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## Cultivating alternative subsistence farming practices in Dangriga, Belize

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**Cultivating alternative subsistence farming practices in Dangriga,  
Belize**

An Honors Thesis submitted in partial fulfillment of the requirements for  
Honors Studies in Economics

By

Alexander Johnson

Spring 2020

Economics

J. William Fulbright College of Arts and Sciences

**The University of Arkansas**

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Sincerely,

**Zan Johnson**

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## Introduction

Subsistence farming, also referred to as backyard farming, is an important opportunity for families in areas of low economic status. Small scale poultry farming is another practice often used by families in similar situations because of the financial and nutritional benefits provided. By combining the two practices in a process where they each benefit from the other, a sustainable system can be created. The poultry-garden system can provide a source of food for the household and, if run effectively, supplemental income can be generated through the sale of excess poultry, eggs, or vegetation. This project attempted to take the concept of a sustainable poultry-garden system and create a model of it using the resources available in the city of Dangriga, Belize.

During the summer of 2018, our team of four traveled to Dangriga to for a two-month period during which the system was built and the process was documented through the creation of a manual. The team consisted of students from various majors including engineering, poultry science, economics, and international studies. While in Dangriga we would be working with our community partner, Derek Jones, a respected member of the Dangriga community who was connected to the University of Arkansas through previous service-learning trips. Previously, he worked as a woodshop teacher at the local Dangriga high school and his expertise in design and construction would be an asset for our team since we would need to create garden beds for our plants. Additionally, Derek had been keeping chickens in his yard for the past 2 years, so he already had many of the supplies needed for us to create this piece of the system. His connections in the

town would serve as additional benefits for our project when we wanted to disseminate our work to the community.

Over a period of eight weeks my team and I would work hands-on reshaping Derek's yard to a system of poultry and produce which worked together in a sustainable cycle. The litter or manure created by the chickens would be combined with woodchips and feathers and would be used as fertilizer to facilitate the growth of plants by providing essential nutrients to them including phosphorus and nitrogen. These nutrients would help the plants produce vegetation which would be used to feed the chickens creating a symbiotic relationship where both the poultry and the garden would benefit. Using this system decreases the costs of the individual elements and produces output that can be used by the household and, if run effectively, excess that can be sold to neighbors or local markets.

Our team completed a number of tasks from shoveling tons of dirt, to pruning passionfruit, to analyzing the poultry production. I led the construction of the structures we needed for our plants while helping with the planting and treatment of the area. As we went, we made a priority to engage with the community about our work, through hosting an open house for the community as well as conversing with Derek's visitors about what we were working on. Derek is a well-known figure in Dangriga and would often have community members stop by to observe his yard and we were able to demonstrate to them how the system would work once we were finished. It was our hope that the promotion of our work would lead other community members to implement similar systems in their yards.

Upon return, our team has continued to collaborate on a manual detailing the construction and maintenance of the poultry and garden aspects of our project. It includes instruction regarding running a business, supplies needed to build grow beds, poultry care techniques, and even nutrition information. We hope future groups can distribute our manual to important community members such as the Minister of Agriculture, who works in Dangriga, or use it to help households create their own systems. The members of the community who do choose to create their own backyard system will have the freedom to take our information and apply it in the best way that fits them. Development in countries like Belize is not a cookie cutter operation, and we hope our information supplies citizens with the resources they need to be able to grow their income using poultry and produce.

## Literature Review

According to its Millennium Development Goals statement, the United Nations Development Programme is aiming to achieve “zero hunger by 2030” (UNDP, 2000). Hunger is a widespread challenge among developing countries, and it can also make other issues apparent. For example, malnutrition has shown to have negative effects on economic development because can lead to “increased risk of acute and chronic disease, impaired learning in school, and lower economic productivity” (Lawrence Haddad, 2015). The Food and Agriculture Organization of the United Nations states, “Chronically undernourished people are caught in a hunger trap of low productivity, chronic poverty, and hunger” (FAO, 2002). To reduce hunger, communities must find better agriculture practices that will be sustainable in the long run.

Eliminating hunger is no small task, and the UN lists “support(ing) small scale farming” (UNDP, 2016) as a key element in working towards their lofty goal. Subsistence farming or subsistence-oriented production is a form of small-scale farming that can serve many purposes, including “nutritional security, socio-cultural requirements, ecological services (pest control), as well as income generation” (Baiphethi, 2009). Households with small amounts of land area also can practice subsistence farming because the land required can be small if the right plants are chosen. The practice also often takes place in households where poverty is present since they cannot afford the materials to sustain larger agriculture production. Hendriks (2003) suggests that subsistence production renders two distinct nutritional benefits, first in the form of whatever food is produced for own consumption, and second in terms of freeing up income that can be spent on even more nutritious foods” (Hart, 2009).

Small scale poultry farming has been studied for its poverty alleviation potential as well as for its nutritional benefits. Poultry is one of the most protein dense meats commonly consumed by humans and tends to be low in cost to produce and consume. As a method of development, poultry “ensures a steady flow of high-quality food and, through cash income, reduces vulnerability” (OTTE, 2010). For this reason, some journals suggest focusing on governmental policy to support these practices. If governments can support these practices by supplementing the initial costs that may serve as barriers to entry, then more households would have an incentive to begin keeping their own chickens. One journal focused on poultry practices in India found that “Policies which support smallholder-centered, but market-oriented, poultry production systems in



rural areas appear the most promising option of promoting a ‘pro-poor’ development of the poultry sector” (OTTE, 2010).

Unfortunately, widespread promotion of small-scale subsistence poultry farming has not been shown to be a consistent form of poverty alleviation. The Caribbean Agricultural Research and Development Institute (CARDI) Strategic Plan 2018-2022 notes “people attach to subsistence production and in some cases depend on it to ensure extra access to food” (CARDI, 2018)” Chickens cannot be sold for much more than they cost to raise and this makes it hard to generate enough profit to make a significant impact on the economic welfare of a household. A key element of the economic benefit a subsistence farm can provide is the sustainability of the system.

Sustainability among subsistence farming is essential in driving down costs long term to ensure the continuation of the practice. Drip irrigation is one method of watering crops that helps minimize the total amount of water used by placing water droplets at the specific location they are needed. With effective placement, the total amount of water used to grow crops decreases greatly leading to lower costs. One study estimated the productivity of drip systems to be larger for drip systems in comparison to the typical surface watering by as much as 0.29 kg per cubic meter. (Hanaa M.Darouich, 2014) The cost of drip irrigation parts can be high but as its popularity grows individual pieces will become cheaper and the overall cost will continuously decrease. With every little bit of savings being essential to the continuation of subsistence farming practices, techniques like drip irrigation will likely become more widely adopted.

## Background

Dangriga is a mid-size town in Belize, home to approximately 8,557 citizens (Statistical, 2010). Dangriga holds the title of “cultural capital” of the country because of the unique diversity and background of its residents. The Garifuna culture dominates the city. The Garifuna culture is a mixture of African, Amazonian, and South American heritage that was brought to Caribbean areas back in the 17<sup>th</sup> century. In 1635, a Spanish slave shipwrecked outside St. Vincent and the Garifuna culture has continuously spread to many countries in the Caribbean area (Thorne, 2004). There are also many other ethnic groups that can easily be found throughout the town including Mennonites, Asian influence, and Central American from surrounding countries like Guatemala.

The GDP of Belize is 8,590 placing it at 111<sup>th</sup> among all countries (The World Bank, 2018). Many citizens in Belize are living below or right around the poverty line. During the years leading up to 2009, the proportion of the Belize population living on less than \$1.25 per day increased from 33.5 to 41.3% (MDGMonitor, 2016). The median income of a citizen in the Stan Creek District, which includes the city of Dangriga, is \$1186.69 per year, below the country median level (Labour Force Survey Tables, 2018). In the Stan Creek District, the unemployment rate is 11.9% which is 2% higher than the country average of 10% (Central Intelligence Agency, 2018). Males are more likely to find work and have an unemployment rate of 4.9%, compared to almost 15% for women (Belize, 2018). Unemployment rate data captures the percentage of the population who is looking for job but have not found work but does not capture those who have given up

looking for work. This means actual unemployment can be greater than reported (Feng, 2013).

Upon our arrival in Dangriga, I quickly noticed the poverty and disparity. A majority of the houses were constructed from simple resources with tin roofs and minimal square footage. These small houses were placed next to large well designed and built houses, furnished and painted with vibrant colors. The large differences between the houses sharing a street served to emphasize the income disparity the city is facing. Overall poverty is an issue which needs attention in this city.

Our team worked with a community partner who had been living in Dangriga for multiple years to better understand the needs and issues of its residents. Derek Jones, our community partner, moved to Dangriga from the UK in his early 20's as a part of an opportunity similar to the Peace Corps and he has not left since. He has spent most of his time working at the local high school teaching a woodshop class, and it was through his teaching that the University of Arkansas was able to get in touch with him. University of Arkansas students have helped him with projects in the past, including a large aquaponic system, which can be found on YouTube<sup>1</sup>, and on his poultry endeavors. His poultry production reached 147 birds in total at one point where he would kill 21 birds each week and buy 21 new birds to fill the spaces. He would take 5-6 birds for his family to cook and eat for themselves and then he would bag and sell the remaining chickens to neighbors or through a local market.

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<sup>1</sup> Link to Derek Jones Youtube: <https://www.youtube.com/watch?v=r2suz65r-nw&t=7s>

The poultry market in Dangriga is heavily dominated by a Mennonite owned company, Quality Chicken Products. Their poultry production is large, and the birds they produce are bigger than any that could be produced through a small-scale farm. This means entering the market for poultry production would be challenging but households may be able to sell a few extra chickens to neighbors and/or family members for small amounts of extra cash.

Derek was also able to provide important additional information regarding how our manual should be written so that it would be the most beneficial to the residents of Dangriga. His extensive experience with backyard projects helped us select cost effective materials when constructing grow beds and his knowledge of the climate helped us chose which plants to grow. His connections in the community were useful when we were looking for additional information about the best methods to grow certain plants and when we wanted to market the system to the community.

The project we worked on was designed for all residents of Dangriga who needed a supplemental food source and possibly a supplemental income source. The subsistence farming practices we would be recommending varied in the time commitment and intensity of work required. Our goal with the manual was to give the audience the information needed for them to make their own system that would match the amount of time they were able to dedicate to the project. This meant whether they only had time for a small operation or if they wanted a larger scale system they would be able create it using the information we were providing them.

Each member of our team provided a different skill set and, when combined, our product covered multiple aspects of the system, from construction to business to

nutrition. My role within the team was heavily based on my engineering coursework and focus on space optimization. Along with my engineering role, I also my used economics skillset to suggest lower cost alternatives to the parts we used in our system. Although each member of the team was unique in the skills they brought, we worked together to make sure our perspectives were included when creating our product.

## The Project

Our project consisted of two main pieces designed to work together as one backyard system. The two projects were the garden side of the backyard and the chicken side. When our team arrived at Derek's the first day, his yard was already split into these two sections. One of the first things I did was to draw an outline of the yard in its current state so we could visualize the area we were working with. In figure 1 and 2 the poultry side is outlined in red and the garden side outlined in blue. The second picture is a larger version of the garden side drawn for clarity since our work would be mainly happening on that side.

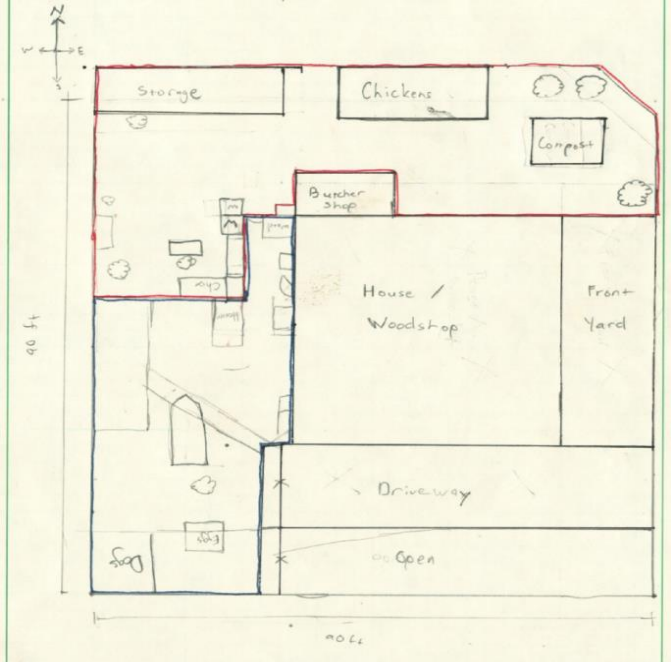


Figure 1 Derek's Backyard is modeled above with the main parts of the yard labeled

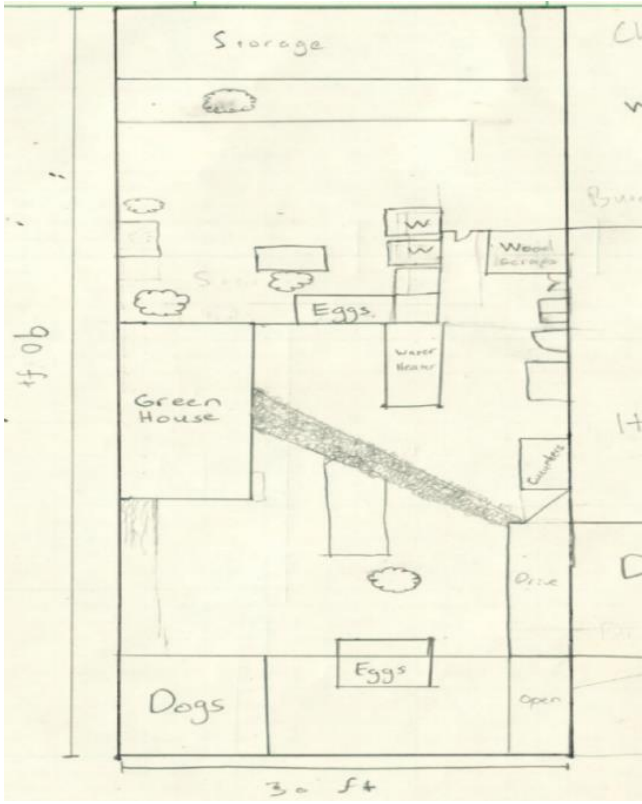


Figure 2 The garden half of the yard is re-drawn above to enlarge and label the area where most of the work would be completed

## Sustainable backyard production process

The purpose of creating the two elements of the system next to each other was partially for space saving but also, we hope they will work together in a sustainable relationship. The chickens create droppings that are used to make fertilizer which facilitates growth of the plants, but the plants also provide for the chickens. Plant droppings, or vegetation that falls off the plants as they grow such as leaves or fruit, can be taken to the chicken side to be eaten. The nutrients help feed the chicken in a healthy manner and result in healthier eggs.

## Garden Side

### **Initial Cleaning and organization**

Overall, Derek's yard was filled with many materials available for reuse in the project we decided to undertake. In the past, Derek created a full aquaponics system in his backyard that is well documented and can easily be found online.<sup>2</sup> The pieces he used to build from this project are still available since he kept most of them after disassembling the aquaponic system. The disorganization throughout the yard was apparent with overgrown weeds and piles of piping and wood lying around in undefined spaces. It was useful for us to take time cleaning and organizing the supplies so we could most effectively put them to use.

The garden section had an area of 1800 square ft. and had little to no organization. There were various crop tests he was running including a massively overgrown passionfruit tree in overtaking the middle of the area as well as sporadic plants being

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<sup>2</sup> <https://www.youtube.com/watch?v=yldlk7m1rBM&t=257s>

grown in the greenhouse. The dogs were kept in the corner on the garden side, and a large boat made of fiberglass sat under the passionfruit tree occupying a large amount of space. It became clear our first task would be to clean the area and remove excess materials so we would have a blank slate to work with.

We started by cutting back large amounts of the passionfruit vine which were overgrown and dominating the area we were working on. Derek told our group it was important to keep the passionfruit because although it would not sprout fruit in the first year, 2019, next summer it would come back and “grow like mad.” Passionfruit is a cash crop in Dangriga because it is rare to find and tastes sweet and delicious. The vines grow incredibly quickly and produce large amounts of fruit in the humid weather, so it is a product we are hoping more households consider growing in the future.

Next, we tore down structures like the fence on the new chicken house. We took apart the fence by the driveway to make room for a dump truck to bring soil from Belmopan, the capital city of Belize, which we would be using for our large grow beds in the future. The soil was from the inner part of the country so it would contain less rock and sand giving us better results on our crop production. During this time, we were also beginning to discuss layout ideas among the team and with Derek.

### **Soil Methodology**

A large part of plant production comes from the soil in which they are grown. It is known in agriculture that animal waste can help facilitate growth in plants, and we hoped to put the waste from the chickens to use for our plants. An agriculture teacher Derek previously worked with at the high school had tried this method in his own yard, so Derek had us meet with him to discuss his method. The main thing he told us was that a



maximum of 25% chicken litter to 75% soil should be used because any more litter would hurt the crops due to the high amounts of Nitrogen. Our team decided to test three different soil combinations: 0% litter with 100% soil, 25% litter with 75% soil, and 12.5% litter to 87.5% soil. The varying levels would provide enough separation to be able to tell the effect of the mixture. After further discussion with Derek we thought it would be best to test different crops with different soil mixtures to see which combinations facilitated the most growth.

### **Seed shelter**

After our organizational efforts were complete, we were able to move into the gardening side of our project. We had to begin with seed production and treatment. Derek had a small seed house, or a 4 ft by 6 ft wooden shelf with two levels, which our team would use for the seed germination piece of our plant growth. To protect the seeds as much as possible I attached a mesh tarp and a clear plastic sheet to the top of the seed house to decrease the sun's intensity and protect from rain.

Prior to coming to Dangriga, Derek messaged our team asking us to bring heirlooms seeds for regions 10,11, and 12 and a water pump timer. We were asked to bring these products because they were hard to find in Dangriga and they would be useful for our system. Our team researched the different plant types to see how many seeds to plant and at what depth they needed to be planted. We used seed trays and filled three sets of trays at the three soil levels mentioned previously. At this point the soil Derek had ordered had not arrived from the capital city so we had to find another source of soil. The soil for the seeds was taken from a friend of Derek's yard because Derek had determined that it was "good soil." The trays were placed in the seed house and given time to sprout

while being watered every day. While waiting for sprouts we were able to design and build grow beds for all our plants.

### **Planning and construction of the garden**

With a clean and organized yard area and seeds growing, our team moved into the construction part of our project. First, we decided on the location of the different pieces of our yard. Figure 3 shows a graphic and drawing of the yard layouts we chose. Derek already had a greenhouse for our team to work within the bottom right of the picture. We decided this would be a good location for the leafiest green products since they would need the most shelter from bugs and pests like geckos.

Using old water barrels which had been cut in half for Derek's aquaponics system, we created formation of nine grow beds arranged in a three by three block. The type of crops would be consistent down the rows of the grow bed, and the soil mixtures would be consistent down columns so each crop would be tested in each soil mixture. The barrels were all placed on concrete blocks to raise their height. All the construction details are outlined in the manual. The whole group of barrels was small enough that Derek would be able to reach across and into any barrel to weed or tend to other plant problems.

We chose to put the grow beds at the very top of the yard because the area between the dog pen and fence was just right to fit 3, 4ft by 6ft beds. Using wood from a local shop our team had to cut pieces to the lengths specified for creating the desired beds. During this time, I learned a large amount about wood cutting and using tools like a table saw and drill. Once the pieces were cut, we assembled the grow beds as detailed in

the manual with the help of the whole nine member Arkansas team. Over the following four days, I also attached the optional roof, found in the manual as well. The plants needing more shade were placed in the grow beds because of the roof addition and what remained was placed in the barrels which only got minimal shade from the tree next to them. The plan for the crop locations is shown in figure 4.

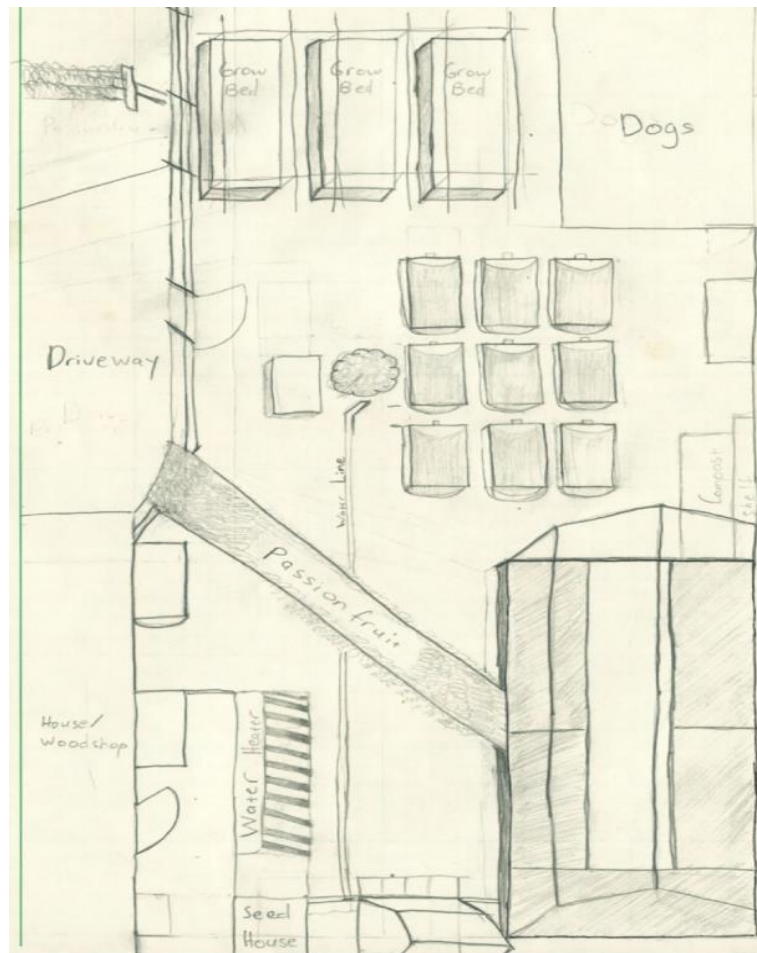


Figure 3 Drawing of our team's plan for the layout of the garden

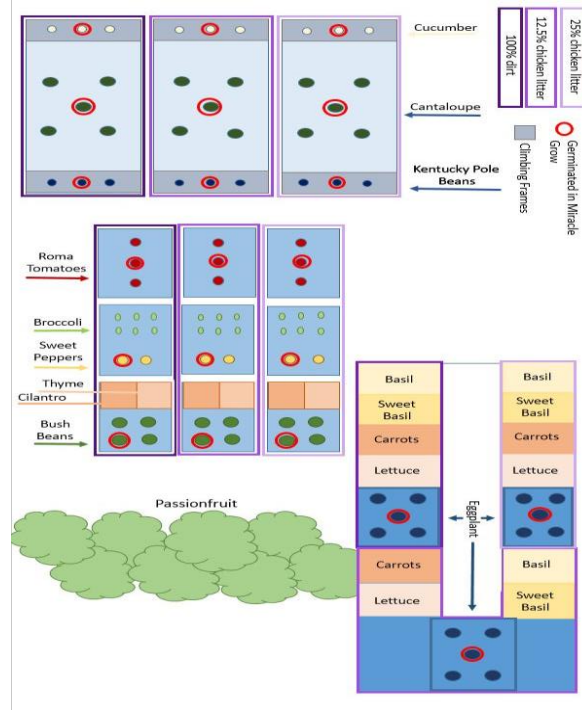


Figure 4 Diagram of the desired layout of the garden. The location of specific plant types and soil levels is also detailed.

### Soil filling and plant transfer

Although the grow beds had been built, we still needed to fill the boxes with the soil mixtures we had decided upon. The soil for this stage of growth had been purchased from Belmopan because it contained less sand and more nutrients. The task of filling beds was labor-intensive and took a few days to complete even with the whole team participating. For mixtures, we had 2 buckets to use and just used simple ratios to create them. The 25% chicken litter mixture was mixed by scooping 1 bucket of dried chicken litter and combining it with 3 buckets of soil. For the 12.5%, a half bucket of litter was picked up and combined with 3.5 buckets of regular soil. To obtain a consistent mixture our team would pour the litter into the barrel at an alternating pattern to the soil so it was spread throughout and would be combined when the mix was poured into the grow bed.

After the beds had been filled it was time to move the sprouting seeds. Usually, 2-3 sprouts could fit in the area specified for the crop, so choosing the best visible growth we removed the sprout from the tray and replanted it in the grow bed at the depths specified by our research. After planting, all the seeds were soaked in water in an attempt to begin the growth process again.

### **Community Education**

At this point in the project, we discussed having an open house for the community to see our work. Derek was also interested in hosting the event, and to promote it he made a few Facebook posts, one of which included a graphic stating the information of the open house as well as two others that had pictures of our team at work on the project. Derek belongs to many groups for builders and growers in Dangriga, and we felt that the message was being spread to a population that would have interest in our project.

During the week leading up to the open house, we made sure to make our work look as presentable as possible. When talking with Derek, we discussed the importance of our work being visually appealing as well as practical. The importance in the aesthetic nature of our project is that if our project did not look good then people were less likely to care about what we were doing. If they saw our work and were interested in the look of it, they are more likely to ask questions and copy our work for their own house which is our main goal. To accomplish this, we spent a lot of time pruning the passionfruit tree, sweeping the year, clearing dirt, and moving pieces not in use to other parts of the yard so it was not cluttered in the backyard. By eliminating clutter, the visitors would focus on only what we wanted them to see and not on other random project pieces that were lying around.

On the day of the event, we had two main groups show up to view our work. The first group was a mother with four of her children. She was very interested in the work that we had completed and was listening to all the tips we had for how to improve her own backyard garden. The children enjoyed looking at all the plants as well as chasing the chickens around. The next group to come was from the Pelican hotel. The Pelican is one of the nicest hotels in Dangriga, and two of the people who help run it along with the gardener came out to help. This was a much more collaborative interaction since they also were growing a number of crops themselves. We talked about our process including the trials and errors and they told us about the experiences they have had trying to grow different products in the Belizean weather. This was helpful to our team as we were able to learn a few tips ourselves while also being able to offer advice to them.

The turnout for the open house was less than our team had hoped for. Initially we were estimating having four or five groups come visit Derek's house across the day but unfortunately, we did not get that many. However, I do not consider our effort to be a failure. The groups that did attend were able to give us beneficial feedback on our project including comments on gardening methods that we would be able to use as we finished our project. We were also able to show the groups ideas for structures they could use in their yard as well as new plants they could consider growing.

### **Drip irrigation addition**

Most of the team's work on the backyard project was complete and with only a week or so remaining there was not enough time to start a large new project. For the remaining time, each member of team worked on the pieces more specific to their role. Working with Derek, I came up with an interesting project/challenge for me focus on that

would fit with my skillset. He wanted to use drip irrigation on the crops but didn't have a system so he gave me a set of connectors and 100 feet of drip irrigation pipe he had left over and told me to design a system to get water to all the pieces of the garden. This was a very exciting last piece and with a few extra feet of pipe purchase, I was able to place and secure a system running from the water line under the sap tree to all three grow beds and all nine barrels with high water flow throughout. Finalized pictures can be seen in the manual.

### Chicken side

The biggest task we had to complete on this side of the yard was tearing down the current chicken coop and replacing it with the one from the garden side. This would give us more space to work with in creating structure and space for the plants we would eventually place on this side of the house. On the second Friday of our work, the whole Arkansas group came to Derek's house to help us complete this work. We started by tearing apart the old house by dismantling it piece by piece and even using a machete or kicking the wood to break it down if necessary. We then placed everyone around the new chicken house and coordinated an effort to move the heavy new house to the location in the middle of the yard where the old house was located. Once in place, we were able to set up chicken wire around the new house so the chickens would be contained from our garden space as well as the dogs who stayed in the back-right corner of the yard. Chickens will eat almost anything they find so containing them from our seed and crop work was very important to our success.

The most impactful experience I had with the chicken-side of the yard was when I went through the process of killing and cleaning a bird. I would not have ever had this

opportunity in the US and, although it was not pleasant, learning about the work required to complete the poultry process was essential to our understanding of the work we were doing. Based on the time required to complete a full cycle of killing and cleaning a chicken, our team was able to offer realistic suggestions in our manual for a family.

Derek's poultry endeavors were more extensive in the past, but the labor required to maintain those systems was too high. He now has committed to a process that produces 8 grown chickens a week. He also has around 25 egg-laying hens and 4 roosters running around the yard which needed to be contained to avoid them eating the plants we try to grow. For this side of the backyard, we did not have to do as much physical work since Derek had already built the chicken coops for himself. Bailey Carpenter, the poultry major on our team, was the only member heavily focused on the poultry piece. She collected data and provided periodic suggestions to Derek regarding ways to improve the chickens he was producing. These suggestions are included in the manual.

## Evaluation

The team messaged Derek shortly after returning to Arkansas about the progress of our crops and the table below summarizes his results. His full message can be found appendix A.

<b>Crop</b>	<b>Growth per month</b>	<b>Best soil</b>
Spinach	5+ lbs.	Any
Sweet peppers (failed habanero)	2-3 lbs.	25% mixture
Green beans	1-2 lbs.	Any
Climbing beans	3-4 lbs. "bountiful"	12.5%
Bok Choy	1-2 lbs.	Any
Sweet basil	"grows well"	any



Fruit trees (Papaya, Soursop, Avocadoes, Star Fruit and now getting Passion Fruit)	“growing well”	0
Tomatoes, melons, broccoli, squash, cucumber	No Growth	n/a

*Table 1 Summary of plant growth as reported by Derek 1 month after the team had left Belize*

The crops that grew well were mostly leafy greens or other vegetables. The nutritional benefit of these products to a household able to grow them would be very large. Also, if the plants are grown correctly, they can reproduce themselves without planting new seeds which would also save money for the household.

The final product our team left with Derek was satisfying and looking at pictures from beginning to end shows an incredible improvement in quality and potential. Our work with Derek was extremely different than any future project will be with other members of the community. With Derek, supplies, like drills and wood, were almost always around and if we did not, we were able to buy them at a local store. When we needed parts ordered, he knew exactly how to do it and where to get it from no matter if it was wood or dirt or a water pump. This luxury will not be afforded to groups working to implement the system in other yards. They will need to be able to think on their feet and find unique ways to solve the issues they run into. It is our team’s hope that our manual will provide significant information for future teams to work with but there is no way to know if it will be enough until they get to work.

The manual provides a guideline for a system practical to Derek’s backyard and the situation he is in, but it is not meant to be one-size fits all. Future groups can alter the directions to fit their situations. For example, dirt does not need to be purchased from Belmopan to be effective. Often the dirt found in the yard or an empty field will work if needed and does not cost the user any money. Multiple choices also bring along the

possibility of reduced cost for parts of a backyard system. For example, our group used water bins as containers, but any large plastic container could work if it is set up correctly. Recycling past used materials like wood are also highly encouraged from an economic perspective as well as a sustainability perspective.

Overall, the practice of subsistence farming has great potential in Dangriga. At its minimum, if it is functioning at low production the system still provides healthy food sources including fruits, vegetables, and protein from the poultry section. The set-up and initial costs of the system is the biggest hurdle for families. Microloans or cash transfers should be investigated by the user, before production begins, for cost assistance. Policies benefitting small-scale farmers would be beneficial and the Department of Agriculture should consider researching options for policy proposals. Families with limited experience with tools and building should consider hiring help or using community sources of information, like Derek, when experiencing issues. A running system needs small amounts of maintenance and user input but reaching this point is critical in the effectiveness of subsistence farming. The process of improving the manual will be ongoing and I hope to see improvement as the years go.

## Next steps

Working in collaboration with Derek Jones has provided our group with an important perspective on the community and connected us with other influential figures, such as the owner of the largest hotel in Dangriga. The next step for Arkansas groups visiting Belize will be to create a backyard poultry-garden system using only the manual we created. It is our hope that they can create the system in a yard in the community with

a household that has the time to tend to both the garden and the chickens. Working with Derek, potential candidates could be identified for households that could benefit from the opportunity but are also responsible enough to take care of the product after the Arkansas team leaves.

The manual was created based on the yard our team was working on this year but with the intention of it being able to be applied and scaled to fit other backyards. Opportunities for expansion are offered and recycling of supplies the household has already is encouraged. By attempting to construct a working product the next group will find the best practices of our version as well as learn important changes that need to be made to the manual. The creation of the system will require some cash input and should be considered before traveling to Dangriga. Towards the end of our trip, there was talk of the Department of Agriculture funding a few garden projects. Visiting them to discuss funding options should be considered.

Educating the household while the product is being created will be an essential part of the sustainability of the product. We did not have to consider this when working with Derek because of his poultry knowledge. But most citizens are not aware of how to tend to chicken and/ or a garden. There are elements of education in the manual but teaching the household while being able to interact with them will be more effective.

## Personal evaluation

My project in Belize was not my first time working in an underdeveloped area. I have had the opportunity to serve in many places around the world with a wide range of development in each area. But whether my work was in Colorado or Mozambique or Belize, the experiences have been meaningful in shaping who I am and what I consider important in my life. My summer in Belize stuck out compared to my other experiences because of one key factor, time. Up until this trip I had yet to have the opportunity to spend more than a month in the area I was serving. The extended time I was able to spend in Dangriga allowed me to dive into the community and culture more than ever before. I ran the streets every morning and formed relationships with so many interesting people. These relationships allowed me to gain a greater understanding of how a project like the one I was working on could be adapted to fit so many different households and benefit a greater number of people.

The University of Arkansas has been working in Dangriga and Belize for many summers now and has been able to form impactful relationships with community leaders like Derek as well as groups like the owners of the Pelican hotel. Through these relationships, we are able to understand the issues they have faced and collaborate regarding the best ways we are able to offer our help. This impact was further improved due to the length of our stay. By staying in Belize for a period long enough to form relationships, we began to form relationships with the citizens of the community and gained a better of how a project like ours could benefit them. I plan to use this experience when I can work in developing areas in the future to shape my work and my interactions with community members.

## Personal Reflections/ Journal

During the trip, I kept a series of reflections as I moved through the weeks to capture my thoughts and feelings while in the Belize environment. I have included some of the most important takeaways I found in my reflections.

Week 6: Today Evan Alvarez stopped by our house to chat and sell us more granola. We met Evan during the first week in Dangriga when we had dinner at Tanisha's. We talked to Evan for about 15 min when he stopped by to sell us the granola. He asked us about our projects and we happily informed him about we were doing. He was very excited about the work and thanked us for bringing our "expertise" to Belize to help the community. He asked us what year we were in college and he went on to tell us about his daughter and her education path... But the most memorable part of our discussion with him came when he began to talk about his past work with the University of Arkansas. He said that just 3 years ago he took classes from students from Arkansas on topics such as accounting and bookkeeping, and he has a certificate that still sits in his house. He also started his own granola company and was assisted by loans given from the University. He has slowly grown his business and was awarded another loan of \$1000 recently to help continue the steady growth of the company. He has added new products to the company and has improved other aspects like packaging immensely. His story made me realize the impact that these studies abroad programs have on the community. Through the help we have offered Evan as education and in the form of loans we have given him the support he needs to pursue his dreams and that brings joy to his life. We have provided sustainable development to Evan as well as others in the community. This can sometimes be hard to see since sometimes the changes being made are something as

simple as a new label on granola bars but to the members of the community that is life changing. I can only hope that the work I'm participating in here has the same effect on some members of the community who may need the boost.

Week 8: As the last week finishes, I begin to reflect on the impact this trip will have on the rest of my life. I will be able to use this project to help me access a wide array of new opportunities like internships or graduate programs. Being able to explain my first-hand experience with working in another country for a service initiative is a great way to catch the attention of many different listeners. I can prove my strong adaptability skills as well as my ability to problem solve on real-world issues like the ones I encountered in Derek's yard. Not only will the experience assist me in my professional endeavors, but I have also grown personally through this trip in more ways than I can explain. Through this trip, I have had the chance to think about where I am in my life on a few different levels. I reflected on the choices I have made and the people who have helped me along the way. And for the first time, possibly ever, I was able to spend a decent portion of time contemplating my next steps. I was able to consider paths which I never expected to take and assess the ones I was already considering. I realized more than anything the important role service plays in my life and I hope to find a way to pursue it in my future.

## Conclusion

Poverty and hunger are issues affecting all developing nations. Two effective measures to combat these issues include subsistence farming and small-scale poultry production. To provide an information tool about poultry and gardening for the citizens of Dangriga, my team and I spent many hours shoveling, planting, and sweating to create our project. The project we created was a poultry-garden system where chickens would be fed from the plants and the plants would be grown using chicken litter creating a sustainable cycle that cut costs. The poultry-garden system will serve as a model in the community to those trying to pursue their own subsistence farming endeavors. The manual we developed to accompany the product will also assist families and we hope to see the next group from Arkansas test it out with a community member. The potential for the backyard system is large and I hope each year brings new ideas and collaboration to make the product as beneficial as possible. Getting to work on this thesis provided professional and personal growth for me and I'm truly thankful to have gotten the support to make it all happen.

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## Appendix A

Message from Derek:

“Let’s start with what grows well Spinach grows like weeds everywhere, in the 3 box beds little difference between them, I trim back the excess and feed it to the egg chickens so we are getting the goodness through the eggs as well. House Usage 1 to 2lbs/week (produced much more 5lbs plus). Sweet Peppers grow well but a little better in the 25% because of this I have expanded to 4 half barrels House Usage 2to 3lbs/week this will increase Habanero Pepper also are doing well, with one little issue, they have no heat to them so we use them as sweet peppers these are in all 3 box beds with no difference House Usage 1to 2lbs/week Green Beans. The bush beans were disappointing in the barrels but I am trying again, the climbing beans in the 3 box beds were bountiful. The first generation have just stopped producing, but I replanted beans from them and 2nd generation is starting to climb slightly better in 12% House Usage 3 to 4lbs/week Pock Choy/Boc Choy/Chinese Cabbage, the beauty of these are they grow well and quick AND you only harvest the outer leaves they just keep going I harvest at least once a week House Usage 1 to 2lbs/week Sweet Basil grows well House Usage whatever we need. Fruit Trees growing well are Papaya, Soursop, Avocadoes, Star Fruit and now getting Passion Fruit. Thing not going too well No look with in any barrel or box still trying, tomatoes, melons, broccoli, squash, cucumber.”