly.

The second teacher workshop in Valle Apu'a was attended by only six teachers all from the same school. This was because the Peace Corps Volunteer in this site only works with this school and thus only invited those teachers. The workshop started the same as before, with an icebreaker, the introduction and then the Project WET activities. The teachers at this workshop were not quite as responsive as the ones in Ayolas. This could be because they did not know me and again, the apprehension of foreigners might play a part or it might simply have been disinterest in the theme of the workshop.

The *suma de las partes* activity was more of an individual task this time due to the small group of teachers. Interestingly enough, all of the teachers presented their drawings with a large house where they claimed,"*para usar los fines de semana para descansar.*"[29] This was an interesting view that these teachers had. Since the community is not located on a large river like Ayolas or Pilar, they do not take seeing a large river for granted. They view it as a tourist destination. They almost all chose to leave the land in its natural state, or to plant fruit trees, again, a connection to the rural upbringing in the community. One teacher even wanted to start a tilapia farm. Given how Valle Apu'a is not located close to a large river, or even any little river, the local connection was not as strong as it was in Ayolas for this activity. Nonetheless, the teachers appeared to see some connections to the affects we all have on water contamination.

After a quick recess, we proceeded again into the individual activities where the teachers would have to teach to the other group. During the *aventuras en la densidad* activity, one teacher commented how, "*es mucho mejor que solo aprendiendo por teoría"*[30]after seeing how the egg floated in the salt water. She quickly made the comparison to an everyday experience where she places her eggs in water to see if they have become rotten. Rotten eggs float and now she was finally able to understand the science behind it.

It was noted how much more these teachers spoke Guaraní between themselves and even with me, even though the workshop was given in Castellano. This does, however, reinforce the importance of having parts of the manual in Guaraní.

The final teacher workshop took place in Pilar. The Peace Corps Volunteer in the city worked with the supervision to invite over 50 teachers to attend, but due to heavy rain in the morning, only 21 teachers participated. However, they

[29] To use on the weekends in order to rest.

[30]It is much better than only learning by theory.

represented ten different schools in the city. Once again the responses for *suma de las partes* were varied. Many modeled their land after Pilar, which is located on the Río Paraguay. Using the influence of what is around them, what they are familiar with and how they were brought up, they created what they wanted on their portion of the river. This is in accordance to how the teachers participated in both Ayolas and Valle Apu'a. Again, like in Ayolas, the teachers were able to make a more personal connection and make observations pertaining to the contamination of the river due to the location of the city on the river. Also, many teachers are familiar with Asunción and easily could relate how dirty the city is and how that garbage flows down to them in Pilar.

The individual group presentations went well. The teachers in the *aventuras en la densidad* group were all able to describe and define density, but sometimes still used the word 'weight' to describe it. After the presentations, one teacher commented to her colleagues, "*estas actividades son sencillas y cortas. ¿Por qué no usamos ya? Implementemos esta semana.*"[31]

Following the format normally used for the MEC teacher workshops, every teacher filled out an evaluation form (Table 2). There was a place for suggestions below the standard rubric but generally the comments were all the same, which stated, "*El taller estuvo muy bueno, continúen con las mismas actividades; que se repita el taller. Que mas docentes puedan participar en el taller.*"[32]

Table 2: Summary of evaluation forms

Category	**OK**	**Satisfactory**	**Outstanding**
Ice Breaker	2	16	20
Material presentation		21	15
Suma de las partes activity		22	18
Activities in groups	1	16	24
The storm	1	17	21
In general	1	17	21

Overall, I felt that the teacher workshops were a success and the positive feedback from the evaluations support this feeling. One teacher from Pilar took the advice of her colleague and used one of the activities that very same week in her

[31] These activities are simple and short. Why not use them now? Let's implement them this week.

[32] The workshop was very good; continue the same activities, that the workshop is repeated. That more teachers can participate in the workshop.

class, without the help any outside aide. She took her own initiative and executed the lesson. This was reported to me by the Peace Corps Volunteer in Pilar. This indicated to me that at least one teacher took to heart the message and intention of the workshop, which was to present simple and fun ways to incorporate water education in the classroom.

CHAPTER 5

THE PROCESSES OF CULTURAL CONTEXTUALIZATION IN ENVIRONMENTAL EDUCATION

From my perspective as a citizen of the United States coming into a developing South American country, there are many stereotypes that we must try to overcome in order to be effective environmental educators. Paraguayans are usually very set in their ways and views of the world, with good reason since they used to be punished for independent thinking or even just questioning what was given to them.

No matter where a Peace Corps Volunteer is stationed geographically in the country, we all have heard the same comments, "*Sos estadounidense, ¿no? Ah, estás acá para robar nuestra agua entonces. Sos espía*"[33] Granted these tend to come more from people who live in the *campo* or places where there are a great number of water resources, like the BAAPA, but I have heard these comments in large cities and even from Paraguayans who no longer live in Paraguay. These comments can lead one to believe that Paraguayans do value and understand they have a wonderful resource, but they may not necessarily understand why it is important or how much of Paraguay is comprised of water. The whole process of this investigation began with the gathering of the water specific information on Paraguay. However, given how Americans are perceived in Paraguay, the investigation for the background water information for the annex to Project WET had to be done as to not arouse too much suspicion on the part of certain organizations and people (Appendix E).

The implementation of Project WET activities also was a challenge. Planning teacher workshops takes much coordination and patience. The chosen sites are places where there are already Peace Corps Environmental Education Volunteers who are using the Project WET materials in the schools. Permission had to be gained by the three regional supervisions in order to properly award the four pedagogic hours for the teacher workshops. This gives more incentive for the teachers to actually show up and participate. Without an incentive, it is quite possible that the teachers fall back into that *tranquilo* lifestyle and not attend or want to commit to coming to the workshop. From those who did attend, a few wanted to leave early or conveniently "disappear" for long periods of time.

Not only having an incentive for teacher participation, but timing was also another important factor that was considered in the implementation of Project WET

[33] You are an American right? You are here to rob our water. You are a spy.

teacher workshops. Since all three workshops took place during the week, the teachers invited had to find substitutes (and the teachers usually pay out of their own pocket) for their classes so that the students would not lose a day of school. This was the case for Ayolas, but for Valle Apu'a it was not. The teachers who attended did not find substitutes for their classes and so the students had a free day.

The normal school year after the Education Reform increased its hours from 666 to 800 (Cáceres de Rodas & Garcete 1999). However, this is on paper only. Frequent holidays (like feast day of the city's patron saint) and teacher strikes occur on a regular basis. When a teacher strike does occur, they usually last anywhere from two days to a week or even more depending on the reason for the strike (usually the teachers are asking for more money). This lost time is supposed to be made up at the end of the year or with Saturday classes, but this rarely happens. The students are set farther back in their studies and thus topics that were supposed to be covered in depth or activities that were supposed to be carried out might not ever occur. This is one of the reasons that contribute to the low level of basic education in Paraguay. In the 1999 report by Cáceres de Rodas & Garcete, people over the age of 25 had the equivalent of 6.2 years of schooling, with a higher level in the urban areas (7.7 years) than the *campo* (4.2 years). For students ranging between the ages of 7-18, 31.8% had to repeat a grade level. Lastly, the overall illiteracy rate for the country is 8.9%. Consequently, even though teachers may have received professional development in water education through Project WET workshops, there is no guarantee that the activities or lessons will be implemented in their classrooms.

These statistics were taken into consideration in the adaption process of the materials of Project WET Mexico. The length of the school day, and the time allotted to each material the students have to learn is very important. Some activities call for two or three class periods of 50 minutes each. This may not always be the amount of time the teacher has for that subject each day. For example, during the school year, the number of hours allotted per week for *Ciencias Naturales* (Natural Science) is only three (or 120 minutes given a 40 minute class period three times a week). In comparison, their language classes and mathematics classes total five hours a week for each (or 200 minutes given a 40 minute class period five times a week) (Jiménez 2008). See Appendix G for a complete breakdown of the time distribution in the schools. This mimics the education system in the U.S. where language and mathematics are given precedence over science. However, this breakdown of hours per week is not consistent with the normal day of four hours of class each day for five days a week (a total of 20 hours). Jiménez (2008) does not explain why there are 30 hours a week for class; she just states that fact.

Due to the copy right laws of UNESCO and Project WET, I was unable to change a single word in the lessons from the manuals. The only change I was allowed to make was to add the Paraguay specific material at the end of the teacher manual. Also, the Project WET Mexico activities give a range of appropriate ages or grade levels, and given again the low level of basic education in Paraguay, this sometimes was not applicable to Paraguay. Some activities that are for a lower level for Mexico might be appropriate for higher grade levels in Paraguay. One needs to understand the system in Paraguay, in order to be able to choose activities which are appropriate for the grade levels in the country.

Since some of the activities were very long, I selected certain points of the activity to highlight with the teachers during the workshops that would fit into the time frame more applicable to Paraguayan schools. Also, for all 11 chosen activities, I highlighted the basic competencies in which the activity fit the best. For example, the activity *Agua en el aire* (Water in the air) can be used in the science classes and completes the basic competency in fourth grade which states, "*Ejecuta experiencias sencillas sobre las propiedades, los estados físicos y los cambios de estados de la materia*."[34] In fifth grade, "*Determina procesos científicos: formular hipótesis, experimentar y formular modelos. Reflexiona acerca de la importancia de las capas de la atmósfera: composición, propiedades e importancia del aire"*[35] and lastly in sixth grade, "*Aplica los procesos científicos básicos (inferir, predecir y analizar datos) e integrados (controlar variables) en la solución de problemas"*[36] (Jiménez 2008).

Overall, adapting these activities to Paraguay would have been a challenge had I not been living and speaking the language in Paraguay for over two years. Working with teachers and understanding the school system helped in developing the annex and choosing the activities. I know many people probably still thought I was trying to steal the water, but the importance of this project was enough for me to persevere and complete it without allowing stereotypes to influence my decision to implement these workshops.

[34] Execute simple experiences about the properties of the physical states and the changes of the states of the material.

[35] Determine the scientific process: formulate a hypothesis, experiment and formulate models. Reflect on the importance of the of the layers in the atmosphere: composition, properties, and the importance of air

[36] Apply the basic scientific process (infer, predict, and analyze data) and controlled variables in the solution of problems.

CHAPTER 6

IMPLICATIONS AND CONCLUSIONS

What does all of this mean for Peace Corps/Paraguay, Project WET, and for the teachers, students, citizens of Paraguay and the future of environmental education in Paraguay?

The information on water education was presented in workshops and hopefully teachers will take the next step to implement water education on a more consistent basis in the classroom. The Peace Corps Volunteers of the future could fill that role alongside the teachers in the implementation process. The manual I compiled will be distributed to incoming Environmental Education Volunteers and they will be trained in how to use them. They also will have some simple and quick activities they can utilize their first few months in site to start to build credibility with the teachers and start to achieve a professional working relationship with them. They also can hold their own teacher workshops on the same topic and thus expand upon the work started in this thesis in the three sites in the south of the country. The mission again for a Peace Corps Volunteer is to "promote a better understanding of Americans on the part of the peoples served" and this includes dispelling the notion that we are in the country to steal their water (Peace Corps 2008).

For Project WET, this signifies the beginning of the work and adaption of a water education curriculum for a new country. Workshops have been presented to 41 educators in three different communities along with 11 activities and instruction on how to use them in the classroom. The message of water conservation and water education has been promoted in Paraguay. Yet it remains to be seen whether this results in a change in thinking and behaviors in the context of classrooms.

Why promote Project WET at all in Paraguay? The benefits of this program are the promotion of water activities, not only in the realm of conservation and preservation, but also in the basic science of the properties of water. Knowledge about a substance that covers 70% of our planet and one of the substances we need to survive is extremely important. Project WET, as of this writing, does not operate independently internationally. The organization usually works with host country organizations, such as Peace Corps, to promote their materials.

Future research could investigate the long-term benefits of workshops. Examples of research questions might include: Do teachers implement water education and if so, how do they do it? Do teachers improvise their instruction to make Project WET activities even more culturally relevant for their students? Do

students understand concepts related to water education better after experiencing Project WET activities in class? Do students change their water habits at home?

Also, environmental education is not only about having "fun and didactic activities" but also understanding why those activities are relevant for individuals, communities and human society at large. Project WET needs to ensure that their curriculum is socio-culturally relevant, meaningful and fun, they should work with Peace Corps and other groups, which already are teaching why environmental education is so important, in order to determine if learning and behaviors are being changed as a result of their efforts through more research.

There are a few successes which can be pointed out pertaining to the teacher workshops. The first was the ease of implementation once all the pre-workshop coordination took place. All the activities planned were successfully presented and the teachers responded well to the activities. The time spent planning ahead of time paid off when the actual day arrived to present the materials. Also, knowledge of how the school system organization (Appendix B) helped when it came to knowing who to ask for permission for the different factors of the workshops, like the pedagogic hours, or use of the library as a location to hold the workshop. Lastly, the help of the Peace Corps Volunteers in Pilar and Valle Apu'a cannot be undermined. Their knowledge of local contacts and advice on how to present the information was also imperative for the ease of the presentation of these workshops.

An interesting aspect of implementing these workshops in three different locations was the different ways in which teachers react to Project WET activities. It reflects ties to local communities and their upbringing such as the promotion of agricultural systems. People have different experiences such as the indigenous knowledge of floating an egg in the water to see if it has become rotten or not, and use them in different yet meaningful ways to make sense of environmental and day to day concepts. So this means that environmental education has to be flexible in the sense of where it is being done; a city or the rural countryside. It means that one must take a step back and evaluate what knowledge is already present, and what is lacking, such as in the case of the teacher who said that they do not teach density in school and they themselves are not sure of what the word means.

As for the future of environmental education in Paraguay, this process of adapting and cultural contextualization is just the first step in a long road ahead. We as Peace Corps Volunteers can only do so much. It is up to the teachers to be motivated enough to teacher these subjects, but not only to teach the theory of water properties, or the water cycle, but also to do it with dynamic activities. Perhaps if education was emphasized and valued more in the society, the teachers might be motivated enough to start teaching these topics on their own. However,

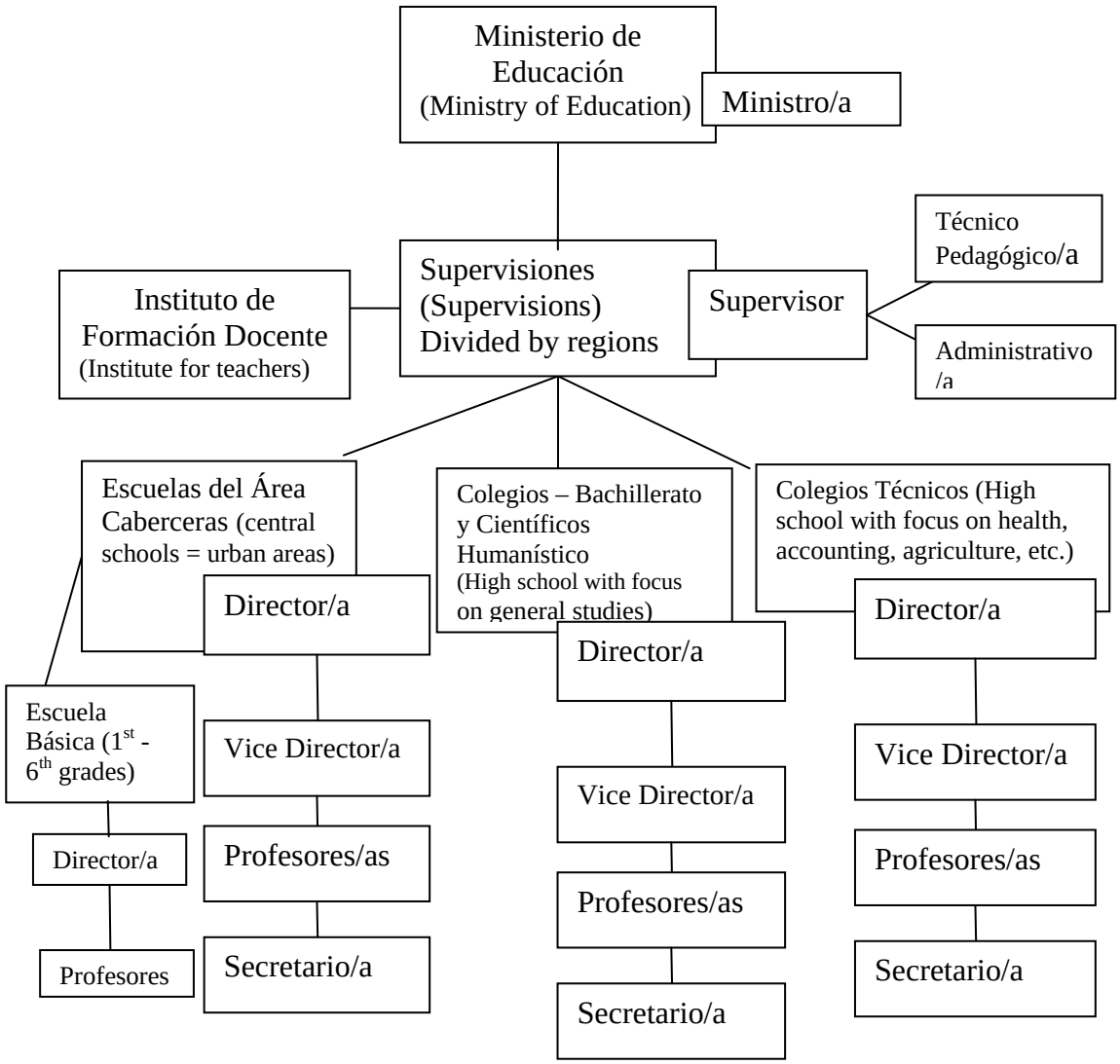
changes within the MEC competencies need to occur in order to reflect the importance of water at every grade level, and not only beginning in 4th grade. This is one difficulty the system will face. More teacher workshops sponsored by Peace Corps Volunteers and the MEC need to occur to help the implementation process occur more quickly and frequently. A distribution of the materials, such as the water annex and Project WET activities should also occur with those workshops. Funding, of course, would be the only issue. Who will pay for the distribution of this information? Right now the cost of the printing of the water annex and basic competency comparison was covered by Peace Corps/Paraguay. This is not sustainable since at any given moment the organization could be asked to leave the country. If this were to occur, then who would shoulder this cost? Project WET or the MEC? These are factors to consider down the road as this process grows to a nationwide extent. Also, to promote more teacher participation, perhaps paying for the teacher's substitutes would constitute an increase in attendance at the workshops; but again, from where will that funding come?

Over all, this process of adaption of Project WET materials specifically for the country of Paraguay was a bit challenging at times, but also an important first step in the long process ahead for the future of water education in a country where the water resources are abundant but the dissemination of information is not. Water education for the citizens of Paraguay is in their reach.

APPENDIX A
COUNTRIES WHERE PROJECT WET OPERATES

Region	Country	Year Initiated
Africa	Cameroon	2003
	South Africa	2005
	Togo	2003
	Uganda	2003
Asia	Japan	2003
	Lebanon	2005
	Pakistan	2008
	South Korea	2008
	Turkey	2008
	United Arab Emirates	2006
	Vietnam	N/A
Central America	Costa Rica	2004
	Jamaica	2007
South America	Argentina	2004
	Chile	2007
	Colombia	N/A
	Uruguay	2008
Europe	France	2007
	Hungary	2006
	Italy	2007
North America	Canada	1996
	Mexico	1999
	United States	1984
Oceania	American Samoa	1998
	Fiji	2003
	Palau	1998

APPENDIX B
ORGANIZATION OF THE PARAGUAYAN SCHOOL SYSTEM



APPENDIX C
TEACHER SURVEY

¡Jamba'apota oñondivepa!

Nombre: **Grado:**

Marque los temas en que quisiera trabajar este año:

Biodiversidad	**Agua** (Contaminación del agua, ciclo de agua)	
Bosque/ Deforestación	Basura	
Animales	Eco regiones del Paraguay	Flora y Fauna en extinción
Salud/Enfermedades relacionadas al medioambiente		Ecosistemas
Ecología		

Actividades que le gustaría incorporar este año en su aula o escuela (Marcar cada uno):

Juegos	Materiales didácticos	Teatros
Canciones	Experimentos	Viveros
Plan integrado	Campañas ambientales	
Huerta escolar	Mascaras/Títeres	
Murales con mapa del mundo o del Paraguay		

Escriba los días que prefiere trabajar:

El mes (o cuando) que le gustaría empezar:

Su información de contacto/teléfono es:

Otras cosas que le interesan, ideas, sugerencias:

APPENDIX D
LIST OF PROJECT WET ACTIVITIES
FOR TEACHER WORKSHOPS

Spanish Title	English Title	Objective of Activity
Memorama	Memorama	Identify the three states of water, recognize that water can be contaminated and cleaned
Agua en el aire?	Water in the air?	Demonstrate that the air contains water, determine the importance of water in the air
Agua segura	Safe water	Observe and investigate forms of water contamination and its affects for human health
Suma de las partes	A sum of the parts	Differentiate between point and nonpoint contamination, learn that all people are responsible for quality of water in rivers
Aventuras en la densidad	Adventures in density	Demonstrate how heat and salinity affect density, relate the compaction of the molecules with density of the same states
Olimpiaguas	Water Olympics	Demonstrate the properties of adhesion and cohesion, relate the cohesion and adhesion with everyday activities
¡Imagina!	Imagine!	Identify and describe the changes in the states of water that occur in the water cycle
La Tormenta	The storm	Work together to mimic the sounds of a storm, learn about precipitation
Parte y reparte	Parts and distribution	Analyze how people perceive and value the diverse uses of water in its distinctive forms
Agua para todos	Water for all	Illustrate the form in that the multiple uses of water can affect the quality and quantity of water
Captación, almacenamiento y liberación	Capture, storage, and liberation	Recognize that subterranean water, superficial water, and precipitation contribute to filling water in wetlands

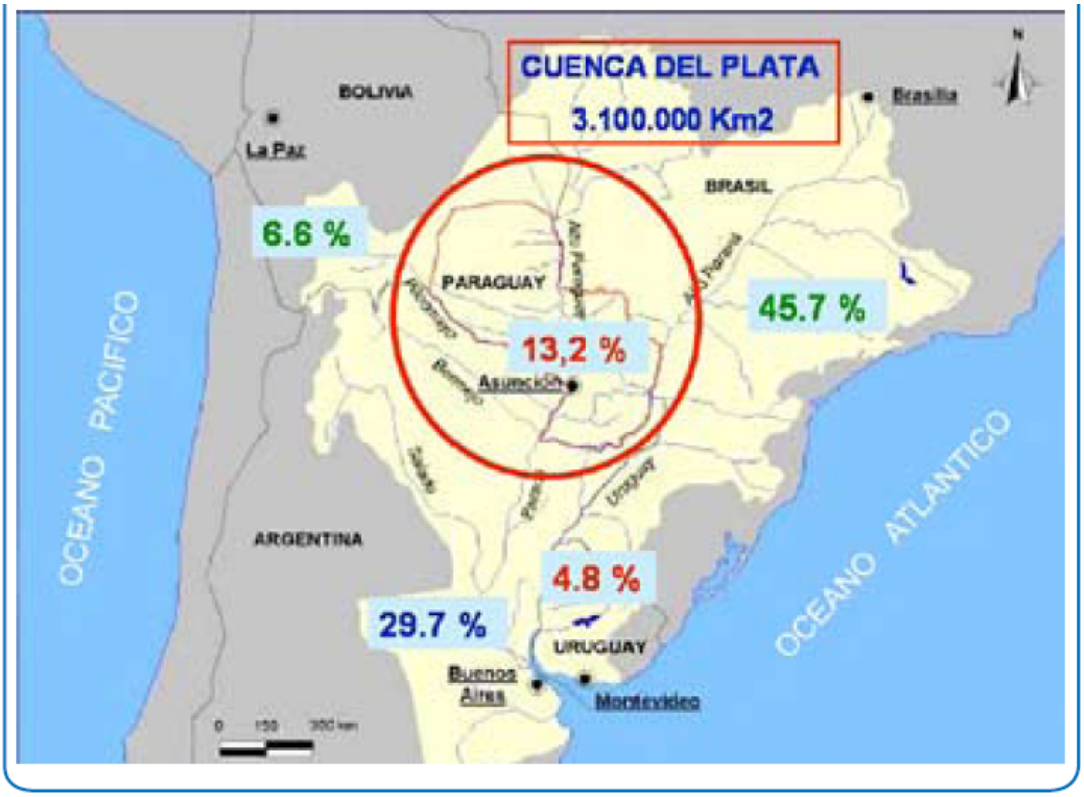
APPENDIX E
WATER IN PARAGUAY ANNEX
USED IN PROJECT WET

Agua en el Paraguay

Paraguay es un país rico en recursos de agua dulce. Está ubicado "entre los 10 países más ricos en biodiversidad y disponibilidad de agua dulce per cápita en el mundo." Tiene un gran potencial hídrico que puede satisfacer la demanda de los usos de la población del país. La disponibilidad de agua es de 60.000m^3/año.[37] El territorio de Paraguay se ubica en su totalidad en la Cuenca del Plata, la segunda cuenca más grande en Sudamérica, luego del Amazona y la quinta más grande del mundo.[38] Aunque Paraguay parece tener suficiente agua para cumplir la demanda, no es así. Hay fluctuaciones en la disponibilidad de agua debido a las estaciones, los efectos de El Niño/La Niña, y los usos del agua en general.

[37] Usos y Gobernabilidad del Agua en el Paraguay. 2006. Imprenta AGR

[38] Barros, V. 2004. The Major Discharge Events in the Paraguay River: Magnitudes, Source Regions, and Climate Forcings. American Meteorological Society.



Fuente: Original de Informe GWP-SAMTAC/Crespo y Martínez (2000).

Figura 1: Ubicación del Paraguay en la Cuenca del Plata

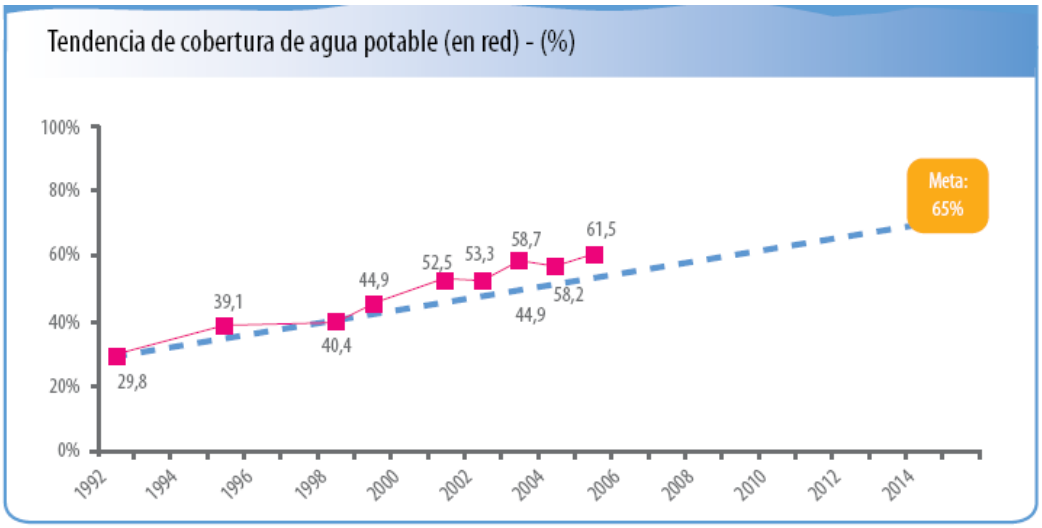
Usos de agua:

1. Usos básicos para la gente:
   El manejo de agua en Paraguay estaba a cargo de la Corporación de Obras Sanitarias de la Ciudad de Asunción (CORPOSANA) y la División de Saneamiento General del Ministerio de Salud Publica y Bienestar Social, cuando la implementación de sistemas para agua portable empezó en la década de los 50. Actualmente, CORPOSANA ya no existe debido a que paso a ser regulada por la Ley 16/14 que crea la Empresa de Servicios Sanitarios de Paraguay (ESSAP), ente autárquico. En caso que la población sea menor a 10.000 habitantes la promoción del agua y disposición de excreta es responsabilidad del Servicio Nacional de Saneamiento Ambiental (SENASA).

El Comité de Derechos Económicos, Sociales, y Culturales de la Organización de las Naciones Unidas declaró que cada ser humano tiene el derecho de acceso al agua potable. Además, el Informe Mundial sobre Desarrollo Humano estipula que por lo menos la cantidad de agua limpia por día es 20 litros para mantener una vida saludable.[39] Algunos ejemplos de uso incluyen: higiene corporal y consumo humano (beber y uso en la preparación de comida). Es responsabilidad del gobierno permitir a sus ciudadanos este derecho básico.

En el 2005, 63,2% de hogares en Paraguay tenían agua portable.[40] La meta para agua potable es de 65% hogares para el 2015.

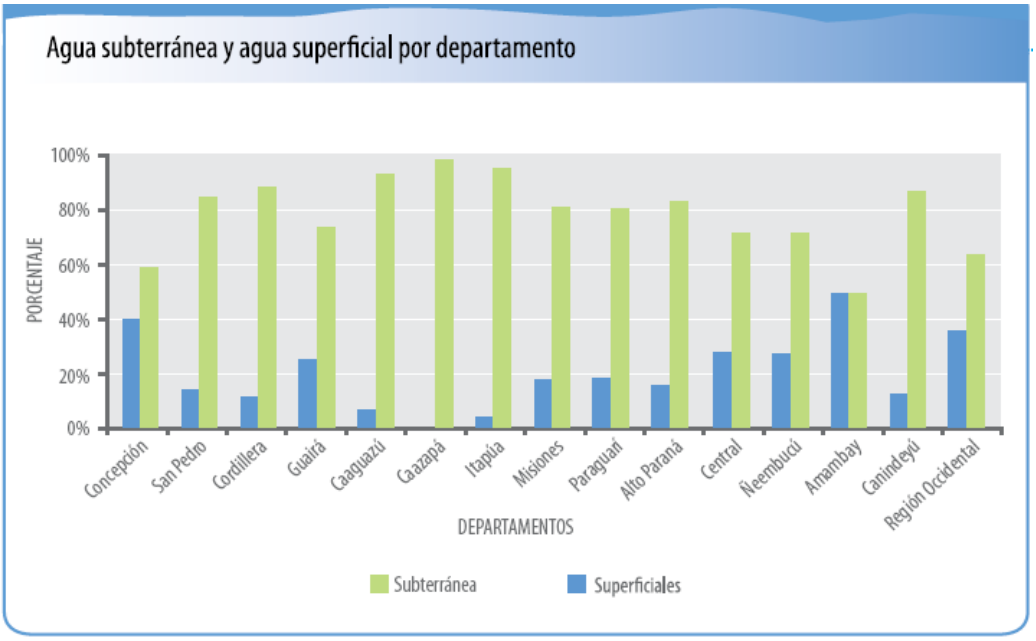
Figura 2: Cobertura de personas con acceso de agua portable



Fuente: Elaboración propia con base en Encuestas de Hogares - DGEEC

[39] Informe Mundial sobre Desarrollo Humano 2006. Más allá de la escasez: poder, pobreza y la crisis mundial del agua. PNUD

[40] Usos y Gobernabilidad del Agua en el Paraguay. 2006. Imprenta AGR



Fuente: DRH – SENASA, 2004.

Figura 3: Por departamento del Paraguay, agua subterránea y superficial

2. <u>Alimentación</u>

   El primer uso del agua en Paraguay es en el sector agrícola. En los últimos 50 años, este sector ha crecido desafortunadamente sin una planificación y con alta tasa de deforestación de los bosques nativos. El uso de pesticidas o agroquímicos puede contaminar el agua y también el suelo, por lo tanto los seres humanos no están recibiendo una alimentación saludable.

   También el cultivo de arroz, especialmente en los departamentos de Misiones e Itapúa, requiere grandes cantidades de agua para el riego. El río Tebicuary y su cuenca sienten la alta demanda de este cultivo.

   La mayoría de los bovinos en Paraguay (una población cerca de 10.000.000 de cabezas) viven en el Chaco, pero también, el departamento de Misiones tiene una gran explotación ganadera. Los departamentos de Presidente Hayes, San Pedro, Ñeembucú e Itapúa son los lugares donde el ganado porcino tiene importancia. Generalmente, el agua que se está usando para

ambos tipos de producción es de origen atmosférico. Por lo tanto, el impacto de la extracción de agua de fuentes subterráneos o de ríos es menos. En casos de sequias o menos precipitación, los rancheros necesitan buscar otro fuente de agua. Esto aumenta la demanda de agua subterránea.

3. Naturaleza

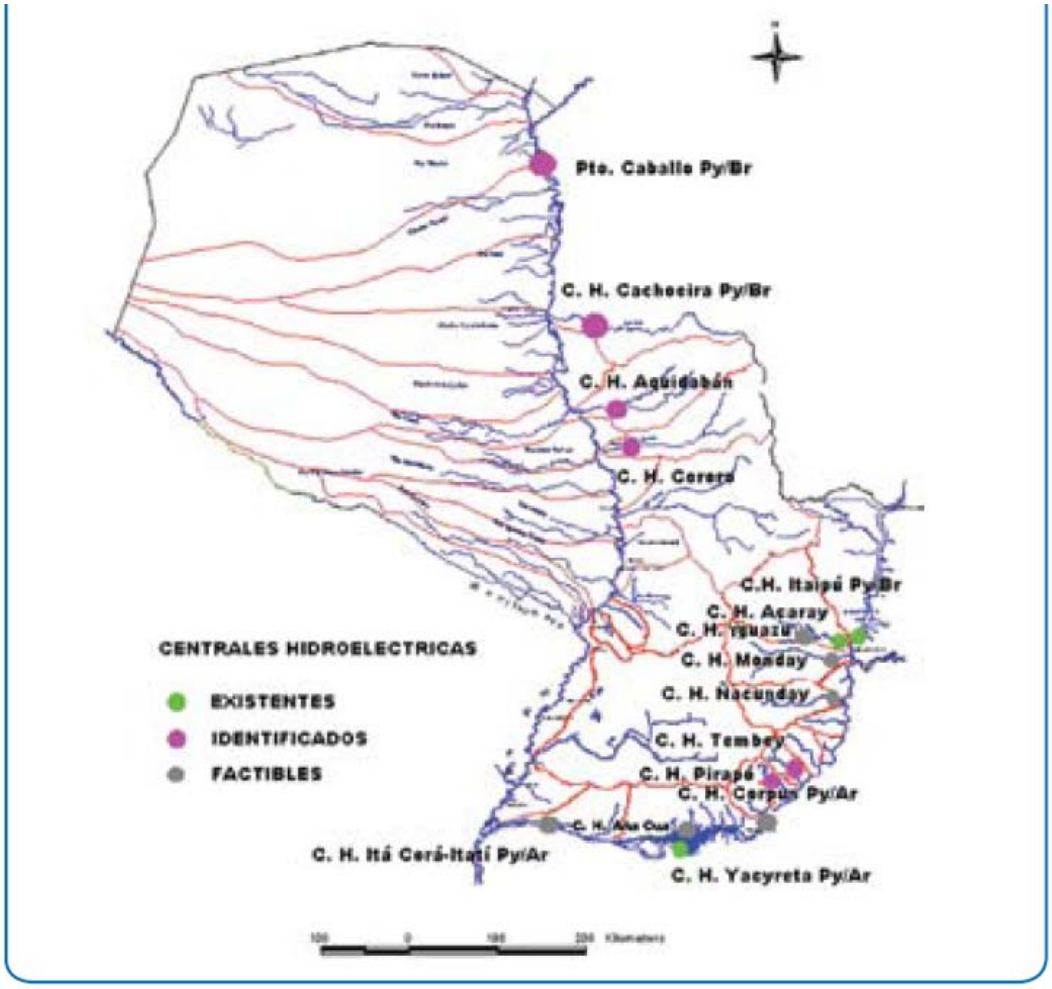
   Los seres humanos no son los únicos que usan el agua para sobrevivir. La biodiversidad de flora y fauna y los ecosistemas únicos de Paraguay, son dependientes de los sistemas de agua del país. Paraguay es rico en lagos, ríos, arroyos, humedales y acuíferos. Algunos estiman que entre 15 y 20% del territorio son zonas de humedales.[41] Pero, otros estiman que es más de 35%.[42] Lastimosamente, estos espacios naturales necesitan ser protegidos, y hasta ahora, no todos están reconocidos. En particular, las praderas son ecosistemas fundamentales en la reproducción de aves y otras especies, la purificación del agua y provee fuentes de económicas para la gente que vive cerca. Estos recursos son utilizados para algunas cosas como: carne, lana, cuero, energía en la forma de leña y turismo.

4. Industria

   Paraguay tiene una variedad de industrias, como industrias alimenticias (lácteas, aceites, harina, dulces, azúcar, algodón etc.), papeles y cartones, e industrias químicas (plásticos, agroquímicos). Para ser competitiva, la industria necesita agua a bajo costo y de buena calidad y cantidad. La industria también es responsable por el uso del agua y el mantenimiento de la limpieza del agua. La mayoría de las industrias en Paraguay están en el área metropolitana de Asunción y dependen del agua subterránea.

   Debido a la ubicación de la segunda cuenca más grande de Sudamérica, Paraguay tiene la habilidad de producir electricidad hidroeléctrica para todo el país. Hay tres represas hidroeléctricas muy importantes en Paraguay: Itaipú, con una capacidad de 12.600 Mega Wat. En esta hidroeléctrica Paraguay comparte la electricidad con Brasil. Yacyretá, con una capacidad de 1.700 Mega Wat, la cual es compartida con Argentina. La tercera es Acaray, la cual no está compartida y tiene una capacidad de 190 Mega Wat. Los departamentos de Alto Paraná y Caaguazú comparten esta represa.

[41] Usos y Gobernabilidad del Agua en el Paraguay. 2006. Imprenta AGR
[42] Salas-Dueñas, D., Mereles, F., Yanosky, A. 2004. Humedales de Paraguay.



Fuente: Visión de los Recursos Hídricos del Paraguay en la Cuenca del Plata, www.cicplata.org, 2004.

Figure 4: Centrales hidroeléctricas en operación y potenciales

Humedales del Paraguay:

Es imposible discutir los humedales de Paraguay sin hablar primeramente de Ramsar. La Convención de Ramsar es un acuerdo internacional que se firmó en 1975 en la cuidad de Ramsar, Irán. Básicamente, la misión de la Convención Ramsar es la conservación y preservación de humedales. Durante la convención, se formó una lista de reglas para definir un sitio Ramsar. "Para que esto sea posible, el humedal debe reunir algunos requisitos exigidos por Ramsar y ser seleccionado en base a la importancia

que tienen en términos ecológicos, botánicos, zoológicos y hidrológicos; pero tienen prioridad aquellos humedales que son importantes internacionalmente para las aves acuáticas en cualquier estación del año." [43] Desde diciembre del 2003, Paraguay ya tiene cinco Sitios Ramsar: Lago Ypoa, Estero Milagro, Tinfunqué, Río Negro y Chacho Lodge.

Todos los humedales no son iguales. Hay varios que incluyen ríos, riachos y arroyos. La característica de estos es el constante movimiento del agua, o lótico. En comparación, los lagos y lagunas son lénticos; o ecosistemas donde no hay constante movimiento del agua. Un gran desafío en esta clase de ecosistema es un fenómeno llamado eutrofización. Este ocurre cuando hay un alto nivel de fosfatos (debido a fertilizantes inorgánicos y jabón) en el agua y la producción primaria (plantas, algas, etc.) usa la mayor cantidad de oxígeno. Entonces, los peces no pueden respirar y el resultado es la muerte de aquellos organismos. Lago Ypoa y Lago Ypacarai están sufriendo de este problema.

Los esteros y pantanos son otros tipos de humedales. Están ubicados entre el agua y la tierra. Recientemente, estos ecosistemas están desapareciendo debido a la cultivación de arroz, canales de drenaje, diques contra inundaciones y otras instalaciones que interfieren con el sistema natural.

A veces mezclado con lagunas, ríos, riachos, arroyos y otras depresiones grandes, como el Gran Pantanal, el humedal de agua dulce más grande del mundo con un área entre 140 mil y 200 mil km^2, el Bajo Chaco y en el departamento de Ñeembucú, se puede encontrar otro tipo de humedal llamado bosque inundable. Estos bosques son muy importantes para los afluentes de los ríos Paraguay y Paraná. Proveen hábitats para muchas especies, alimentos para los peces, y protegen la producción superficial de agua y el curso de los ríos. En Paraguay, la Ley Forestal protege estos bosques de deforestación y explotación.

Gracias a las represas del Paraguay, hay embalses artificiales. Estos ayudan en zonas donde hay pocos cuerpos de agua y pueden aumentar la biodiversidad. Pero, irónicamente eliminan tierras fértiles y pueden aumentar la salinidad del suelo, y por supuesto, cambiar el ecosistema. El

[43] Burgos, S., Gonzalez, R., Rodas, O. 2004. Guía para la conservación de los humedales del Ñeembucú.

embalse de Itaipú, tiene una capacidad de 29 km^3 y por otro lado, el embalse de Yacyretá, inunda 1.690 km^2 y almacena cerca de 81 km^3.

La mayor parte de los paraguayos viven cerca o en uno de estos humedales. La gente utiliza los recursos de este ecosistema. Además, la cultura guaraní tiene su origen cerca de esta clase de ecosistema y hay muchas mitologías y leyendas sobre el agua.

Amenazas a los humedales:

1. Construcción de obras de ingeniería (rutas, represas, canales, hidrobia Paraguay-Paraná)
2. Drenaje y conversión para la agrícola o ganadería
3. La caza y pesca sin limites
4. Deforestación
5. Contaminación industrial y agroindustrial
6. Expansión de zonas urbanas
7. Introducción de animales y plantas exóticas
8. Sequías
9. Inadecuada protección y manejo de recursos naturales
10. Minería

A pesar de que Paraguay tiene cinco Sitios Ramsar, la calidad de estos sitios es pésima. Cada año desde la década de los 70, la condición de los humedales de Paraguay se ha deteriorado. Posiblemente esto sea debido a la falta de educación ambiental y buena protección a nivel gubernamental. Se notan condiciones como la erosión en la cuenca, inundaciones con más frecuencia, contaminación del agua, más especies exóticas y más especies en peligro de extinción, y un alto nivel de la población humana.

Los humedales son como una zona tapón durante tormentas y otros desastres naturales. En Paraguay, la función principal de los humedales es regular el clima regional en la Cuenca del Río de la Plata. También, es la fuente principal de evaporación y la formación de nubes durante el verano, que ayuda a la precipitación para la ganadería y agricultura. Pero, no sólo tiene un efecto grande, en una escala local, los humedales ayudan con la regulación de la temperatura en las ciudades y pueblos.

La biodiversidad de los animales de los humedales del Paraguay[44]:
Peces: 48%
Aves: 21%
Reptiles: 14%
Mamíferos: 11%
Anfibios: 6%

El Pantanal:
El humedal más grande del mundo está ubicado entre Bolivia, Brasil y Paraguay. Es reconocido internacionalmente por su biodiversidad.[45] Más de 600 especies de aves viven aquí y también, muchos animales únicos, como iguanas, ardillas, nutrias gigantes o arira'i, las cinco especies de monos en el Paraguay, y extraños lagartos como el viborón. Las inundaciones en el Pantanal ocurren debido a la inhabilidad del Río Paraguay de llevar las aguas del verano. La región funciona como un gran embalse que demora el flujo de las aguas provenientes de la cuenca superior, retardando la crecida anual en aproximadamente seis meses.

Precipitación:
La precipitación media anual en Paraguay es de 1.128 mm, que suponen unos 459 km^3/año en todo el territorio paraguayo. Las pérdidas por evapotranspiración y evaporación suponen el 80% de la precipitación en el país. El 44% recarga los acuíferos, mientras que el 56 % restante se convierte en escorrentía superficial. La precipitación es irregular y el Chaco recibe menos precipitación durante el año que la región Oriental.[46]

También, hay una tendencia en la precipitación. Generalmente, la precipitación disminuye del norte al sur y del este al oeste. En el norte del país, el ciclo sigue con mucha lluvia por el verano (diciembre a febrero) y mucho menos por el invierno.

[44] Burgos, S., Gonzalez, R., Rodas, O. 2004. Guía para la conservación de los humedales del Ñeembucú.

[45] Barrios, V. 2004. The major Discharge Events in the Paraguay River: Magnitudes, Source Regions, and Climate Forcings. American Meteorological Society Journal of Hydrology.

[46] http://www.fao.org/nr/water/aquastat/countries/paraguay/indexesp.stm

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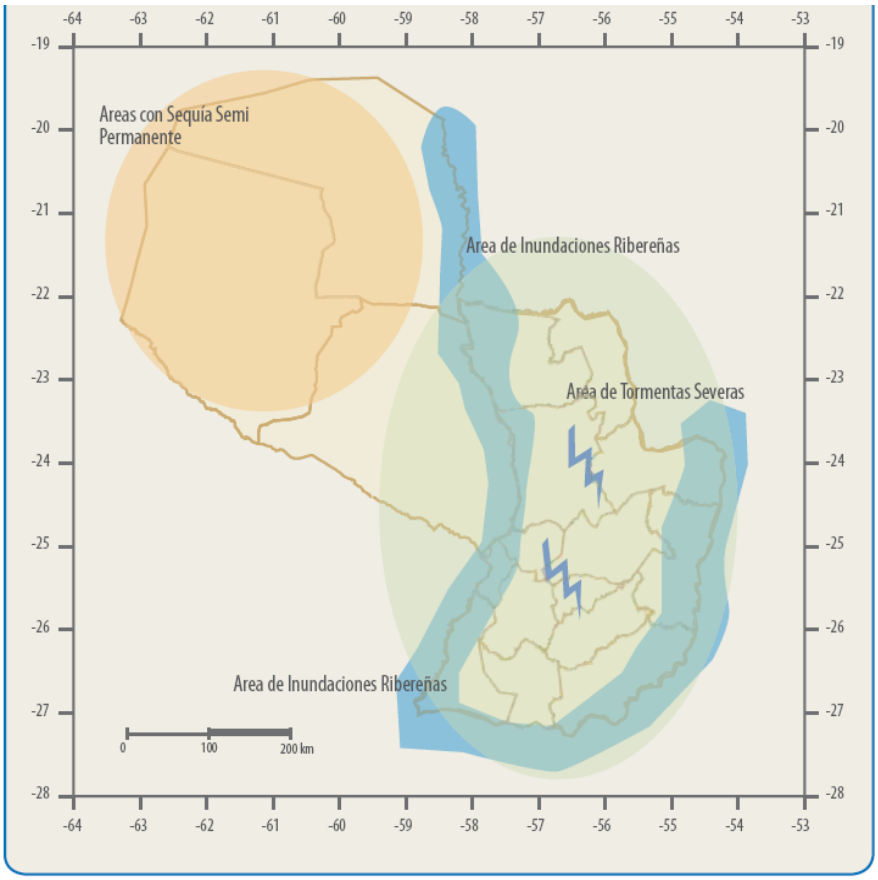


Fuente: J. Báez, APRH, 2006.

Figura 5: Áreas de inundaciones, sequías y tormentas de Paraguay

Ríos e inundaciones:

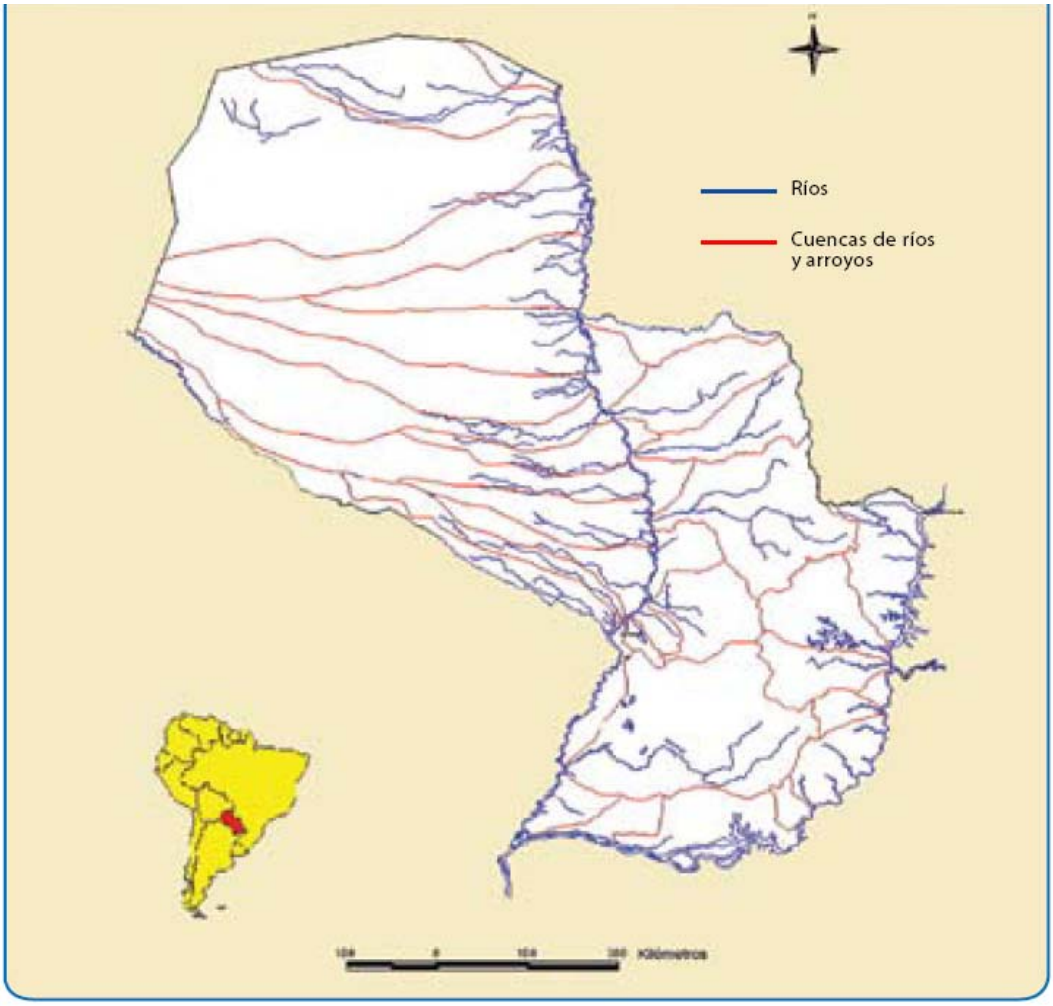
El Río Paraná empieza en la confluencia de los Ríos Paranaiba y Grande en Minas Gerais, Brasil y fluye hasta Paso de Patria en el departamento de Ñeembucú donde encuentra el Río Paraguay.[47] El Río Paraguay es el más

[47] Especies Nativas del Río Paraná. 2009. Departamento de obras complementarias, Sector Medio Ambiente de la Entidad Binacional Yacyretá.

importante tributario al Río Paraná y uno de lo más importante ríos en la cuenca del Plata. El Pantanal es responsable de la regulación de inundaciones y flujo del río.[48] Hay una correlación de años con El Niño e inundaciones de los ríos. Antes del año 1904, no había records de las inundaciones, pero por cuentas históricas se puede estimar cuando hubo inundaciones graves en el Río Paraguay y el Río Paraná. Las inundaciones de importancia en el siglo XX: 1904, 1982-83, 1992, 1997-98.

Río/Arroyo	**Área de la cuenca (Km^2)**	**Longitud (Km)**
Paraná	3.100.000	4.700
Paraguay	1.000.000	2.670
Pilcomayo	270.000	2.500
Tebicuary		235
Monday		170

[48] Quirós, R., Bechara J.A., de Resende E.K. 2007. Fish diversity and ecology, habitats and fisheries for the un-dammed riverine axis Paraguay-Paraná-Río de la Plata (Southern South America). Aquatic Ecosystem Health & Management.



Fuente: Visión de los Recursos Hídricos del Paraguay en la Cuenca del Plata, www.cicplata.org, 2004.

Figura 6: Sistema hídrico de Paraguay, arroyos y ríos

Acuíferos:

El acuífero más conocido en el mundo es el Acuífero Guaraní. Tiene un área de 1.200.000 km², tocando 20% del Paraguay y también, Brasil, Uruguay y la Argentina, y tiene un volumen de 40.000 km³. El agua está 50 m a 800 m debajo de la tierra con un máximo de profundidad de 1.800 m.[49] Con una demanda más alta ahora, la conservación y el manejo del acuífero es muy

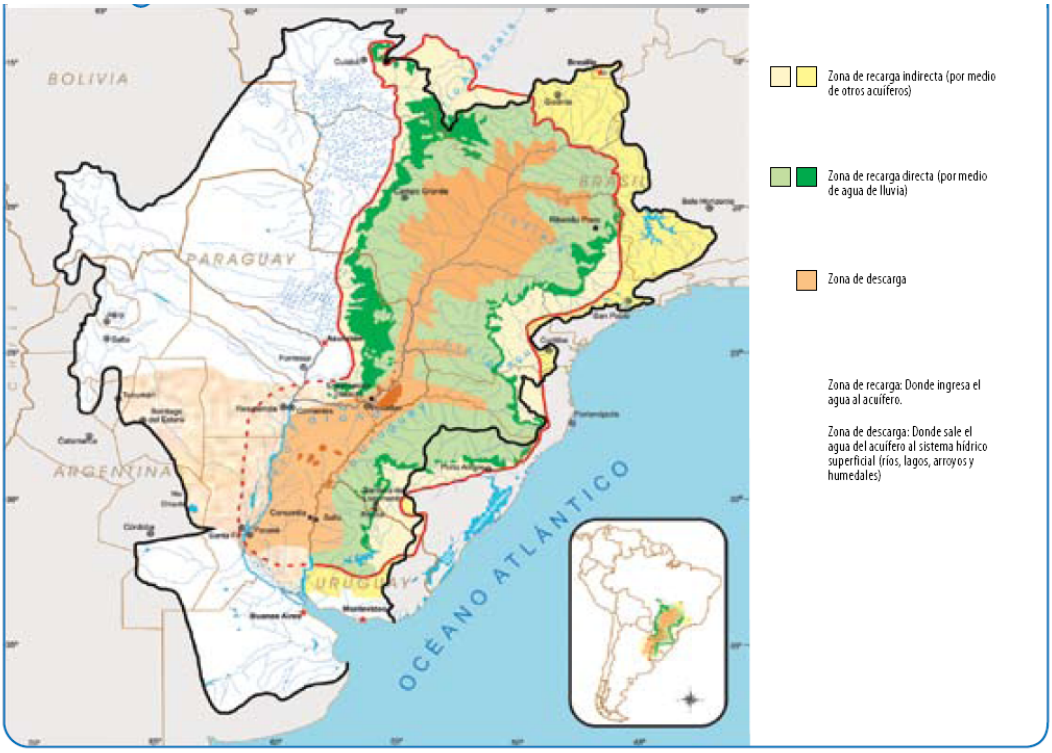
[49] http://www.natureserve.org/latinamerica/guaraniAquifer.jsp

importante para prevenir la contaminación del agua. El agua no solamente es usada para agua potable. También los usos incluyen industria, riego para agricultura y turismo debido a la temperatura alta (entre 60^{o}C a 65^{o} C) en varios lugares. Los turistas pueden bañarse en el agua caliente como una spa.[50]

El acuífero Patiño es más pequeño y está ubicado debajo de Asunción hasta el departamento Paraguarí. Provee agua para aproximadamente dos millones de personas del área urbana. Tiene un área de 173 km^2, es decir que el Patiño es "el hermano menor" del Acuífero Guaraní. Como el Acuífero Guaraní, el Patiño siente una demanda más alta ahora. La SEAM (Secretaria del Ambiente), menciona que cada año el nivel del agua baja un metro.[51] Además, la contaminación y la salinización son los problemas más graves. La basura que entra por los pozos y los restos de las letrinas están arriba del acuífero y pasan por el suelo a contaminar el agua.

[50] Office for Sustainable Development and Environment. 2005. Guaraní Aquifer System.

[51]Vargas, D. 2007. Paraguayan Aquifer Wounded and Contaminated. http://tierramerica.net/english/2007/0505/iarticulo.shtml



Fuente: Proyecto Sistema Acuífero Guaraní: Geff – OEA, 2003.

Figura 7: Área del Acuífero Guaraní

Contaminación:

Las acciones de los seres humanos producen la contaminación en el agua. La agrícola, industria, ganadería y minería producen demasiada contaminación sin mucha regulación. Metales pesados, agroquímicos, basura y también el suelo debido a la erosión de la tierra son ejemplos de la contaminación que hay en Paraguay. El tema de los metales pesados es muy serio a la salud de los seres humanos porque los peces tienen un nivel de aquellos metales muy alto en sus cuerpos. Cuando los seres humanos los comen, están incorporando los metales pesados en sus cuerpos también.

Parte cultural: Leyendas

Los carpincheros:

"Histórica figura ancestral de fantasmas navegando incasables por las aguas y esterales, capturando el pan de cada día, que en este caso es de carne

y huesos: carpincho, peces, yacaré, o cualquier otro animal que viva en las aguas y en los humedales. Ya sea en canoa, o en cachibeo, viven del la naturaleza pródiga y paradisiaca que Dios dotó a estos lugares. Navegar, matar, y cazar son acciones en la cual esta gente marginada y discriminada, que el poder no piensa en ellos encuentran en el río la descarga emocional de sentirse superiores a alguien, de tener poder sobre algo y matando descargan sus amarguras y son el puente entre el pasado ancestral y el presente indiferente y mordaz."[52]

El secreto del Ypoá y la Campana Perdida

"En el período colonial los jesuitas de las misiones, les enseñaban a los indios reducidos toda clase de arte. En esa época fue fundida una campana por los jesuitas, la más grande y sonora de la región. Sin embargo muchos ignoran su historia. La historia sigue así.

El Superior de la Congregación ordenó que se hiciera fundir una campana cuya resonancia se oyera desde las más lejanas comarcas. Juntaron los metales de cobre, hierro, oro, hasta plata, para que la campana fuera más potente, profunda, sonora y suave.

Alrededor del cuello de la soñada campana tendría inscripciones de los libros sagrados. Luego cuando estuviera concluida, se colocaría en el centro de la población en el atrio de una de las más hermosas y artísticas iglesias jesuítica. Esto es para que se difundiera sus sonidos de lejos.

Prepararon los metales, los instrumentos, el molde a la vez el crisol. Empezaron a fundir la campana, trabajando por el día y noche, prestando atención a los más pequeños detalles, a ver si la obra saliese con éxito. Pero cuando prepararon el molde, la campana aún incandescente, observaron que los trabajos no resultaron, faltaba otro elemento y la aleación no estaba bien mezclada.

Tuvieron que fundir de nuevo, los metales necesitaban un fuego de más alta caloría, porque la plata no había querido unirse al hierro. El Superior supo del fracaso, se irritó y con su nerviosidad amenazó a los técnicos. Dijo: "Si la segunda fundición no salía, castigaría como se merece, porque los metales mermaron considerablemente." Tuvieron que agregarle a la mezcla con más cantidad de oro y plata, para obtener un tamaño y la sonoridad deseada. Con la pérdida de los metales de más valor, los técnicos tuvieron que reponer, porque si esta última volvía a fracasar, el Superior interpretaría como una traición a él y a la Iglesia. Con los técnicos, trabajaba

[52] Salas-Dueñas, D., Mereles, F., Yanosky, A. 2004. Humedales de Paraguay. Capitulo 5.

un criado de los jesuitas, un robusto indio, muy inteligente y obediente; tenía una hija, se llamaba Ysapy (Rocío). Era muy hermosa, la más bella de la población y dentro de las tribus. Le amaba a su padre con todo su corazón.

Ella escuchó de una de sus doncellas la amenaza del Superior a los trabajadores, y juntó los tesoros que tenía y fue ante un sabio de la mineralogía, con la intensión de pedir el secreto para mezclar los metales. El sabio la recibió cordialmente. Ysapy le ofreció los tesoros, en pago, si le revelaba algún método de fundir los metales para el éxito seguro en la conclusión de la obra. El sabio consultó su libro de los principios del Universo. Después de revisar, dijo: "No se mezclan el oro y el cobre ni la plata y el hierro, a menos que la carne de una virgen sea disuelta en el mismo crisol, más aún la sangre de la misma con las de los metales en fusión."

Ysapy contenta regresó a su casa, pero no encontró a nadie que se animara a tal gesto suicida y quedó pensativa y resolvió a última hora. Por fin el día llegó para fundir nuevamente la obra. Ysapy fue al taller y cuando el momento llegó a fundir los metales, Ysapy se arrojó en el líquido candente, seguido de un grito lastimero, cual si fuera un canto de un pájaro herido pronunciando por última vez en voz guaraní: "*Che ru nde rehehápe amano"* (padre mío por ti muero).

Se oía un sonido suave y melodioso, parecía un canto del pájaro campana. El padre de Ysapy quedó enloquecido de dolor, intentó también tirarse detrás de su querida hija pero sus compañeros lo retuvieron. Instantes después de un éxito completo quedó muerto. Este fue el fin entre el padre y la hija, cumplieron un deber de amor de la religión de Dios. Todos quedaron en choque y dolor por sus pérdidas. El sacrificio de Ysapy fue un éxito. Se oía el sonido de la campana de lejos.

Luego, los Jesuitas tuvieron que abandonar el país y sus misiones porque fueron perseguidos por los gobernantes del país. Poco antes del éxodo del país, los Jesuitas resolvieron trasponer la campana en un lugar oculto, y ordenó a un Jefe Cacique que la llevaran donde a él le pareciera mejor ocultar la joya de los jesuitas. Los indios resolvieron llevarla al tapýi. Para este fin tenían que cruzar el lago Ypoá. Embarcaron la gran campana con mucho cuidado, pero al llegar a un lugar cenagoso chocó el cachibeo, por un raigón y se volcó, tanto los marineros y la campana cayeron en el medio del histórico lago Ypoá. Hasta hoy día dicen los lugareños, a veces se escucha el repiqueteo de una sonora campana de ultratumba. Cuando el lago está embravecido por las tormentas, dicen que se percibe mejor de noche, cual si fuera una música celestial."

El mito de Pira hû y el origen legendario del lago Ypoá:

Hay un riachuelo llamado Reventón que está ubicado en el sur del municipio de Ñaguarú hacia el arroyo Caañabé, naturalmente divide Carapeguá y este partido. Reventón empieza en Paso Malo, luego cruza y se junta con otro arroyo para formar Calandria, y una pequeña arteria surtidora nacida de una región cenagosa llamada Moñãi Kuaré, una serpiente de leyenda. Reventón sigue su curso hasta el arroyo Yaguarón en el campo de Guaviray, que alimenta las aguas de la laguna Ypecuá.

En las aguas en el campo de Guaviray, había un animal semejante a un monstruoso pez negro, Pira hû. Este monstruo era feroz y devoraba cualquier cosa. No nadaba en principio, prefería estar en el suelo abriendo una gran zanja con su colosal peso por donde se recogían y circulaban las aguas de los esteros ribereños. Impulsada por el hambre, Pira hû se dirigía hacia el occidente, llevando una gran cantidad de agua hasta llegar así hasta la laguna Ypecuá, de donde pasó al lago Ypoá, su sitio de residencia.

Ypoá actualmente era Ypóra, que por una deducción idiomática alude a Pira hû considerando como deidad monstruosa del agua con el nombre Ypóra, sobrenombre de Pira hû. Pero hay otras opiniones sobre accidentes desgraciados ocurridos en lago Ypoá, atribuidos a la acción de Ypóra. Algunos creen que Ypoá significa agua de la suerte (Ypo'á significa suerte en guaraní) por la riqueza de la flora y la fauna en la región.

Debido a su peso y lento movimiento, Pira hû dejó una zanja ancha y profunda por la senda recorrida que se llenó de las aguas de los esteros, dando origen al riachuelo Reventón. No se puede navegar Reventón los días lluviosos.

Pira hû es hijo de Pyharé, (tiniebla) y de Y (agua), que quedó fecundada después de ser cubierta por el manto tenebroso de la noche que bajó del cielo Yvaga, para gozar de las caricias de su esposa mientras Kuarahy (sol), viajaba por el océano misterioso del abismo. Pira hû o Ypóra, es deidad vigilante de las aguas de la tierra Guaraní. Ypóra es el mensajero de Tupang, Dios guaraní, enviado del cielo para vigilar como un centinela alerta a las aguas de Guaraní con el fin de impedir que los mortales atrevidos, las profanen impunemente.

También, en lago Ypoá hay un fantasma blanco y vaporoso y a veces negro y nebuloso llamado Cerro Valdes. Otras se manifiestan en las aguas y dan miedo a los mortales que quieran llegar hasta el lago.

Cuando un cazador o pescador u otro mortal intenta cruzar el pequeño estrecho de referencia para acercarse al Cerro Valdes, el Ypóra

agita las ondas, dando origen al desencadenamiento de un fuerte torbellino de agua que se levanta verticalmente en forma de una tromba blanca vaporosa de espesa neblina que se divisa en lontananza en la lejanía del horizonte sobre la antes tranquila superficie líquida. Al chocar con la débil embarcación, suena como un tiro de cañón, y el agua se divide en dos brazos. Se puede ver la arena del fondo pero al volver a juntarse la arroja lejos con toda la carga o la sepulta en su entraña misteriosa.

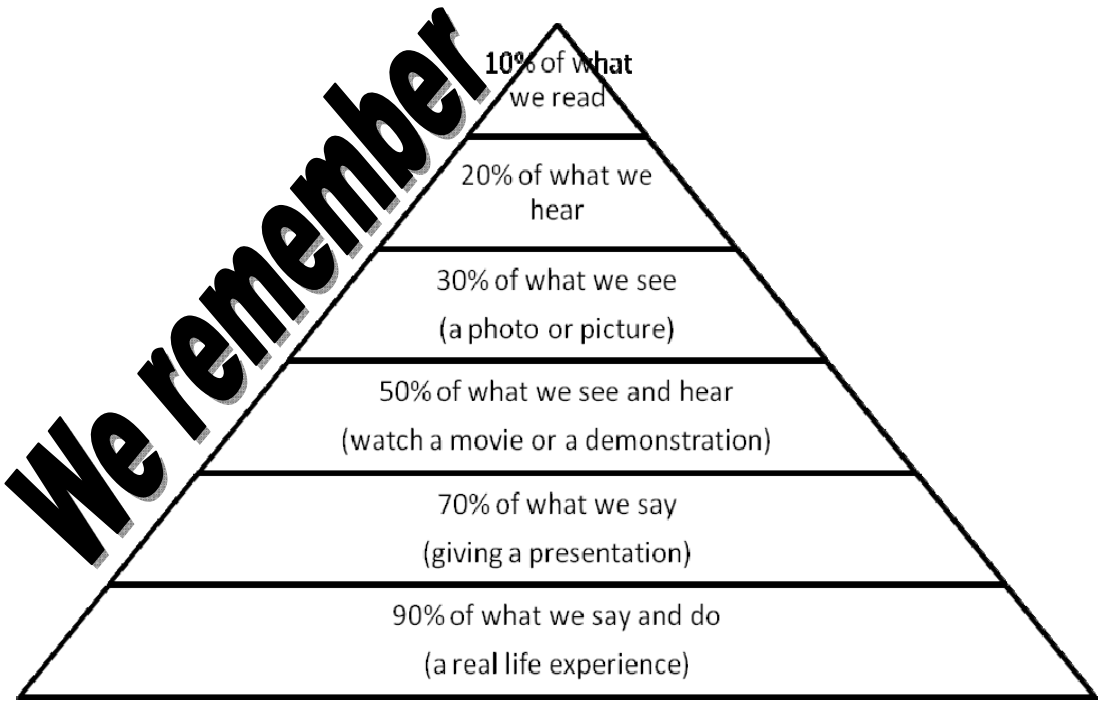
Revetón simboliza la fuerza bravía, rebelde y hostil de la naturaleza en su lucha eterna contra la acción civilizadora del hombre que tiende a dominar la tierra, el océano, y el aire, cabalgando sobre el mundo come rey soberano de la creación.

Pira hû/Ypóra es la representación del espíritu protector de las aguas en el seno de la naturaleza bruta, salvaje, virgen de pretéritas edades.

APPENDIX F
TEACHER WORKSHOP SCHEDULE
(TRANSLATED FROM SPANISH)

Time	Activity
15 minutes	Ice breaker
5 minutes	Introduction - Importance of being didactic in the classroom
10 minutes	Why teacher about water? Water resources in Paraguay Basic competencies
15 minutes	Presentation of Project WET materials
30 minutes	Project WET Activity (Sum of the parts)
15 minutes	Recess
30 minutes	Separate into groups to practice presenting other activities from Project WET
45 minutes	Presentation of activities to other group
10 minutes	Conclusion, evaluation, presentation of certificates

Introduction – The imporatnce of being didactic in the classroom



Why water education?

Resources in Paraguay

- Paraguay is located "as one of the 10 richest counties rich in biodiversity and fresh water availability per capita in the world."
- Paraguay is entirely located in the watershed del Plata, the second largest watershed in South America, after the Amazon, and fifth largest in the world.
- Paraguay has many lakes, rivers, streams, wetlands and aquifers. Some estimate that between 15-20% of the country are wetlands, but others estimate it is closer to 35%.
- The actions of human beings produce the contamination of the water. Agriculture, industry, ranching and mining produce the majority of the contamination and there is not much regulation to how much they produce.
- Heavy metals are a very serious health problem for human beings because the fish have a high level of those metals in their bodies. When humans eat the fish, they are incorporating the heavy metals into their own bodies, a process called biomagnification.

Basic Competencies

4th Grade: "The Natural Sciences favor processes knowledge construction that help the students question, doubt, demonstrate curiosity and creativity, create, plan and form solutions to problematic situations related to nature, such as: collection and disposal of sold residues, management of hydrologic resources of the community, among others."

5th Grade: "This unit favors that the students make assertive decisions, with a scientific attitude, in the formation of solutions to problematic situations referring to the diver classes of biomes, in addition that they understand the ecological succession and beginning with this knowledge, they can construct attitudes of respect, care and preservation of the environment."

6th Grade: "The development of this unit with permit that the students resolve problematic situations, applying the knowledge of aquatic biomes, trophic pyramids, and the conservation and preservation of natural resources."

APPENDIX G
WEEKLY ALLOTMENT OF TIME FOR
SEGUNGO CICLO CLASSES

		Area	Percentage	Weekly Total	Total Minutes
Fundamental Components: Democratic Education, Family Education, **Environmental Education**	Academic Component	Natural Science	10	3	120
		Social Studies	13.33	4	160
		Art Education	6.67	2	80
		Physical Education	3.33	1	40
		Health	6.67	2	80
		Maternal Language	16.67	5	200
		Second Language	13.33	4	160
		Mathematics	16.67	5	200
		Work and Technology	6.67	2	80
	Local Component	Personal and Social Development	6.67	2	80
		Educational and Vocational Orientation	3.33	1	40
		Community Project	3.33	1	40
Total Academic Component			**100**	**30**	**1,200**

These times do not include the designated time for neither recess, nor entrance and exit from school. Also, the Total Minutes column is based on a class session of 40 minutes. Lastly, given the normal school day of four hours, five days a week, this calculation does not exactly add up.

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