

Evaluating Dietary Diversity Change After the Introduction of Household Gardens in the
Informal Settlement of Claverito-Iquitos, Peru

Megan Malone

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Joseph Zunt

Leann Andrews

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Megan Malone

University of Washington

Abstract

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in the Informal Settlement Community of Claverito, Iquitos, Peru

Megan Malone

Chair of the Supervisory Committee:

Dr. Joseph Zunt

Department of Global Health

Abstract:

Introduction:

Informal settlement families are burdened with a multitude of barriers to achieve good health, including food scarcity and lack of dietary diversity. While much research has been conducted for food security in rural settings, much is still unknown for urban settlements. To explore these ideas, InterACTION Labs initiated a Household Gardens Project as part of a larger longitudinal study working with the informal community of Claverito in Iquitos Peru¹¹. Through implementing household gardens in Claverito, we hope to demonstrate how urban agriculture can increase dietary diversity while simultaneously producing healthier diets. The analysis in this thesis was performed to

determine if the household garden project changed dietary diversity and consumption of diverse food groups in the community.

Methods:

This paper focuses on the Household Gardens Project intervention of building gardens at the homes in the community of Claverito. To assess dietary diversity and garden foods consumption, a 24-hour dietary recall survey was administered pre and post intervention in February and July of 2018. Participants were also administered a Household Gardens Diary to quantify plants grown as a result of the gardens project. Consumption was then tabulated and analyzed using Individual Dietary Diversity Scoring, and rates of consumption between groups with and without gardens were compared.

Results:

Dietary diversity decreased community wide, with exception to the participating group with gardens who did not significantly change. Overall consumption decreased though Household Gardens participants were found to have an increase in consumption of overall protein, and starches and a decrease in fruits, oils/fats, and sugar/sweets.

Discussion:

Overall, this project aimed to investigate whether the Households Gardens Project changed dietary diversity of participating households and the current study found there to be no change. Important pieces of data were gleaned from study on consumption, more so than dietary diversity. Suggestions for future studies include more robust

surveys, consideration of plants grown, and collection time in order to accurately assess the individual dietary diversity along with following of garden food consumption.

Introduction:

Urbanization and Health

By 2020, nearly 1 billion people will live within urban slum conditions, characterized by a lack of infrastructure for water and sanitation along with a lack of tenure, overcrowding and precarious infrastructure¹⁷. These informal settlements are seeing a rise in population partially due to urban migration with a lack of political will to be able to address their needs^{1,2}. The rapid urbanization leaves slum dwelling families with a multitude of barriers to achieve good health, including food scarcity and lack of dietary diversity. Claverito is one such community in which many residents suffer from health issues such as parasitic infection, chronic diarrhea, depression, and food insecurity².

Urban poor in low-income communities are particularly vulnerable to food insecurity and poor dietary diversity¹⁰. Food security is defined as “when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life⁷. Studies have shown that fruits and vegetables consumption in low and middle income countries often fall below the recommended value, no scores were found for Peru, giving way for the need for further investigation⁸. While much research has been conducted for food security in

rural settings, much is still unknown for urban settlements which made way for the Household Gardens Project. InterACTION Labs initiated this project and the associated study as a way to make improving informal communities a priority¹¹.

Household Gardens Project

The Household Gardens Project (HGP) was an intervention that was part of an overarching community based One Health program. HGP was centered around providing household gardens to address food insecurity among other health issues in the larger study¹. We hypothesized that there would be an increase in dietary diversity as well as vegetable and fruit consumption in the community post HGP intervention with some of those fruits and vegetables being from the household gardens themselves.

The floating informal settlement community of Claverito was chosen in this study due to its known food insecurity, willingness to participate in the Household Gardens Project, similarity in size to a community previously studied in Lima, Peru, and its potential to serve as a pilot for similar community-based urban agriculture programs to address the dietary diversity and food insecurity crisis in larger slum communities². This paper will discuss one project within the InterACTION Labs, the introduction of a Household Gardens Project and the resultant effect upon dietary diversity.

Dietary Diversity Indicator

Dietary diversity is an indicator of household food security and is defined as the number

of unique food groups consumed by a household member over a given period^{3,9}. Healthy dietary diversity (DD) ensures nutritional adequacy through consumption of a variety of both macro and micronutrients⁶. A core component of dietary diversity is creating an evidence-based healthy diet pattern that includes fruits, vegetables, legumes, nuts, and whole grains^{5,7,9}. DD is associated with improved health outcomes that include improved body weight and anthropometric status and improved hemoglobin concentration, and is correlated with caloric and protein adequacy¹⁰. It is quick to document with an easy to use survey indicator for measuring the impact of a food access program with food insecurity as a core objective⁹. It serves as a qualitative measure that may reflect access to the variety of foods at the household level. Measuring dietary diversity has also been used as a proxy for individual nutrient adequacy and a surrogate marker for food access by showing a positive relationship between an increase in individual dietary diversity and household food security^{9,10}. This comes with a certain degree of difficulty as it is technically advanced in both data collection and analysis as well as time consuming, expensive, and difficult to track individual consumption⁸. Adequate household food access requires sufficient quality and quantity of food to meet all household members nutritional requirements to lead a productive life⁹.

Urban Agriculture

Urban agriculture has the potential to increase food security in the following ways: 1) households are able to produce their own food and thus provide nutritionally rich foods

and subsequently support a more varied and desired diet; 2) household expenditures on food are reduced and permit funds to be used to purchase other household needs, including more nutritional items; and 3) household gardens can provide a more stable access to food across seasons^{7,16}. Alternatively, lack of farming space can cause families to be subject to the fluctuating market cost of goods for consumption¹⁶. There are currently 821 million people experiencing food insecurity globally, with a majority residing in low income urban settlements^{3,10,17}. Many times, families spend half of their income on food and it has been shown that families fare better with supplemental food production for the home^{8,16,19}. Through implementing household gardens in Claverito, we hope to demonstrate how urban agriculture can increase dietary diversity while simultaneously producing healthier diets.

Objectives:

This analysis was performed to determine if the household garden project changed dietary diversity in the community, regardless of participation in the HGP, and to identify the potential impact on human health. The questions formulated to analyze this study are the following:

Research Questions:

1. What type and quantity of fruits, vegetables and herbs were added in Claverito as part of the Household Gardens Project?

2. How did dietary diversity change across the community of Claverito from February 2018 to July 2018, regardless of participation in the Household Gardens Project?
3. How did dietary diversity change in households who participated in the Household Gardens Project in comparison to those who did not participate?
4. Do the produce and herbs included in their Household Gardens show up in the diets of individuals living in those Households?

Methods:

Study Setting

The study took place in the informal floating community of Claverito located in Iquitos, Peru and is home to nearly 500,000 people and situated along the floodplain of the Amazon river within the Amazon Rainforest. Floating settlements such as Claverito are common in Iquitos and have resulted from rural to urban migration from indigenous villages^{1,2}. Within this community are 52 households with 270 individuals, and 240 domestic animals. Residents have lived here from 1-45 years¹. Many families in the community earn a living through selling goods in local markets or taking part in the fishing economy². The seasonal river levels see a 15-foot change in water level leaving the homes floating half of the year throughout the wet season². This plays a vital role in safety, illness, and food availability. Claverito isn't recognized by the city of Iquitos and therefore lacks resources that are needed to secure land tenure, and the infrastructure for sewer, water and electricity². As a result, residents suffer from health issues that

include chronic diarrhea, food insecurity, depression, injury, and parasitic infection^{2,11}. Preliminary studies have noted that 89% of the population identified as food insecure and as living in extreme poverty in contrast to Peru's national average of 30%^{2,4,11}. The site demonstrated needs that could be met through interdisciplinary work provided by the investigators². The community also expressed an interest in improving the conditions of their environment, solidifying the need that would help to mitigate negative impacts of the impoverished conditions^{2,11}.

InterACTION Labs proposed a long-term longitudinal study in the community of Claverito that included the introduction of a landscape intervention that would be installed each year and the effects upon human and ecological health were measured¹. Using a diverse team along with a participatory design approach, the focus of the study was placed on strategic design with the community to target and measure specific needs using the Transdisciplinary Action Research (TDAR) framework¹ to include 90 professionals across 16 disciplines¹¹.

Participants

Flyers were distributed with community leaders and workshops were held in order for residents to sign up to participate in both the HGP and a larger health study involving the built environment. All residents in Claverito were invited to participate in HGP if interested. The community engaged in the design process and implementation of the HGP which allowed preferences of the individual and household to be considered and

integrated. In place of monetary compensation, participants received materials, use of tools, and new skills to build gardens in exchange for participation in surveys before and after the intervention. All participants signed an agreement to participate in all surveys and workshops with the option to make up one missing workshop by meeting with the project team at a later date. Additional alternative compensation was brought in the form of modest food at workshops.

Intervention

A participatory design approach was used to ensure community needs were heard and that they had autonomy in the intervention process. The core project team initiated the partnership with Claverito residents in July 2015 and the time frame for this data in this thesis study is February 2018 to July of 2018. The project team collaborated with the individuals from households that participated in the HGP to design their gardens in February of 2018 and participants chose what would be planted within the gardens and what type of garden would be planted. The contents of the garden were herbs, fruits, vegetables, and beautification plants.

Data Collection

Each household in the community completed a 24-hour dietary recall survey before and after introduction to household gardens to measure dietary diversity, following the Food and Agriculture Organization of the United Nations (FAO) guidelines and then later tabulated into excel for cleaning and analyzing⁷. The 24 dietary recall survey asked the

individual to describe the foods that they ate or drank during the day or night beginning in the morning, listing all ingredients. Atypical consumption, and eating outside of the home are taken into consideration. Each household that participated in HGP also completed a Garden Diary to note what was grown and in what quantities.

Individual Dietary Diversity Score

The Individual Dietary Diversity Scoring (IDDS) system was used to compare dietary diversity pre and post intervention. This evaluated the number of unique food groups consumed over a given period of time and in this case, was calculated using the 24 hour recall from our surveys⁸. This is relevant to the study as the consumption of a diverse diet has generally been associated with better health outcomes^{5,6}. Dietary Diversity can be evaluated at the household or individual level as a proxy measure for food security. Household focuses on the socioeconomic status of the family while the individual evaluates nutritional adequacy which aligns more with the HGP^{5,13,18}.

The USAID and Food and Nutritional Technical Assistance guidelines were used to measure dietary diversity⁷. This categorizes foods into 12 basic groups and if a food group was eaten it counts for a score of 1, resulting in a simple addition score of 0-12^{7,9}. Dietary diversity does not have a standard score that needs to be met, we observed for change over time^{7,9}. The 24 dietary recall data were used to calculate IDDS which was used to compare individuals scores at pre and post intervention, calculating the mean and standard deviation along with using a paired t-test. In addition, a paired t-test was

used to test the hypothesis that the garden intervention group had higher IDDS scores than those who did not participate. Individual serving amounts were then compared to see if the amounts eaten of food groups changed.

Dietary Diversity Food Groups	
Grains <ul style="list-style-type: none"> • Rice, wheat and wheat products, maize, other 	Dairy or Dairy Products <ul style="list-style-type: none"> • Evaporated milk, yogurt, other
Tubers, Roots, Starchy Vegetables <ul style="list-style-type: none"> • Potatoes, Yuca, Plantain 	Meat and Poultry <ul style="list-style-type: none"> • Beef • Chicken • Pork • Organ meat
Vegetables <p>Green vegetables</p> <ul style="list-style-type: none"> • Peas, Cucumber, other <p>Red and Orange vegetables</p> <ul style="list-style-type: none"> • Pepper, tomato, carrot, other <p>Aromatic vegetables</p> <ul style="list-style-type: none"> • Garlic, ginger, onion, cilantro, other 	Fish
	Eggs
	Fats and Oils
	Legumes and Nuts <ul style="list-style-type: none"> • Dry beans, lentils, peas • Soy product • Peanuts
Fruits <ul style="list-style-type: none"> • Coconut, cocona, lemon, mandarin, other 	Sweets and Sugar <ul style="list-style-type: none"> • Sugar, prepared sweets, other

Figure 1: Dietary Diversity Food Groups

Given that IDDS would not show what garden foods were eaten during the intervention, individual consumption was also calculated. The 24 dietary recall data were used to calculate individual consumption of ingredients, which was used to compare individuals consumption before and after the intervention. Each ingredient used in meals was counted and put into the same DD categories. There was no minimum amount needed for the purpose of this study to be included. Individual servings were then calculated

and compared using the paired t-test.

Lastly, to determine if the produce and herbs included in the Household Gardens were present in the diets of the individuals living in the households that participated, the produce was listed and compared to produce that appeared in the dietary recall of those individuals that were living in that house.

Data Management

Initial data from the physical form was input into the REDCap online data management system and then transferred into excel with password protection for cleaning and analysis.

Participation Selection

All individuals in the community were invited via *mingas* (neighborhood work parties), door to door or through flyers. All individuals with pre and post intervention 24 hour dietary recall were included in this thesis study.

Results:

Participants

Claverito was home to 52 inhabited households in 2018 with a population of 270 individuals with an average household size of 5.19 individuals. 31 households participated in the Household Garden Project, a 41% increase from the previous year's intervention.

	Garden Participants	Control Group
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Individuals	67.6% (n=73)	32.4% (n=35)
Age (Mean)	22.2 (0-79)	26.1 (0-81)
Male (%)	46.5%	43.4%

Table 1: Demographics for HGP participants

Household Garden Diaries:

The household garden diaries provided insight into what plants were grown and in what quantities. 2018 Household Gardens grew a total of 64 species of plants, 901 plants total; 9% of the plants grown were for beautification and 91% were edible.

Type	Name	Plant #	Percentage of total plants
Edible	Vegetable	159 plants	17.6%
	Fruit	229 plants	25.4%
	Herb	428 plants	47.5%
Total Edible		817 plants	90.5%
Non-Edible	Ornamental	84 plants	9.5%
Total Plants Grown		901 plants	F+V Total: 43.0%

Table 2: Percentage of Plant Types Grown in HGP

Vegetables		Fruits		Herbs			
AJI CHARAPITA	27	CAÑA	2	ALBACA	16	MOTELILLO	1
AJI MIRAZOL	1	COCONA	2	ALBAQUILLA	1	MUCURA	18
AJI PIMENTON	1	LIMON	1	CAGUENA	5	OREGANO	10
AJI PIQUITO DE MONO	1	MANDARINA	201	CAIHUA	3	PAMPA OREGANO	14
AJO	2	MANGO	1	GUAYUSA	5	PATQUINA NEGRA	7

CAMOTE	1	MANI	1	HIERBA LUISA	24	PATQUINA ROJA	12
CEBOLLA CHINA	53	MARACUYA	2	KION	18	PLANTA DE LA VIDA	1
CEBOLLA ROJA	19	PINA	3	LIMONCILLO	6	ROSA SISA	20
PEPINO	2	PIÑON COLORADO	2	LLAMA PLATA	6	SABILA	9
SACHACULANTRO	49	SANGRIA	14	MALVA	203	TUMBO	4
TOMATE	2			MENTA	34	TOE	2
WAGUAR PIRI PIRI	1					VERBANA	6
Total	159	Total	229			Total	428

Table 3: Plants Grown in Household Gardens Project and Quantities

The average household grew 29.06 plants, ranging from 1 - 218 plants with two outlier families growing 200 malva (mallow) plants or 200 mandarin plants grown between six different garden vessels. 87% (27) of HGP households said the gardens were useful for consumption while 13% (4) disagreed. 61% of households reported sharing their produce along with 51% reporting investing in their own resources to continue growing their gardens after the intervention period had ended.

Household Plants in Gardens (901)				
Species	Minimum	Maximum	Median	Mode
64	6	218	29.06	11

Table 4: Garden Type



Wall 11.9% (8)	Potted 6% (4)	Window 16.4 (11)	Entrance 20.9% (14)	Floating 43.3% (29)	Other 1.5% (1)
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Figure 2: Garden Types

Dietary Diversity:

In regards to the hypothesis that there will be an increase in dietary diversity as well as vegetable and fruit consumption in the community post HGP intervention, we found this hypothesis to be incorrect as there was no increase in dietary diversity for the individuals that participated in the study. When looking at dietary diversity (DD) from the 24-hour dietary recall surveys, DD decreased statistically significantly across the entire community regardless of whether the household had a garden or not. Dietary diversity also decreased statistically significantly amongst the individuals who did not participate in the HGP over the intervention period (n=35), however this decrease was more than the average across the community. While not statistically significant, the individuals who did participate in the HGP (had a garden) decreased their IDDS score more than half as much than those who did not have a garden (n=73).

IDDS Scores Significance Level					
	Feb	July	P-value	MEAN DIF	
Total (n=108)	8.62	8.30	0.048	-0.32	
Garden (n=73)	8.48	8.26	0.19	-0.22	
No Garden (n=35)	8.91	8.37	0.038	-0.54	

Figure 3: IDDS Scores, mean difference and their p-value

Individual Consumption

Individuals who participated in the Household Garden Project had a statistically significant increase in overall protein consumption (meat, poultry, fish) and the root and starches category. These same participants saw a decrease in eggs, fats, and sweets. The group of individuals who did not participate in HGP showed a decrease in overall consumption and had a decrease in servings of fruits and oil/fats categories.

		meat/ poultry	fish	root/tub er	cereals / grains	fruits	vegetable s	eggs	legumes/n uts	milk	oil/fat	sugar/swe et	misc (condimen ts)	ALL SERVINGS	only fruit or veg serving	combined protein
All individuals in the community of Claverito who participated in the study (n=108)	Difference of Means, pre to post intervention	0.15	0.15	0.15	-0.20	-0.77	-0.32	-0.20	-0.03	-0.10	-1.31	-0.99	0.24	-3.25	-1.09	0.30
	paired t-test(pvalue)	0.09	0.06	0.17	0.13	0.00	0.21	0.02	0.30	0.11	0.00	0.00	0.20	0.00	0.02	0.03
Individuals who participated in the HGP and have a garden (n=73)	Difference of Means, pre to post intervention	0.21	0.14	0.34	-0.25	-0.55	-0.25	-0.16	0.01	-0.12	-1.15	-1.33	0.03	-0.26	-0.40	0.17
	paired t-test(pvalue)	0.06	0.12	0.05	0.15	0.01	0.31	0.08	0.41	0.10	0.00	0.00	0.47	0.00	0.11	0.03
Individuals who did not participate in the HGP and do not have a garden (n=35)	Difference of Means, pre to post intervention	0.03	0.17	-0.36	-0.11	-1.23	-0.49	-0.29	-0.11	-0.06	-1.66	-0.29	0.69	-0.30	-0.86	0.10
	paired t-test(pvalue)	0.44	0.15	0.12	0.34	0.00	0.24	0.04	0.15	0.37	0.00	0.12	0.07	0.01	0.04	0.25
Comparing differences of means of those with a garden to those without a garden	Difference of Means Differences	0.18	-0.03	0.70	-0.13	0.68	0.24	0.12	0.13	-0.07	0.51	-1.04	-0.66	0.04	0.46	0.07

Table 5: Consumption significant level changes in IDDS categories.

	Garden	No Garden
Increase in Consumption	Overall protein, root/starch	
Decrease in Consumption	fruits, oil/fat, sugar/sweets	fruits, eggs, oil/fats, combined fruits and vegetables, all servings

Table 6: Statistically significant consumption changes per category pre and post intervention for those participants with gardens versus without gardens

Household Gardens Project Produce Consumption

With 91% of the plants grown in HGP, tracking produce grown to find if they became a part of the community diet was an important and difficult task. Of the items that were grown as a part of HGP, cocona (local citrus vegetable) and hierba luisa (lemongrass) were new additions found in the diet post intervention. Foods that previously were found in the diet but continued to be a thread in the diets of HGP participants were aji charapita, aji pimenton, aji piquito de mono, ajo (garlic), cebolla china (green onion),

cocona, hierba luisa, limon (lime), sachaculanthro (local cilantro), and tomate (local tomato).



Figure 6: HGP plants used post intervention

Discussion:

Study Findings

In this study, the IDDS created by FANTA (FAO) was used to analyze dietary diversity in Household Garden Participants and community members as a proxy measure for food security. We found the hypothesis to be incorrect as there was no increase in dietary diversity for the individuals that participated. There was a decrease in overall consumption in the entire community and in both intervention groups. The group that participated in HGP saw no statistically significant change in dietary diversity. Analyzing individual consumption between groups gave more insight into what was being eaten, including items from the household gardens.

Strengths

HGP allowed the researchers to create a program that would incorporate community needs and interests. Overall, household garden usage and participation in HGP increased from the previous year's interventions. Even though there was an overall decrease in consumption levels community wide, the increase in the total protein, protein, and starch categories has large implications for the food security in the community. A secondary paper within the same working group found the same increase in protein consumption. As protein is more expensive, increased consumption may reflect increased purchasing power through supplementation from the household garden. If there is supplementation of fruits, herbs and vegetables for consumption from the gardens, this may open up an opportunity to purchase more high satiety items like protein. To further support this possibility, there was a reduction in both fats and sweets and sugar groups in the intervention group who had an increase in protein. If more dense foods with higher satiety and nutrition, like protein and starches, are being consumed, there is likely to be less of a need to add fats and sweets to the diet. In addition, while not statistically significant, there is some indication that participants with a garden may be more resilient to overall community declines in consumption than those without a garden; more analysis is needed over the longer term and with more participating individuals to understand this trend further.

Limitations

The methodology used in this thesis study may need to be adjusted for future research. For the purpose of this thesis, assessing if the gardens had an effect on diet dietary

diversity using the 24 hour dietary recall may not have been the appropriate method. Data was focused on 24 hours of the same day which only provided a snapshot into the diet which is limited in accuracy of overall diet. This does not show true diversity for IDDS or at the household level, especially in reference to the garden items being consumed, as they may have been consumed on a different day.

The survey administration period also limited the analysis. February to June was originally chosen to meet funding requirements, and capture data within the same season, the high river season. However an unpredictable and changing climate in the Amazon Rainforest caused severe weather events that delayed garden construction and the post intervention period was moved to July to allow for one month of garden growing and consumption. While in other recent years (2015, 2016, 2017, 2019) July is also the high water season, the season turned unpredictably the year of the study (2018), making the pre and post in two different seasons- the high river season and the transition period between the high and low river seasons. This new season may have contributed to the overall decline of community consumption, and may have had an effect on not only what is being grown but also on dietary recall. For example, the day of collection for July surveys there was a drastic change in river levels causing community members to purchase additional supplies to stabilize their houses, which may have left participants concerned with food access on this day, or what they recall eating at this time.

It was also difficult to track consumption of garden produce using 24-hour recall alone, as residents may not have consumed their produce on that exact day of data capture, or they may have bartered or sold their produce to others within or outside the community. Additional instruments would be needed to track the produce from the gardens and where they end up within the community. Lastly, the environment plays a large role in this experiment and as such is a limitation in itself. Seasonality unpredictability in conjunction with first harvest may be a reason why a majority of the items did not show up in the diet of individuals with gardens. Items such as roots and tubers, annual fruit trees, and some vegetables may take longer than the initial one month to harvest that the study allowed.

Lastly, the small number of participants in which we had their data pre and post intervention and the overall small amounts of servings of categories of food may have contributed to issues calculating statistical significance using the paired t-test. Consideration of other methods of statistical validity and/or increasing study participation might be helpful for future studies.

Impact of Household Gardens

Though dietary diversity was the key study focus, the study has a broader impact past food consumption. Participating in green spaces improves overall physical and mental health¹⁰. Participating in the Household Gardens Project offers access to fruits and vegetables that have the ability to increase consumption in income areas like Claverito

that have a high incidence of non-communicable disease^{8,10}. Long term participation can improve food security and reduce the onset of chronic NCD and reduce overall stress^{10,12}. The items that were consumed from the household gardens are nutritionally substantial and feed into important components of the overarching study. Peppers, cocona, and lime are all high in vitamin c, which is a promoter of iron absorption, an issue being covered by another study in Claverito. Hierba luisa, one of the new plants that appeared in the diet, is used culturally to aid in digestion, soothe stomach pains, and prevent vomiting as well as aids in oral health.

Recommendations

Future research may benefit from shifting the 24 hour dietary recall to a 3-7 day recall period. This will allow for a reduction in inaccuracy by providing a frequency of items eaten and spanning more than one point in time. By showing more than one day, we may be able to see if items were ready for harvest from the garden and eaten. An additional instrument to track produce could also supplement the dietary recall data. Seasonal variation needs to be taken into consideration by surveys being conducted to span an entire year or repeated in multiple seasons. Here, we approached collection in two different seasons. Annual or seasonal collections may serve as better indicators for consumption of garden items.

Constructing a validity point by setting a minimum portion value for individual food group consumption in place if including any and all ingredients is another consideration for

future work in order to eliminate some noise of items that are not nutritionally important for the purpose of following urban agriculture, garden usage and consumption.

Redefining nutritional groups based on nutritional values specific to Claverito, as done in a previous study in Ghana is another recommendation to consider to make sure that all food groups are being represented properly²⁰. Many items grown and eaten in Peru serve both medicinal, herbal, and nutritional purposes.

Lastly, following the community's engagement and consumption proved difficult with this analysis. By providing an additional qualitative component at the time of collection, we may be able to follow items that are grown to see if they are being shared, sold, or used for bartering. This in turn may solidify our findings and assumptions about how protein consumption has increased in garden participants. Food Insecurity is a complex issue that requires a deeper evaluation of contributing social components.

Conclusion

Overall, this project aimed to investigate whether the Households Gardens Project changed dietary diversity of participating households and the current study found there was no change, but suggested that access to products grown in the gardens may have liberated funds to purchase more expensive consumables, such as meat, thus reflecting signs of decreased food insecurity. Important pieces of data were gleaned from study on consumption. Improvement for future studies could include more robust surveys, consideration of plant's growth needs, data collection time and additional data to be

gathered in order to accurately assess the individual dietary diversity along with following of garden food consumption.

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