

# Using Community-Based Participatory Research to Identify and Prioritize Interventions for Ameliorating Food Security and Health in Chacraseca, Nicaragua

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## Abstract

In this study, we report the results of a needs assessment conducted using community-based participatory research (CBPR) and concept mapping to identify and prioritize interventions for improved food security and health in Chacraseca, Nicaragua. The study involved stakeholders from Auburn University, a non-profit organization (JustHope, Inc.), medical doctors, and community members from Chacraseca. We purposively recruited twelve participants from the Chacraseca community for focus group discussions, food security surveys, and the determination of socio-economic characteristics. Two medical doctors and three community leaders were recruited for key informant interviews. We identified priority health concerns, environmental issues, and available community assets that affected community food security and health. Participants suggested five interventions to health and food security disparities: extension of micro-credit facilities, the establishment of small-scale food processing technologies, investment in sustainable agriculture practices, the extension of nutrition education mission groups, and expansion of the community medical staff. Through concept mapping, investment in sustainable agriculture, and extension of nutrition education mission groups were identified as priority interventions. We used the findings from this study to design community gardening and nutrition education interventions for the Chacraseca community.

**Keywords:** Community-Based Participatory Research; Key Informants; Focus Groups; Concept Mapping

## Introduction

Chacraseca is one of the 119 rural communities within the department of Leon in Nicaragua [1]. In the 1960s and 1970s, Chacraseca, and the rest of Leon largely depended on the cultivation of cotton driven by the need for intensive farming for export [2]. Excessive cotton production required a continuous increase in chemical use to combat resistant cotton diseases and thus led to contamination of local water sources and the soil that were key resources for food production [3]. After the collapse of the cotton industry due to surplus world cotton production, rise in synthetic cloth products, and increased cotton production costs [3], the level of unemployment in Leon rose to as high as 60% during the 1990s thus leading to decreased food security and health [4]. Additionally, in a bid to expand to virgin soils, many trees had been felled leading to soil erosion, further affecting crop production [3].

Another setback to community food security was government structural adjustments. In the 1990s Nicaragua's central government established economic policy reforms in a bid to reduce government expenditure on the social sector and to make Nicaragua eligible for assistance from the international lending community [5]. However, the structural adjustment reforms led to decreased financial support to rural farming communities specifically within Leon [5]. With limited government support, a coalition of stakeholders including representatives from the local government, community-based organizations, non-government organizations, and bilateral agencies banded together to address priorities and health needs [4].

Even with combined efforts from community organizations and with partnerships from local and international organizations, effects of policy reforms, climate change, and cotton monoculture on community food production and health in Chacraseca remain eminent [6]. This could be partly because organizations working within Chacraseca do not actively engage the local community in decision making. Community-based participatory research (CBPR) is an approach that accentuates inputs from various stakeholders with varied experiences and perspectives to develop community appropriate interventions [7]. Even though CBPR has been shown to lead to the development of communally acceptable interventions, one major limitation is that the formation of

working relationships among stakeholders is slow and interventions generated may not attend to all perceptions of the group [8]. This shortcoming may be overcome by supplementing CBPR with concept mapping.

Concept mapping is a structured method for organizing ideas from multiple, diverse stakeholders into a common framework [9]. Even though both CBPR and concept mapping have been used in needs assessment and in designing interventions around the world [10-12], there is limited literature where both approaches have been used to design priority community interventions. Thus, the goal for the present study was to conduct a needs assessment using CBPR principles and to use concept mapping to prioritize interventions for combating food insecurity and health disparities in Chacraseca, Nicaragua.

## Methods

### The Chacraseca Community-Academic Research Team Partnership

In this study, we designed the methodology section to ensure active participation of all stakeholders involved in food security and health issues in Chacraseca. Researchers from the Auburn University College of Human Sciences teamed with JustHope, Inc., a non-government organization that has worked to improve living standards in the Chacraseca community for over 20 years. JustHope, Inc. organized a meeting during which the academic team was introduced to leaders of the 12 sectors within Chacraseca. Through purposive sampling, sector leaders recruited participants, one from each of their respective sectors. The 12 participants identified were divided into two groups of six for the focus group discussions. The academic research team designed both the focus group and the socioeconomic questionnaires following human subjects' protocol and approval from Auburn University as well as from the National Autonomous University of Nicaragua in Leon.

All survey instruments were available in English and Spanish and were pre-tested for appropriateness in literacy, language, and clarity with the help of three sector leaders. The three sector leaders involved in pre-testing were later not included in the needs assessment as they would have gained knowledge about the study, and thus likely provide biased data. In addition to organizing the meetings, JustHope, Inc. provided the site for the focus group interviews and was the intermediary among the stakeholders. The team was joined by two medical doctors from two of the three health centers in Chacraseca. The doctors were later interviewed as key informants together with three sector leaders. The academic team led the interviews, recorded, and analyzed the data. Due to complexity that is usually associated with understanding numbers, the Chacraseca community was not involved in data analysis but researchers explained the relevancy of the data to the community. At the end of the research, we organized a debriefing session where results were explained to the stakeholders.

### Focus Group Discussion and Key Informant Interviews

The focus group discussions and key informant interviews were done between June 11<sup>th</sup> and June 18<sup>th</sup>, 2015 at the peace house owned by JustHope, Inc. Two focus group discussions were done comprising of six participants per group recruited from the 12 sectors of Chacraseca. The key informant interviews were done with two medical doctors and three community leaders. Two similar semi-structured interview scripts were used for the 12 participants in the focus groups and the five key informants. The key informant questions were designed to supplement responses from the focus group discussions. Topics for focus group discussions were chosen based on literature that showed Chacraseca to have irregular rainfall patterns and soil erosion that affected crop production [13]. From the topics, questions were formulated based on a questionnaire design set by a non-profit organization, ACAPS [14]. Topics for the focus group included: (i) foods available in the community, (ii) availability of food in markets, (iii) ease of access to the markets, (iv) market food prices, (v) foods grown in their home gardens, (vi) presence of food storage facilities, (vii) issues surrounding the growing of food, (viii) interest in working as a community, and lastly (ix) suggestions for community interventions to help improve food security and health.

We arrived at the focus group discussion site 45 minutes in advance, allowing for ample time to set up materials: seats, flipcharts, drinking water, snacks, informed consent forms, and pens and to welcome the participants as they arrived. To overcome language barriers, JustHope, Inc. provided a translator who was fluent in both English and Spanish. The translator would listen to English questions and comments read by researchers and convey the information to participants in Spanish, then deliver responses to the researchers in English. The discussions began with greetings and introductions. This was followed by explaining the purpose of the study along with informing participants that participation was voluntary and that they should air out their views while respecting other participants' opinions. After the attainment of written informed consents, discussions began and were audiotaped for analysis. At the end of the discussions, participants were asked whether they had additional information and were later thanked for participation.

Key informant interviews with the two medical doctors were done at two health centers in *Pedro Arauz Palacios* and *Raul Cabezas Lacayo* sectors, whereas interviews with the sector leaders were done at the same site as the focus group discussions. The format and content for sector leaders' interviews were synonymous with that of the focus group discussions. Key informant interview questions for the doctors were related to (i) common health conditions, (ii) risk factors for the most common health conditions (iii) availability of medicine in the health centers (iv) ease of access to health centers, and (v) suggestions for improvement of community health. All the five key informant discussions were audio-recorded and each lasted 30 minutes.

## Surveys

Quantitative data was collected after the focus group discussions and the key informant interviews. The USDA six-item short-form food security survey module was used to collect information about the food security status of respondents [15]. The six-item survey module consists of questions relating to whether participants could afford food in the last 12 months and if not, how often they cut meal size portions, skipped meals, or went hungry. Completed surveys were given scale scores and classified into food security levels based on the total number of affirmative responses: 0-1 = high food security, 2-4 = low food security, and 5-6 = very low food security [15]. An additional questionnaire was administered to determine the socioeconomic status of participants including age, household size, source of income, the food crops grown on their farms, food purchased from the market, food security coping strategies, arable land size, and ownership of farm animals.

## Analysis

Focus group discussions and key informant interviews were audio-recorded and transcribed verbatim by a researcher on the academic team. The principle investigator reread the transcripts and created separate summary documents for the focus group discussion and key informant interviews. Researchers coded and analyzed the transcripts for content to reveal major emerging themes using ATLAS.ti version 8.2.4 for iOS. Interventions suggested for the improvement of health and food security were subject to concept mapping to identify priority interventions. Analysis of quantitative data consisted of calculating descriptive statistics including means, frequencies, and percentages using Microsoft Excel for iOS.

## Results

### Characteristics of Participants

The characteristics of the 12 participants involved in the focus group discussions and the three community leaders involved in key informant interviews are presented, Table 1. Of the participants, 66.6% (n=10) were female whereas 33.4% (n=5) were male. Participants' age varied from 18 years to 65 years with the average age of  $40.1 \pm 12.4$  years. Household sizes varied from 1 to 10 family members. The average household size was  $4.9 \pm 2.5$  family members. Most participants (n=8) sourced their food from both the market and from their farms. Seven participants sourced their food exclusively from the markets. There were no participants who reported obtaining food exclusively from their farms. Using the six-item food security survey module, out of the fifteen respondents, six were classified as food secure. Coping strategies for food-insecure households included reducing portions, getting food from family members, skipping meals, selling farm animals, and bartering.

Characteristic	Frequency (n = 15)	Percentage
<b>Gender</b>		
Female	10	66.6
Male	5	33.4
<b>Household size</b>		
1 to 3	5	33.3
4 to 6	7	46.7
7 to 10	3	20.0
<b>Source of food</b>		
Market	7	47.0
Market and farm	8	53.0
<b>Coping strategy</b>		
Reduce portions	1	6.7
Skip meals	2	13.3
Borrow from Neighbors	1	6.7
Barter trade	1	6.7
Borrow from other family members	3	20.0
Sale farm animals	1	6.7

**Table 1:** Socioeconomic Characteristics of Respondents, Chacraseca, 2015

### Major Themes

Major themes derived from focus group discussions are presented in Table 2 and include sources of food, food access, attitudes towards communal work, and preferred interventions. The themes are discussed below.

**Food Source:** Participants reported that most of the foods including staples (rice, beans, tortillas, and cheeses), fruits, meat (poultry, beef, and pork), seasonings, cooking oil, and drinks were purchased from markets in Leon and in case of immediate need, from local small shops located throughout the Chacraseca community. One respondent was quoted saying,

*“We have a variety of fruits in the market, at least you find different fruits in the market.”*

While another respondent reported that, *“Fruits are seasonal, now you will have access to mangoes and oranges, but you will barely find any of those fruits in December. Even in the market, fruit prices will steadily increase starting in August.”*

Some residents reported hunting for iguanas from thickets that covered most of Chacraseca. The iguanas were used to make soups that were an important protein source. Tortillas and cheeses that accompanied the main dish were readily available locally.

Themes	Focus group Sample Quote
Source of food	<p>“It depends on what you want to eat. Most times we eat rice and beans and these we buy from markets in Leon. Sometimes from our small shops. My husband grows pipian and eggplants but sometimes we buy them too.”</p> <p>“I buy the major foods, like beans, rice and sometimes beef from Leon. I usually send my daughter to buy cooking oil and salt from a shop across the road.”</p> <p>“I grow Pipian in my garden, my older brother grows papayas and mangoes. When I want a papaya, I take to him some Pipian.”</p>
Food access	<p>“There is transport to Leon. In Leon there is everything, eggs, beans, rice, beef, pork, anything you want. The bus is always here, you get on the bus, buy food and get back.”</p> <p>“In Las Lomas, we have to buy a lot of food for about two weeks, especially in the rainy season. You will see how bad the road is when you come to visit.”</p>
Food source preference	<p>“Food is food, whether you grow it, buy it or beg. But it is good to know that you will have food. If you can go to the market, well and good but sometimes it is good to grow your own food. You never know.”</p> <p>“From any source, to me it doesn't matter.”</p> <p>“I would love to grow my own food so that I can use money for my business to complete constructing my house.”</p>
Affordability	<p>“Rice is cheap, everywhere rice is cheap, 16 Codobas for one pound. It feeds my family of four. Beans too are cheap. I think food is affordable. Especially if you work, life may be different if you don't work.”</p> <p>“It does not matter whether food is cheap or expensive, I still have to feed my family.”</p>
Food storage	<p>“There's no need to store food, we can buy from Leon using the bus. Rice and beans and tortilla and cheese. Tortilla you can get it here.”</p> <p>“Rice and beans store well. I have a fridge to store meat and fruits, but the cost of electricity is high, most times my wife turns off the fridge.”</p> <p>“Everyone in my sector has electricity but speaking for myself the bill is expensive when you turn on the fridge even for a few hours.”</p>
Attitude towards group work	<p>“We always work in groups. With mission groups at casa de Paz. Medical missions, music groups. My daughter is in the music group at JustHope, Inc. If we work together as a group, we can solve many issues, not just food issues, health issues and education too.”</p> <p>“I like group work, especially if everyone completes their assigned task.”</p>
Preferred intervention	<p>“Microcredit for women and maybe for men. We need to have our own businesses – to be bosses and create jobs. Our community is agricultural but now we can't grow food. No rain. Crops can't grow without rain.”</p> <p>“My son-in-law has a papaya farm. La Colonia buys our papaya's and it is profitable. Now our whole family is involved in papaya farming and we are becoming famous for that.”</p> <p>“We have many markets but most of the food in these markets is not grown in Chacraseca. I wish we could be able to supply these markets.”</p>

**Table 2:** Major Themes Derived from Focus Group Discussion, Chacraseca, 2015

Some participants reported engaging in food processing in their homes to supplement foods purchased from markets, local stores and, those grown in their gardens. Cheese was available from markets in Leon city, but some families purchased milk and made their cheeses. In the same way, even though tortillas were widely sold in local shops, to save money, most families purchased whole corn kernels, had the kernels milled at either of the two maize mills in *Raul Cabezas Locayo*, and used the flour to make tortillas in their homes. A few participants reported to grow some vegetables; one participant said that,

*“I have a garden where we grow green pepper, red pepper, winter squash, and some corn. But my soil will not allow beans to grow, we therefore have to buy the beans. Rice will not grow too, it requires a lot of water and Chacraseca is dry, so I buy that too.”*

From the focus group discussions, it was evident that participants sourced their food from markets in Leon, from small shops within the community, and from their gardens.

**Food Access:** Participants reported that one major unpaved transport route ran through Chacraseca. They further explained that markets in Leon were accessed through that major route using buses that ran on a fixed schedule from Monday to Saturday. The residents who lived distant from the access road used bicycles and horses to get closer to the road and then hopped onto the buses to food markets in Leon. The discussion revealed that a few residents owned motorcycles and did not rely on the bus system for transport to the markets. With these modes of transportation, some residents reported that it was easier to get access to food. However, even with the access route, some participants reported difficulty in accessing food markets. One participant who was also the sector leader for *Boca de Cantaro* stated that,

*“The major road does not go through our sector; my people use horses to get close to the road and only then can they board the buses to access markets”.*

From the focus group discussions, it was revealed that besides the seasonal changes in fruit and vegetable availability, the rainy season influenced food access by having an impact on the quality of the road. Participants reported that the main road remained passible in the rainy season, but the feeder roads became flooded and impassable during heavy rains hindering transport to and from food markets.

**Attitude Towards Working as a Community:** The discussion revealed that participants welcomed working on community projects in groups. This was shown as participants reported to engage in group activities organized by JustHope, Inc. From the responses, it was revealed that participants perceived group work to mean less work per individual but with higher outputs. Conversely, some respondents said that during group projects, the most active members would end up having to do most of the work in case some group members skipped or chose to be inactive. As such, some respondents advised that group work had to be organized with designated roles for everyone. One of the respondents involved in a saving and credit group organized by JustHope, Inc. was quoted saying that,

*“I have been involved with our saving group for two years now. In the beginning, we had disagreements but now we learned our weaknesses and strengths. We complement each other. We still have a few disagreements but now we can work around our differences.”*

Participants explained that given that their settlements were divided into sectors under guidance from JustHope, Inc., for future projects, sector leaders can organize their members to work on set projects. Participants reported how they have always gathered in groups at health centers to receive information from health mission groups.

**Preferred Intervention:** Several interventions were suggested during the discussion most of which were in line with creating employment. The three most mentioned interventions were: (i) extension of credit services, (ii) training in food processing technologies, and (iii) investing in sustainable agriculture practices. Participants reported that they had observed operations of saving and credit groups in neighboring communities and they hoped to establish their own. It was also reported that JustHope, Inc. had introduced a saving and credit group for women within Chacraseca and the suggestion was to increase the size of the already established group to allow for more members. Additionally, there was a hardware store (a shop for house construction materials) connected to a secondhand clothes' shop that was set up by JustHope, Inc. to create employment for women. Participants expressed interest in expanding the microcredit, hardware, and secondhand cloth businesses that were already operating within Chacraseca.

The discussion group suggested investment in sustainable agricultural interventions. This topic kindled a great debate as participants rushed to explicate how poor in nutrients their soil was and that the ever-changing climate conditions presented a challenge. Participants argued that the summers had become longer and hotter extending into the rainy season. One participant, a farmer, explained how he learned manure composting and irrigation from a mission group and that he currently employs both technologies to grow cashew nuts. The farmer stated,

*“We have the greatest resource, soil. We just need to learn from each other how to best use our land.”*

However, some participants pointed out that they did not have land for growing food, while others claimed that they leased out their land to companies that had the financial ability to buy soil fertilizers and herbicides.

## Major Themes Derived from Key Informant Interviews

Major Themes	Sample Quotes
Most common health conditions	<p>“Most people who come here have respiratory problems. It is due to thirst, not anything else. It is not smoking, but it could be to some extent. But women do not smoke, only a few do.”</p> <p>“Patients present with various health condition from diabetes, blood pressure, gout, chikungunya and respiratory problems”</p>
Availability of medicine	<p>“If patients present with flue and cough, we give them the medicine. Even paracetamols. For complicated cases, we just write them prescriptions.”</p> <p>“Some medical missionaries come and treat patients right here. Other missionaries choose to just send us the medicine. other than that, we are sometimes short on medicine.”</p>
Ease of access to health centers	<p>“My patients come here by bus. It drops them right there and they walk. The bus stop is close by.”</p> <p>“We treat patients from the sectors that are close by, others will go to the hospitals next to their sectors.”</p>
Suggestion for improvement of health conditions	<p>“Mission groups are of great help, they bring medicine. Last month a medical team came here, they held a meeting and taught the community how to prevent eye problems and take care of their health.”</p> <p>“We appreciate advice and services aimed at helping our community.”</p> <p>“We work with JustHope, Inc., whenever they bring ideas, we work tirelessly to implement them because this is our community.”</p>

**Table 3:** Major Themes Derived from Key Informant Interviews

The health professionals were recommended for interviews by JustHope, Inc. staff given that these doctors attend to the medical needs of several community members during medical visits and therefore knew more about issues within the community. The major emerging themes are presented in Table 3 and are discussed below.

**Most Common Health Conditions:** Interviews revealed various health conditions including respiratory problems, gout, high blood pressure, chikungunya fever (chikungunya is a viral disease transmitted by mosquitoes), and diabetes. Adult populations were reported to have a high prevalence of diabetes and high blood pressure. Both doctors mentioned respiratory problems as the most common health issues in both children and adults. Doctors explained that respiratory problems were due to dust storms that existed in the dry season stretching from November to May. One doctor stated that,

*“Since fields are left bare in the dry season after harvesting, the wind raises the dry topsoil carrying it towards the community. Besides, respiratory conditions could be caused by Sulfur gases from the constant volcanic eruptions.”*

Doctors reported that based on their medical records, men had higher rates of gout and uric acid levels than women and that this could have been due to the higher consumption of alcohol in men than in women.

**Availability of Medications:** Key informants revealed that health centers in Chacraseca provided free medication for medical conditions like influenza, cough, and pain. The doctors reported that diagnosis and prescription were free at health centers in Chacraseca, but complicated cases were handled at the larger hospitals in Leon. Doctors explained how there were various privately-owned pharmacies in Leon from which patients received prescribed medications. Doctors reported that JustHope, Inc. invited medical mission groups from the U.S.A. and Europe. In Chacraseca, the Nicaragua Ministry of Health provided medication for two health centers, but the third center was stocked by JustHope, Inc. In addition to providing medical equipment, doctors reported medical mission groups to provide medical services.

**Ease of Access to Health Centers:** The doctors reported how there were three health centers in Chacraseca located approximately 12 miles apart. All the three health centers were easily accessible from the main road and, were open to the public on Mondays, Tuesdays, and Thursdays but closed the rest of the week except for Fridays that were reserved solely for emergency cases. All surgeries were reported to be free of charge in the main hospitals in Leon but not in any of the three health centers in Chacraseca. The doctors reported that community members who resided in sectors distant from the main road including *Las Lomas* and *Boca de Cantaro* had to use means of transport other than the bus to get to the transport route to the health centers. This commute was reported to be a hardship, especially during rainy seasons when the dirt roads become slippery and impassable. One of the doctors was quoted saying,

*“I receive patients from Las Lomas and Boca de Cantaro. These sectors are distant from us and technically we should have medical centers there too. They have some of the poorest roads and at the beginning of the rains last month, the road to Las Lomas was cut off by a mudslide.”*

Doctors explained how they sometimes traveled to distant sectors to extend medical services to the elderly and expectant mothers. Additionally, doctors mentioned how some patients relied on traditional medicine because of the inability to access the hospitals.

**Suggestions for Improvement of Health Conditions:** The doctors expressed appreciation for the support from JustHope, Inc., especially for the medical services and equipment given by the mission groups. On that note, the doctors said that they were open to receiving more medical mission groups as well as any other help from other parties. The team desired to establish collaboration with universities from the U.S.A. or other countries. The doctors expressed the need to have missions or programs targeting lifestyle and diets. The doctor from *Pedro Arauz Palacios* expressed how they needed more permanent staff or if possible, to extend some private clinics within Chacraseca. The doctor from *Raul Cabezas Lacayo* insisted on the need for health-promoting projects by saying,

*“We need to prevent some of the medical conditions before they appear.”*

Both doctors expressed how the prevention of disease was a better option than treatment given that Chacraseca had only three health centers with inadequate medical supplies. Doctors further conveyed how the construction of roads to reach distant sectors or the enrollment of more doctors was far from sight.

### **Prioritization of Community Interventions**

From results of interviews and surveys, stakeholders identified five community interventions they believed would improve the health and food security of residents including (i) extending micro-credit facilities, (ii) establishing small-scale food processing technologies, (iii) investing in sustainable agriculture practices, (iv) inviting nutrition education mission groups, and (v) expanding community medical staff. The five identified interventions were subjected to concept mapping to identify priorities [9,10]. To ensure that all stakeholders were involved in prioritizing interventions, in addition to the twelve community members involved in the focus group discussion, concept mapping included the three doctors from the three health centers in Chacraseca, the two researchers, and eight representatives from JustHope, Inc. Researchers were involved in voting because they were equally responsible for aspects of the study including time and financial resources. The inclusion of various stakeholders was done to

ensure that the identified interventions were accepted by all stakeholders involved with JustHope, Inc. Thus, the total participants in concept mapping were 25. Concept mapping involved four stages, namely: (i) ranking the intervention based on the frequency of preference, (ii) identification of criteria to judge the interventions, (iii) assigning values to the interventions based on the identified criteria in the latter step, and (iv) assigning final scores to the interventions.

In the first stage, the number of participants who liked each intervention was determined by asking stakeholders to raise their hands if they liked an intervention. From the frequency of liking, percentages were determined and presented in Table 4.

Intervention	Stakeholders (n=25)	Frequency (%)
Credit facilities	22	88.0
Food processing technologies	19	76.0
Gardening	23	92.0
Nutrition mission groups	22	88.0
Expanding medical staff	20	80.0

**Table 4:** Frequency of Preference for the Various Interventions, Chacraseca, 2015

The second step involved the identification of criteria to aid in the presentation of practical interventions. After calculating the frequency of preference for the various interventions, stakeholders identified four criteria (in addition to frequency) that were further used to judge the applicability of the interventions. The identified criteria included (i) seriousness (how important stakeholders viewed the intervention), (ii) urgency (timeline of need for the intervention), (iii) practicability (ease of application of the intervention in the real world), and (iv) financial capacity (the availability of funds to execute the intervention). In the third step, each stakeholder assigned weights to criteria on a scale of 1-10 with one carrying the least weight. The weights meant how important each of the criteria was in judging the intervention. The weights applied to each criterion by all stakeholders were averaged and yielded 6.5, 9.0, 8.0, 7.0, and 5.0 for frequency, seriousness, urgency, practicability, and financial capacity, respectively.

Lastly, each stakeholder was tasked to assign a value number to each of the interventions based on the criteria in the latter step. Values were assigned on a scale of 1 to 100, with 100 being the highest value. Average values from all stakeholders are presented in Table 5.

Intervention	Average value (%)					Average %
	A	B	C	D	E	
Credit facilities	80	60	90	30	88	69.6
Food processing	70	20	50	30	76	49.2
Gardening	90	80	90	40	92	78.4
Nutrition missions	90	90	70	90	88	85.6
Expanding medical staff	70	90	40	50	80	66.0

A: Seriousness, B: Urgency, C: Practicability, D: Financial Capacity, and E: Frequency

**Table 5:** Average Value for Each Intervention Based on Criteria, Chacraseca 2015

The average percentage for each intervention was then multiplied by the weights for each criterion to yield a final score that was used to select the best intervention. The higher the score, the more feasible and preferred the intervention was. From Table 6 below, stakeholders determined that the most applicable interventions were in the order of inviting nutrition education mission groups, investing in sustainable agriculture practices, extending micro-credit facilities, expanding community medical staff, and lastly establishing small-scale food processing technologies.

Criteria	Score (Total value multiplied by criteria weight)					
	F	G	H	I	J	K
Seriousness	9.0	626.4	442.8	705.6	770.4	594.0
Urgency	8.0	556.8	393.6	627.2	684.8	528.0
Practicability	7.0	487.2	344.4	548.8	599.2	462.0
Financial capacity	5.0	348.0	344.4	392.0	428.0	330.0
Frequency	6.5	452.4	319.8	509.6	556.4	429.0
<b>Final score</b>		2470.8	1845.0	2783.2	3038.8	2343.0

F: Criteria, G: Credit Facilities, H: Food Processing, I: Gardening,

J: Nutrition Education, and K: Expanding Medical Staff

**Table 6:** Final Score for Interventions, Chacraseca 2015

## Discussion

The combined CBPR and concept mapping approaches used in our study led to the quick engagement of the newly formed partnership among stakeholders and ensured that all their voices were heard during decision making. Even though the stakeholders had different backgrounds and that there was a language barrier between researchers and other stakeholders, the process of

concept mapping involved brief instructions that were completed within two hours. The process of concept mapping involves working with numbers that would ordinarily be hard for community participants with low literacy levels to comprehend, but the collaboration efforts from the academic team and JustHope Inc. led to the simplification of the process. Prioritizing interventions as a group built a spirit of togetherness that minimized authoritative and power differences. Given that leaders and subordinates expressed their views freely and with respect, there was a meaningful collaboration that was not influenced by differences in demographics of age, gender, and leadership positions.

In our study, there was an overall dislike for gardening as an intervention to improved food security and health, yet agriculture is the primary economic activity for Chacraseca residents. This dislike for gardening is probably because of the changing climate conditions, irregular rainfall patterns, and the infertile soils that have made agriculture in Chacraseca unproductive over the years. Participants who reported involvement in gardening and those who owned land also reported to be more food insecure. This is probably because individuals involved in gardening do not harvest enough food to feed their families. Low crop yields may be due to several reasons including, declining soil fertility that requires more soil fertilizer inputs or reduced rainfall both of which were mentioned by participants during focus group discussions.

In another study, Canada [3] reported that a decline in soil quality in Nicaragua due to excessive use of fertilizers led to a decline in subsistence farming and thus an increase in household food insecurity [3]. In the study by Canada, farmers resorted to selling their land to large multinational agricultural companies that could afford the increasing cost of fertilizer application. The practice of selling or leasing land to large multinational companies was also reported by participants in our study and it is likely to escalate the problem of food insecurity. After participants sold or hired out their land, they ended up being employed by those same companies to work for low daily wages, and sometimes the work required migration to other villages. Continuous migration out of Chacraseca could be another reason for food insecurity as able-bodied community members would have to leave their families without breadwinners.

In our study, during the focus group discussions, participants suggested manure composting and harvesting rainwater for irrigation to improve soil quality. These traditional farming technologies changed the negative opinion of most participants towards farming and thus gardening was once again viewed as a suitable intervention to food insecurity. This change in attitude is necessary due to the current need for adaptation strategies towards the effects of climate change on agriculture. Implementing affordable technologies to improve soil quality is vital as it may attract residents to grow their food, limit the practice of hiring out their labor, and reduce migration.

During the interviews and discussion, improvement of health facilities was reported as another factor that needed attention. The doctors voiced a need to supplement the healthcare system of Chacraseca with support from mission groups. The preference for support from mission groups to that from the local government may be because mission groups provide immediate support to the healthcare facilities. Most medical mission groups operate by collecting surplus medical supplies from donors and redistribute them to health centers in Chacraseca. The three health centers in Chacraseca are predominantly stocked with supplies from mission groups probably because other sources of supplies are unreliable or nonexistent. In addition to medical supplies, mission groups train local staff in simple surgery and primary health care service necessary to meet the dire need for expansion of the local medical staff. Besides, training of medical staff is necessary given the low literacy levels in Nicaragua. Like our study, Ahari *et al.* [11] identified the need for increased access to health care and the need for employment opportunities as major themes that arose from CBPR in a rural community in Iran.

## Conclusion

The present study showed how diverse stakeholders with a common objective of improving food security and health worked collaboratively to develop universally acceptable interventions for the community of Chacraseca. From this study, it was evidenced that CBPR and concept mapping were complementary approaches that led to the identification of nutrition education and gardening as priority interventions for the Chacraseca community. The use of CBPR alone would only lead to identification of possible interventions but its combination with concept mapping led to the prioritization of two out of the five suggested interventions. The advantages for this combination are that: the prioritized interventions are most likely to be accepted by the community as the community members participated in their formation; narrowing from many to a few manageable interventions is likely to save money and time as only the feasible interventions will be implemented; the interventions were contextualized and specific to the community of Chacraseca thus placing a possibility for sustainability when support from external researchers ends; and ultimately, the democratizing process was necessary for valuing the community as an equal contributor to the knowledge production process. Findings from this study led to the promotion of home gardening and nutrition education in Chacraseca.

## Strengths

The strength of this study was that stakeholders were involved at all stages of the research process which could indicate that all stakeholders feel a sense of ownership for the suggested interventions. Interventions from this study are more likely to be accepted by the community as the members will feel accountable for the process and outcomes. The small sample size made it possible for individual voices to be heard as every participant received ample time to air out their views. Information from focus group discussions was supplemented by key informant interviews which enabled a broader capture of community needs.



## Limitations and Recommendations for Future Research

The present study used purposive sampling to recruit participants involved in the needs assessment. Purposive sampling has limitations of failure to control for variability and bias and that data may not be generalized beyond the sample [16]. Nevertheless, the use of purposive sampling aided in recruiting participants with expertise, geographic distribution, and community knowledge needed to identify community needs. Additionally, although findings were adequate to determine and prioritize community needs, a sample size of 15 participants was determined to be small for analysis of food security and socio-demographic characteristics. A suggestion would be to include secondary data from medical records to supplement key informant interviews.

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