



Factors that Influence Food Security in Nicaragua and the Role of Home Gardening in Reducing Food Insecurity and Improving Income



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Abstract

Food insecurity and malnutrition are widely recognized as global issues that require immediate attention using multifaceted approaches. In 2015, the Food and Agricultural Organization reported that in the last quarter of the century, undernourishment in the developing world reduced by more than half to an average of 12%. Despite several interventions, United Nations Children's Fund reports that some countries still have high rates of chronic malnutrition. Nicaragua, for example, had a chronic malnutrition rate of 22% in 2013. Home gardening is a system of crop and animal husbandry on small plots of land within the vicinity of human dwelling practiced majorly to improve household food security and income. The purpose of this paper is to assess the major factors affecting food insecurity in developing countries with specific emphasis to Nicaragua. The role of home gardening in improving food security of developing countries is approached through studies from India, Bangladesh, Nicaragua, Senegal, Mexico and South Africa. Overall, this literature finds positive impacts of home gardening towards reducing food insecurity while providing opportunities for improvement of income and quality of life. In conclusion, community gardening requires limited inputs and can be a useful tool in reducing food insecurity if barriers are addressed.

Keywords: Home gardening; Food security; Constraint; Developing countries; Agriculture; Economic access; Safety of food; Nicaragua

Introduction

Globally, there was a general declining trend in food insecurity from 18.6% (1011 million) in 1990 to 10.9% (795 million) in 2014 [1]. Food security entails aspects of economic access and safety of food [2]. Chronic malnutrition which is defined as long-term nutrient deprivation is a major indicator of food insecurity [3]. The global decline in chronic food insecurity (prevalence of undernourishment) is majorly due to a decline in global poverty [4]. However, with declines in poverty coupled with declines in chronic malnutrition Sub-Saharan Africa, South Asia and Latin America still showed higher levels of undernourishment in 2015 [1]. More to that, projections by the Food and Agriculture Organization of the United Nations show that 637 million people will be undernourished in 2030 hence falling short of achieving zero hunger by 2030 [5].

The increase in chronic food insecurity translates into chronic malnutrition and is due to increased conflicts, climate-related shocks and economic slowdown that have led

to difficulty in implementing strategies to protect vulnerable populations [1,6]. Home gardening is seen as a necessary tool to avert food insecurity given that it increases the availability of food and improves diet diversity. Additionally, home gardening improves income, enhances rural employment by encouraging off-season production and decreases agricultural production risks through diversification [7].

Nicaragua is a country in Central America that has recorded a reduction in poverty levels over years but has persistently high levels of undernourishment [8,9]. The objectives of this paper are therefore, to define the major factors that influence food security in Nicaragua and to examine the role of home gardening in improving food security as well as constraints to successful adoption of home gardening.

Causes of Food Insecurity in Nicaragua

There are several factors that influence food insecurity in Nicaragua including: poverty, education, employment opportunities, social capital, policies and climate change.

Poverty

Poverty is defined in absolute, relative and social subjective terms [10]. The concept of absolute poverty is more applicable to developing countries and relates to having an income level that falls below some minimum (poverty line) necessary to meet basic needs [10,11]. Relative poverty is defined based on the overall distribution of income in a country set as a share of the country's mean income whereas subjective poverty is based on what people perceive as the minimum income that a person, or household needs in a specific society not to be considered poor [10,11]. Researchers have concluded that poverty in rural households is a key contributor to the household's food insecurity and thus of malnutrition [12-14].

Nicaragua is a developing country with reported poverty, food insecurity and malnutrition issues. Even though it is the second poorest country in the western hemisphere [15,16], Nicaragua has seen poverty levels drop from 42.5% to 24.9% between 2009 and 2016 and extreme poverty has dropped to below 15% [16,17]. As a result, there has been a decline in food insecurity leading to a decrease in undernourishment from 55.1% to 20.1% between 1990 and 2010 [18,19] and to 16.6% in 2016 [20].

Among other reasons, the decline in undernourishment is due to expansion of several government assistance programs especially in rural areas of the Caribbean Coast [21,22]. However, around 2.4 million Nicaraguans still live below the poverty line with some 83,000 living in extreme poverty [22]. Even in one country, extreme poverty differs between urban and rural areas and is defined as living on less than \$1.90 per person per day [23].

Close to half of Nicaragua's population lives in rural areas [24,25]. According to Harvey, rural poverty rates are three times higher than the 14.8% in urban areas; 70% of the poor live in rural areas [26]. In rural areas, one in six households is extremely poor compared with one in twenty for urban areas.

Poverty is more severe in central Nicaragua and the Caribbean coast, despite their high potential of agriculture and forest activities [27,22]. As a sum up, in 2016 Nicaragua had a Global Food Security Index score of 50 out of 100 and is ranked number 72 out of 113 countries based on food security. More to that, in 2016 Nicaragua had an absolute poverty level of 24.9% and an undernourishment rate of 16.6% [9,16,17,19,28]. These statistics are reflective of high values of poverty, food insecurity and malnutrition when compared with other countries.

Education

Formal education is one of the main determinants of an individual's income and a key factor for achieving economic and social opportunities [29-31]. Adult specific informal education services such as Agricultural Extension can increase

food security through the transfer of skills and behaviors [32]. According to 2014 statistics by the Education and Policy Development Center, 37% of 15-24 year olds in Nicaragua did not complete primary education. The same statistics showed that approximately 21% of boys and 15% of girls of primary school age did not attend school. Nearly 39% of female youth and 47% of male youth of secondary school ages are held out of school in Nicaragua [33].

Mothers in Nicaragua with a secondary education had 47% lower odds of moderate/severe household food insecurity as compared to households with lower maternal education [34]. Higher maternal education was associated with lower food insecurity in Honduras [35], Bangladesh [36], and in Mozambique [37]. Access to education and having a higher education beyond elementary school was reported as a key determinant of food security [37-41].

The connection between higher education status and improved food security may be because educated individuals often possess more assets and have access to better infrastructure thus providing opportunities for non-agricultural employment and reducing dependence on agricultural sources of income [42]. Having access to education positively correlated with having fewer children where women with higher education levels had an average of two children compared to six children in rural uneducated women.

Employment

Unemployment is positively associated with food insecurity [42-44], it leads to a decline in living wage and hence increasing the risk of food insecurity [45]. The unemployment rate in Nicaragua fell from 8.2% in 2009 to 5.3% in 2013 but again rose to 5.9% in 2016. The total unemployment rate for Nicaragua in 2016 was below the world average of 5.7% [46]. Agriculture has been the main source of job creation, helping to stabilize Nicaragua's employment rate. Rural households earn 60% of their income from agriculture, 27% from nonfarm activities and 13% from transfers. However, agricultural jobs are mainly informal, low skilled and low income [22].

Despite improvement in primary education completion rates, attainment of labor skills remains the major reason for unemployment [47]. Nicaragua presents the lowest minimum wage in Central America with all sectors having an hourly minimum wage below U.S. \$2 per hour. This is one of the reasons that 29.6% of the population that lives in poverty and 8.3% in extreme poverty [48].

Men and women are recruited for low wage jobs in local agro-industries, road and house construction sites as well as agro-cultural farms hence having low monthly income [49]. Some small scale farmers have resorted to migrating to neighboring countries like Costa Rica and el Salvador during harvesting seasons in order to obtain money for sowing ,

however new regulations in America are impeding this coping strategy [50]. To seek income, migrants either work within their countries or migrate to other countries, work and send remittances to their families [49,51,52].

Social capital

Hanifan defined social capital as good will, fellowship, mutual sympathy, and social interaction among individuals in a social unit [53]. Stronger social networks and higher levels of social capital are consistently associated with better health and community well-being [54,55]. Nicaragua was found to have a low social capital in terms of net percent trust and community participation scale compared to other Latin American Countries [56]. Social networks and social capital can provide the food insecure with private transfers in times of need that may decrease the severity of food insecurity episodes [57].

Social capital was found to be helpful in promoting sack gardening in the Kibera slum of Kenya. This was helpful especially in attainment of seeds, shared space for placing the sacks, topsoil and sharing of the produce [58].

Social capital improves food security by enhancing unity of group members, access to information from external institutions and observance of group norms. For social capital to be effective in improving food security, it should be accompanied by human capital enhancement [59]. The low social capital of Nicaragua compared to other countries in Latin America may indicate lesser social interaction, a quality that could be a good coping strategy in food insecurity situations [56].

Policy

The Nicaragua law on food and nutritional sovereignty and security was adopted in 2009 [60] to replace the unmet initiatives for food security policy made in the late 1990s and early 2000s [61]. Past policies favored privatization of natural resources and deregulating markets in favor of large agribusiness companies hence dismantling programs that benefited small-scale farmers [62]. Under the food sovereignty law of 2009, local governments, civil society, farmer and peasant organizations liaise to promote the development and adoption of food security policies with emphasis on food sovereignty [60]. The law is in agreement with international laws on human rights to food [63-66]. Agro-export industry and trade agreements are discussed here as the major policies that affect food security in Nicaragua.

Agro-export industry: In 2017, Nicaragua's exports were higher than its imports, creating a negative trade balance [67]. Due to support from the government and from policymakers [68], growth in agricultural exports is significantly higher than growth in food production [69]. Unlike agro exports that

are produced by large-scale farmers, smallholder farmers, who are the poorest in the region, handle more than 75% of domestic food production [70]. Domestic food production is therefore unable to meet household food demands shifting consumption patterns towards imported foods [71]. It is therefore not surprising that Nicaragua imports a third of its grains for domestic consumption [72].

Trade agreements: All United States consumer and industrial exports enter Nicaragua duty free with tariffs on U.S. agricultural products expected to be phased out by 2024 [73]. Nicaragua signed free trade agreements with Mexico in 1998, Chile in 2011, Panama in 2009, Dominican Republic in 2002, Taiwan in 1967 and the European Union in 2010 [74]. Nicaragua has the second lowest GDP per capita in the western hemisphere after Haiti, which translates into having one of the lowest level of exports [15].

Nicaragua is among the countries in Latin America with least exports to the European Union [75], United States, Asia and to China [76]. Between 1992 and 2017, Nicaragua had a negative trade balance indicating that Nicaragua is not maximizing benefits from the free trade agreements [77]. This is heightened by the fact that after 1990, price controls set by the Sandinista government of Nicaragua as a measure to reduce macroeconomic imbalances were eliminated [78]. This left Nicaragua with no direct public intervention for controlling prices.

Due to globalization and trade liberalization, non-traditional crops like flowers and soya beans have become profitable but peasant farmers lack capital, technical skills, and access to infrastructure to compete in the export market. Therefore, peasant farmers cannot compete with cheap imports driven by free trade agreements [49].

Under the Food for Progress initiative, U.S. agricultural commodities are donated to Nicaragua and sold on local market [79]. This may indirectly compete with local Nicaraguan produce for market. This policy along with support to the agro-export industry may be responsible for the severe decline in prices for traditional locally produced staple foods. The decline in market prices may lead to lower income and higher inputs hence forcing peasant farmers to abandon food production.

Climate change

The global climate risk index shows that Honduras, Myanmar and Nicaragua experienced the greatest effects of climate change from 1992 through 2011 [80]. Climate change has an impact on agriculture [81-84]. Due to its geographical location in the inter-tropical convergence zone, one sixth of Nicaragua's surface is in zones with high or very high sensitivity to climate events [85-86]. The Northern Caribbean coast is the highest risk area to climate events, with gradual decrease in risk towards the south [86].

Impacts of climate change are of utmost importance to Nicaragua because its economy largely depends on agriculture, cattle raising and fishing; all of which are highly sensitive to climatic conditions. Nicaragua has taken shocks from major climatic events including Hurricane Mitch in 1998, the 1972 earthquake in the capital Managua, landslides, and volcanic eruptions [87,88].

Hurricane Mitch of October 1998 created significant flooding and mudslides that were responsible for a loss 30% of the coffee crop in Nicaragua [89]. Projection show that between 2020 and 2050 Nicaragua will have average temperature increase of between 1 °C and 2 °C and between 3 °C and 4 °C by the end of this century. This will be accompanied by a reduction in precipitation at the national level and a slight increase in the Pacific region [85,90]. The dry corridor of Central America of which 20% belongs to Nicaragua is predicted to experience severe drought conditions [86]. Climatic events were responsible for annual economic losses of 1.89% in GDP between 1990 and 2012 [86]. Predicted climate events will affect food security, jobs, economy, social structure and overall development [90].

Backyard Gardening as a Strategy to Reduce Food Insecurity in Developing Countries

There was a decline in global food insecurity from 2005 to 2015 [1] attributed to numerous multidisciplinary strategies aimed at reducing hunger [91-95]. However, the increase in the world's population and driving forces that accompany it pose a threat to the success of current food security strategies necessitating new or improved strategies to combat hunger [96,97].

Even with the decline in food insecurity between 2005 and 2015, one in seven people were still food insecure [1]. With declining arable land [98] and a predicted decline in precipitation [99-101] the currently employed food security strategies should be rethought. Strategies aimed at improving food security may be applied to both developing and developed societies depending on the existing social, political and economic resources available to design and implement the interventions [102].

Home gardening also referred to as backyard gardening is a food security strategy that has been promoted for decades in urban, rural, developed and developing communities [102-103]. Usually home gardening projects start with a demonstration community garden followed by skill transfer to backyard/home gardens.

Home gardens are usually small portions of cultivated land within walking distance from homes planted with mixed crops and some livestock with an aim of providing supplemental food and income [104]. Ninez describes home gardens as small-scale production systems that are located near dwellings and

have a primary purpose of supplying both plant and animal items that would not otherwise be obtained, affordable or readily available from local markets, field cultivation, hunting, gathering or fishing [105]. Home gardens employ family labor, low capital investment and simple technologies [105].

The following section reviews published literature on the role of home gardening projects in reducing food insecurity and increasing household income. In this section nutrition and income benefits as well as constraints to successful implementation of home gardens are discussed. A Google Scholar search was done with search terms of "Economic and nutritional importance of home gardening, community gardening, backyard gardening in developing countries." This search yielded over 10,000 results which were filtered to include only studies involving more than one garden, and that included evaluation aspects. Studies were limited to just one per country based upon sample size leading to a result of six different studies in six different countries to include India, Senegal, Bangladesh, Mexico, Nicaragua and South Africa.

Home gardening in India

A cross sectional study in Andaman and Nicobar islands of India was conducted to determine species diversity and productivity using a sample of 430 home gardens [106]. Andaman and Nicobar islands have limited opportunities for employment due to lack of industries and factories.

Plant diversity: Subsistence as well as commercial farming characterized home gardening.

The planted species in Andaman and Nicobar Islands' home gardens included vegetables, fruit trees, palms, spice trees and agro-forestry trees. This diversity of crops grown in home gardens was reported by others [107-110] and may be tied to economic status of garden owners [111]. The variety of plants in home gardens is advantageous in maintaining plant genetic resources [112-114]. In most households, the variety of species in home gardens is determined by the household's capacity to obtain social capital and planting material [102].

Labor and input supply: In terms of labor, home gardens in Andaman and Nicobar frequently employed family labor with designated gender roles. Use of family labor is indicative of limited capital investment and small size of home gardens. Although generally limited, mechanization and hired labor were employed especially during tilling and in some cases, draft animal powers were used. Maroyi reported the frequent use of family labor and limited use of machinery and hired labor in his study on characteristics of home gardens in Zimbabwe [109].

In home gardens of Andaman and Nicobar, farmers did not apply pesticides to control diseases but used biological control measures where pheromones traps were applied around the

garden. Rice was cultivated without use weeding or use of insecticides but vegetable gardens required both weeding and insecticide application. The Andaman and Nicobar islands are endowed with plenty of rainfall distributed over nine months but home gardeners lacked knowledge to utilize rainwater effectively.

Gender roles in home gardening: Even though women play a vital role in providing food for most households, their involvement in home gardening is determined by socio-cultural norms [104]. In some cultures of rural Russia, Senegal and Latin America, women were reported as sole caretakers for home gardens [115-117]. On the other hand, women were reported to play only supportive roles at certain stages of plant production in home gardens [118].

Food and income benefits: More than 70% of the vegetable, rice and fruit yields from home

gardens in Nicobar and Andaman islands were sold in the market leaving the remainder as food for household consumption. Some produce especially coconut kernels were fed to pigs, which in turn were not sold but distributed to neighbors. Researchers reported several uses of home gardening to include source of fresh food, reduction in food budget, hobby and relief of emotional stress [119]. Reyes-Garcia et al. [120] reported practicing home gardening for reasons other than economic benefits [120].

The average monthly commercial yield from all home gardening components in this Indian study was estimated to be over US \$2,000. Other economic benefits from home gardening were reported by other researchers to include; promotion of entrepreneurship and rural development [112,121], sale of produce, development of small cottage industries [104], the purchase of additional food items, as well as savings for education and other services [122].

Major constraints to gardening in Andaman and Nicobar islands were ineffective use of rainwater and absence of mechanization, which were thought to limit production. These challenges are different from those reported in other studies, which included limited extension services, limited finance and credit facilities, lack of adequate water, cultural barriers and lack inadequate labor [104,118,123].

Home gardening in senegal

In Senegal, researchers determined the impact of community gardening on health and food security by comparing longitudinal data between a baseline survey done in 1970 and four post gardening surveys in 1980 [124]. Cross sectional data was compared among the four surveys done in 1980s. Families surveyed in the 1980's were different from those surveyed in 1970s hence there were no paired t-tests for results.

Food and income benefit: Food frequency data showed that nutrient intakes of iron, retinol activity equivalents, calcium and ascorbic acid did not differ between the two-time periods. Income from vegetable sales during the dry season supplemented income obtained from the sale of main crops in the normal farming wet season. Income from vegetable sales was more helpful in case of bad harvests from main crops due to inadequate rainfall. In Navajo, residents reported positive economic savings from home gardens by not spending money to purchase vegetables in the markets [125]. In other studies, researchers reported absence of evidence for home gardens to significantly improve nutrient intake [126,127]. Galhena et al. [102] & Lombard [128] acknowledged that selling excess produce to farmers markets could supplement income for progressive individuals. Unlike income from main crops that is budgeted by men, women kept profits from vegetable sales [102,128]. This raised purchasing power for the women enabling them to better cater for basic needs in the family.

Marek et al. [129] explained that family income might indirectly affect health and nutritional status through improving education attainment, raising cognitive performance and improving environment sanitation and personal hygiene [129].

Participants from home gardening households consumed more vegetables than those from non-home gardening households indicating a possibility of having better health [130-131]. Toher researchers reported increased consumption of vegetables and general diet diversity due to home gardening [130-132].

Bangladesh

In response to high rates of night blindness in Bangladesh, Helen Keller International (HKI) initiated a pilot gardening project in conjunction with nutrition education [133-134]. The aim of the HKI project was to increase the number of households that sustainably produced dark green leafy vegetables and fruits throughout the year and to increase the variety and consumption of vitamin A rich foods.

Collaborating gardening projects with existing local programs: During program implementation, HKI constantly reviewed ongoing gardening programs in Bangladesh to learn from others' experiences. The HKI project was elected in partnership with local NGOs as a means of collaborating the gardening project to ongoing developmental activities. Creating partnerships with local NGO's is necessary because the various causes of malnutrition are linked and local NGOs are already involved in the community and may already have a good understanding of the target community. This partnership may also be necessary to avoid replication of studies. In most cases, Local NGOs have established infrastructure within the community a factor necessary for scale up. Linkage with already

established NGOs also ensures that the target community has access to multiple developmental services and that the program can be sustained after HKI terminates its services. FAO states that institutionalization of gardening projects is key to sustainability. Sustainability implies independence from long-term external inputs and participation of all stakeholders [135].

Benefits of home gardening in bangladesh: After a year of implementing home gardens in

Bangladesh, HKI reported an increase in percentage of households who practiced year-round gardening of multiple vegetable varieties on fixed plots from 3% to 33%. HKI reported a decrease in households without a garden from 25% to 2%. Production of a variety of vegetables and Consumption of beta-carotene rich foods increased significantly in households that practiced improved home gardening. An increase in vegetable consumption among children and adults in a community-based participatory gardening study was reported [131]. Households that participated in improved gardening saw a rise in income from sale of garden produce that was used primarily for purchase of food with the remaining profits being used for developmental activities [131].

Constraints realized in the HKI project: Even though the HKI project realized several benefits, households needed a regular supply of quality seeds and inputs to sustain a change in gardening practices. The HKI project reported poor soil fertility, inadequate fencing, and poor irrigation infrastructure were additional constraints to sustained home gardening. Even though the community-based participatory research by Carney et al. [131] reported improved food security, health and economic benefits, it had challenges comparable to those reported in this HKI project and by other researchers [104,118,123].

The nutritional benefits of home gardening in the HKI study were limited by cultural beliefs about child feeding and intake of certain foods during pregnancy. This is different from a study done in Nepal where Jones et al. [136] reported a cultural practice where women showed an increase in consumption of special foods during pregnancy [136].

Home gardening in nicaragua

In Nicaragua, a research study was done to determine the extent to which home gardens could effectively lead to food sovereignty and why farmers resist changing their food consumption strategies to embrace biodiverse home gardens [51]. This study was done through in-depth interviews across four cooperative societies including sixteen men and eight women in Estelli and Somoto municipalities of Northern Nicaragua. In addition, researchers interviewed the project management team members as key informants to prove responses from participants.

Benefits and constraints to home gardening in nicaragua: Results showed that 90% of farmers perceived home gardens as contributing to diversified and healthy diets while offering an opportunity to save money by not purchasing food from local supermarkets [51]. Likewise, Arimond et al. [137] reported increasing food availability and access through production for household consumption as one of the major pathways by which agricultural interventions influence nutrition [137]. Farmers in this Nicaragua study reported that the cost of raw materials and amount of labor discouraged them from engaging in home gardening. Other farmers in the same study reported that it was cheaper to plant more coffee, sell to the international market, and in turn purchase goods from the local market [51].

This same situation in another review [137]. The high cost of inputs, the needs to construct fences and unreliable rainfall especially in the dry season were perceived as the major constraints to home gardening in this Nicaragua study. Lack of sufficient/appropriate land near the home was also perceived to hinder gardening. The authors reported that farmers perceived the cost of materials outweighed the benefits from home gardens. In this coffee farming community, 95% of respondents who engaged in subsistence growing of crops such as corn and beans depended on international sale of coffee to buy seed and other materials. However, respondents explained that the sale price for vegetables in the markets was low yet transport costs to the markets were high making the sale of vegetables unprofitable. Other farmers explained that they lacked experience growing vegetables and that it would require them to re-prioritize their labor and economic investments to accommodate home gardens. The costs of seed saving and storage techniques as well as food preservation technologies were a hindrance to successful home gardening.

Home gardening in a Mayan community of Mexico

Using semi structured interviews and participant observations, a study in Mexico aimed at identifying the principal factors that defined the type, number and performance production of home gardens in a Mayan community in the state of Yucatan [138]. In this Mayan study, 31 home gardens were assessed through cash flows and production cost ratios. Ninety per cent of households reported keeping a home garden primarily for economic reasons and because they enjoyed exchanging products with other members of the village.

Residents established home gardens for sharing produce with neighbors, relatives and community members [139]. In descending order, respondents in this Mayan Mexican community study identified having fruit trees, fowls, pigs, vegetables, ornamentals and cattle. Some home gardens had pigsties, irrigation systems, and chicken pens. Livestock, fowl and pigs had negative cash flows due to the high costs of fodder and high initial capital. Households reported major

requirements in improvement as water for plants and animals, animal enclosures, motivation, time, and technical assistance.

South Africa

In Easton side South Africa, researchers assessed the impact of home gardens on nutrient intake, access to food and dietary diversity in pre-school children [140]. Food consumption and dietary diversity was based on a 24-hour recall of children's consumption as reported by the caregivers. Analysis of nutrient intakes before project start showed that average nutrient intakes were below recommendations for optimal nutrition except for protein that was double and vitamin A was above RDA.

Changes in food frequency: Using 24-hour recall conducted at project start and end, Selepe & Hendriks reported an increased frequency of consumption of fresh fruits and vegetables. The consumption of nuts and legumes doubled by project end. The number of children consuming dark green vegetables and other vegetables increased by 25%. The number of children consuming fish and eggs increased by almost a quarter. Paired t-tests showed statistically significant changes in the consumption of vitamin A rich vegetables, other vegetables (seeds, nuts and legumes), cereals, meat, organ meats and milk. In this South African Study, improved dietary diversity representing a direct positive impact of home gardens was reported. In other studies, researchers reported increased consumption of vegetables due to promotion of gardening [141-143]. Increased diet diversity as a result of promoting home gardening was reported by researchers in Bangladesh [130,144].

Changes in nutrient intake: According to Selepe & Hendriks nutrient intake from consumed foods was established using a computer package Dietary Manager. Using before and after 24-hour recalls, the only significant nutrient intake was vitamin A and iron but vitamin A intake was way above the recommended daily allowance at the beginning of the project. No significant change in fiber intake, and macronutrients through paired t-tests was observed. Intakes of energy, fat, fiber and calcium remained inadequate by the end of study. However, lack of significant changes in nutrient intakes was reported in other studies [126-127]. Success of agriculture and nutrition interventions should take into account women's economic status, education level, access to and use of health and sanitation services [137] and whether nutrition education services were provided [145-148].

Conclusion

This literature review presents challenges to achievement of food insecurity and discusses how researchers in different countries have employed home gardens as a tool to improve food security and economic stability in households. Using Nicaragua as a case study, the review pulls together researchers' views

on how high levels of poverty, unemployment, unfavorable trade policies, low social capital and climate change are a hindrance to attainment of food security. The challenges could indicate that a multidisciplinary approach that includes experts in climate studies, government bodies, local non-government organizations, community leaders as well as community members is required. It can also be concluded that interventions aimed at improving food security should be tailored to needs of the target community given the differences in policies, climatic effects and demographic factors.

In this literature review, households engage in home gardening for economic reasons, social reasons or for attainment of food for household members. The importance of home gardens varies not only among communities but also within households in the same community. This may indicate that researchers hoping to start community gardening should design home gardening interventions to cater for various household expectations. Home gardening projects should also allow for promotion of different crop and animal varieties to meet the varying food staples of the community. Barriers to home gardening include labor, limited inputs, poor soil fertility, inadequate fencing, cultural beliefs and poor irrigation infrastructure. Barriers to home gardening should be addressed as much as possible to attain maximum benefits.

In conclusion, given economic and food production benefits discussed in the review, home gardening can be used to improve household food security in developing countries. Developing countries like Nicaragua have limited budgets to invest in large-scale agriculture, climate change mitigation, nutrition, health care and education. Home gardening that requires family labor, small pieces of land and small initial investment can be employed by governments, researchers, community organizations and non-government organizations to improve food security.

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