

ADVANCING HUMANITY IN BELIZE

Learning Community

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DEVELOPING SUSTAINABLE COMMUNITIES IN BELIZE

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In northern Belize the McMaster Belize team is working in an area that is struggling to develop sustainably; balancing indigenous farmers' exploitation of their 'natural capital' in order to feed their families against the vision of preservation of rainforest and savanna; and desperately trying to put in place an infrastructure that supports improved access to education and an improved quality of life for each individual and each community. As part of this 2008-2009 Belize initiative I focused on work that would positively impact the challenges of our Belizean partners in these areas.

Specifically I continued soil nutrient analysis partnering with indigenous farmers to increase profitability while simultaneously preserving their 'natural capital' - the soil. This effort, at the same time, reduces the overall impact of agriculture on effective natural resource management especially relative to the Rio Bravo Conservation and Management Area which borders many of the fields analyzed as part of this initiative. Additionally I worked with a McMaster scholar, the 2008-2009 McMaster Belize team, and others to develop the pathway toward the installation of a photovoltaic system capable

of providing electricity for San Carlos Government School. Once installed this access to electricity will significantly improve those students' access to technology. It is this component of my overall initiative that advances the long term goal to improve the human condition by developing communities that are synergistic with environmental sustainability.

PART I

The Status of Soil in the Northern Agricultural Regions of Belize

Soil nutrient depletion throughout Latin America and the Caribbean was documented by Ayoub in 1990 as occurring in over 71.4 million hectares (Ayoub, 1999). The severity and extent of nutrient depletion for Latin America and the Caribbean was more than double that seen in Africa and nearly five times more severe than that documented in Asia for the same period (Ayoub, 1999). This is due to the fact that farmers are cultivating soils that are only moderately fertile to begin with due to rapid nutrient depletion after the natural vegetation has been removed. The thin soils of once tropical rainforests throughout the northern areas of Belize require nutrient regeneration that is largely being accomplished today using chemical fertilizers and extremely short-term fallow periods.

With population increasing worldwide, the demand for food as well as forest products is escalating. Gregory and Ingram in their article *Global change and food and forest production: future scientific challenges* state that, "[T]his challenge can be met either by extensification or intensification" (Gregory & Ingram, 2000). In other words increased production will result from more land being farmed (extensification) or the yield per area must be increased (intensification), which is generally accomplished by increasing the use of fertilizers and pesticides. Gregory and Ingram projected that by 2010 Latin America and the Caribbean region will increase its food production by expanding cultivated land area by 29% and intensifying cropping cycles by 19% (Gregory & Ingram, 2000). It is interesting to note that this study also recognizes the fact that much of this potentially arable land is in remote areas that lack the infrastructure, particularly roads, necessary for the crops produced to be transported to global markets. This is what we have witnessed firsthand in the northern areas of Belize that border the Rio Bravo Conservation and Management Area. Increasing yield is secondary to providing the farmers that I work with access to markets in Belize and elsewhere. Crops piled high in the back of pick-up trucks make the trek over heavily rutted roads to the closest local market three hours away. So the development of infrastructure, specifically roads, balanced with the concept of conservation is the challenge. The Belizean government has little interest in investing in such infrastructure leaving small indigenous communities with no means to develop above a subsistence level of income

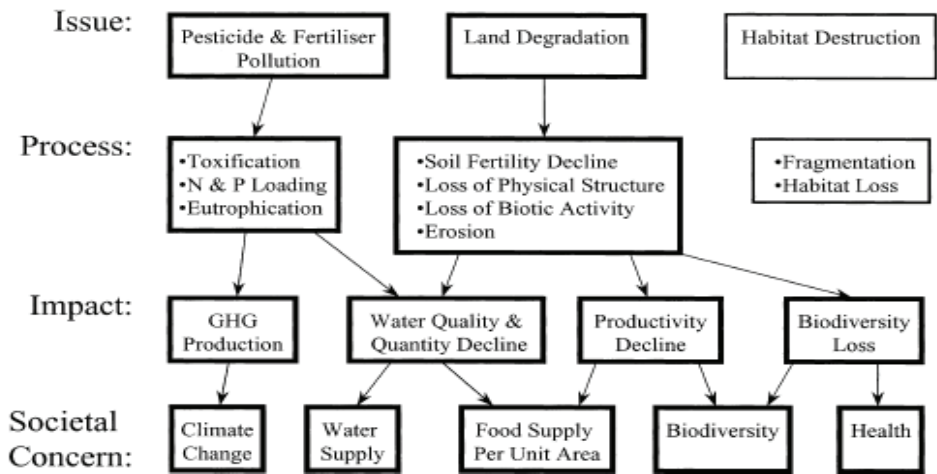
through intensification. The roads that currently connect small villages such as San Carlos and Indian Church, as well as the rutted web of unpaved roads between Mennonite camps, are privately cleared and maintained by these communities or in some cases the result of simply worn paths. It is remarkable that any movement toward a reduction in the isolation of small agricultural communities such as those on the periphery of the Rio Bravo has come despite the government's lack of support and not because of any centralized effort to recognize the potential of these communities.

While Gregory and Ingram's work lends itself to credible geographic regional characterizations, extensification would not be the preferred methodology for these areas since it would require more deforestation and the expansion of cultivated land which then couldn't be feasibly farmed without mechanization. The population density in Belize is the lowest in Central America and as such the labor force is not sufficient to farm increased tracts of land without equipment. Funds to purchase farm equipment are non-existent and perhaps more importantly many of the Mennonite camps in this region forbid mechanization. Gregory and Ingram's generalizations about extensification may be valid in Central America, but these concepts lack credibility in northern Belize. Each year we arrive in Belize to see more and more forest land cleared for agricultural use, however this does not correlate with an increase in food production. It simply means that other tracts of land are being short-term fallowed. The limiting effect of the labor force in these small communities prohibits the concept that an increase in arable land equates to an increase in production.

Extensification is not only problematic from a labor standpoint. Clearing more land in this region would diminish biodiversity and increase runoff in return for only a tenuous supply of short term fertile soils. The traditional practice of slash and burn coupled with long fallow periods (literally decades) once made this practice of cultivation and regrowth feasible. Today, however, slash and burn practices which incorporate only short-term fallow periods contribute to the depletion of soil nutrient reserves and contribute to compaction and erosion, thus making the need for soil amendments in the form of chemical fertilizers common practice.

Intensification is already underway as Belizean subsistence farmers struggle to increase cropping and yield. The impact of intensification on the biophysical processes and their pathways is shown in this summary diagram by Gregory and Ingram (Gregory & Ingram, 2000).

Land Use Change: Intensification/Extensification



The environmental impact of intensification on the waterways includes toxification, nitrogen and phosphorus pollution and eutrophication – all critical to the health of the water supply. In addition, the negative impact this practice has on the natural capital of the farmers in terms of reduced soil fertility, increased erosion, and deterioration of the soil's physical structure is staggering. We have witnessed this impact first hand in the wake of gross over fertilization promoted by foreign papaya processors. This damage is prevalent in the areas that we have been working in and thus it has been critical to not only continue to provide soil nutrient analyses but to also couple that information with advice on mechanisms that would be effective in restoring soil structural health.

The environmental impact of continuous chemical fertilizer use and overuse in farm fields that lie on the periphery of the Rio Bravo Conservation and Management Area is a concern not only for those who seek to preserve the tropical forests in the region, such as Programme for Belize (PFB), the managing nongovernmental organization (NGO) of the Rio Bravo Conservation and Management Area, but it is a great concern to the farmers as well. In terms of input costs and damage to their soil, these farmers have paid dearly for the fast track yield promoted by the papaya processors. Over the past three years the McMaster Belize project to monitor soil nutrient levels for indigenous farmers in the region has resulted in a 50% average reduction in macro nutrient fertilizer use while maintaining optimal yield (Studer, 2009). Working to simply reduce chemical fertilizer usage to appropriate levels was an immediate and deliberate attempt to reduce not

only the cost to the farmers but to also reduce the negative impact on the soil and the fragile environment that surrounds these fields as well, but it is only the first step. This initiative has resulted in an increased profit through decreased cost while maintaining yield.

Intensification which calls for the addition of more chemical inputs increases the risk of runoff and thus the potential for significant nutrient loss (Nair & Graetz, 2004)[pg269]. This is especially true in areas where excessive rainfall increases the potential for surface and groundwater contamination. While the baseline water quality data, compiled over the past four years through the McMaster Belize initiatives, does not indicate increased levels of nitrogen or potassium in the New River Lagoon; it has noted high phosphorus levels, from an undetermined source (Fix, 2007; Mavroidis, 2008; Rostocil, 2009; Kleman, 2010). The New River watershed includes agricultural areas. While the distance between the fields and the lagoon may be extensive enough to remediate agricultural runoff, there is still the potential for agricultural runoff to contribute to non-point source pollution. It is critical for the health of this region and its residents that fertilizer application be strategic not only in economic terms but in environmental terms as well.

Research on the fragile soils of the tropics has identified management components necessary for preservation of the potential productivity of these soils. These components are (1) maintenance of organic matter and soil cover (we continue to record low levels of organic matter on the farms we work with in Belize.); (2) minimal surface soil disturbance; (3) appropriate and strategic fertilizer use (this is the focus of our continued partnerships with agricultural communities on the periphery of the Rio Bravo); (4) intercropping; (5) effective fallow periods and crop rotation (effective fallow periods are not implemented due to minimal landholdings and the growing need for income; however crop rotation occurs on a small scale over three growing periods annually (Kang, 1997). Thus for intensification to be successful in the regions on the periphery of the Rio Bravo, it has to be carefully managed to include the above listed components. This year's initiative strategically informed farmers about mechanisms that would work to increase the amount of organic matter in the soil and how to use the soil nutrient level analyses to dictate fertilizer application with an emphasis on the use of organic soil amendments.

Since the global introduction of mineral fertilizers in the late 1940's farmers have seen a significant increase in yield. In addition, past cultural practices allowing fields to lie fallow for decades before re-cropping have been abandoned in favor of short-fallowing fields in order to feed a growing population. This has increased the region's dependence on inorganic

nutrients to maintain production. The trend towards dependence on chemical inputs is not specific to Belize. Globally the nutrients actually used by crops to grow have been increasingly supplied by chemical fertilizers. Likewise the uptake by plants of organic and soil-based nutrients has decreased. It is estimated that by the year 2020 only 21% of the nutrients used by crops will be supplied by the soil, only 9% by manure, and 70% by chemical fertilizers. This compares to 48% (soil), 13% (manure), and 39% (fertilizers) just 35 years ago (Ayoub, 1999). This is exactly what we have been documenting in the fields of subsistence farmers in Belize – organic content is low and the residual nutrients in the soil are minimal. Data from the McMaster Belize project over the last three years evidences that past trends in macro nutrient levels (nitrogen, potassium, and phosphorus) can be directly correlated with the amount and type of chemical fertilizer the farmers are applying (Studer, 2009). This is indicative of the lack of natural soil fertility and sadly enough the dependence of soil fertility in this region on inorganic inputs.

MECHANISMS FOR SUSTAINABLE SOIL HEALTH

This project researched methodologies that would support minimal chemical fertilizer input (and thus cost), maintain adequate yield on the short term, and preserve soil quality over the long term given current soil macro and micro nutrient levels. One possibility for both the remediation and maintenance of soil nutrient levels is an integrated plant nutrient-management system which utilizes a combination of inorganic and organic fertilizers including manure and crop residue (Oberson, Besson, Marie, & Sticher, 1996). This combined system is even more feasible since during the past year there has been a significant increase in the number of cattle on Mennonite landholdings in the northern rural areas of Belize, thus providing a ready source for manure.

While many studies have been completed in temperate areas on the effect of organic fertilizers Kaur, Kapoor, and Gupta (2005) document specific results on macro nutrient levels in fields in tropical areas. The results of this study indicated that higher levels of organic carbon, total nitrogen, and phosphorus were obtained using organic fertilizer alone or in combination with chemical fertilizers, compared to levels obtained using chemical fertilizers singly (Kaur, Kapoor, & Gupta, 2005). These results conclude that for tropical regions, with higher temperatures and extensive rainfall, an integrated system that incorporates both organic manures and chemical fertilizers can facilitate effective nutrient cycling and reduce the negative impact, long term, on both the environment and the soil.

Alley cropping is another potential remediation for exhausted soils. This practice involves planting crops in the alleys interspaced with trees and

shrubs. In *Forest Ecology and Management*, B. T. Kang writes “that this technique is scale neutral” (Kang, 1997) meaning it can be effective on small landholdings, making it an attractive option for the subsistence farmers in Belize. Studies on acidic low-fertility soils (like those in the region where we work) have not produced results as promising as base status soils with moderate fertility. However, negotiating a compromise of buffer strips between the edges of the rainforest and farm fields would perhaps have more positive results if these areas were populated with deep root native species. Alley cropping has the potential to (1) protect the surface soil from compaction due to heavy rains; (2) provide shade that would have the potential to lower surface temperatures; (3) work to maintain soil moisture; (4) increase or maintain soil microbial and faunal levels; (5) suppress weeds; (6) improve physical soil properties (Kang, 1997). All or any of the potential impacts attributed to alley cropping would be beneficial to the fields we are currently working in. In addition, research supports the fact that having rainforest in close proximity to agricultural fields may provide a habitat for biological controls of crop pests. By serving as a habitat for biological controls the buffer areas have the potential to allow farmers to reduce their pesticide use. This methodology is not new to Belize and parallels the customary practice once employed by Mayans and others in the area termed the bush fallow system.

The Mayan bush fallow system provided a critical element to soil fertility – the restoration of organic matter to the soil. In the tropics where cultivation is continuous or nearly so, as is the case in Belize, organic matter declines rapidly. When crops are harvested crop residue is removed. The heavy rains contribute to both leaching and erosion which depletes the nutrient levels in the soil. It is clear from the above-mentioned studies that an integrated approach involving the introduction of organic matter to the soil in the form of manures, crop residue, mulch from hedgerow or buffer growth, and strategic monitoring of nutrient levels to inform chemical fertilizer usage will give these subsistence farmers the best chance of success in both the short and long term. This information was both discussed with farmers on site while in Belize and protocols for implementation of both alley cropping and the use of inorganic fertilizers was returned to Belize with each partners’ field/crop specific soil nutrient analysis. This information will hopefully provide the impetus for more sustainable farming practices.

SOIL NUTRIENT ASSESSMENT PROTOCOLS

A field sheet was prepared for each field tested that included an analysis of soil color using the Munsell scale, texture, pH. The results of a physical assessment of soil quality that I conducted while onsite using a modified version of the schema Observational Approach to Soil Health (Romig,

Garlynd, Harris, & McSweeney, 1995). Criteria for the modification were synthesized using information provided by Assessment of Soil Quality by Maurice J. Mausbach and Cathy A. Seybold. (Lal, 1998). All macro and micro soil nutrient analyses were completed using LaMotte Smart2 Electronic Soil analysis apparatus. The following chemical reactions will be completed to allow for digital analysis of the soil extract to quantify nutrient levels to hundredths of parts per million or pounds per acre.

Macro-Nutrients (LaMotte, 2004)

Nutrient, Protocol

Nitrate-Nitrogen, Cadmium Reduction Method
 Nitrite-Nitrogen, Diazotization Method
 Phosphorus, Ascorbic Acid Reduction Method
 Potassium, Tetraphenylboron Method
 Calcium, Schwarzenbach EDTA Method
 Magnesium, Schwarzenbach EDTA Method

Micro-Nutrients (LaMotte, 2004)

Nutrient, Protocol

Manganese, Periodate Method
 Iron, Bipyridyl Method
 Chloride, Direct Reading Titrator Method
 Copper, Diethyldithiocarbamate Method
 Ammonia-N, Nesslerization Method

The results of the analyses of soil taken in December 2008 continue to evidence a reduction in fertilizer use compared to like fields (similar composition and texture and same crop types) first assessed in 2005 and now at the fourth year of this initiative. In the fields of onion farmers in San Carlos, nitrogen levels have decreased by 91%, potassium levels by 5% and phosphorus levels by 65%. At the same time while currently maintaining levels of macro nutrients have been maintained resulting in optimal yield. Tomato fields in the same village have macronutrient level trends that indicate an 18% reduction in nitrogen, a 10% reduction in potassium and a 37% reduction in phosphorus. Similar reductions in all macronutrient levels were documented in fields where these farmers were growing potatoes and carrots. Again these nutrient level reductions have been directly attributed to a reduction in chemical applications when correlated with the application protocols provided by each farmer. It is important to note that optimal nutrient levels have been maintained as has yield for these farmers. Armed with information that allows them to strategically introduce soil amendments has allowed profit margins for these farmers to increase. In other areas on the periphery of the Rio Bravo that were formerly papaya farms, farmers struggle to diversify and restore soil health. The nutrient levels of these farms indicate the need for information specific to a diverse selection of crops as these farmers transition from the deliberate misinformation provided by the papaya processor to that which would be appropriate to maintain

optimal yield. For example the results of macro nutrient analysis for one farmer indicated a 82% reduction in nitrogen, 44% reduction in potassium, and a 74% reduction in phosphorus since the field had been planted with papaya these levels were still high for potassium and phosphorus and below optimal for nitrogen when correlated with the peppers he had planted. Connecting with these farmers to anticipate the crops that will be planted as they rotate through the next several growing seasons may allow for information use of fertilizer application. This group of largely Mennonite farmers can also begin to incorporate the ready supply of manure from the cattle that have been allowed to graze the residue of former papaya fields. Therefore continued monitoring of these fields will be critical to these farmers.

Overall this project over the last four years has recorded average reductions in macro nutrient levels due to reduced fertilizer application as follows: 54% - nitrogen, 34% - potassium, and 58% - phosphorus for all fields that have been repeatedly tested as this project has evolved. In addition, due to more appropriately prescribed fertilization, crop yields have been improved or maintained according to documentation provided by the farmers themselves, some of which is written, most of which is gleaned from conversation.

CONCLUSION

I have been fortunate to have partnered with exceptional farmers. The success of any initiative like this is grounded in the willingness of people in the community to allow such a partnership to occur and to incorporate the information provided. I have learned so much about the behavior of tropical soils and the rapid loss of natural fertility that is faced by people trying desperately to feed their families. Each year I have returned to Belize to sadly see more rainforest cleared for agriculture; however the landholdings of the Rio Bravo remain intact. The immense struggle to clear by hand a piece of the rainforest for farming is unfathomable to anyone from a developed country; yet deforestation is rapidly changing the landscaped in northern Belize. Long term the information provided through this McMaster Belize initiative hopefully will allow farmers to provide an adequate living for their families while preserving their soil so the rate of deforestation can slowly subside.

PART II:

Solar Power Becomes Reality for San Carlos Government School

In December 2007 I conducted a solar power feasibility study for San Carlos Government School, a remote school of 45 students in a village of 150 people on the periphery of the Rio Bravo Conservation and Management Area and on the shores of the New River Lagoon. The village of San Carlos was without electricity except that which could be provided by occasional use of

a generator. The impact this lack of power had on the students of San Carlos was significant because they didn't have the technology that was available to other students in Belize. Many urban schools in Belize City, Belmopan, and Orange Walk have computer labs that the students can access, not to mention the simply luxury of a fan or lights that would make educating these students so much more effective. This feasibility study allowed me to estimate the cost of the system necessary for the school and begin to consider the fundraising aspects of the project. Samantha Higdon was named as a 2008-2009 McMaster Scholar to Belize to develop a fundraising plan that would span multiple years and see the project to completion.

Before Samantha Higdon could develop a plan, word of the project spread and donations began. The first donation came from a former McMaster Scholar David Hammersmith, who donated a monetary award that he had received. Over the summer of 2008 Higdon raised funds from supporters in her hometown. Then Books for Belize, an NGO based in the U.S., notified its constituents about the project and donations from that group came in as well. The project was on its way, but these efforts confirmed the anticipated four year time frame for the project.

The time frame changed dramatically in October 2008 at a Friends of McMaster event where I was able to talk to an individual knowledgeable in the area of alternative energy. This generous individual agreed to fund the project to completion. We were all ecstatic. The four year timeframe had been instantly shortened to a year and a half. This donation was made in memory of Harold McMaster for his pioneering efforts in the field of solar energy and the donor slipped, on paper, into anonymity. The faith that this donor had in me, Defiance College, and the project was remarkable.

By the end of October Alan McMaster had reviewed the feasibility study and suggested that I contact John Witte at Advanced Distributed Generation for help with the system design. After a couple of phone conversations, John advised that they would indeed handle the system design and actually go to Belize to install it. So the system components were being planned, the installation was going to happen but the logistics of how exactly we were going to get the components including solar panels into the country (duty-free) and through the jungle to San Carlos was still a challenge. I can remember John asking me if I had ever done something like this before. My answer was no; but failure to make it happen would impact the children of San Carlos significantly. There was no turning back.

I headed to Belize in December 2008 with the 2008-2009 Fellow and Scholars team to inform San Carlos School that we would be installing the system



in the spring 2009 dry season. While on the ground I set up a team of local residents led by the San Carlos village chairman Mr. Perez that would be on hand to help with the installation and to learn the system maintenance protocols. Ivan Gillett, ranger from Programme for Belize and our integral partner on the ground, was as excited as we were, and he agreed to be our direct contact in Belize as the project moved forward. This was critical because there is no communication with the village of San Carlos through phone or email, and snail mail generally takes a month for a letter and a reply to be exchanged. Imagining the completion of the project was difficult in December 2008 even with the money in place to complete the project and even with ADG on board. But John Witte provided me with clarity during one conversation I distinctly remember. He and I were both worried about successful outcome of the project. But I was worried about the technical aspects of the system –not my area of expertise but certainly his; he was worried about the logistical aspects of getting the system and our team in country and to the village – something I could handle. So from that point on, we both moved the project forward with a bit less stress relying on the partnership that had so easily developed.

While I called numerous departments and ministries in Belize about getting the crate of equipment into the country, I became an expert at getting officials' cell numbers in addition to office numbers, committing all their secretaries' names to memory. I worked with not only Ivan Gillett, PFB, but with Daniel Luna, Orange Walk District Education Officer, who became my conduit to both the Ministry of Finance and the Ministry of Education. The people in Belize were as excited about the project as we were and they were anxious to help. This project moved to completion faster than anyone in the U.S. thought possible, so you can imagine how fast this appeared to happen from a Belizean perspective where paperwork for exemption of duties literally can languish for months and months in the Ministry office. In March, Ivan Gillett oversaw the construction of a battery house adjoining the school so that everything would be in place when we arrived.

Alan Bowen, ADG, prepared and packed the crate of materials. His expertise and diligence made our work on the ground easy. "The crate" as it became affectionately known around the DC campus, was being prepared and we began to search for shippers. How does one get a fragile 600 pound crate from northwest Ohio to San Carlos village – a village so remotely located in the Belizean rainforest that it isn't on most maps? We just needed to get it to the airport in Belize City and out of customs – I knew that from there I could get it to the village with help from Ivan and PFB. Laurie Worrall provided a contact with DHL and so we crossed the shipping hurdle. The crate was on its way and two weeks later John Witte, Lynn Witte, Alan Bowen – all from ADG along with Samantha Higdon, Kaitlin Studer (DC students and McMaster scholars to Belize) and I boarded a plane to make a dream happen. Every person on this team was critical to this project's success.

So to recap, the four year plan for solar power had been condensed to 16 months. As we left, we anticipated but still couldn't realize the project's fruition. Loosely connected by a couple of meetings and a few phone calls the six of us had no ability to anticipate the synergy that would evolve between the members of this team and our Belizean partners.

Once we arrived in Belize City, John and Lynn went with PFB rangers to pick up the batteries we had purchased in country while Ivan, Alan, Kaitlin, Samantha and I waited to meet Mr. Luna at customs. After waiting a couple of hours and a conversation with the head of customs official at the airport, we still couldn't exactly locate the crate of equipment even though shipping documentation had it at the airport the week before we arrived. We decided to head to the HillBank Research Station where we would be staying for the duration of the trip. From there I was able to make a number of local calls

to track down “the crate.” But by the end of the day both the crate and the batteries had been trucked to HillBank. Anxiously we unpacked and verified that everything seemed intact.

Early the next morning we headed to San Carlos with half of the equipment packed in our rented Ford Excursion. John, Alan, and I stayed in San Carlos to begin the installation while the rest of the team headed to HillBank to pack and carefully transport the panels on trip two. One way from HillBank to San Carlos is approximately 90 minutes of really heavily rutted roads. By lunchtime they had returned to San Carlos and we placed the panels on the roof of the school with a sigh of relief. John was confident that the system would be operational by late the next day. He was right in reassuring me early on that if I could get the equipment to San Carlos then he could make everything else happen and he did!

By day three, equipment unpacked and onsite partially installed we were only missing two things both of which Alan could not have anticipated. We needed four screws to mount the plaque on the outside of the battery house and a four inch PVC elbow. This meant that we started day three driving one and half hours north of San Carlos to Shipyard and a large Mennonite store that had the screws and PVC. Upon returning to San Carlos we immediately began installation of the panels on the roof. The temperature was in the 90’s and the humidity the same. John, Lynn, Ivan, Mr. Perez, and I worked on the roof of the school while Samantha, Kaitlin, and Alan worked in the battery house. School was in session but village residents came and went, curious to see how the project was moving forward. By late in the afternoon we were able to turn on lights in the school!

The dedication was held that afternoon. Many of the officials who planned to attend the event were called away to an emergency meeting to brief everyone on the swine flu but the excitement wasn’t dampened. All the important people were there - the children, the village residents, the teams from ADG and DC, Ivan Gillett. Well almost everyone - just two were missing - Harold McMaster and our anonymous donor. Harold would have been proud that the school the McMaster family had envisioned seven years earlier had made such an impact and that it had drawn in, in partnership, the community of Defiance College, alternative energy experts from northwest Ohio, and this not so insignificant village in Belize. Missing too was the donor who made time disappear by funding immediately a project that means so much to this community.

We returned to San Carlos the following afternoon, this time by boat because our bones were weary of the rutted roads, and over a period of several hours John and Alan worked their magic conducting a system check. They then trained local people to maintain the system.

CONCLUSION

I have reflected on this initiative over and over. As I explained during the dedication ceremony, it was easy for me to be invested in this initiative. I know the people of San Carlos, the children by name who attend the school there, I see the potential. What I cannot yet fathom is how the major donor to this project or John, Lynn, or Alan who had no previous contact with San Carlos or Belize committed themselves, giving of their time, resources, and expertise so completely to a project like this. For their efforts and the efforts of all who contributed to this project on and off the Defiance College campus we will be forever grateful. I said to John as the trip ended - it is going to be a whole lot easier to do this the next time and he agreed.

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LEARNING CENTERS AND DIFFERENTIATED INSTRUCTION IN BELIZE

Robin Kratzer, McMaster Fellow

Two problems that drive our work in Belize are (1) increasing poverty and (2) degrading of natural environment. Solutions to these problems can be grouped according to (1) increasing or enhancing productivity, (2) enhancing ecosystem functions, and (3) enhancing human well-being. Improving and increasing access to education is a major key to enhancing human well-being and improving the quality of life in Belize.

During the December 2007 initiative I met with the principals and teachers from two schools in the villages on the periphery of the Rio Bravo Conservation and Management Area (RBCMA). The teachers from San Carlos were specifically interested in manipulatives, setting up learning centers for their new school, and understanding how to integrate the centers into their lessons (Lopez, 2007). Their interest had developed as a result of an initiative that McMaster Scholar Alyssa Shuherk began in 2006 through the McMaster School for Advancing Humanity. Alyssa built two bookshelves and provided carpet squares and storybooks to create an informal reading space. The teachers from San Carlos Government School and St. Paul's Bank Roman Catholic School are also interested in implementing technology for student learning (Lopez, 2007).

In 2007 San Carlos Government School had the opportunity to acquire three computers through the government, but because they lacked a stable power source at that time, it created a roadblock in acquiring them. The teachers at St. Paul's Bank are very much in need of manipulatives and training on how to effectively incorporate these into the classroom. Since St. Paul's Bank has electricity, the school would be ready to integrate technology. The current need is for basic technology items (computer, TVs, DVD player, CD players, etc.). The teachers also would require technology training to enhance their current knowledge. One of the teachers transported a DVD player to the school every day. With technology integration, this would no longer be necessary.

Education in Belize has been a concern for many years. Teacher education training has been undergoing reform in recent years. Many of the teachers in Belize, especially the rural villages, only have a high school education while other teachers have an equivalent to an associate's degree. The requirements to be a teacher in Belize are currently under review. There is a movement

that would require a four-year degree to become a teacher; however, this is a slow process. Schools vary widely in quality of teachers, equipment, and facilities. While talking with teachers regarding their associate degree education, emphasis is focused mainly on content knowledge and less on pedagogy, such as learning styles, discipline, classroom management, identifying learning disabilities, etc. (Con, 2008).

Common practice for a person entering the teaching profession in Belize is to begin teaching immediately upon high school graduation for at least three years. Teachers may then take a study leave to work on their associate's degree followed by a three month internship. To be admitted into the teacher education program, teachers are administered a test. Even though teachers are given five years to obtain their associate's degree, this is not adhered to as evidenced by teachers in rural villages or southern parts of Belize (Lopez, 2007).

Teacher licensures are reviewed every five years and within these five years, teachers are to earn 210 credit hours of additional training by attending workshops. As a comparison, to renew a five year teaching license in Ohio, the teacher must complete 180 professional development hours. The problem this creates for rural teachers in the villages is that the workshops are only offered in cities such as Belize City, Orange Walk, and Belmopan, which are difficult for teachers to get to because of the infrastructure in Belize. In addition, teachers must attend these workshops at their own expense and most do not have the money or the means to travel to these destinations.

In talking with Ivan Gillett, Programme for Belize Ranger; Mr. Jose Lopez, teacher and principal of San Carlos Government School; Natalio Solis, retired teacher of August Pine Ridge; Adrian Leiva, Dean of Muffles Junior College; and Dr. Wilma Wright, Head of Teacher Education at University of Belize, a need was expressed to work with teachers of the rural villages in classroom pedagogy (Gillett, 2008). In response, I developed a project with two components. The first was working with the teachers of San Carlos Government School and St. Paul's Bank Roman Catholic School in the development of materials and learning centers that provide resources for differentiated instruction. The second component was to begin a technology needs assessment for future projects to help teachers integrate technology into their classrooms.

BELIZE EDUCATIONAL SYSTEM AND TEACHER EDUCATION

Belize has a complex education system. The Belizean Education System is divided into five sectors (preschool, primary school, secondary school, tertiary [junior college/sixth forms], and adult and continuing education and is based on age instead of grade levels. Preschool is optional for ages 3 to 4. However, students are required to attend school from age 5 to age 13. Primary School is eight years ranging in age from 5 to 13 and is divided into standards. Standard 1 is ages 5-7, Standards 2, 3, and 4 are generally ages 8-10 and Standards 5 and 6 are ages 11-13. Children are usually placed in classes with one teacher who will be primarily responsible for their education and welfare for that year. This teacher may be assisted to varying degrees by specialist teachers in certain subject areas, often music and physical education. However this is practiced mainly in the cities rather than the rural villages. Children in Belize are required to attend school until they complete Standard 6, which is generally equivalent to Grade 8 in the U.S. Since San Carlos Government School is a primary school with no electricity, many children in this rural community do not further their education.

One reason students in San Carlos do not continue their education past primary school is because of the infrastructure. Transportation is an issue since a bus only comes to San Carlos two days a week and only a few families own cars. Because of the distance of the schools and poor infrastructure, children who decide to further their education must have the resources for room and board as well as other school expenses. The wages in



Belize make it extremely difficult for families to be able to send their children to a United States equivalent middle school or high school.

The certificate or diploma awarded to students upon successful completion of Standard 6 is the Primary School Examination (PSE), which tests students' achievements in English, Mathematics, Social Studies, and Science. "The result of the Primary School Examinations is an important factor in the application and enrollment process of some high schools in Belize, but it is not the only factor. Other important factors are Standard Four and Five report cards, teachers' recommendations and personal interviews" (Williams, 2009). As is common in the United States, many in Belize feel that the results of the PSE are tainted, because teachers teach to the test especially in standards five and six. However, according to Williams, this process has proven throughout the world that it improves test results.

Belizeans refer to secondary education as college. The secondary education school system is for ages 13 to 17 and consists of two tracks in which students are placed based on the results of their PSE. The two tracks are: General Education and Vocational or Trade School. Upon completion of secondary school, students must pass an examination in English, Geography, History, Mathematics, and Integrated Science to receive the Caribbean Examinations Council Certificate, which is similar to the U.S. high school diploma. Students must pass this examination to enter universities and tertiary institutions (Caribbean Examination Council, 2009). Post-secondary or higher education is available at the University of Belize (the largest university in Belize), the Belize School of Nursing, the Belize School of Agriculture, and the Belize Teachers' College. However, only a small percentage of Belizeans receive any kind of postsecondary education.

To become a teacher in Belize, individuals complete the Three-Year Certificate Programme with School Experience, which can be followed with a one-year full-time course at Belize Teachers Training College (Level One), followed by one or two years of experience in the field, returning to the College for one additional year of full-time studies (Level Two). An opportunity for further training will be possible with the introduction of a Bachelor's degree in Primary Education being developed by the University College of Belize and the Belize Teachers College (Belize Education, Schools in Belize and San Pedro). Secondary-school teachers for the first two years of secondary education are also trained at Belize Teachers' College, which offers a diploma in Teacher Education after three years, including one semester of practice and the completion of a research paper. Other individuals who become teachers graduate abroad (Belize Education, Schools in Belize and San Pedro).

According to Table 1 Percentage of Trained Primary School Teachers 2003-2004, the highest percentage of trained teachers is in the Belize District and the lowest figure in Toledo. The area where we work is the Orange Walk District. As evidenced in the chart below, the overall percentage of trained teachers is still a concern in Belize.

TABLE 1: Percentage of Trained Primary School Teachers 2003-2004

District	Trained	Total Teachers	% Trained
Total	1376	2643	52.1
Belize	416	764	54.5
Cayo	279	555	50.3
Corozal	219	336	65.2
Orange Walk	224	388	57.7
Stann Creek	131	316	41.5
Toledo	107	284	37.7

The level of teacher education or the qualification of teachers is often used to judge the quality of education provided to students. With teacher education being a concern for years in Belize, a Belize Board of Teacher Education and the Teacher Education and Development Unit of the Ministry of Education was established on October 25, 2006. This fifteen-member advisory board reports to the Chief Education Officer on general policy regarding teacher education in Belize, including but not limited to the entry qualifications of teacher trainees, the curriculum, the supervision of institutions, training teachers, and the setting of standards and requirements for certifying all teachers trained by such institutions (Government of Belize, 2006). The development of this board is going to take several years to impact the overall educational system of Belize. As a result of national elections in early 2009, there was a change in political parties which also resulted in a change in the Ministry of Education. Although this is a beginning, the infrastructure of Belize has historically supported the inequalities of Belizean education. Urban schools are usually public and get more government aid including better qualified teachers because they get better pay. Often, the rural schools receive less funding because they tend to serve fewer students. Thus the

villages tend to get the least qualified teachers. Even though English is the official language of Belize, many times the teachers in the villages teach in Spanish because this is the common language spoken in the villages. This results in lower test scores because the tests are written in English.

Through conversations with teachers in the rural villages of Belize, it became apparent that great inequality exists in the schools depending on where the school is located in Belize (Juchim, 2008). These inequalities include:

- The education and training of teachers is not consistent throughout the regions of Belize.
- The teacher/pupil ratio varies throughout the schools. For example in August Pine Ridge, the teacher/pupil ratio is one teacher to 30-40 per class teaching one grade level, but in the rural village schools the ratio of students is smaller but multiple ages are taught in one classroom.
- The access to technology varies in the schools throughout Belize. Even within the two schools where we worked, one school had no electricity and no technology compared to the other school which had one computer with no software and a year ago had a television and DVD player which belonged to one of the teachers.
- The amount of money schools receive per pupil for supplies varies according to where the school is located and the affiliation of the school. At San Carlos the school is given \$5 per child for grade cards and tests. This is only \$2.50 in United States currency per child. Teachers must pay for materials out of their own pocket. (Juchim, 2008) The amount paid to schools per child in Ohio ranges from approximately \$2500 - \$6000 per student (Hug, 2009).

One of the biggest problems in Belizean Teacher Education is the lack of pedagogy, instructional strategies, and classroom management. The majority of teacher education is focused on content and curriculum. This focus leaves trained teachers under-prepared in lesson planning and how to utilize different instructional strategies. On October 25, 2006, with the creation of the Belize Board of Teacher Education (BBTE), the then current Prime Minister, Francis Fonseca, emphasized the importance for all classrooms in Belize to be led by trained and qualified teachers. Honorable

Fonseca stated, "I consider teacher education and training to be the single most important factor in improving the quality of education in Belize." He asked the BBTE to ensure that teacher training programs focus on pedagogy, course design, staff development, and instructional development materials (Government of Belize, 2006).

According to the Educational Statistical Digest (2003-2004), 276 primary schools, 51.8% were rural schools and 45.7% were urban schools. The percentage of trained teachers at the primary school level was 52.1% which declined from 2002 when there were 53.0% trained teachers. (Pineda M Ed., June 2, 2006) Although the Belizean Government and the Ministry of Education have recognized the need for trained teachers in Belize, the number of trained teachers dropped in most districts in Belize with the exception of Belize district. (Pineda M Ed., June 2, 2006) According to UNESCO Institute for Statistics report in January (2008), there were only 39.4% trained primary teachers and 35.8% trained secondary teachers.

Statistics from the Belize Development Trust (2002) report revealed that only 32% of the teachers who took the Belize National Teachers Exam passed. This percentage reflects that out of nearly 900 teachers who could have taken the exam, only 178 elected to do so and out of that 178 only 58 passed. The actual qualification percentage for the estimated 900 elementary school teachers teaching in Belize classrooms is only 19% (Trust, 2002).

HOW STUDENTS LEARN (DIFFERENTIATED INSTRUCTION)

According to the Belize Development Trust (2002), Belize has very poor reading capability in the 288 schools in rural areas (Are English Teachers in High Schools, and Colleges of Belize Doing Their Job? What is Their Job?). Adult literacy rates are often quoted as high as 76%, however the functional literacy rate was approximately 40%. However, people are considered literate if they can read infant school primers, but lack comprehension (Shuherk, 2009). How do these under-educated rural school teachers get the needed help, support, and enthusiasm to teach students in these areas?

Although there are public schools in Belize, there are still a number of costs that prohibit many children in the rural areas from attending school, especially high school. Parents are required to pay for compulsory uniforms, books and supplies, and annual registration fees. The average size of a family in the villages is 11 children while in towns it is 5 children (Belize 2000 Housing and Population Census Tabulation System, 2007). The cost to educate this number of children is cost prohibitive for families.

Classrooms in the rural village schools are most generally one room school buildings which house grades Pre-Kindergarten through Grade 8. These schools usually only have three teachers who are responsible for teaching three grade levels. Not only do these classrooms contain students of different age levels but also contain students with a wide range of abilities and varied experiential backgrounds. A well-trained teacher believes that every child is unique, therefore they all learn differently.

“In most elementary classrooms, some students struggle with learning, others perform well beyond grade-level expectations, and the rest fit somewhere in between. Within each of these categories of students, individuals also learn in a variety of ways and have different interests. To meet the needs of a diverse student population, many teachers differentiate instruction” (Tomlinson, 2000). The students at San Carlos Government School are no different than American students. They all have different interests, learn in different ways, or struggle with learning. For Belizean students, the additional burden is that they are being taught in a classroom which contains students of multiple grade levels. Differentiation in a basic sense is the way that teachers respond to the variances among students in the classroom. “Whenever a teacher reaches out to an individual or small group to vary his or her teaching in order to create the best learning experience possible, that teacher is differentiating instruction” (Tomlinson, 2000). According to Tomlinson (2000), modifying instruction to draw on student interests is likely to result in greater student engagement, higher levels of intrinsic motivation, higher student productivity, greater student autonomy, increased achievement, and an improved sense of self-competence” (Cox, 2008). Because of the physical structure of the building, teachers in rural Belize are faced with the challenge of not only differentiating instruction to children of same grade levels but also of multiple grades simultaneously. In some sense they have already been practicing differentiated instruction by having to meet the needs of learners at the different age-levels.

Some learning processes are not compatible with the brain’s natural learning process. Most often in the traditional classroom students are expected to memorize one correct response and regurgitate it on a standardized test. They begin to learn early on that there is only one way of answering a question or completing a task which contradicts the natural inquisitive ability they are born with. According to Smilkstein (2003), teachers often believe that students use their innate learning process to transfer knowledge to the new information provided by the teacher, therefore learning new information. Some students perform well in the traditional classroom. These

are normally students who have good test-taking skills and have strong previous knowledge. However, teachers also encounter students who cannot learn, who do not want to learn, are rebellious to school, etc. How do teachers reach these students? These students normally do not learn well in a traditional classroom. Smilkstein's "Natural Human Learning Process Research" (NHLP research) "shows that an individual might learn one skill, concept, or body of knowledge more readily than another skill, concept, or body of knowledge. It is unlikely that any single person will be able to learn everything with the same amount of practice and time" (2003).

Differentiated instruction is teaching to what the students already know and where they are rather than assuming that all students learn at the same rate and same level. Differentiated instruction usually incorporates a variety of grouping styles such as individual learning, small group, and large group instruction. "The goal is to maximize the capacity of each learner by teaching in ways that helps all learners bridge gaps in understanding and skill and help each learner grow as much and as quickly as he or she can" (Cox, 2008). Students can be grouped based on their interests, the knowledge, their readiness to learn, or their learning style. "Differentiated instruction integrates what we know about constructivist learning theory, learning styles, and brain development with empirical research on influencing factors of learner readiness, interest, and intelligence preferences toward students' motivation, engagement, and academic growth within schools (Anderson, 2007).

According to Tomlinson (2000), teachers can differentiate four elements of the classroom: (1) content – what the student needs to learn, (2) process – how the students learn the knowledge, (3) products – culminating projects the students create to demonstrate their knowledge learned, and (4) learning environment – the way the classroom works and feels. This project will focus on the process and learning environment with the teachers at the San Carlos Government School. The plan was to help them create materials to use in learning centers. Presently the schools have few resource materials. Until last year, students had to purchase their own textbooks which placed a hardship on many students. Teachers had to create worksheets by hand in order to have teaching materials for the students. Although the government presently is supplying textbooks to all students, teachers are missing critical resources to vary instructional strategies. "There is ample evidence that students are more successful in school and find it more satisfying if they are taught in ways that are responsive to their readiness levels (Vygotsky, 1986 as cited in Tomlinson, 2000), interests (Csikszentmihalyi, 1997 as cited in Tomlinson, 2000) and learning profiles (Sternberg, Torff, & Grigorenko, 1998 as cited in Tomlinson, 2000).

“Our brain is...born with the natural impulsion and ability to figure out –through logic, through seeking patterns and solving problems— how the world works so we can survive” (Smilkstein, 2003). From the time we are born, our inquisitive nature guides our learning. Each of us developed our own ways of learning about the world around us. Human beings have an innate learning process, which includes a natural motivation to learn. When students are not motivated in school, it may be because of the natural ability they developed regarding learning from the time they were born until they entered school. “Although the brain innately knows *how* to learn, the knowledge, skills, or concepts the brain acquires by means of its innate learning process depends on the learner’s experiences and environment. When human beings have the opportunity to experience activities and environments that are compatible with the brain’s natural learning process, they learn naturally, successfully, and with motivation” (Smilkstein, 2003).

How effective instruction is, and how much students learn, is influenced by individual differences among students. These differences include the thought process used by the student, their rate of learning, and most importantly the level of capability or knowledge at which the student enters the instruction. According to Gagne, “methods of compensating for individual differences in the delivery of instruction include small-group instruction, the tutorial mode, independent learning and individualized instructional systems” (Gredler, 1992).

Readiness to learn refers to the student’s previous knowledge, understanding, and skill and their desire to learn. Most students learn best when the work or content is somewhat above their current knowledge level. Students are often discouraged if the material is too easy or too difficult. “A student’s gender, culture, learning style, and intelligence preference can shape their learning profile” (Cox, 2008).

There are a variety of instructional strategies which promote differentiated instruction. One of these strategies is to create learning centers and learning stations to allow students to work individually and/or in small groups while other classroom learning is taking place with other students. “Learning centers are comprised of a collection of materials and activities designed to teach, reinforce, or extend students’ knowledge, understanding, and skills. Learning stations are areas in the classroom where students visit on a specified timetable to complete specified tasks” (Cox, 2008).

In a differentiated classroom, assessment is vital. Individual growth is emphasized instead of being based solely on an achievement norm. This type of instruction usually results in greater student learning. When

observing a classroom where every student is doing exactly the same thing, then differentiated instruction is not taking place. This does not mean that students do not all learn the same material but instead they learn the same material in different ways and at different rates. The end product is the same but the path they take to get there can and should be different for every student. Most teachers practice some form of differentiated instruction. Teachers, who give a student more time to finish an assignment, allow children a choice in what they read or a choice of how to complete an assignment are differentiating instruction. An easy method to begin differentiated instruction is to know each student's learning style. This can be done by having every student complete a learning styles inventory.

TECHNOLOGY AND LEARNING

In Honorable Cordel Hyde's address at the launch of the Internet for Schools Project in 2002, he stated "We are providing Internet access services to all students and teachers in all our primary schools, libraries and secondary schools at no cost to the students, the teachers or the schools" (Hon. Cordel Hyde's Address at the launch of the Internet for Schools Project, 2002) This would allow Belizeans opportunities to connect to the global community. This announcement came from a government Manifesto commitment which had been made over four years prior. Peace Corps volunteers began training teachers at District Education Centers. This initiative only benefitted where towns had electricity for technology. Many of the rural villages do not have access to electricity as is the case with the village of San Carlos where we work. However, a McMaster School for Advancing Humanity initiative by Mary Ann Studer is to install solar panels in the village of San Carlos. These solar panels will provide electricity to power the school so that technology can be added for student learning.

The second component to this project was doing a technology assessment at San Carlos Government School because of the solar panels that were going to be installed in spring 2009. During the visit in December 2007, San Carlos had the opportunity to receive two computers contingent on an adequate power source. With the installation of the solar panels, a question was asked about the status of the two computers and the response was "The last time we met with the Ministry of Education, they said there were two computers but since San Carlos had no electricity, they were given to a village that had a power source. Those computers were supposed to be for the San Carlos Government School but now they are gone. Once San Carlos has electricity a new request for computers will be put into the Ministry of Education" (Juchim, 2008).

GROUND WORK

The school used for this project was the San Carlos Government School which has 44 students with three teachers, and one of the teachers also serves as the principal. In the December 2007 trip to Belize the teachers and principal discussed their instructional needs. Their request was for manipulatives and instructional strategies to help the students (Jose Lopez, 2007).

In July 2008 there was notification that two of the teachers would not be returning for the 2008-2009 school year. One teacher chose to leave the teaching profession to work in the tourism sector as a guide because of higher pay and the other teacher was transferred to a different school. Thus San Carlos was assigned two new teachers that would not arrive until the first day of school in August. This would be the first opportunity that Mr. Lopez, principal of the school, would have to meet these teachers. He had no further information on the teachers in regards to their teacher education preparation.

The current teachers, Mr. Jaustino (Tino) Juchim and Mr. Romeli Con have a vast amount of experience compared to the teachers we worked with in December 2007. Tino has 21 years of teaching experience. Most of his experience has been at larger schools. After six years serving as a principal, he had done what he needed to do and felt it was time to move on. Since then, he has taught three more years. He came to San Carlos because he asked to be placed in a rural village closer to home. Mr. Con has taught for approximately 15 years in four different schools. Both teachers felt that compared to other schools they have taught in that San Carlos is way behind. Tino feels the people in San Carlos are very smart and have lots of information about their culture. However, the students are very focused on agriculture and not education. He tries to teach them that a good education can get them out of San Carlos (Juchim, 2008).

A problem which affects many of the rural village teachers is the proximity of the school to their home. Tino for example lives in Orange Walk. A typical school day for him is to leave home at 6 AM in order to share a ride to Indian Church Village with another teacher. From there he catches a ride with Mr. Lopez, the principal, to San Carlos Government School. He usually arrives back home between 6 or 7 PM. He is exhausted upon arriving home after a 12 hour day, therefore he doesn't have the time to prepare lessons for the next day. According to Tino, teachers are given \$100 BZ per month (\$50 US) hardship allowance for driving but it costs \$60 BZ (\$30 US) per week to travel. Tino has asked the Ministry of Education to build a home for teachers in San Carlos and was told "we will see" (Juchim, 2008).

After asking the teachers at San Carlos how they deliver instruction within classrooms of multiple ages, they responded by saying that the same information is given to everyone in Social Studies while in Math and Language Arts they provide separate instruction for the age levels. Therefore when the teacher is working with one age level, the other age levels are given seat work. A question was asked about how teachers keep from covering the same material each year with students if they are taught the same information. The response was that even though there is a National Curriculum, teachers decide from year to year what they are going to cover and develop an annual plan from topics chosen from the National Curriculum. They first create a five week resource unit and from that unit, they create weekly plans. Teachers then create a final test for each of the three terms based on the lessons they taught. The problem with this is there is no consistency from school to school. In one of the villages visited, two children from one family dropped out of school. One child was age 15 performing at a second grade level and the other was 16 performing at a fourth grade level. The children lived with their grandmother, who because she had never attended school, was unable to help them with homework (Pook, 2008).

In December 2007, when visiting St. Paul's Bank Roman Catholic School, they had three teachers one of which was Therese Pook who is also the principal with 32 students. When visiting this past December, there were only two teachers due to the fact that one of teacher is on study leave to get her associate degree. However, the school also only had 18 students. The encouraging news is that St. Paul's Bank has however graduated six from their school that have went on to college (high school as we refer to in the U.S.) which is 100% of their graduates.

Changes noticed at St. Paul's Bank Roman Catholic School from last year to this year were:

- The number of teachers and students has decreased.
- The school building was run down.
- Desks needed replaced.
- They no longer have the technology they had last year, because the technology belonged to the teacher on study leave who carried it with her to and from school every day.

- The Principal wasn't able to go to a training last year because she didn't have the money for transportation and hotel for 2 weeks. She is however, hoping to attend in summer 2009. Therese, the principal, is trying to use learning centers to work with students of different grades and abilities. She felt the materials provided would be very helpful. However, there is definitely a need for more training as she did not understand how to use some of the teaching materials. When Therese was presented with learning center materials for counting math, she commented that the students will enjoy using these for crafts.
- Students are administered a test created by the teacher at the end of each grade. Students can miss the test by 1-5 points and still be moved up a grade. However, they are put on probation and placed in a remedial group. If a student misses a test by more than 5 points they repeat the grade. No matter whether the students are moved up on probation or retained a grade, learning centers would be beneficial in improving their education.

The project to create learning centers is a way for students to work individually, in pairs, or small groups for reinforcement or instruction on a topic. Learning centers utilize manipulatives which are teaching aids to help students learn. The centers allow for differentiated instruction by addressing the different learning styles and abilities of students.

Examples of learning center materials provided to the schools were:

- foam letters and shapes, die for mathematics, flash cards, counting beads,
- Reading literacy materials,
- File folder activities, and
- Reading and math games.

DISCUSSION

What is interesting is the instability of the schools from year to year. Two schools have been worked with during the last two years and both are in great need of assistance. Their situations from last year to this year have changed. When this project was proposed, the teachers with whom I was planning on working had no formal teacher education, so it was important to provide training on how to use the learning center materials. However, because of the change in teachers, these teachers had experience with

learning centers but lacked the resources. Therefore, the training was not provided. However, after a later meeting with the teachers, there appears to still be a need to do training or conduct workshops with setting up and integrating learning centers into the daily classroom routine. It will be interesting to conduct a follow-up assessment as to the effectiveness of the learning center materials.

Currently Mr. Con uses chairs with a large piece of plywood sitting on top of them for a learning center. He had a piece of cardboard that he had created an activity similar to one brought down. He was extremely excited when I showed him all the materials provided for him to create his own learning center activities. We discussed how to use the file folder games prepared by Defiance College Early Childhood Education students and how to incorporate them into the lessons. To put it into perspective, they do not have access to Ziploc baggies and were most appreciative for them. This is how scarce some resources are for the teachers.

Mr. Con stated they are being pressured by the Ministry of Education to create materials for students to use (Con, 2008). Since teachers do not have money for supplies, the Ministry of Education tells them to use their natural resources or things around them. Mr. Con also informed me that during his education for his associate's degree, lecturers gave them the content and they practiced it in the classroom. However, information for classroom management, instructional strategies, and learning centers comes from their own classroom experience not college preparation. He stated "In Belize a teacher must be intelligent, resourceful, and creative because teachers' salaries do not give teachers enough money to buy materials so they have to use resources around them like cardboard and bottles, etc. (Con, 2008). And if teachers do not have that creativity, they will stay behind." What that means is that the students will also stay behind.

One of the teaching aids provided for the classrooms to aid in differentiated instruction was lap chalkboards. Cindy Toth, Holly Stein, and Megan Sherman modeled for the teachers how to use the chalkboards in instruction. The students were given a math problem to complete on the chalkboard and then would individually display their work. This allows the teacher to immediately assess whether students understand the material in order to continue or adjust instruction.

REFLECTION

The training with the teachers that I had expected to carry out on the ground never took place due to the knowledge level of the two new teachers. Instead the materials were delivered to the teachers with a brief discussion

of how to use them. Without access to the Internet, scholarly publications, and professional development, one has to wonder if the experienced teachers are truly familiar with the ever changing instructional strategies. Knowing that they lacked the pedagogical training, this is an area that needs to be continued. Also the format of our interdisciplinary learning community did not lend itself to the time that was needed to work with the teachers. In future projects, more time needs to be allotted for work between students and Belizean teachers. The plan was to be able to observe student learning for a couple days to assess ways to integrate the learning center materials and work with the teachers on differentiated instruction. Projects providing educational resources, especially in the areas of science and social studies, need to continue.

As for the background teachers have with computers, Mr. Con is fortunate that he had a technology course. However, the teachers do not know how to integrate it with students. Mainly they will use them as a classroom management tool and to create materials. After talking to the teachers these past two years, there is a strong need for training teachers on ways to integrate technology into their classroom teaching and learning (Gillett, 2008). Students have access to computers at college (high school) so the students in San Carlos are at a disadvantage because they have had no experience with technology. Once the solar panel project has been completed in spring 2009, a plan needs to be developed to help San Carlos acquire technology, and Internet access. Possibilities were discussed during the December 2008 visit. However, this assessment needs to continue next year to help them move forward with the acquisition of technology and the training of how to integrate it into their classroom.

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CREATING A PLAN: A FUNDING CAMPAIGN FOR THE SOLAR PANEL INITIATIVE IN BELIZE

Samantha Higdon, McMaster Scholar

The principal and teachers of San Carlos School directly requested the help of the Defiance Belize team in finding a more source of energy for their school. Because the lack of reliable power severely hinders San Carlos students, and because education plays a huge role in determining students' futures, this need was critical. In order to provide the students of San Carlos with a better education and better future opportunities in life, I developed a financial plan that outlined a process for funding the installation of solar panels for the school. I also raised funds along with others so that the panels could be purchased and installed in a timely manner. I partnered with a number of different donors to assist in funding this project.

LITERATURE REVIEW

To better understand the nonprofit fundraising work that I engaged in as part of the McMaster School's Belize team, it is important to first understand something about nonprofit organizations and their fundraising strategies. In *Effective Fundraising for Nonprofits*, Ilona Bray brings nonprofits up to the modern day, stating, "Gone are the days when a nonprofit could charm people with its desperation and grassroots inefficiencies" (Bray, 2005). Instead, today's nonprofit groups must rely on technology, business savvy, and the public's attitude toward nonprofits in order to pursue effective fundraising. No longer can an organization rely on the sincerity of their work in order to garner funds. Asking for money in today's business world is an art form, and it is especially vital to a nonprofit organization because, unlike for-profit businesses, the process to gather capital is far more variable.

The differences between for-profit and nonprofit organizations are important for the nonprofit fundraiser to understand. For-profit organizations are, as the name suggests, seeking to earn a profit for the company and its shareholders. Granted the company may be very ethical and upstanding, but their goal is ultimately to make money, which means that even if questions of values arise, chances are the company won't be torn apart by such scrutiny. Also, much of a for-profit company's revenue and capital come from an actual physical product, which is not the case with most nonprofits. By contrast, nonprofits are not profit driven, but value driven, meaning that the members of the organization are driven solely by their individual commitment based on individual values (Swaigen, Wyman and Young, 2002). Instead of relying on the revenue from products or services, nonprofits have to turn to other sources for funding.

Nonprofits rely heavily, if not entirely, on the kindness of relative strangers. Fundraising and donations from a variety of sources comprise most nonprofit budgets. All attempts at raising funds must adhere to certain guidelines to ensure that the fundraising is both effective and ethical. According to Nick Costa, it is vital that the fundraising chair, as well as any member of the fundraising committee, be willing to work with the administration and not against them. He explains that many times during a project the fundraiser will feel as if the administration is purposefully slowing the process down or involving excess red tape, but each fundraiser should remember that the administration also has rules that it is responsible for following. Integrating resources and materials with administrative departments is vital to the success of any fundraising campaign (2005). Because nonprofits rarely, if ever, have a product to show potential donors, having a written, well-researched, organized business or fundraising plan is vital. Because the document will change several times over the course of the project, it is best to keep the business or financial plan simple, usable and flexible (Bray, 2005). While no single document outline can be used for all plans, a comprehensive business plan always includes financial information, the organization's purpose and mission statements, and information on the market and organizational operations (NonProfits, 2005). Further, it is important to strike a balance between the issues and aspects vital to that particular project without deviating too far into the larger scheme of the organization (e-How, 2008).

A large portion of effective fundraising depends on the manner in which the donors are sought out, approached, and shown gratitude for their support. It is not economically feasible for a nonprofit in the early stages of development to approach a large number of random individuals and hope to be successful. In these situations, fundraising typically starts at a grassroots level with members approaching family, friends, and fellow activists (Bray, 2005). As the organization grows and becomes more prominent, donation seeking can expand to mass mailings, large rallies, and possibly even television spots depending on the depth of the organization. Regardless of donation seeking methods, it is vital that an organization show appropriate gratitude to its donors promptly. Generally speaking, donors should receive a well-written thank-you letter that is post-marked between twenty-four and forty-eight hours post donation. Keeping donors involved in the development of the project is key in decreasing donor attrition or "buyer's remorse", which is necessary if the organization is to turn those occasional donors into repeat supporters.

Raising funds for a project on any scale would be easy if all one had to do was plug numbers into a set formula. However, my research and personal

experience led me to conclude that there is no singularly best way to raise money for any project because no two projects will be affected by identical variables. Basic guidelines are applicable but each and every project will be different, and a fundraising tool that is effective for one project may prove unfeasible for another. The only fact of fundraising that is set in stone for nonprofits is this: before a cause can be championed, it must be understood both in its current state of need as well as the course of its development.

Today, rural Belize villages are isolated from one another as a result of the severe lack of infrastructure in the country, vestiges of the British occupation that began in the early 1800s. Everything from agriculture to education is greatly hindered by treacherous roads, generator-powered electricity, severely restricted educational access and limited communication with the rest of the world. The isolation of each village makes it immensely difficult to provide current and relevant materials regarding educational matters, new business strategies, and even philosophical approaches to government to both the schools and the communities at large. This severe lack of progress and infrastructure hinders the development of villages in rural Belize, making the continued work of the McMaster School more vital than ever.

The Belize team works closely with the village of San Carlos, and this village serves as a prime example of how lack of infrastructure is limiting education in a self-perpetuating cycle. Given Belize's geographic location, solar energy appeared to be the prime option for an alternative energy source in San Carlos. In 2007 Professor Mary Ann Studer conducted a solar panel feasibility study in the hopes that funding and installing such panels would assist the people of San Carlos to move beyond the subsistence level that so many are currently living at. The results and implications of her study were staggering. Installing a solar panel system would increase the students' access to current technology, and this would assist them in becoming more productive members of society. The use of the school building by the entire community indicates that the solar panels would serve not only as a method of increasing access to education for students but also as a method of decreasing the isolation of this village from the rest of Belize and even the world. The funding and installation of these panels would help combat on multiple levels the subsistence lifestyle led by many Belizeans in rural Belize (Studer, 2007).

Armed with a comprehensive feasibility study and first-hand knowledge of the conditions in Belize, Professor Studer set out to turn the possibility of funding solar panels into a reality. However, her expertise was centered in the scientific aspect of the project, and she lacked the knowledge of how

to approach the business side of the project. After reading the study and hearing Professor Studer and the other members of previous Belize teams speak, I needed little prodding to join in this endeavor. As an accounting and economics major at Defiance College, I had the business expertise that Professor Studer knew would be necessary to provide San Carlos with the solar panels they so desperately needed. Armed with Professor Studer's research, I was faced with the challenge of further acquainting myself with the history of Belize, and with that knowledge I structured an effective fundraising campaign and a philanthropic business project the likes of which the McMaster School had yet to experience.

PROJECT METHODOLOGY

My project focus was to develop a business plan with an in-depth financial section that would include a fundraising plan to serve as a framework for continual fundraising of money for the solar panels over the course of four years. This business plan was to be filed within the McMaster office to serve as a template for any future initiatives that might find it useful. However, shortly into our fundraising campaign, a completely unexpected donation allowed the project to be funded with a single year's effort. This was truly a most fortuitous happening because it allowed me to take my technical skills and expertise and create something based on reality rather than something abstract and theoretical.

PRE-GROUND WORK

This project's scale was far beyond any work previously attempted in a single year, and as such, required a great deal of precision, detail, and accountability. This called for a business plan that outlined the project's fundraising campaign and procedure. In order to ensure the highest quality of product possible, meetings were held with individuals and organizations on the Defiance College campus, and their help was vital in the success of this project. Before beginning to raise funds, the administration and Office of Institutional Advancement of Defiance College were consulted to ensure that proper protocol for fundraising was followed. These meetings included proper approval for letters, fundraising event ideas, and the proper flow of donations through the fiscal channels of the college. After becoming acquainted with the procedure, several informative presentations about the Belize initiative and the solar panel project in particular were made to local community members and groups. The attendees were very generous and eager to inform others about my work, and through that generosity of donors, I was able to raise \$629 toward the ultimate goal of the installation of solar panels into San Carlos's school.



Dr. Wayne Buchanan assisted with developing a comprehensive and professional business plan that outlined the fundraising campaign in intricate detail, in order to not only be thorough, but to also allow the skeletal framework of my plan to be applied to future McMaster initiatives. In order for the business plan to be beneficial to future scholars or fellows who may look at it as a reference, it was vital that I also include a highly detailed “operations” section that would chronicle each and every step of the design, fundraising, purchasing, and installation of the panels in the school. Professor Mary Ann Studer, who served as the lead person for this project, involved and informed me about meetings with system designers, researching reduction or elimination of tariffs, and ways to handle other shipping and importing costs associated with moving such a large commodity. Additionally, Professor Studer also allowed me to help brainstorm a list of possible people or organizations that would need to be informed of the project’s progress and new earlier-than-expected completion date. I remain extremely grateful to Professor Studer for allowing me to be her shadow because it made compiling a comprehensive operations section of my business plan so much easier.

GROUNDWORK

While on the ground in Belize, much of my work again was basically chronicling the happenings involving the solar panel project. I was present at the measuring of the roof and several strategic points at the school, such

as the side of the building where the battery house was to be built and the heights some of the windows. All of these measurements were taken to assist the installers and provide them with as much information about the site as possible prior to actually seeing it. A maintenance team was also developed to ensure the panels would continue to function properly long after installation. The Belize team met with Edilberto Romero, director of Programme for Belize, and discussed the unexpected progress of the project and how soon the system could be implemented. The potential impact and attention this project would gather from Belizean media and political figures was also discussed, and I was once again lucky enough to be involved with each of these steps to ensure an accurate chronicling of the process both for McMaster and for my business plan.

POST-GROUND WORK

Upon returning to the United States, it became clear that the work for this project had only just begun as the business plan was constantly updated as more accurate and recent figures came to light. I was able to attend a meeting with the engineers and potential installers with Professor Studer, which provided much relief because the company seemed very eager to complete the project and help in whatever way necessary. After discussion with team members, it was determined that I should develop a newsletter chronicling this project, thus keeping donors informed of the progress being made. For this endeavor to be a success, Kathy Panches, the Director of Public Relations and Marketing for Defiance College, met with me and discussed options for a professional and comprehensive newsletter to be distributed to all the donors for the solar panel project and to be made available during the Belize team's presentation at the McMaster Symposium/Global Summit event on the campus of Defiance College. After speaking with Kathy and Professor Studer, I determined that the newsletter would include an overview of the project, a progress update, concrete installation dates, and a section allowing readers to get to know the village of San Carlos. The wonderful people who assisted us in making this project a reality deserve to know and understand the people they have helped so tremendously.

DISCUSSION/CONCLUSION

Even after reading all the research on how non-profits function and how the business plan develops and changes, I never imagined the ways in which this project would allow me to experience how versatile and flexible a person must be to be successful in the world. I was overwhelmed by the unspeakable kindness of each and every one of the donors and partners I had the opportunity to work with; because of the generosity of people, San

Carlos Government School will have their solar panels by May 2009 instead of having to wait four years. The business plan that I completed not only benefited this project but also opens the door for future initiatives in Belize and other McMaster sites. Likewise, the newsletter I developed has the potential to connect our donors and others to our Belizean partners, thereby increasing the possibilities of working again with a partner in a business sense.

Providing San Carlos with solar power will allow both currently enrolled children and future generations to have greater access to education, reducing the community's isolation from the rest of Belize and having a direct impact on the subsistence living of this community. While bringing the village into the 21st century too rapidly is a concern as people must adapt to a new way of life, allowing the children and the village access to electricity and a higher quality of education is the beginning step to gradually preparing this village to sustainably develop and thrive far into the future.

REFLECTION

This trip was a very emotional one for me. Due to the speed at which my project radically changed, there was a period where I felt a slight disconnect from the project. However, once I arrived on the ground and had the opportunity to work with the school, the villages, and Programme for Belize with Ivan Gillett, everything made sense. This trip was never about me or my project. It was and always has been about the people with whom we work. I learned more about the exploitation and conscious efforts to subdue people while on the ground than I ever could have from a book, video, or presentation. I saw first-hand the impact that the McMaster School has had in Belize and the differences it makes even in the time between our initiatives. The people we work with do not just take whatever the year's projects are and move on as if nothing has changed. They actively seek to help themselves and us to make their village, and Belize in general, a better place. I cannot begin to describe the level of trust they had towards me even as a first time scholar.

After coming back to the U.S. and reflecting on what I accomplished and the business plan I produced, I finally understood just how much this trip changed me. I, a student, was able to hand a business plan to an organization as highly regarded as the McMaster School and have it filed as an academic reference. For me, that is an amazing feeling. Even more than that, the trip changed me from the inside out. Never again will I look at anything about Belize or hear about economic, social, or political struggles anywhere in the world and just wish that I had the ability to make a difference. I now know I can make a real impact. McMaster showed me that, and I am truly grateful

to the school. My experience, these people, and the trust and faith they have in the McMaster school has motivated me to apply again because, if accepted to return to Belize, nothing would stop me from going back and continuing to work and further the relationships I have already begun.

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DEVELOPING NON-CHEMICAL SOLUTIONS FOR LEPIDOPTERON AGRICULTURAL PESTS

Kaitlin Studer, McMaster Scholar

Integrated Natural Resource Management is a framework that is frequently used in developing countries that want to develop in a sustainable way. Within Integrated Natural Resource Management there are three major problems developing nations need to address (Sanchez, Palm, and Boul 2003). These problems are; food insecurity; increasing poverty; and degrading natural environments (Sanchez, Palm, and Boul 2003). In this particular case, Belize is the focus country that will be analyzed through the Integrated Natural Resource Management framework. The problem that I will be focusing on is deforestation which is one of the major environmental issues currently in Belize.

Belize has approximately 33.5% of its people living in poverty, with a 9.4% unemployment rate (CIA, 2008). 22.5% of the people of Belize work in agriculture, and mainly in the rural areas (CIA, 2008). There are many effects of deforestation in areas where agricultural activities are trying to expand. This is a major issue in Belize because Belize is the Central America country that has the largest forest coverage area (Young, 2008). With the high demand for agriculture the deforestation rate has increased at an average rate of 2.3% a year and over 13% in areas that are close to bodies of water (rivers, lagoons, etc). If this increase continues there will be no rainforest ecosystems left in Belize in approximately 40 years (Young, 2008). In rural areas, both high levels of environmental diversity and poverty are found. When this occurs issues such as illegal logging, poaching (wildlife), and slash and burn practices are also high because people are trying to make a living (Young, 2008). Subsistence farmers located in these highly diverse ecosystems are increasingly cutting down the rainforest because they are trying to increase their crop area to increase both the amount of food grown and their income.

The concern however is not completely over environmental issues in Belize. These methods of habitat destruction also affect the country's economy and the livelihood of the people. Rainforests are not only home to a great diversity of plants and animals, some of which have not been identified, but it also holds the largest natural resource collection of medicinal flora (William, 1999). Many plants native to tropical rainforests have been found to be effective cures or treatments for severe diseases contracted by humans. The rainforest also supplies many resources for people living in rural locations that are in and around rainforests (William, 1999); however,

exploitation of these resources results in a negative impact on the entire ecosystem.

Deforestation can be done in a variety of methods. One of the major causes of deforestation especially in Belize can be attributed to slash and burn. This practice is prevalent particularly in the area in which we work the northern region of Belize, where cultivated areas are continually shifting to short term fertile soils of a newly cleared rainforest. Theoretically speaking, an increase in food grown would ideally increase the economic sector of Belize because more food can be exported or sold in country. However, an increase in food production that involves clearing the rainforest would cause a decline in the resources available from the rainforest such as medicinal plants. Another major impact of expanding farming is an increase in the number of endangered species of Belize due to habitat destruction. One of the underlining effects of deforestation that is usually not considered is how it unbalances the interactions of the entire ecosystem community (including the food chain). A few types of organisms that are reduced when deforestation occurs are birds and bats because the area they thrive in is being destroyed. These organisms are major sources of native biological control of agricultural pests; thus a reduction of these species would allow insect populations to increase. There is evidence of this occurring according to Sayer and Campbell, "Modern agriculture creates biological imbalances that increase crop vulnerability to pests, while simultaneously undermining populations of birds and other biological agents of pest control..." (Sayer & Campbell, 2004).

Insect populations increasing translate directly to a potential increase in crop damage, or an increase in the use of insecticides/pesticides both of which negatively impact the farmer's income. Pesticide use increases farmer's costs thus reducing profits. Pesticide use also negatively impacts the environment. The toxic run off of chemical pesticides could potentially affect aquatic life in bodies of water and impact the water quality for human consumption (Kurtz, 2007). In addition this increase in insect populations and subsequent increase in crop damage could potentially reduce yield, reducing income. This cycle could trigger the farmer to increase their crop area even further which would only increase the negative impact of this cycle even more. You can begin to understand, ecosystems can be highly affected by the actions of humans.

Non-introduced biological controls are native insects, and animals, that prey on problem insect populations in a certain area. As shown in the pamphlet *Biological Control* (Agriculture, 2006) biological control reduces the use of harmful pesticides and or insecticides and is beneficial to the environment (Agriculture, 2006). Also included in the definition of biological control

in this case is the use of botanical biological control. Botanical biological control is the use of native plants that can be toxic to pest insects but is still completely natural and will not disrupt or become invasive in an area. Botanical biological control has found to be very useful in some situations with lepidopteron (butterflies and moths) pests, particularly in tropical areas where there is no dormant period for the insect. This leads into the importance of my project.

Since there is a large problem with slash and burn of the rainforest near the Rio Bravo Conservation and Management Area Programme for Belize director Eddie Romero was very concerned about the recent increase in Lepidoptera populations. These concerns led to a request for me to work with farmers on the periphery of the Rio Bravo Conservation and Management Area to control their lepidopteron pests through the use of biological controls. By working with the farmers to find alternative methods to control the pests that are damaging their crops through the use of biological (and botanical) control, will perhaps allow for a reduction in the amount of pesticides used. If the amount of pesticides are reduced this will allow for lower input costs for the farmer, a reduction in chemical run off, and last but not least a reduction in the rate of deforestation.

My project with the 2008-2009 Belize Team was composed of three goals. The core of my project was working with farmers on the periphery of the Rio Bravo and their Lepidopteron pests. After identification of the pests non-chemical solutions were found for removal/reduction. Secondly, I worked to restore the insect collection at Hillbank by mounting all insects in display boxes in order to facilitate their educational use at the research station. Finally I am working with the environmental science professors at Muffles Junior College to help them incorporate field exercises in their laboratory courses. I created a short video describing three field exercises and collected the field equipment to conduct these exercises.

GROUND WORK

On the ground I visited various farmers on the periphery of the Rio Bravo. I asked a series of questions about any insect problems in their crops. If there was an insect problem I analyzed the plant damage, different life cycle stages, and took photographs of all the insects and damage that the insects produced. I asked the farmer questions about any pesticides they used, when they started noticing the insects, and also if the insects were a common occurrence. This information was then brought back to the States and the insects were identified.

At Hillbank I took all of the insect collection and restored all of the intact specimens. These insects were then placed in glass covered insect boxes to better preserve the insects for educational purposes at the Hillbank Research Station. I also added to the collection of insects while there in December 2008.

I continued the Yellow-headed parrot education initiative and I was able to distribute field packs to more school on the periphery. These field packs contain binoculars, a field guide to Central American birds, checklists, and a water proof notebook. I was able to distribute these to a new school with 35 children in the village of Lemonal. This village actually inhabits a pine savannah ecosystem so it was very beneficial to get field packs to this school. Field packs were also supplied to St. Paul's Bank School.

We travelled to Orange Walk Town to meet with Muffles Junior College during the time on the ground. I was able to present the equipment and video to the Dean, Adrian Leiva, the Assistant Dean along with one of the biology professors, Mr. Gonzalo Castillo. This equipment and instructions will be able to support the environmental science majors in their effort to gain more field experience.



DATA

The data collected while on the ground in Belize was then used for identification of the insect pests, and then used to find non-chemical solutions for removal. A pest analysis report was then written to give a brief overview of the life cycle, the damage the identified insect can do to crops, and also removal methods. The removal methods suggested are all non-chemical solutions.

There were four insects recorded and identified. One insect was identified in August 2008 Melonworm *Diaphania hylinata* and non-chemical solutions were found and sent in September 2008. The insects found in December 2008 identified were; Cutworm *Agrotis ipison/subterranea* (both Black and Granulated), Banded Cucumber Beetle *Diabrotica balteata*, and Broad mites *Polyphagotarsonemus latus*. Each of these insects produced significant damage to the crops in which they were found. Some were found in more than one location/farm. The non-chemical solutions ranged from natural biological control (a few native plants) to simple bait recipes using non-chemical substances.

DISCUSSION

This project unintentionally started in August of 2008 when I was visiting partners in Belize. I was visiting a farmer who at the time was having a moth species significantly damaging his cucumber crop. After taking notes and pictures and returning to the US I was able to identify it as Melonworm *Diaphania hylinata*. After much research I located a native plant in Belize called the Mammey Apple tree *Mammea americana* (related to the magosteen) which is toxic to Melonworm. I found a few ways to treat Melonworm with a water fruit mixture, or a water ground seed mixture. The pest analysis I produced for Melonworm was sent to Belize in September. Just before the Belize team left in December I received word that the Mammey fruit was working and took care of the Melonworm problem. This greatly supports my project objectives and has had great impact on the communities in which this insect was most prominent.

Non-chemical solutions for cutworm were found many of which included grassy weed control, and the promotion of Egrets and Ibis, local bird communities that can consume the majority of the cutworm population. Avian control will be especially effective since the population is rather large within the surface soil of the cabbage crop. It was found that Mammey Apple fruit is toxic to the Banded Cucumber Beetle and can be used to control its population in the crop area. Broad mites are very intolerant to hot water (ranging in the high 90s degrees F) so plants could be sprayed with a hot

water mixture. All species of insect identified could be reduced by grassy weed control in and around the crop location.

The Muffles Junior College initiative started in August when I along with Professor Mary Ann Studer and Professor Robin Kratzer met with Dean Leiva. He discussed his concern for the environmental science major and how the students in this major need to gain more experience with field techniques. This drove me to create an instructional video of three major field exercises that the professors at Muffles Junior College could then use in their classes. These exercises would teach the basic techniques that a forester or other environmental professional would use on a daily basis. This video was accompanied by the equipment needed to conduct the exercises and also a field ecology lab manual the professors could use in more of their labs.

CONCLUSION

Working with the farmers on the periphery of the Rio Bravo had a significant impact in both enhancement of productivity and enhancement of ecosystem functions. By identifying the insects and finding non-chemical management solutions this not only helps reduce input costs for the farmer it also reduced harmful chemicals that run off into waterways and improves the quality of the environment. I think that this project should be continued and to be extended to all species of insect instead of just lepidopteron. This is due to the fact that some of the insects found and considered as pests were not lepidopteron but coleopteron (beetle) pests.

Working with partners in Belize is the most beneficial experience I have ever had. Working with individuals to better their productivity, ecosystem, or general well-being is what really drives me to go above and beyond my research project. Seeing an impact first hand such as my work with the Mammey Apple fruit is the most incredible experience I could ever have. It really showed me that the mission of Harold and Helen McMaster is not impossible and it is very real. One person can make a difference and impact humanity.

I think something that interested me was the process of Mr. Redecop getting the Mammey fruit. It literally took him a whole day to collect the fruit and another to process the seeds in order to use them as a botanical pesticide. I was surprised to see he was willing to do this and to spend more time to process the seeds than to buy a chemical pesticide. This showed me that people are really willing to work with low cost natural treatments. This caused me to think that maybe we can actually change their view on the environment and show them how important and vital it can be, especially the importance of the diversity of animals and plants. A continuation of sharing

knowledge about the environment to the farmers on the periphery of the Rio Bravo could bring a better future in preserving the ecosystems of Belize because with knowledge comes a great appreciation with the importance of why to conserve it.

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WATER TESTING IN BELIZE: SUPPORTING THE INTERDEPENDENCE OF WATER AND LIFE

Austin Kleman, McMaster Scholar

The brilliant innovator Jacques Cousteau once said, "We forget that the water cycle and life cycle are one" (Water Quotes, Etc. - Pausing to Think). Without water, no life could exist. While Earth has an abundance of water supporting all kinds of life, from bacteria to plants and animals, as humans we tend to be only concerned about water when it affects other humans. Most people feel that all humans should have access to water, but access alone is not enough. According to the United Nations Economic and Social Council, "the human right to water entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses" (United Nations, 2002)." In short, all humans should have access to clean water. Even so, over a billion people worldwide lack this access.

My goal in Belize was to conduct full range water quality analysis of the New River in order to establish baseline information for my partner, Programme for Belize director Edilberto Romero, who had requested the information in December 2007. Baseline information allows for easy detection of any deterioration in water quality, thereby helping to determine whether or not the water available to the rural Belizeans is safe to drink and use. Testing had previously been done on the New River, but my project aimed to test for ammonia, chlorine, nitrates, dissolved oxygen, phosphorous, and phosphates further downstream. In addition to carrying out testing of the New River, I executed a similar analysis of wells and cisterns as year two of a monitoring system of drinking water in Belize. This monitoring of wells and cisterns through various indigenous villages along the periphery of the Rio Bravo Conservation and Management Area allows for the detection of harmful chemical levels that could have a substantial impact on the health of these communities.

To better understand the importance of my work in Belize, it is important to first have an understanding of the harmful effects and potential sources of nitrate, chlorine, ammonia, dissolved oxygen, and phosphates.

LITERATURE REVIEW

Nitrate is a contaminant that can cause environmental pollution problems and potentially serious health risks to humans, especially infants. Potential environmental effects, which may indirectly affect humans, include "eutrophication of surface and groundwater, algal bloom and oxygenation

which can cause fish starvation" (Haruvy, 1997). Eutrophication is the process where bodies of water receive excess nutrients that stimulate excess plant growth, which can cause the death of some organisms (USGS, 2008). To adults, nitrate is relatively safe and is filtered from the blood rather quickly by the kidneys; however, when "nitrate concentrations become greater than 10 mg/dm³, nitrate can become fatal to infants under six months of age" (Bohdziewicz, 1999). When infants drink water with nitrate above the maximum concentration level, they can develop a blood disorder called methemoglobinemia which causes shortness of breath and blueness of skin (Control, 2003). This condition is commonly known as "blue-baby syndrome" and can lead to serious illness or death (Bohdziewicz, 1999). Long term effects of excess nitrate in adults can lead to "increased urination and bleeding of the spleen" (Control, 2003). The main source of contamination of nitrate in water is due to runoff from fertilizer use by excess rain or irrigation. Farmers use chemical fertilizers to increase the fertility of their soil and productivity of their crop (Haruvy, 1997). Of the entire nitrate "applied at the time of planting, only 50-70% is actually taken up by the crop" (Haruvy, 1997). This means that farmers use between 30-50% more nitrate for their plants than the plants can actually use. Nitrate not used by the plants simply wallows in the soil, waiting to be carried into groundwater by heavy rains or irrigation waters. Other potential sources of nitrate in water include leaching from septic tanks and the erosion of natural deposits (Agency, 2008).

Chlorine, like nitrate, can be dangerous to the environment and humans. "In high concentrations chlorine is toxic to fish, and even in lower concentrations it causes gill damage and consequent stress" (Wittig, 2008). If the fish are harmed from the presence of chlorine, then people who use the fish for their livelihood will also be affected. Chlorine also has more direct effects on humans. "The National Cancer institute estimates cancer risks for people who consume chlorinated water to be up to 93% higher than for people who do not" (Aguasana, 2002). While most people attempt to reduce their risk of cancer by avoiding risky things, drinking water is not typically considered a risk. While these statements are not facts, most experts agree that there are significant risks associated with drinking chlorinated water (Aguasana, 2002). The main source of chlorine in water comes from humans directly adding it into public water supplies; however, in Belize, this is not the case. Recent evidence has shown that the burning of biomass can add chlorine to the atmosphere and potentially to water sources by releasing the chlorine as chloroform (Laternus, 2002). Given the prevalence of burning biomass in Belize, this could be a large source of chlorine in the water.

Ammonia, a contaminant in its own right, can also be linked with nitrate and chlorine because it can be broken down into these components, causing additional problems. The main danger of ammonia to the environment is that, at high enough levels, it becomes toxic to fish. If the ammonia levels are elevated, the fish will experience "alterations of the central nervous system function, energy metabolism, and ionic balance as well as morphological changes such as fusion of the gill lamellae" (Wick, 2002). To fish, high levels of ammonia can be deadly. Ammonia is dangerous to humans because it affects the fish population and can also be broken down into the more hazardous chlorine and nitrate products. Potential sources of ammonia in water sources include fertilizer, storm water, sewage, animal feedlot runoff, and certain industrial wastewaters (River, Water Quality), making it very hard to determine the exact cause of ammonia in a specific water source.

In contrast to ammonia, nitrate, and chlorine, dissolved oxygen is a very important component in the water and is necessary for the survival of aquatic life. In the tests for ammonia, nitrate, and chlorine, the hope is that the levels of the contaminants are low. With the test for dissolved oxygen, the hope is for high rather than low levels. "Water with a low concentration of dissolved oxygen is called hypoxic" (USGS, 2008). The concern is that the levels of dissolved oxygen will be too low for fish to survive comfortably. Such low levels can be attributed to nitrifying bacteria using the dissolved oxygen to break down ammonia into the more toxic nitrate (River, Water Quality). Other microorganisms also use the dissolved oxygen to break down organic compounds into inorganic ones in two main ways: "atmospheric diffusion through the water surface and to a certain extent its production by photosynthesis" (Misra, 2006).

While phosphate contaminant levels do not pose a specific danger to humans like nitrate, chlorine, ammonia, and dissolved oxygen, phosphates can be dangerous to the environment by being "a key element causing eutrophication, which leads to abundant development of aquatic plants, and growth of algae, with some kinds of them being toxic" (Karageorgiou, 2007). This reduces the amount of dissolved oxygen in the water, which can lead to the death of some organisms (USGS, 2008). Most times, eutrophication occurs naturally, but excess phosphate levels speed up this natural process. While phosphates have little direct affect on humans, excess phosphates can be very harmful to the environment. Because of their widespread use in many industries, phosphates have many potential sources, being found in "many industrial applications, with fertilizers being the most important" (Karageorgiou, 2007), in addition to other applications including "detergents, water softening, food and drinks, and metallurgy" (Karageorgiou, 2007). Therefore, it is important to control phosphate levels to prevent

eutrophication and to protect the environment.

Having established some of the harmful effects and the potential sources of nitrate, chlorine, ammonia, dissolved oxygen, phosphorous, and phosphates in the water that I will be testing, I can now explain why my project is vital to the citizens of Belize. With all the harmful effects these pollutants have the potential to cause, it is very important to make sure there are not dangerous levels of these contaminants in the water supplies. Also, by determining the potential sources of these contaminants, Belizeans can reduce their use of fertilizer to help control the levels of the contaminants if the levels prove to be high. High levels can cause large environmental problems and, even more serious, health problems in humans. The citizens of Belize could be drinking water or using water that could lead to health problems, including death, without realizing it. Belizeans cannot take clean water for granted.

My baseline water quality analysis marks the fifth year that the Defiance College McMaster Program has completed such testing in Belize, and continued water quality testing is critical to preserve the health of Belizeans that make use of the New River Lagoon, Belize's largest body of freshwater. Rural Belizeans use the New River Lagoon, in addition to drinking, for fishing, and since many contaminants also affect fish, it is important to make sure the fish as well as the citizens are safe. Aquatic life has a major impact on the citizens of Belize as a source of food and income; therefore, water quality testing not only ensures the safety of fish, but also the safety of Belizeans.

METHODOLOGY

I conducted a full range water quality analysis of the New River Lagoon and wells and cisterns in various communities on the periphery of the Rio Bravo Conservation Area. The first step in conducting my water quality analysis was to collect the water sample. Ivan Gillett, our guide in Belize, helped to direct me to bodies of water that would be beneficial to test in addition to sites previously tested on past McMaster Belize initiatives. Upon arriving at a site, I collected a sample of the water in a 250 milliliter round sampling bottle. On a label that I affixed to the bottle, I wrote the location of the sample, the type of water being collected (rainwater or groundwater), and the longitude and latitude coordinates of the site as measured by a GPS unit. Since none of my samples needed immediate testing, all of my tests could be performed when we arrived back at Hillbank Research Station.

The nitrate, chlorine, ammonia, and phosphate contaminant tests were all based on color wheel colorimetric principles. A color wheel comparator

uses a color wheel specific for each contaminant to compare the color of a sample of tested water with the color of an untested sample from the same source. Based on the color of the sample compared to the untreated sample, a value can be given for the amount of that contaminant in the water sample (given in mg/L). All of the contaminants use a specific chemical reaction which allows the color change to occur in the treated sample. Nitrate uses a cadmium reduction reaction to cause a color change; chlorine uses a reaction involving DPD (N,N Diethyl-1,4 Phenylenediamine Sulfate); ammonia uses salicylate to cause the necessary color change; and the amount of phosphate correlates with an ascorbic acid reaction (Company, Surface Water Test Kit, 1993).

While the nitrate, chlorine, ammonia, and phosphate tests were based on color wheel colorimetric principles, the dissolved oxygen was based on a different concept, acid drop titration. This acid drop titration for dissolved oxygen was based on a slightly modified Winkler Method (Company, Surface Water Test Kit, 1993). The number of drops of acid that were added to the treated sample was equal to the results of the test in milligrams/liter of dissolved oxygen (Company, Dissolved Oxygen Test, 2006).

DISCUSSION

Overall, thirty-one water sites were tested and analyzed. The contaminants that are potentially harmful to humans are nitrate, chlorine, and ammonia. Tests for nitrate contaminants varied widely, from 0 milligrams/liter at many different sites to as high as 9 milligrams/liter from the groundwater at Mr. Redecop's farm. However, all of the samples were below the 10 milligram/liter maximum nitrate contaminant level as established by the United States Environmental Protection Agency (Survey, 2006). Since there had been a recent flood in Belize due to Tropical Storm Arthur before we arrived, the elevated levels of nitrate, as compared to the other samples, from Mr. Redecop's groundwater (9 mg/L) may be attributed to run-off from the fertilizer that he uses on his farm. Nitrate was also higher at Mr. Hernandez's house (5.5 mg/L) in San Carlos. Next to his house was a small garden, which he may fertilize, and this would explain the higher, yet not dangerous, levels of nitrate. The chlorine tests, both free chlorine and total chlorine tests were much more uniform. Values for the amount of chlorine in the water samples ranged from 0 to .3 milligrams/liter. These values are nowhere near the 4 parts per million, which translates to 4 milligrams per liter, that is considered dangerous (Services, 2008). The ammonia test resembled the nitrate test, in that many values were low with only a few outliers. At the St. Paul Community Well, a reading of .7 milligrams/liter was determined and at Inner Irish Creek the level of ammonia was .5



milligrams/liter. All the other sites had ammonia values between 0 and .4 milligrams/liter. Ammonia levels are not considered to be dangerous to humans, even in long-term duration, until they reach 25 parts per million or milligrams/liter (1:1 ratio) (Institute). The elevated ammonia levels, at least at the St. Paul Community Well, may be due to manure from the nearby field where cows were observed grazing.

Besides testing for nitrates, chlorine, and ammonia, which can be dangerous to humans, I also tested for dissolved oxygen and phosphate, since low levels of dissolved oxygen or high levels of phosphates can be damaging to the environment. Fish require dissolved oxygen in the water for survival, and warm water fish, such as bass, carp, and catfish like those in Belize require a dissolved oxygen level of at least 4.0-5.0 milligrams/liter to avoid becoming stressed (Matter). If the dissolved oxygen levels drop to 1.0-2.0 milligrams/liter, large amounts of fish will die (Matter). All of the water samples that I tested for dissolved oxygen were at or above the safe level of 5.0 milligrams/liter. The low levels of phosphate that I observed in Belize could have been due in large part to the recent flooding. While high levels of phosphate have been reported in years past, I only had one water sample, at Mr. Hernandez's House, that even registered above 0 milligrams/liter on the orthophosphate test. This test was still at a very low level of 5 milligrams/liter. This is not enough to cause a significant impact on the environment.

All of the water quality analysis that I performed will be placed into a baseline water quality guide, which will be sent back to Belize. This information contributes to the baseline water quality analysis performed in previous years that is critical to the citizens of Belize and will be used to assure that the current water supplies are safe. Also, this guide can be used in the future to detect abnormal contaminant levels in the water.

CONCLUSION

After testing thirty-one water sites for nitrate, chlorine, ammonia, dissolved oxygen, and phosphate, I conclude that the water of Belize is safe for use and consumption by humans and is safe for the environment in relation to these contaminants. Every water site that I tested contained levels of nitrate, chlorine, and ammonia that were safe to humans. No value of nitrate, chlorine, or ammonia exceeded the maximum contaminant level. All of the water sites also contained levels of dissolved oxygen that were high enough to maintain the survival of fish and low enough levels of phosphate to make sure the environment is not harmed.

REFLECTION

The conclusions that can be drawn from my project help to epitomize the goals of the McMaster School. By performing baseline water quality analysis, I helped to advance humanity because the citizens of Belize can now be reassured that the water sites that I tested are safe to drink. In addition to the rewarding experience of working to assess water quality, just traveling to Belize has given me a unique perspective on the human condition worldwide, and I am grateful to have been given the opportunity to learn about others worldwide through this program. As a person, I have learned a lot about myself and others through this experience, having moved from simply being thankful for what I have to recognizing in the Belizeans I met a happiness and contentedness without an overabundance of material possessions. As a professional, I learned how to perform real world laboratory experiments that are beneficial to both humans and the environment. Learning in the classroom is one thing, but being able to go out and do real world applications that advance humanity and truly make a difference is another thing all together.

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CPR, HEIMLICH, AND WATER SAFETY IN RURAL BELIZE

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My project consisted of demonstrating the techniques of CPR, Heimlich, and water-safety to residents of the village of San Carlos in rural Belize. The project required fundraising \$1100 for the purchase of first-aid and water safety equipment which was placed at the Hillbank Research Station and in the village of San Carlos. The community had expressed concern about children dying on the lagoon and this project was directly aimed at doing just that! A risk assessment was constructed to determine which threats were most likely to occur and which of those were most able to be remediated with on site emergency response. I incorporated into my project teaching a tutorial on how to perform CPR, Heimlich and water-safety techniques. My project was aimed at saving lives by providing Belizeans with the knowledge to help each other in the event of an emergency.

LITERATURE REVIEW

Emergencies happen at all times of the day around the world and the effectiveness of the treatment and survival of the individual is dependent upon the preparedness and training of the first-responders. Knowledge of life-saving skills could mean the life or death of a loved one. Knowledge of CPR and first-aid are among the most useful tools that an individual can possess. With accidental injuries being the number one reason of child fatalities (CPR Facts and Statistics), knowledge of life-saving skills is especially important when working around children. Along with knowledge of skills, injury prevention and safety follows closely behind in saving the lives of human beings.

“Unintentional accidents continue to be the fifth leading cause of death overall, exceeded only by heart disease, cancer, stroke, and chronic obstructive pulmonary disease” in the United States (Unintentional Injury Statistics). Accidental injuries include, but are not limited to, road traffic accidents, drowning, fires and burns, falls, and poisonings. Although accidental injuries are among the top five reasons for death, they are preventable and predictable (Howe, Huttly, & Abramsky, 2006, p. 1557). Education about dangers in the household can prevent predictable deaths. Death is often the outcome of unintentional accidents. However, according to Howe et al. it is just the “tip of the iceberg, for every child who dies many more will suffer non-fatal injuries; a proportion of these will be left with varying degrees of disability” (Howe, Huttly, & Abramsky, 2006, p. 1557).

Lower income, rural families are 98% more likely to be affected by unintentional injuries than any other social status (Howe, Huttly, & Abramsky, 2006, p. 1558). Lower income families are more susceptible to being exposed to an environment which is hazardous to children. Such hazards include roads which do not have adequate walking space for individuals on the side, unsafe living conditions, and lack of medical facilities. Lower income families “have worse access to care, which means they have less opportunity to receive treatment to control risk factors for chronic disease and to manage established chronic diseases and injuries” (Perel, Casas, Ortiz, & Miranda, 2006, p. 1449). Delayed treatment of injuries can cause infection which can lead to amputation or possibly even death.

Motor vehicle accidents are the number one reason for unintentional deaths around the world and could easily be prevented if there was an increase in distance between pedestrians and moving vehicles. In Belize the roads are surrounded by tall brush on both sides. Walking on roads, especially at night is extremely dangerous. Poorly maintained roads, excessive speeding, and drunk driving also pose hazards to developing countries. “Injuries from road traffic accidents already cost developing countries \$US 65 billion a year-more than the annual amount of development assistance they receive” (Child Injuries are Preventable).

The environment in rural communities has more “hazards of agricultural machinery, chemicals, and exposed bodies of water” which all lead to possible accidents. Agriculture is a major form of income to families that we worked with in Belize. They are routinely exposed to chemical fertilizers and do not wear protective equipment when exposed to the fertilizers. This poses many health issues including respiratory and skin diseases. Agricultural machinery, even if this machinery is not mechanical, can easily turn into a human killing device if the operator is not focused or paying attention to his/her surroundings. Household and farm chemicals that are left out in unsecure locations become potential poisons to the children who have access to them.

Exposed bodies of water can become a death trap if there is no supervision or the proper lifesaving devices are not used or present. From my observation, the children of San Carlos are often unsupervised while playing around and swimming in the New River Lagoon. Unintentional injuries include those due to drowning; every year, over 800,000 people around the world die from drowning accidents (Drowning Facts and Figures). Even with the availability of swimming lessons and water safety instruction these accidents still happen at an alarming rate. Yet in the rural areas in the northern regions of Belize there is not access to either form of remediation.

Drowning accidents can happen to even the most experienced swimmer. One might get a cramp or be carried underwater by a current and panic. Although everyone is a potential victim of drowning, the majority of accidents happen to children under five years old, adults 20 to 25 years old, and adults over 60 years old (Drowning Facts and Figures). Over half of all drowning victims are within two meters from safety (Simple Rescue Skills Save Lives, 2008), which emphasizes that having proper lifesaving devices near bodies of water is a critical step in saving lives. Drowning also does not only occur in open bodies of water, they may also happen in a bathtub or shallow bucket of water (Drowning Facts and Figures); therefore, proper safety precautions, especially with children, must be taken when around water. In addition, boating accidents continue to cause numerous amounts of accident due to occupants not wearing lifejackets or personal floatation devices (Simple Rescue Skills Save Lives, 2008).

SAFETY IN BELIZE

Belize is located in Central America surrounded on the east side by the Caribbean Sea, to the west by Guatemala, and to the North by Mexico (Geography of Belize, 2005). The country has 22,806 square kilometers of land and 106 square kilometers of water (Geography of Belize, 2005). The tropical climate provides Belize with high temperatures and extreme humidity. The humidity provides a nice growing season for crops which makes agriculture one of the highest forms of income for the country. In a July 2005 estimation, the population of Belize was just below 300,000; 40.1% of the population ranged from ages 0-14 years, 56.4% ranged from ages 15-64, and 65 years and older made up the remaining 3.5% of the population (Geography of Belize, 2005).

The death rate among the Belizean population is greater for males than for females. It is generally assumed that males participate in riskier activity and work in conditions that pose a higher risk for injury. According to the Belize Health Situation Analysis and Trends summary "it is estimated that over 30% of deaths are not registered" (Belize Health Situation Analysis and Trends Summary), which could significantly raise statistics. The number one cause of death was due to circulatory system issues and the second major cause of death was due to external causes which include traffic accidents, poisoning and drowning (Belize Health Situation Analysis and Trends Summary).

Children are the innocent victims of poverty in Belize. The mean income of families in Belize was \$835 per month which totals \$10,020 a year (Young, 2003, p. 13). Families support themselves by commercial, agriculture, tourism, and domestic work (Young, 2003, p. 48); "child labourers are found

throughout the country with higher concentrations in rural agricultural communities and some urban centres" (Young, 2003, p. 48). The rural areas of Belize have the highest rate of child labor and are the areas in which poverty occurs most often (Young, 2003, p. 22). Children, as well as adults, work in harmful conditions in which they are often exposed to harsh chemicals and sharp objects used for their trade. The equipment used in agricultural work can pose many health hazards, as well. Chemicals that are used improperly can cause internal organ damage, and the machetes used daily in the jungle can cause physical damage to the body. With hospitals few and far between, first-aid and CPR would become a lifesaving skills that would be invaluable to Belizeans. In fact, the people in the village of San Carlos are over three hours away from medical care.

The combination of extreme heat and high humidity in Belize increases the likelihood of water accidents. The Belize Channel 5 News indicates up 179 drowning (others may not have been reported). For a population of approximately 280,000 people, this is a significant number of people drowning. Most of the stories involve children who were unsupervised and had fallen into wells or wandered out into the sea. The most heart-wrenching stories were about children seeking relief from the heat. Six children die each year from overturning in buckets of water (World Health Day spotlights children, 2003). One has to realize that most of the accidents that happen in the home are due to neglect or negligence on the part of the parents" (Most Infant Accidents are Preventable, 1999). Educating Belizean parents on preventing drowning accidents is one step in the prevention of child and infant drowning. The second step is to educate them on the technique of Cardiac Pulmonary Resuscitation. Teaching Belizeans to act on an accident will better enable them to save the lives of others.

The village San Carlos is located in the northern part of the country on the New River Lagoon. The nearest hospital to San Carlos is in the Orange Walk Town approximately 32 miles away. From my experience on the ground, the drive is exhausting with only a small portion being paved and the other portions being dirt roads that are laden with potholes which increase in size exponentially when it rains. To get to the hospital in Orange Walk, it would take over 3 hours of driving, which is far too long to withhold care from an individual. Although prevention is the key to reducing the amount of accidental injuries, knowledge of the treatment of injuries and life-threatening situations constitute an enormous role in the survival and well-being of individuals. By providing Belizeans in this remote rural area with the basics of CPR and first-aid, as well as water safety equipment, I hoped to empower the people that I trained to save lives.

PROTOCOL

A probability impact grid was created to determine what the immediate needs of the communities were. A probability impact grid contains “ranking values that may be used to qualitatively rank previously identified risks” (Management of Risk: Guidance for Practitioners, 2007). The information that led to the impact grid was collected from McMaster Scholars and Fellows who had previously worked in Belize. The impact grid was very one-sided with most events being very likely to happen and the probability for remediation either high or very high. From the probability impact grid, I proposed the four most likely topics that I would be able to discuss in a short amount of time and make the most impact on the village. The topics I chose were choking, heart attack/CPR, puncture wounds, and burns. Water-safety techniques were also a critical component of my project which was not addressed in the risk assessment model.

To prepare myself for the ground work, I began by updating my CPR certification. I attended a five-hour CPR class that reviewed safety hazards, regulations, CPR for adult, child, and infant, and choking for adult, child, and infant. I reduced the content of this training in order to shorten the training time in Belize and provide only the basic information needed to perform the techniques correctly. Due to the remote location of San Carlos, it was my judgment that CPR and choking for all ages needed to be taught. The water-safety portion of my project was important due to the village being on the New River Lagoon. I referred back to my lifeguard certification skills that were still valid. I reviewed the techniques that would be especially useful for a child to save a victim in a waterfront situation.

Through my fundraising efforts, I was able to purchase equipment that would assist in the training demonstrations and would also be left at San Carlos for future emergency use. I was able to provide the Hillbank Research Station and the village of San Carlos with equipment that is essential for emergency situations (See Appendix A). All of the equipment, except the backboards, was purchased in the United States and brought down to Belize. The backboards would have been too large to carry so they were made at the Hillbank Research Station prior to giving the demonstration. The designs for the backboards were made using the dimensions from a backboard at the Defiance YMCA. The straps, D-rings, and varnish were purchased and sewn together by an outside individual prior to leaving for Belize. In Belize, the boards were purchased and planed in the Mennonite Community. They were then cut to size, sanded, glued, and screwed together before being varnished. The straps were added last after the varnish had completely dried.

DATA/ANALYSIS/ EVALUATION/DISCUSSION

While on the ground I spoke to the children about accident and injuries they had sustained. Most children indicated that they had not had many broken bones or serious injuries. I found this hard to believe since I observed children engaged in potentially dangerous and unsupervised activities while I was in Belize. It is possible that the student did not comprehend what I was saying in English. However, I observed that children were often unsupervised and allowed to go as they pleased. The communities have a societal bond where everyone knows everyone else and they look after one another. This mindset, though, could provide the potential for very



hazardous events. At one location, I saw a little girl peeling an apple with a knife while her parents were talking, paying no attention to her. Several times the knife slipped which could have cut the girl severely. Children were also unsupervised while swimming in the lagoon. Children were diving head first into the lagoon which I discovered from personal experience was covered in sharp rocks on the bottom. Jumping head first could be a potential catastrophe. A child could be paralyzed or drown from a head, neck, or back injury sustained from landing on the bottom of the lagoon.

While talking with a group of women in the village, they expressed the need for this information in the event that an emergency might occur. One mother spoke about how her child had swallowed a marble and was choking. She hit him on the back and the marble came out, but had the marble not come out so easily, she stated she would not have known what to do. She also stated how important it was for the water-safety lesson because parents do not normally watch their kids in the lagoon. The parents and teachers who attended my training expressed appreciation for the new knowledge.

Although the kids were not vocally expressive, their attentiveness as they were practicing on the manikins showed their interest in the lesson. The students were very involved and hovered over the area where the manikins were positioned. They also helped assist their other classmates by clapping to the beat of "Stayin' Alive" when they were waiting their turn to practice CPR.

REFLECTION/CONCLUSION

Through my research and implementation of this project, I am deeply satisfied that I have truly helped the community of San Carlos in Belize. I was able to critically exam the needs San Carlos while I was in Belize and believe that my project meets community needs. I have been able to successfully fulfill two McMaster School goals: to critically examine the root causes of human suffering that impede human progress, and to contribute actively through sponsored scholarship and service to the improvement of the human condition worldwide. The remote location of San Carlos is a major impediment to accessing emergency care. If an emergency would happen, this community would have to travel over three hours to seek medical help. With the common knowledge of water-safety and the basics of CPR and the Heimlich maneuver, the community can react properly to the most common emergencies.

Seeing how interested the teachers and the families in the community were in my project was truly gratifying. With the whole student body and the five mothers who attended the session, over one-third of the village was present at the presentation. I believe that I accomplished two things: first, my project demonstrated the need for information about emergency response procedures in the community of San Carlos, and second, it helped to build trust between the individuals of San Carlos and the Defiance College McMaster School. This project has helped me to understand that what I know and take for granted can be empowering to someone who is less fortunate and does not have access to the information that I do. I know this project has the potential to a huge impact on the whole community because if one person's life is saved, it affects the community as a whole.

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CATALOGUING CONTACTS IN BELIZE

Kyle Shong, McMaster Scholar

The purpose of my project with the 2008-2009 Belize McMaster team was to compile a functioning list of nonprofits, nongovernmental organizations, and individual contacts in Belize, both those that the McMaster team currently counts as partners and those the team would like to work with in the future. The 2007-2008 Belize learning community made several contacts with nonprofit organizations, establishing connections to benefit the people and villages that we work with on the ground. My work continued in that vein, creating a contact list that will assist in leveraging appropriate resources not only to our individual partners but also to many Belizean citizens. Further, the list contains contacts for networking with NPOs and NGOs that have a common vision with the Belize McMaster team in funneling resources to the Belizeans we work with.

LITERATURE REVIEW

Networking is all about building connections and creating enduring, mutually beneficial relationships. Ask any politician, community leader or successful businessman which skill has helped them excel throughout their careers, and networking would be an overwhelming answer. It helps companies and organizations expand contact lists and grow communication outreach, thereby opening doors and encouraging new directions. By networking and establishing high-quality contacts organizations are able to accelerate their goals and developments (Sridhar, 2008).

Effective networking means taking advantage of all opportunities to meet new contacts and communicate goals and interest (Puetz, 2007). When in the company of actual or potential contacts, individuals must be aware of the constant potential for professional networking. Through networking, I developed a contact list containing knowledgeable resources in agriculture, education, environment, art, health and energy. These resources were drawn in part from previous contacts that have then communicated with members of the learning community through general conversation with professional organizations. For future Belize learning communities, further contacts can develop out of conversation while working on the ground.

The rules of networking require that relationships with contacts be maintained, keeping contacts continually informed rather than just using them when needed. Keeping in touch requires periodic contact, such as email updates or telephone conversations. Additionally, helping the contacts in the network by responding to requests in an appropriate and thorough

manner will ensure that the contact will be in partnership for the long run. Above all, it is important that networkers not burn bridges as past contacts may become useful in future situations (Puetz, 2007; Sridhar, 2008). For the Belize initiative to move forward, it is important to maintain good relations and contact with Programme for Belize, our main partner on the ground. This is done via email and phone conversations, and through their review of projects before the team departs, giving our partners a glimpse into pre and post trip work.

Non-profit organizations are defined as publicly supported charities that provide services or benefits to some part of the larger public and that typically receive some financial support from donations (Herman & Renz, 1999). Inside of the world of non-profit organizations are three sectors. The first is the independent sector, which stresses the important role of organizations as a “third force” outside the holdings of government and private business. Contrary to their name, these organizations are often far from independent; on the financial side, they depend greatly on both government and private business (Salamon & Anheier, 1992). The second is the voluntary sector, which works upon the significant input that volunteers make on the management and operation. Even so, in the voluntary sector, the majority of the work is more often done by paid employees than by volunteers. The third is the tax exempt sector which emphasizes the understanding that under the tax laws of many countries, these organizations are exempt. This is not an overall rule throughout the world as each country has its own laws and rules for tax exemption. In Belize, tax exemption is granted to companies or organizations that are consistent with the principles enshrined in the preamble to the Belize Constitution and the Universal Declaration of Human Rights and all those international and regional human rights treaties and instruments to which Belize is a party, and that are designed to contribute to sustainable human development in Belize (Belize Non-Governmental organization ACT, Chapter 315).

Non-Governmental Organization (NGO) is the term given to organizations in the developing world that are engaged in the promotion of economic and social development, usually at the grass roots level (Salamon & Anheier, 1992). The term NGO became common in 1945 because of the need for the UN to set apart its international private organizations and intergovernmental agencies. The UN recognizes all private organizations as NGO's provided they are free from governmental control, non-profit making and non-criminal (Willettts, 2006).

RESEARCH PROTOCOL

Before leaving for Belize, I prepared a worksheet asking the learning community to fill in contacts that they had made or worked with in the past. This preparatory worksheet allowed me a head start on the contact list and provided direction for future contacts, ultimately allowing the work on the ground to be more directed and focused.

On the ground, my project protocol was to listen and gather as much information as possible. Depending on where our group would go, I collected information on community and population needs mostly in conversation with community leaders of August Pine Ridge, such as the mayor, town elders, principals and teachers. Principal Marlin Muscar provided information on the school's current status and future needs. She talked about working with the technology and computers that the school already has in place but has little training working with. This led into direct conversations about a governmental program that provides internet services if a school has five or more computers, and as a result has opened the door for a future technology project and a direct line into this new location. As the conversation with Muscar continued, other projects emerged including a physical education project to help develop playground space, providing the learning community with valuable information on how best to use our contacts in furthering development.



When the Belize project first started, Programme for Belize, our main partner on the ground, was our sole contact. Over time, the partnership between Defiance College and Programme for Belize has developed such a positive reputation in the area that organizations see the potential in working with our teams. By the end of the 2007-2008 trip, so many new contacts had been made that this project was developed to record and catalog all of the information. At the end of this year's initiative our list has grown to 22 contacts and partners in both Belize and the United States.

The end result of my project is a catalog of actual and potential contacts which allows future scholars both to assess how about our current contacts could fit with their projects and to imagine how projects could be developed with new contacts. The catalog also divides organizations into categories – Agriculture, Education, Environment, Art, Energy, Health, and Business. For example, because Programme for Belize's main body of work as an organization deals with conservation and the environment, they have been placed in the "Environment" (EN) category. This system will enable scholars to find contacts that align with their specific projects and to add new contacts to the list in the future.

REFLECTION

Because I was able to work one on one with the people of Belize, learning about the important aspects and needs of their daily lives, I will remember this project for the rest of my life. After working with several schools, disadvantaged by their lack of access to technology, I have an appreciation for the access to abundant information I have at my fingertips and am glad to have been a part of bringing much needed tools and resources Belize. This project has allowed me to take my history major skills of researching and performing oral histories from the classroom into an international level as I have performed interviews on the ground, asking questions and recording information that will continue to be of use to others.

CONCLUSION

The 2008-2009 McMaster trip to Belize was a return trip for me and, as such was a completely different experience. Unlike last year where I was in awe of the scenery and new location, this year I was able to experience a new Belize and see it in a different light. Last year when we arrived to San Carlos, one of the villages that we work in, I only walked off the boat and directly to the school in which we worked. This year I had the opportunity to work in the community and meet the majority of the people living there, and because of this I saw the faces of the children in a different way. They were no longer just students; they were kids that had families and a life in the community.

In San Carlos and elsewhere, everything was different this time around. This time I saw Belize for more than its problems and poverty. This time I saw a country that is a community, a country united in working toward progress.

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HELPING EDUCATORS AND PARENTS IDENTIFY DEVELOPMENTAL DELAYS WITH CHILDREN IN BELIZE

Holly Stein, McMaster Scholar

My project was to provide information to help teachers and parents identify developmental delays within children. I also taught a lesson on healthy eating. The Ministry of Belize has begun to focus on early intervention and has opened twenty-four new preschools. These preschools are located in cities or the surrounding areas. The rural areas, like the communities of San Carlos and St. Paul's Bank are in need of some guidance in early intervention as well as being able to identify developmental delays within these children. The project will impact the students, teachers, parents, and community members of the San Carlos and St. Paul's Bank by providing them information about developmental delays that could alter early stages of learning. My defined outcome was to come back to the United States with an assessment that shows what resources are provided for intervention and also provide the people of San Carlos and St. Paul's Bank with knowledge of routine child care and education of child development. My end product was to provide information which will be distributed to them through brochures that distinguish the stages of development.

LITERATURE REVIEW

The first three years of a child's life are critical to the future of the child's health, growth, and development (World Health Organization, 2006). Studies have shown that while the fetus is still in the womb they begin to develop not only physically but also cognitively. According to the studies, fetuses are capable of responding, processing, and interpreting stimuli in many ways (County, 2008). Fetuses have the ability to recognize sound and they can actually learn and remember exactly what they heard. According to Piaget, a developmental psychologist, cognitive development is defined as the "mental process such as perceiving, remembering, believing, and reasoning." (Singer & Revenson, 1997) Piaget recognized that both experience and culture influences the age at which a child will reach a certain level.

Child development is the process that outlines how a child learns to do more complex things as they develop in age, such as learning to sit, walk, talk, skip, and even tie shoes (County, 2008). There is a difference between child development and child growth. Child growth refers to the size of the child based on height and weight. Child development is divided into five skill and

developmental categories. These categories are fine motor skills, gross motor skills, cognitive development, speech and language, social and emotional development. Fine motor skills develop as children use their small muscles, like their hands and fingers to pick up toys, turn the pages of a book, and to eat. A gross motor skill is when the child begins to use large muscle to perform skills like sitting, standing, walking, and keeping their balance. The child's ability to solve and learn problems is cognitive development. This range of cognitive development of the early stages when the child attempts to go out and explore things with his hands and eyes to later years when the child learns to solve simple math problems. Speech and language development is the capability to communicate and understand what other people are saying through language or body gestures. Social and emotional development is when the child can learn to interact with others. This could occur when helping others by taking turns in a game or simply by waving good bye or smiling (County, 2008). While working with mothers in Belize, I began my project by assessing their awareness of the developmental stages of their children at different ages. Many mothers were aware of the importance of making sure their child is developing properly, but they lacked the resources to ensure it.

The skills and development categories are assessed at developmental milestones. Developmental milestones are the set of skills and developments that a child is supposed to accomplish within a set time frame. This is how pediatricians and other professionals check to see if the child is developing on time. When the child doesn't accomplish the milestone in the time required it is a warning sign that the child might have a developmental delay. Each child is different and will meet the developmental milestones at different times. This could occur later or earlier than his or her peers. However, remember, each child is unique and the milestones develop in a pattern and certain skills need to develop before you can develop new ones (UMSS, 2008). For instance, a child can't walk until they first develop how to sit and crawl. Within the first year of a child's life, milestones are set at one, three, six, and twelve months. After year one the milestones are grouped in six month intervals.

These developmental milestones correlate with Piaget's four stages of development. Within each of the four stages of Piaget's development plan there are changes in the areas of play, language, morality, space, time, and number. He identified the sensory motor stage from the child's birth to two year of age. The repetition of these acts is the beginning to intellectual development (Singer & Revenson, 1997). Activities that the babies engage in are rediscoveries in which they can further process what is going on. The baby begins to explore on its own and play with toys that deal with shapes.

The baby will try to fit the shapes together and pull things apart. The baby performs trial and error until the objects fit. When children play and explore things on their own it helps them to develop socially, emotionally, physically, and intellectually (Singer & Revenson, 1997). When children play it helps build their knowledge, experience, curiosity, and confidence. Play develops the child's skills of language, thinking, planning, organizing and decision-making.

Piaget's preoperational stage occurs from ages two through seven. In this stage the child is not yet able to think logically but is able to represent the world through images and symbols. The preoperational stage is broken up into preconception (ages two to four years) and perceptual thought period (ages four to seven years). My focus is on the preconception stage where the child begins to use language and mental images, and attempts to generalize in illogical ways (Singer & Revenson, 1997).

Before I can discuss further the role of the milestones and developmental stages it is important to define developmental delays. "Developmental delay is when the child does not reach their developmental milestones within the expected time" (UMHS, 2008). A developmental delay is more than just a brief occurrence in a child's life when he/she temporarily fall behind in skills and development. Developmental delays are ongoing and may occur in one or more categories. This means that because the developmental categories connect with each other, difficulty in one area will more than likely affect development in other areas. Developmental delays occur at any age, but in my project I am focusing on the developmental delays that occur from (or between) birth to five years of age. When the child reaches the age of five, the parents should consider placing their child in preschool in order to ensure that the child is and stays at the appropriate level of development.

Two categories which can affect developmental delays are genetic and environmental (County, 2008). Genetic based delays require complex medical expertise. My focus will be on the environmental category since basic intervention by parents can be implemented to remediate these delays. Environmental risk factors can develop from experiences in their surroundings like home, school, and interacting with others.

Environmental factors which can have an effect on developmental delays are things such as nutrition, water quality, and home care. "For example, malnourished children who live in third world countries may not reach their IQ potential because of the impact on their environment on their brain development" (County, 2008). Breastfeeding for the first few years of life protects the children from infections and it also provides a source of nutrients

while being economical and safe. Breastfeeding during the first six months of life is recommended; however, only approximately ten percent of the children in Belize are breastfed, which is much lower than the recommended percent (SIB, 2007). This means that over ninety percent have switched to infant formula, which can contribute to growth faltering and micronutrient malnutrition and is unsafe due to the unclean water (WHO, 2006).

The home care is also a major determinant of the child's development during the first three years of a baby's life. Parents' or caregivers' involvement with the children in activities such as reading or looking at picture books, telling stories, singing songs, taking children outside the home, playing with children and spending time with children naming, counting, or drawing things is important to the cognitive development of the child (SIB, 2007). In Belize, over eighty-five percent of children under eight have parents or caregivers that have engaged in activities that promote learning and school readiness (WHO, 2006). In Orange Walk there was eighty-one percent that have engaged in such activities and seven percent have no toys at all but could be substituted with environmental stimuli (SIB, 2007).

"The first three years of a child's life are an amazing time of development and what happens during those years stays with a child for a lifetime. That's why it's so important to watch for signs of delays in development, and to get help if you suspect problems. The sooner a delayed child gets early intervention, the better their progress will be" (UMHS, 2008). If a parent suspects that their child may have a developmental delay, the best course of action is to seek medical attention. However, people in the rural villages of Belize may be at a disadvantage because they lack the access to routine child care. Due to the differences in developmental delays in our country and Belize, the delays in the children could be more serious in Belize due to lack of medical assistance. The sooner a child is diagnosed and appropriate treatment is started the better the progress the child can make.

Another avenue in which parents may seek assistance for their child if they suspect a delay is the school system. Piaget is particularly concerned with the education of preschoolers. He feels that teachers can help the child through sensory motor skills and help them through step by step preparation for logical operations and language development. Preschool or earlier education is one of the main components for the development of a child's social, intellectual, and emotional growth. As stated by Piaget a child learns through two methods: physical knowledge and logical knowledge. Piaget stresses that the children will only perform these tasks when they are ready. This applies to the stages of development as well (Singer & Revenson, 1997). Performing an assessment at a young age will allow teachers and parents to



help their children with the area of weakness to help improve their child's ability to learn.

"We face challenges as a nation in the area of child development" was a statement made by the Ministry of Education in Belize (2006). The Ministry of Education has begun to focus on early intervention and has opened twenty-four new preschools. These preschools are located in cities or just outside the city. Although the Ministry of Education of Belize has identified this as a major concern, teachers in the rural villages are at a disadvantage as they have not received the necessary training. The rural areas, like the communities of San Carlos Government School and St. Paul's Bank are in need of some guidance in early intervention as well as being able to identify developmental delays within these children.

It is important for parents to be aware of some of the warning signs involved with developmental stages in a child's life. By watching children and how they respond to touch, sound, and sight, parents can identify signs of possible developmental problems. Therefore I am preparing a brochure that will be sent back that will explain some of the important development milestone.

Mr. Lopez, the principal at San Carlos Government School has asked Defiance College to teach a lesson on healthy eating. Infant and child nutrition are the cornerstones for childhood development and play factor for the health and development of young children. Better nutrition means stronger immune systems, less illness, and better health (Evers, 2006). Healthier children are stronger, capable of learning more information; more productive and more able to create opportunities that are hard to do when they are underfed. Hungry children often fail to reach their full potential (WHO, 2006). "School-age children who ate breakfast did better on performance tests than children with no breakfast" (Mississippi, 2001). Children who eat school meals will get the nutrients tend to perform better in schools. Children in the rural village schools of Belize are not provided school meals including lunch. It is important to stress that a nutritious diet fuels the body for learning, growing, and having energy to play. A child who is hungry or poorly nourished is not ready to learn. Malnutrition is a result of more than half the deaths in children worldwide (Evers, 2006). Three quarters of the children that die only have a mild case of malnourishment and show no outward signs. Malnutrition weakens the immune system and increases the risk of ill health which leads to other problems such as developmental delays that can cause a stunt in growth. In Belize six percent of children under-five are underweight and eighteen percent are stunted or are too short for their age (SIB, 2007).

In Belize there are high cases of anemia and vitamin A deficiency. Eighteen percent of children have an iron deficiency and twenty-four struggle with the lack of vitamin A (SIB, 2007). Only the people that report the problems are reported, so naturally the percentages could be much higher. Vitamin A is essential for eye health and proper functioning of the immune system (SIB, 2007). It is found in foods like milk, eggs, and fresh fruits. Even though in Belize vitamin A is an available source that is consumed in fruits and vegetables, the daily per capita is usually not enough to meet daily requirements. One out of four preschool children suffers from under-nutrition, which severely can lead to a child's mental and physical development (SIB, 2007).

DISCUSSION/CONCLUSION

While on the ground in Belize I interviewed parents and teachers dealing with nutrition, developmental delays, and access to routine child care which included questions about glasses. For my first component on developmental delay within children from birth to five, I interviewed parents to see if there was a need for information on some of the basic activities that they could perform with their children to prevent development delays from occurring. My second component on teaching a lesson plan to the students of San

Carlos Government School was done on request by Mr. Lopez, principal of the school. I had gathered basic information dealing with school lunch and typical meals from a teacher at San Carlos, Mr. Con and from Mrs. Lopez. The third component to this project was to talk to parents of the villages along with the teachers to see if there is a need for screenings in vision. It is important to know if the children are being properly equipped with resources needed to perform their best in school as well as outside of school. This was just a preliminary assessment to see if the resources are needed and how those resources might be accessed.

While working with the people of Belize I have found out a lot of information directly related to my three main components. While interviewing Mrs. Lopez I learned that there is access to child care checkups. One problem they face is that it isn't very convenient. A bus comes once a month to bring people to Orange Walk for the day. This will help the parents to make sure their children are healthy and don't face any developmental delays. One of the hardest things that Mrs. Lopez talked about was that if the child gets sick and the bus doesn't come for a while many families don't have the resources to take their child to Orange Walk for medical attention. This leads to a problem because if the child is severely sick they have to rely on medicinal plants to help fight the sickness until they can get a ride to Orange Walk. Mrs. Lopez stated that she received information from her mother about how to raise a baby and that she was accompanied by her mother for the first two weeks after the baby was born. She said that information on child care was passed down from generation to generation. Mrs. Lopez suggested that information about some of the common developmental delays would be helpful for young mothers. Mrs. Perez, a mother in the village of San Carlos, said that while her baby was growing up she took her baby to Orange Walk for checkups at one month, six months, and nine months to make sure the baby was developing properly and remained healthy.

Nutrition plays a big role in the health of the children. While talking with a teacher from San Carlos Government School I learned that the students are responsible for eating their own lunch. He also said that most of the students hang around the school during lunch time and many students don't receive the nutrients needed to learn the maximum amount of information daily. Eating a healthy and balanced diet will help maintain and decrease the chances of having vision problems. Mr. Con, teacher at San Carlos Government School, said that none of his students have glasses. He told us that the Red Cross is supposed to come in once a year to check the student's vision and hearing; but they don't always make it their top priority to travel to the rural villages in Belize. He also said that the students in need of glasses have free access through the Red Cross, but they have to go to either

Orange Walk or Belize City to get a checkup with a doctor. Most of these families lack the money and the transportation to provide glasses for their children. Mr. Con said that when he does find a problem or has a student that may struggle with seeing, he will perform a simple eye test. If the student struggles, he will place the student closer to the board to help his ability to copy stuff from the board.

REFLECTION

My project was to recognize some of the developmental delays that are currently a concern in the communities in Belize. I examined the communities and tried to help identify some of the delays and inform people of them. I created brochures that will be distributed throughout the communities of concern. Through materials I am disseminating to the people in the periphery, I am able to be an active citizen in the world community and help those in developing countries hopefully lead a more sustainable life. I hope that the parents, as well as the teachers, will be more aware of the situation at hand.

While being on the ground in Belize I have developed as a person. As a person I have become more aware and understand the lifestyles of different cultures. I have learned to accept the way things go with a more laid back and positive outlook on life. This is a direct reflection of the behavior of the people of Belize that I admire. I have learned that there is not a sense of urgency in my everyday life. As a professional I have developed my skills to perform scholarly work and to put forth a proposal and put it into action. My trip to Belize has opened more opportunities that can come in the future. This opportunity has also help build my resume to become a future teacher.

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IMPROVING LITERARY RATE IN RURAL BELIZE

Megan Sherman, McMaster Scholar

While studying to be a teacher, I have become increasingly aware of the importance of literacy in education. I have found that literacy development starts with children almost immediately upon birth, continues throughout their education, and follows them into adulthood. Without the development of literacy skills, learning can be stifled. My purpose for this project is to focus on creating a link between home and school for the children and families in the rural communities of Belize. Alyssa Shuherk's previous project of creating an informal reading space for the students in San Carlos planted the seeds for my project. By taking to Belize more books, audio equipment, and books on tape that can be used in the library and in the school, I will be directly impacting the families, teachers, and children of San Carlos. As an addition to Alyssa's endeavors in Belize I worked towards creating a more formalized library to allow books to be checked out and taken home. I have established a checkout procedure by using a card system. I intended on completing an assessment of the community as to the interest and the willingness of the teachers to create a public library to be used by all. However, during a meeting with Mr. Lopez, the school's principal and teacher, Mr. Romeli Con and Mr. Jaustino Juchim, the school's other teachers, it was decided that they would like the library to be stocked and running within the school prior to opening it up to the public. They were interested in finding a member of the community at some point to work in the library and be able to check books out to the community. By providing a well stocked library, it will support and strengthen literacy development of the entire San Carlos community.

The checkout system that was to be put into place at the San Carlos Government School was a simple card system. Each book that they currently had in their library, along with the books that I had taken down, received a book pocket adhered to the back cover of each book. A book card was then created that included the title, author, date the book is due and the person who borrowed it. In addition to setting up the library I have also taken extra cards, pockets, colored dots for labeling the types of books, and a file box to aide in organization of the library. The book cards will be filed in the box by the month that it is due back when someone checks the book out. More information could be provided about setting up the system into categories in the future when there is a larger variety and quantity of books.

DATA

There remains a great need for books and for a library that families can use. In research done by Alyssa Shuherk, she states that “the functional literacy rate of Belize is approximately 40%” (The Cornerstone Foundation, 2008). This functional literacy rate is listed for the entire country of Belize and, as Shuherk mentions, is surely lower in the secluded rural areas. These rural areas do not have consistent access to books or consistent use of libraries. One must travel three or more miles to the nearest library, making access to literature very minimal. One must take note that three or more miles does not seem far or unreachable. However, after traveling over the roads in rural Belize, I have discovered that it would be very difficult for the people who live in San Carlos to get more than three miles away and back in a day with the roads in the condition that they are in. That said, I feel that it is more important than ever for the rural communities to have access to a well-stocked library for the children and the members of the community. “Children need a place that will ignite their passion for reading, a stimulating place that will invite them to sit, explore, and return” (Shuherk, 2008). I believe that this also extends to families and to the community as well.

The need for family and community involvement with the education of their children is supported through a variety of research and is also very evident when looking at families that take an active role in their child’s education. The United States Department of Education states, “when parents and families get personally involved in education, their children do better in school and grow up to be more successful in life” (U.S. Department of Education, 1999-2000). While on the ground in Belize I did not witness any parents or community members at the school helping in anyway, however, we were only in attendance during a period of testing for the students. Mr. Con, a teacher at the San Carlos School, stated that he was hoping to somehow find a way to involve the families more within the school and was very hopeful that families would attend a First Aid and CPR workshop that was being held by Casey Burkhart, another McMaster Scholar. In the end, there were several members of the community that did attend the First Aid workshop, which made me hopeful that with the right type of program community members would involve themselves within the San Carlos Government School.

There are three main issues that affect the 40% functional literacy rate as described by The Cornerstone Foundation, a local non-profit organization founded in the town of San Ignacio, district of Cayo, Belize. The first issue is financial problems. “Parents are required to pay for compulsory uniforms, books and supplies, and annual registration fees. These rates increase substantially at the high school level. Often, families do not have the income

to provide all their children with even a primary school education, let alone a more expensive high school education” (The Cornerstone Foundation, 2008). The next issue that the Cornerstone Foundation cites is “women and literacy.” Often when a family cannot afford to send all of their children to school, girls are removed first because they are not typically going to be the “breadwinners” of the family and are considered to be the caregivers of the children. This directly impacts the education of those girls who could have succeeded in school, but now will not have the opportunity to try.

Finally, the last issue that the Cornerstone Foundation addresses is immigration and language barriers. The national language of Belize is English, however, many Belizean families speak “Spanish, Creole or one of several Mayan dialects” (The Cornerstone Foundation, 2008). Another obstacle regarding the language barrier is that Belize is home to many immigrants that come from surrounding Central American countries such as Guatemala, Mexico, and Honduras where English is not the national language” (The Cornerstone Foundation, 2008). By implementing the goals of this project and continuing to build upon them over time vast improvements in education can be made for the people of rural Belize by improving their own literacy rates through the use of the library and audio resources available to them.

DISCUSSION

Mr. Con and Tito, two of the teachers at the San Carlos Government School, both cited language as a substantial barrier in their instruction. Mr. Con stated that the teachers are instructed to teach in English, however, they then have to spend time translating information to Spanish or another language so that the students can understand what is being taught. This is particularly a problem within the lower two levels of the students, the younger students, who only speak Spanish at home and come to school with little or no knowledge of how to speak or write in English.

The Government of Belize also feels that financial problems, the role of women and their education, and the language barriers are obstacles to not only literacy rates but also education as a whole (Ministry of Education, 2006). The Ministry of Education, a group put together by the Belizean Government, also has found that family and community involvement is an important factor in the education of their children. The fifth goal of the Ministry of Education’s Action Plan (2005-2010) cites Parental Involvement as one of the top five goals. One plan in place to accomplish this goal is to train parents of preschool children to assist other parents in order to “increase their knowledge” and “have greater and more effective home support”

(Ministry of Education, 2006). This goal falls only behind creating schools, hiring qualified teachers, providing accessibility to the students and creating assessments for the schools. Without the first four goals there would not be schools for the children to attend; therefore, making a partnership between the schools and families is a very important goal in the Action Plan.

When looking at the goals for teacher training, one of the goals that has been highlighted is that of “research” created by the Ministry of Education. The “research” that is being referred to is that the Ministry of Education would like to “establish an appropriate library/ resource centre” within each school by the next ten years. The Ministry of Education states that the outcome of this goal is that there are “educational materials” available for the teachers to use (Ministry of Education, 2006). Upon reading this goal, I strongly felt that by creating a library with more books and a checkout system the teachers and the students would be able to utilize the library as a resource that they did not have prior to our arrival on the ground.



Another focus of my project was on family and community involvement. While on the ground I spoke with the teachers at San Carlos Government School regarding the involvement of the families within the school. Mr. Con stated that there is very little involvement in the school and he felt that a main reason there was little family involvement was due to the language barrier within the families and the school. Mr. Con also stated that he hopes that as time passes they are able to find a variety of ways in which they can begin to involve the parents of the students within the school environment.

When a family and/or community is involved with the education of their children those children do significantly better in school and often go on to further their education. An article published by the U.S. Department of Education shows that when parents and family members are involved with their children's education, the children get "better grades and test scores, graduate from high school and go on to higher education, and are better behaved and have more positive attitudes" (U.S. Department of Education, 1999-2000). The National Coalition for Parent Involvement in Education (NCPIE) states that "when schools and families work together to support learning, everyone benefits" (National Coalition for Parent Involvement in Education, 2008). The NCPIE cites the following as outcomes when families are involved in student's learning: "students do better in school and in life, parents become empowered, teacher morale improves, schools get better, and communities grow stronger" (National Coalition for Parent Involvement in Education, 2008). For those reasons alone, it is imperative for the rural schools of Belize to implement some kind of plan to encourage families and the community to become more involved in the school.

Currently 33% of Belize's 300,000 people are below the poverty line and another 10% are considered indigent (Young, 2008). By increasing the availability of resources and the connections between school, family and community, education will become an attainable goal among the people in rural areas. By providing more access to books and audio books I will be promoting literacy within the schools and the community. I will also be promoting literacy development by establishing a checkout system in the San Carlos School Library allowing the students and community members to access a variety of reading materials without having to travel to another community. The end product of this project and potentially future projects is to provide the tools and the knowledge to the educators, students, families, and community members to enhance their children's learning and literacy skills.

REFLECTION

Overall, the impact that my project has had on the children and community of San Carlos, I feel, is that I have not only laid the ground work for future literacy initiatives but I have enhanced current literacy goals within the school by providing more books and listening devices that the students can use to further their education. As a future teacher, my goal for all students that I come into contact with, regardless of the location is that they can each develop a passion for learning. One of the main components of this goal is engaging students in meaningful experiences that begin with learning to read and surrounds them with opportunities to achieve.

I have also been affected by this experience as a McMaster Scholar. I feel that I now, more than ever, want to pursue being an educator and want to work towards allowing my students the opportunities to capture a glimpse of what I experienced while in Belize. The students in San Carlos are much like the students that I will encounter daily. They are eager to learn and absorb everything that is taught to them. Upon my arrival back home, I realized what advantages the teachers here have over areas like rural Belize, and how much more we all want. I can remember thinking how great it was that I had a Smartboard in my classroom and how much easier things would be with it. Then I think about the teachers in San Carlos that walk into a school each day and don't even have power. I look up to these teachers that come to school each day hoping to educate these children with minimal supplies and don't complain.

I also am very grateful for this experience because I think that I have improved the human condition in rural Belize through my contributions within the school and the community. I truly believe that I could make a lifetime worth of money and could go down to Belize on my own and even visit the community of San Carlos if I wanted. However, there is no way to put a dollar figure or any amount of money that could buy me the exact experience that I encountered while being on the ground with the McMaster fellows, scholars and the community members of San Carlos. I would never be able to recreate this experience on my own. We spoke to people that would never have spoken to me alone, we were treated with such respect while on the ground that I believe I will never experience that again during any travel in Belize.

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IMPROVING BELIZEAN EDUCATION THROUGH INTERVENTION STRATEGIES

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Schools in Belize often contain two or three grades in the same classroom with classrooms separated sometimes by chalkboards (as in St. Paul's Bank) or by retractable walls (as in San Carlos). This structure, because of children's different developmental stages and the ways in which they develop knowledge, could cause problems for both educators and students. Mr. Romelio Con, a teacher at San Carlos Government School, said that their having to teach the same topic to all students is hard for the teachers (Con, 2008). Because teachers in Belize have a difficult time working with different levels within different grades all in the same classroom, strategies must be taught to encourage all learners to succeed according to their individual abilities.

LITERATURE REVIEW

To better understand where such difficulties come from, it is helpful to first understand Piaget's four stages of cognitive development which are related to age and specific ways of thinking. These stages overlap and children in each stage form their knowledge in different ways (Santrock, 2008). Because children view information and form knowledge differently, teachers need to present the same information in a variety of ways in hopes of reaching all.

Children also exhibit different learning and thinking styles in ways that best fit with their abilities, which is not to say that children only have one learning style because they have a variety. In fact children are so different in the ways that they view information that hundreds of learning styles have been proposed, two of the main sets being impulsive/reflective and deep/surface (Santrock, 2008). Impulsive/reflective learning "involves a student's tendency either to act quickly and impulsively or to take more time to respond and reflect on the accuracy of an answer" (Santrock, 2008). Deep learners view information to help them understand the meaning whereas surface learners look for simply what they need to know (Santrock, 2008). How children learn will impact how they view information because of what parts they see as important. For this reason classroom interventions are critical to ensure that children don't get left behind simply because they don't understand the information in the way that it is being presented.

Intervention, a very broad term, can be interchanged with such words as implementation plan and teaching method (Parkinson & Humphrey,

2008). When a child is not performing at an expected level, intervention is necessary. As has been shown:

effective instruction and intervention serve at least three functions: to increase achievement in the overall population, to prevent academic difficulties in individual students or particular groups of students, and to remediate problems that compromise the learning of particular individuals or groups of individuals (Francis, Rivera, Lesaux, Kieffer, & Rivera, 2006).

When deciding what form of intervention to use, a teacher must keep in mind the purpose of the instruction (Francis, Rivera, Lesaux, Kieffer, & Rivera, 2006). While on the ground in Belize I asked questions to get a better idea of what kinds of intervention, if any, were used and what kinds would work best with the teachers' styles. Based on these conversations, I determined that two forms of intervention would be most useful: scaffolding and modeling.

With scaffolding, the level of support given to the students changes depending on the need. Teachers can adjust their level of instructional support based on the student's understanding of the material. As the student gains a better understanding, the teacher can scale back the amount of instructional assistance. Scaffolding is often done using dialogue as the teacher asks in depth questions that require the student to have a solid understanding of the concept being taught (Santrock, 2008). With this method, the student is responsible for forming his or her own knowledge as opposed to it just being fed to them. Other ways scaffolding can be used is by limiting the number of problems the student is responsible for completing, and then placing the student in a group where all students together pool their knowledge to form a better understanding of the concept (Wright, 2001). Scaffolding is a great strategy for building a student's confidence on a skill that he or she may not be performing at grade level.

In addition to scaffolding, modeling and demonstrating are also effective forms of classroom intervention as "Researchers have found that effective teachers spend more time explaining and demonstrating new materials" (Parkinson & Humphrey, 2008). Once a strategy has been modeled it is important to observe students demonstrating the correct use of the strategy (Wright, 2001). Modeling is an especially effective intervention method for reading instruction as there exists a close relationship between fluency and reading comprehension (Armbruster & Osborn, 2001). When modeling reading, teachers can also explain why they are reading a text in a particular way, therefore modeling not only fluency but also emotion. Visual learners

in particular find modeling helpful because they can see what is being asked of them and make better sense of the information being presented. Intervention, by the very basic fact that it helps students understand information not previously understood, can decrease the drop out rate of students.

In Belize, we worked primarily at the San Carlos Government School in Orange Walk district, though we also spent some time at St. Paul's Bank Roman Catholic School. The possible correlation between repetition and drop out rates is especially important in Belize as examined in "*Investigation into high rates of repetition and drop out in Belize*" by Allyson Harmel-Smith which states, "There is a low level of awareness of the extent and seriousness of the problems of repetition and drop out" (EFA, 2000). The study also found that each school has its own criteria for deciding when students should be held back and that little is changed in the student's experience when she has to repeat a grade (EFA, 2000). These findings were confirmed by Mr. Romelio Con, a teacher at San Carlos Government School who said that if students did not pass the test at the end of the grade and were retained, nothing really changed in the way the information was presented the second time around.

In 1994-1995 from infant 1 to standard 6, 10.9% of the total enrollment of males were repeaters; 8.9% of the total enrollment of females were repeaters (EFA, 2000). This is a problem because "Students who experience retention may face an increased risk of leaving school because they do more poorly in school, or have lower self-esteem as a result of that retention" (Roderick, 1994). The farther along students are in their education, especially if they reach the middle school grades in Belize, the more likely they are to drop out because they are embarrassed about being older than their fellow classmates. The students who don't drop out will show an increased decline in attendance (Roderick, 1994). At St. Paul's Bank we found that currently when students miss school the teachers try to catch them up on missed work whenever there is time. Work is generally not sent to the student's house when they are gone, and in most cases the teacher is from a different village, so visiting the student's home is hard to arrange (Pook, 2008).

We also discussed with Mr. Romelio Con the effects of students being gone for summer break. Both teachers at St. Paul's Bank and San Carlos said they noticed a difference in the students when they returned to school. In fact, they both stated that they spent a lot of time in the beginning of the new school year reviewing previously learned information (Con, 2008) (Pook, 2008). This is a common problem in the United States as well.

I spoke in-depth with the teachers at San Carlos about how they spent their summer months, thinking that some form of summer school would be beneficial to these students, especially those who fail the end of the year test. They said that July was the only month the teachers have free and that most choose to take some classes in the summer (Con, 2008). As opposed to retaining students, the Ministry of Education is instructing the teachers to pass students on regardless of if they pass the test at the end of each grade (Con, 2008). This type of promotion in turn creates an even bigger problem for the teachers because they now have to adapt their teaching to meet student performance levels. Research supports that promotion with intervention provides the most academic benefits to the student, more benefits than retaining the student (Roderick, 1994). For this reason and based on my research in Belize I am sending the teachers back an instructional handbook which will include an assortment of instructional methods teachers can use for a variety of subjects and some examples of the methods. By providing the teachers of Belize with this handbook they will have more methods within their reach to help these students succeed.

Belizean students want to learn, and my end goal is to enable success for all students. While this may sound like a hefty task, it comes down to wanting all students to believe they can succeed. By providing the teachers of Belize with tools and teaching strategies to reach a wider range of learners, I can help make this goal a reality.

PROTOCOL

Establishing strong relationships with the teachers and students at St. Paul's Bank and San Carlos Government School was important for my work on the ground. These relationships enabled me to ask the questions that I needed to complete my research, and because it was very important that my research and work not be perceived as accusing teachers of not doing their jobs, I carefully created lists of questions in advance. Prior to asking specific questions we had to establish a background for the information by asking more broad and basic questions. Questions to teachers centered around the types of intervention used, the test given at the end of each grade, the special education unit, and what teachers felt was the hardest subject to teach and why. To students I asked questions more about their own personal experiences, such as favorite/least favorite subject, favorite part of school was, and most difficult subject.

While on the ground I also designed a respect lesson for the older students at San Carlos at the request of the principal, Mr. Lopez, though there was only one teacher on the day we taught so younger students were also present. This was perfectly fine and the lesson was simply adjusted to better fit the

audience. Another reason for the adjustment was that because it was our first day in the classroom the students really didn't know us yet so they were initially a little shy. During the lesson each student drew something they enjoyed, after which students held their pictures above their heads and looked around the room at all the different drawings. We talked about how important it was to respect each other and treat everyone nicely because we all are so different. Overall my work on the ground consisted mostly of asking questions and gathering answers.

DATA

The information I gathered while on the ground in Belize really helped me better understand their education system. The first school we gathered information at was St. Paul's Bank Roman Catholic School, which consisted of 17 students and 2 teachers (Pook, 2008). A lot of our conversation with Principal Therese Pook centered around testing. She told us that the students are tested in each grade and the tests are created by the teacher over material covered that term (Pook, 2008). At the end of 6th grade, which is equivalent to U.S. 8th grade, the students are given a test to determine if they will pass on to high school. In addition, students are also tested at the end of every year to determine if they will pass on to the next grade. Pook told us that if students are close to passing the test they are moved on and put on probation in that next class (Pook, 2008). The talk about these tests led to a discussion about students with learning disabilities, how they are identified, and whether they receive any assistance.

Principal Pook stated that there is a special education unit in Belize City; however, they had yet to come out that year. "If a student were to qualify for special education then they would be recommended to go to Belize City for schooling. This would ultimately be the parent's choice if they wanted to send them or not" (Pook, 2008). After talking about students who may be identified as having a learning disability, we began discussing the dropout rate. The teacher had had a 15 year old student drop out with a 2nd grade education and a 16 year old student drop out with a 4th grade education. Both children were from the same family. She suspects that these two children had a type of learning disability that led to their dropping out of school (Pook, 2008).

The same set of questions was asked to the teachers at San Carlos Government School, and as before, most of the discussion focused around testing. Mr. Con, a teacher at the school, stated, "According to the Ministry of Education if the child is not coping with what we are teaching at first we leave the child in same grade, but right now Ministry is telling us no matter what if child not performing still have to promote them to the next grade."

The teachers are then told that they are still to give that student work at their level and even go as far as to make worksheets for them. As far as telling the child's parents, "the parents are told that their child is doing separate work.... We are not telling a child you're failing, you're still passing but on your own level." Mr. Con stated that a large problem for the teachers was the lack of resources. He stated that he was trying to set up his own learning centers; he just didn't have all of the items he needed (Con, 2008).

In addition, the language barrier between English and Spanish is a problem. Mr. Juchim explained that the students are taught in English in school, but when they continually don't understand, the teacher will revert to teaching them in Spanish so that they at least understand the concept being taught (Juchim, 2008). Because most of the students' parents speak Spanish or another language in the home, the students often struggle with English comprehension. Because of the language barrier it is nearly impossible for the teachers to send any work home; because the parents in most cases won't be able to help them with it (Juchim, 2008). Children need this extra practice but as of now have difficulty getting it because of the language barrier.

ANALYSIS/EVALUATION/DISCUSSION

Based on the information collected, teachers are doing an excellent job with the information and materials that they have. From talking to the teachers, I learned that most of their education classes focused on content and the pedagogy was learned by experience. At St. Paul's Bank the teachers want to see the students succeed but sometimes success is hard with limited resources, especially when they cannot get the special education unit to come out and test students they feel may be suffering from a learning disability. The teachers then become solely responsible for adapting the schooling to the individual student's needs. In a class with varied ages and learning styles this can be an added challenge.

Along with the importance of identifying learning disabilities came the importance of the test given at the end of each grade. As Mr. Con stated, they use an annual plan and choose general topics they want to cover from the curriculum which is used as a guideline for choosing topics. The Ministry does come to the school twice a year and looks over the lesson plans (Con, 2008). I found it interesting that the curriculum simply acted as a guideline for instruction to follow. Since the teachers have the ability to construct their own test based on the information taught that term, there is nothing truly mandated by the Ministry about what topics must be covered. However when it comes to the 8th grade test, which determines who may move on to high school, the Ministry of Education designs it. I don't feel that this is the most effective way to test the students, especially if the Ministry of

Education doesn't have any set requirements of topics that the teachers must cover. These students are already at an unfair advantage if they are sitting down to take a test for which they may not have been taught all of the topics.

My end product will help provide these teachers with different methods of instruction that could be useful in catching students up on missed topics as well as providing them with more tools to make the content more comprehensible to a wider range of learners.

REFLECTION/ CONCLUSION

Working in Belize was amazing in large part because the Belizeans I interacted with were not only welcoming but also full of information. Being in Belize helped put a lot of things into perspective for me as an education major in the United States used to a system with much greater resources. In Belize this is not the case, but the teachers work hard with the materials they have to do what they can, and they enjoy their job regardless of such limitations. The teachers at San Carlos Government School, Mr. Lopez, Mr. Con, and Mr. Juchim, all shared such a passion for their work with children. No amount of schooling can create that kind of passion in a person. As a future teacher it is very encouraging to see fellow teachers doing the best they can to achieve student success.

The students also exhibit passion, the passion to learn and the openness to engage even with us who started out as strangers. The children did not ask us for things; instead we were simply more people to play with, and play we did. These children played and learned as children should, without worry or fear, in communities where their tight knit families and teachers truly have their best interests at heart, regardless of any limitations in material wealth and possessions.

Every child should receive an education. Regardless of the path that education takes, each and every child should be made to feel that he or she can succeed and be equipped with the means to do so. This is why I feel so strongly about my project and the impact that it will have on the communities of San Carlos and St. Paul's Bank as a whole by helping the teachers reach students they may not have been able to reach before with a variety of instructional strategies.

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A MARKETING PLAN FOR THE ARTISAN CENTER AT INDIAN CHURCH

Brooke Shinabarger, McMaster Scholar

The Artisan Center in Indian Church, Belize, has yet to reach its full potential with its craft products and sales. My project focused on helping them develop a marketing plan to promote their craft products. After visiting Belize, I decided to make a hard, plastic sign that can be hung around the village in places of interest. The poster is intended to add interest to the village for visitors, making it more appealing to want to visit its businesses and be patrons. Additionally, I took family photos in the small village of San Carlos, which will be sent back to the families.

LITERATURE REVIEW

Belize has been a struggling country ever since it received independence from Britain in 1981. A country approximately the size of Massachusetts, it has little power to exert when compared to surrounding countries, particularly in the area of commerce. Belize is hindered by its quite recent independence from Britain, its small economy, its large trade deficit, and its foreign debt, which does not seem to be decreasing (CIA, 2008). The current Gross Domestic Product is \$2.444 billion, and the GDP per capita is \$7,900, both estimated in 2007. Belize has a large percentage of the population below the poverty line- 33.5% (CIA, 2008). Despite these current conditions, the GDP has shown steady growth since 1999 (CIA, 2008).

The negatives of the economy create problems for the infrastructure of Belize. Transportation is certainly one of the main barriers hindering further development. There are plots of land that could be developed, but the lack of roads is a major dilemma. There are 3,007 km of roadways, of that only 575 km are paved (CIA, 2008). This may not be as much of a concern for the country if the weather did not feature massive bouts of rain for long periods which often wipe out roads. Additionally, there are 44 airstrips in Belize, only four of them have paved runways (CIA, 2008).

The slow but steady growth of Belize has been attributed to the growing tourism industry. In 2007, services accounted for 65% of the GDP (CIA, 2008). Belize has much potential with its unique coral reefs, boating, fishing, rainforest wildlife, numerous archeological sites, approximately 500 bird species, and over 200 kinds of orchids (Merrill, 1992). In 1980, tourism dollars equaled about one-tenth of the sugar export dollars. But ten years later the sectors were almost equal in receipts, and tourism had more than tripled its number of visitors (Merrill, 1992). In 2006, tourist numbers were a little

under one million; 70% of those tourists were from the United States. The government has declared tourism development to be a top priority over the last few years (Travel Document Systems, 2008). However, with so many tourists being U.S. citizens, the downturn of the U.S. economy has affected the industry in Belize.

The current U.S. economic crisis resulted in fewer U.S. tourists traveling to Belize in 2007; 14% of American travelers stayed home for their “vacation”, but only about 9% planned on doing that in the upcoming six months, according to the Travel Industry Association (Belize Tourism Board, 2008). The cruise ship segment of tourism showed a 6.1% decrease from January to September in 2008. Although there has been an overall decrease from U.S. tourists by 1.8% during that same period, Canadian arrivals went up 11.6%. Additionally, European and British visitors also went up significantly this past year (Belize Tourism Board, 2008).

Despite American travelers’ numbers decreasing in the past year, when the U.S. economy strengthens, it is likely that the number of visitors to Belize will rise as well. Additionally, the likelihood of Belize tourism to expand in popularity among other nations is great. The notion of ecotourism should only help the growth of tourist prospects. The International Ecotourism Society defines it as “responsible travel to natural areas that conserves the environment and improves the well-being of the local people” (Hirst, 2008).



While the society could define the term, it is difficult to pinpoint numbers as to how many tourists are actually participating in this type of visitation. It is, however, necessary to bring up when discussing the potential of the Artisan Center in Indian Church, Belize. This is because Lamanai, an ancient Mayan site, is just a short walk away from the Artisan Center. A focus on ecotourism would encourage travelers to respect and conserve the “natural and culture heritage” of the area being visited as well as contribute to the well-being of the local communities (Hirst, 2008). This could be done by preserving the wildlife and rainforest around Indian Church as well as financial contributions, such as purchasing local craft items.

My project collided with this idea of ecotourism through helping the Artisan Center create a more effective business vision in hopes of furthering the appeal to tourists. The Artisan Center in Indian Church, Belize, produces metal jewelry and other specialized crafts. The center needs better marketing plans to push their sales. This will enhance the ecotourism of the area, which will hopefully better support the community financially, considering a large fraction of families (approximately one-third of the community) are supported by the center.

A study was done in 1992 by a research team from Iowa, Nebraska, and Minnesota. They gathered information on tourist trends from 1400 participants, including tourists, craft producers, and craft retailers located in these states. While these states do not directly relate to the types of tourists in Belize, I find the study relevant due to the large number of tourists coming from the United States. The study found that over 50% of tourists used brochures, travel packets, magazines, guidebooks, people who have visited locations, and word of mouth sources to find crafts to purchase (Gahring et al, 1992). It was found that the price range for an item for themselves, a relative or a friend was \$20-\$30.

Crafts are 61% of what tourists generally like to buy, and they specifically are attracted to things that can be used in the home, jewelry items, and crafts that can be added to a collection. The study found that a favored shopping environment included rustic-looking shops and artisans demonstrating their work. Tourists tended to like nature, ethnic, historic, and regional in their craft items (Gahring et al, 1992). Tourists also tend to prefer crafts that are easy to pack, can be displayed, display cleverness, and include a name or theme related to the destination visited. Other ways to seal a sale include providing written information about the product on care, use of, materials used (especially ones with a history particular to that region), and unique information on the producer of the craft (Gahring et al, 1992).

Now that the popularity of crafts with tourists is known, focusing on the business aspects of the Center can further drive sales. Marketing is an essential management function needed to create a demand for your product” (Cyr & Gray, 2003). Included in a marketing plan must be understanding the customers, finding and developing products that are within limits that satisfy customers, finding a way to tell the customers about the product, and making sure the product gets to the customer. Studies have shown that failure of a product to sell could be attributed to poor marketing in 75% of all cases. These failures can be from a number of problems: lack of quality, lack of marketing effort, poor planning, and failure to adapt, which are all possible obstacles at the Artisan’s Center.

METHODOLOGY

I first visited the house of a woman who is a member of the Artisan Center and set up a date for Defiance College Art Professor Steve Smith and me to have a meeting with the Center’s members. I went to the Artisan Center not knowing what would be needed for their marketing plans. The meeting was set up with a member from each craft group (ceramics, needle working, stone carving, and metalworking) of the Center. I asked what they wanted me to do for them in the area of marketing. The definition of marketing was explained to them and further questions were asked to get a better grasp on what the Center was looking for in terms of growth. The concept seemed foreign to them, as they had not dealt with the issue themselves. The brochure they had in the past was created by a visitor, but they did not take part in the process. They suggested a *new* brochure that they could distribute at their Lamanai shop. However, they also informed me that the brochure the Center had in the past was discontinued due to lack of printing resources. I took photos while there of the center and craft products from each group to use them in the brochure. After returning, it was decided a sign would be more economical and last longer than a take-away brochure. The sign would avoid discontinuation problems and would be very durable.

Steve Smith recalled information presented to him by Bruce Baker, craft marketing guru, in support of signage and background information. Smith believes contextual information about an organization draws customers in by creating a deeper connection between the two. Additionally, the sign would allow visitors to read about the background of, as an example, Las Orquideas (a small Mayan restaurant) and learn about its founding. This is helpful because the women at the restaurant cannot speak English too clearly, thus visitors would not learn more about the organization.

I thought that including more places of interest on the poster would draw more eyes to the sign, so I contacted the involved business organizations and asked for permission. I decided to include photos and history on the Center, Las Orquideas, the village library, and a small section about the founding of Indian Church. Ten signs were designed to be 20" by 18" and printed on hard, weatherproof plastic and were to be delivered to the village in May 2009.

SIDE PROJECT

As for the family photos in San Carlos, Ivan Gillett (Programme for Belize, Head Ranger) and I walked door-to-door through the village a few days before the planned photo day. He told residents that we would take their family's photo at their house that coming Sunday, and asked if they would like it. The people that were open to the idea were told that we would return between 1-5 P.M. on Sunday and go around the village to take their photos. We returned and walked around the entire village taking family photos and recording their names. The printing and frames were quite inexpensive, yet the act of Ivan taking the photos back into the village will build countless relationships with Defiance College and Programme for Belize.

DISCUSSION

The lack of infrastructure in the country and at the Artisan Center contributes to the limited access to the Center's products. The high printing prices and lack of resources also constrain the Center ability to market itself. While a marketing plan could have a positive impact on the Center's sales, another major problem is the lack of quality of the Center's products. The lack of resources, including books, internet, and craft education all contribute to products with poor artisanship. In addition, the lack of skilled resources causes the Center to buy products in Guatemala and sell them with their own products. The availability of Guatemalan products diminishes the local character and uniqueness of the Center. If there were more materials, such as books and the internet, the Center would have more instruction on production techniques and ideas. Additionally, the Center could use marketing techniques such learning about the importance of a nice shop set up and how to engage a customer to increase chances of a sale. However, the craft quality should be addressed before a serious marketing plan is pursued.

CONCLUSION AND REFLECTION

My project allowed me to understand the attitude of the Artisan members when it comes to boosting sales. Unlike the Unites States' attitude of 'I'll do anything for the almighty dollar,' Belizeans do not have this drive. That is a huge component missing in the equation of financial wealth and success

for the Center. Additionally, the lack of organization, stemming from an uninvolved leader, displayed an environment where communication seemed minimal and goals unclear. My purpose statement morphed drastically before the trip and was still perhaps too broad when I arrived in Belize. The language barrier I encountered when I met the Artisans made it hard to ascertain what the Center needed. I had to adjust and seek an answer based on the bits of information I could pick out from their requests.

The marketing project that I executed for the Village of Indian Church specifically for the Artisan Center will enhance human well-being. This will be accomplished by the signs I created. They will highlight the local businesses and the village history, thus generating more interest in the area. This, in turn, should increase patronage to the businesses. If more support is generated, the organizations will receive a financial boost that will support their families and village. The informative signs can only help generate interest in the village, which would advance humanity, even if only to a small degree.

The process of working in an interdisciplinary learning community opened my eyes to other areas of academic processes and terms. It allowed me to see how an academic team works together and how effective solutions are decided. Putting the projects together in a new environment, where we often had to adapt to changes, tested our creativity in our own disciplines as well as others. This skill is useful for any work environment, as different careers interact on a regular basis. As a businessperson, the learning community gave me a feel for an open environment where ideas flow freely – it was an environment where solutions were more eclectic and seemed to come quicker. I can see how this “learning community” style would work well in a boardroom setting.

My personal goals in photography have changed as a result of the trip to Belize. Before, I was unsure what I wanted to do as a photographer. That changed while on the ground in Belize. I realized I thoroughly enjoyed taking photos and traveling at the same time. I knew after the trip I wanted to pursue travel photography. The trip opened my eyes culturally and sparked a new passion in my photography.

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