Process Evaluation of the School Meals Program as Part of the Farm to Fork Project in St. Kitts

By

Annyck Besso

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Thesis Advisors: Dr. Katherine Gray Donald and Dr. Gillian Bartlett

Abstract

INTRODUCTION: The goal of the CARICOM project "From Farm to Fork" is to encourage smallholder farmers to increase revenues by producing fruits, vegetables and local meat (goat) in quantities suitable for the School Meals Center to improve the food offerings for the children of the school district. This study evaluates the strengths and weaknesses of the 'Farm to Fork' project in St. Kitts in its current state, and identifies potential drivers and barriers which contribute to the sustainability of the intervention. **METHODS:** St Kitts has 17 elementary schools which provide a daily lunch to approximately 3200 children. Four schools made changes to their menu and the others served as control schools. This research project evaluates and compares the intervention schools and the control schools in terms of cost, nutritional value provided and food waste in order to measure the impact the new menu has had on the school budget, its success in providing healthier foods to the children and how many children are consuming the options provided. **RESULTS:** The intervention schools provide more protein, potassium and vitamin C ($p<0.05$) when compared to the control schools. Calcium is low in both control and intervention schools. The intervention meals are also more costly than the control school meals ($p<0.05$), but servings of meat drive up the cost of the intervention meals rather than the addition of fruits and vegetables. **CONCLUSION:** The School Meals Center has made large changes to their food offerings and improved nutrients offered to children. Adequate calcium intake is still a challenge due to the limited consumption of dairy products. Adding extra meat is not needed and needs to be curbed. This may further contribute to cost control in the intervention meals.

Résumé

INTRODUCTION: Le projet CARICOM, intitulé “From Farm to Fork”, a été mis sur pied dans le but d’encourager les petits agriculteurs locaux à produire plus de fruits, de légumes et de viande (chèvre) pour desservir le Centre de Repas Scolaire. Cette initiative vise à augmenter les revenues des agriculteurs participants ainsi qu’à améliorer la qualité de nourriture servie aux élèves. L’objectif de cette étude est d’évaluer les forces et les faiblesses de projet et d’identifier les éléments qui peuvent aider ou nuire à la durabilité de l'intervention. **MÉTHODE:** St. Kitts a dix-sept écoles primaires, qui fournissent un diner quotidien à leurs élèves. Quatre de ces écoles ont apporté des changements à leur menu pour se conformer au projet CARICOM alors que les autres ont conservé intégralement leur menu. Ce projet de recherche évalue et compare les écoles dite d'intervention (c.-à-d. celles qui ont modifié leur menu) avec les écoles dites de contrôle (c.-à-d. celles qui n’ont pas modifié leur menu) en termes de coût, de valeur nutritionnelle et de la popularité des repas servis. **RÉSULTATS:** Les écoles d'intervention fournissent des repas contenant plus de protéines, de potassium et de vitamine C ($p < 0.05$) et dont le prix est plus élevé ($p < 0.05$) par rapport aux écoles contrôles. Cette hausse de prix est attribuable à la quantité de viande servie dans les écoles d’intervention : cette addition supplémentaire de viande, plutôt qu’une addition de fruits et légumes, augmente les coûts des repas. L’apport en calcium pour les écoles d’intervention et les écoles de contrôle est bas. **CONCLUSION:** Le Centre de Repas Scolaire a fait plusieurs changements importants à leur gamme de produits offerts dans le but d’améliorer la qualité des repas servis aux élèves. Cependant, l’augmentation de la quantité de viande dans les engendre des coûts plus élevés pour les écoles participantes. Étant donné que le niveau de protéine présent dans les repas des écoles contrôles est suffisant, l’ajout de viande supplémentaire n’est pas nécessaire et engendre donc inutilement des coûts plus élevés pour les écoles. Un apport adéquat en calcium est toujours un défi; attribuable à la consommation minimale de produits laitiers sur l’ile.

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Introduction

Context of Research

Malnutrition in developing countries is increasingly taking the form of overnutrition due to both food insecurity and obesity (Finney Rutten, Yaroch, Patrick, & Story, 2012; WHO, 2013b). Malnutrition is defined as "an abnormal physiological condition caused by inadequate, unbalanced or excessive consumption of the macronutrients that provide dietary energy and the micronutrients that are essential for physical and cognitive growth and development" (WHO, 2012). The prevalence of obesity and overweight is on the rise in most developing countries (WHO, 2010). Approximately 60% of the global burden of Non Communicable Diseases (NCDs) is found in developing countries and related to type 2 diabetes mellitus and coronary heart disease, which are both obesity related (Misra, Singhal, & Khurana, 2010).

The purpose of this study is to evaluate the process, as well as the strengths and weaknesses of one aspect of the 'Farm to Fork' project, the school meals program, currently implemented in St. Kitts, and identify potential drivers and barriers, which may contribute or hinder the sustainability of the intervention. This project aims to answer research questions which address the economic feasibility of the intervention, as well as the acceptance of the new meals on the target population.

Literature Review

OBESITY

In 2008, the combined prevalence of overweight and obesity worldwide was that of 1.5 billion adults (Popkin, Adair, & Ng, 2012). Data from the 2009-2010 National Health and Nutrition Examination Survey found that 36% of American adults are obese (Flegal, Carroll, Kit, & Ogden, 2012). This prevalence has increased 2-3 fold over the past 40 years (Corey & Kaplan, 2014). The World Health Organization WHO (2013b) defines overweight as having a Body Mass Index (BMI) above or equal to 25 and obese as a BMI above or equal to 30, and describes both conditions as having abnormal or excessive fat accumulation that may impair health. Worldwide, more than 400 million people suffer from this health problem (Finucane, 2011). For the first time, the number of people overweight and obese trumps that of the hungry (MacDonald, 2012). By 2030, it is estimated that globally, 2.16 billion people will be overweight and 1.2 billion will be obese (Popkin et al., 2012).

While obesity was once thought to affect only the rich, characterized by an abundance of food and energy, it is now recognized that even the poor are affected by this issue and consequences associated with the epidemic (Henry, 2011). A study in 37 low income countries conducted by Jones-Smith et al. (2012) found that estimated increases in overweight prevalence over time have been greater among lower wealth and education groups.

Obesity is associated with more than 65 co-morbidities, such as diabetes mellitus, cardiovascular disease, hypertension and cancer, and therefore, increased mortality (Corey & Kaplan, 2014; Hawkes et al., 2013). In the United States, the cost of obesity-related health care is estimated to be $163-$300 billion per year, which is approximately 10% of the total costs of health care in the country (Finkelstein, Trogdon, Cohen, & Dietz, 2009; Wang, Beydoun, Liang, Caballero, & Kumanyika, 2008). The cost of health care for overweight and obese people is approximately 30% higher than that for other people (Withrow & Alter, 2011). Data from WHO in 2008 reported that 63% of deaths worldwide are due to Non Communicable Diseases, of which 80% occur in low and middle income countries (WHO, 2011).

Childhood Obesity

Estimates from the National Health and Nutritional Examination Survey reveal that not only are one third of American adults obese, but so are 16% of children (Flegal et al., 2012), representing approximately 12.5 million American youth (Ogden, Carroll, Kit, & Flegal, 2012). In 2010, approximately 170 million preschool children in developing countries were stunted and 35 million were overweight or obese (WHO, 2012). Obese children are more likely to suffer from co-morbidities such as type 2 diabetes, hypertension, dyslipidemia, asthma and nonalcoholic fatty liver disease (Foltz et al., 2012; French, Story, & Perry, 1995). They are also at increased risk for social and psychological issues, such as poor self esteem, eating disorders and discrimination (Foltz et al., 2012; French et al., 1995). The greatest concern is that obese children are more likely to become obese adults (Foltz et al., 2012).

The prevalence of childhood obesity increased by 100% between 1980 and 1994 (Troiano, Flegal, Kuczmarski, Campbell, & Johnson, 1995). In two decades, obesity has grown by 400% (Henry, 2004). Between 1965 and 1996, total energy intake and fat intake decreased among adolescents aged 11-18, but over the same period, consumption of fruits, vegetables and dairy foods decreased as well, whereas consumption of soft drinks increased (Cavadini, Siega-Riz, & Popkin, 2000). At the beginning of the millennium, soft drinks were the leading source of added sugars in the diet, contributing approximately 36.2g/ day for adolescent girls and 57.7 g/ day for adolescent boys (Guthrie & Morton, 2000). In a longitudinal study conducted by Philips et al. (2004), researchers studied girls between 8 and 12 years of age, who were non-obese and measured dietary intake, physical activity and anthropometrics. Researchers found a significant relationship between soft drink consumption and BMI, but did not identify a relationship between the latter and percent body fat (Phillips et al., 2004).

FACTORS AFFECTING THE OBESITY EPIDEMIC

The obesity trend has been characterized by a shift toward energy dense foods, high in both fat and sugar, affecting both the rich and the poor (MacDonald, 2012; Popkin et al., 2012). Fat and added sugars account for >50% of energy in the typical American diet (Frazao, 1999). As those that are poor may not have access to nutrient dense foods, they fuel themselves off calories of low health value, resulting in greater energy consumption (Drewnowski, 2003; Henry, 2011).

Dietary Fats and Oils

One causal factor of overconsumption was the revolution of edible oil and vegetable oil, which took place in the 1950s and 1960s (Popkin et al., 2012). During this time, technology advanced to a point where oils could be removed from oilseeds, such as corn, soybean, and cottonseed at a low cost, increasing their availability all over the world (Drewnowski & Popkin, 1997). For example, because olive oil is sold at such a high cost, it is used scarcely, while mustard, sunflower and soybean oils are used heavily (Misra et al., 2010). From 1985 to 2010, intake of vegetable oils among populations in the developing world increased three to six fold (Popkin et al., 2012). The widespread availability and use of vegetable oils has increased dietary intake of fat including trans-fatty acids, leading to an increase in obesity, the metabolic syndrome and type 2 diabetes mellitus. (Misra et al., 2010).

Another source of fat, related to increased energy consumption, is the increased intake of animal-source foods, which has particularly occurred in low and middle income countries (Popkin et al., 2012). Though this may be beneficial in some countries, by addressing issues of anemia, stunting and malnutrition, excessive consumption of these foods is accompanied by increased consumption of saturated fat and increased mortality due to obesity related chronic diseases such as cancer and cardiovascular disease (Sinha, Cross, Graubard, Leitzmann, & Schatzkin, 2009; Steinfield, Gerber, Wassenaar, Castel, & De Haan, 2006).

Sugar

Another major issue contributing to the current obesity epidemic is the added sugar in diets around the world. Seventy five percent of foods and beverages bought in the United States contain added caloric sweeteners (Duffey & Popkin, 2008). For the average American over two years of age, 375 calories a day is due to dietary sugar (Duffey & Popkin, 2008). Sugar can be found in foods naturally and as added sugar, but it is the amount of added sugar in sweetened beverages that has increased dramatically. Sugar sweetened beverages are for the most part, sweetened with high-fructose corn syrup or sucrose and provide approximately 100-170 kcal per 375ml (Ebbeling, 2014). The effect of sucrose on body weight was explored in an intervention study, where overweight subjects consumed either sucrose or artificial sweeteners for 10 weeks. After the 10 weeks, the sucrose group had a significant increase in both body weight and fat mass compared to the artificial sweetener group (Raben, Vasilaras, Møller, & Astrup, 2002).

In 1977-78, solid food provided two thirds of added sugar in the United States; today, two thirds comes from beverages (Duffey & Popkin, 2008). There was a 125% increase in soft drink consumption among youth from 1977- 2000 (Duffey & Popkin, 2008). In Mexico, one of the few developing countries with data on caloric beverage patterns, energy intake from sweetened beverages doubled from 1996-2002, with 21% of kilocalories per day coming from these drinks, for all age groups (Barquera et al., 2010; Barquera et al., 2008; Rivera et al., 2008).

Per capita consumption of added sugars increased approximately 20% between 1970 and 2000, of which, consumption of high-fructose corn syrup increased ~4000% over the same time period (Putnam, Allshouse, & Kantor, 2002). Studies demonstrate a relationship between sugar sweetened drinks and childhood obesity (James, Thomas, Cavan, & Kerr, 2004; Ludwig, Peterson, & Gortmaker, 2001; Phillips et al., 2004). A systematic review conducted by Malik, Schulze, and Hu (2006), which reviewed 30 studies, found that there is a positive relationship between the consumption of SSBs and overweight and obesity, based on findings from cross sectional studies, prospective cohort studies and experimental studies. In a study conducted by Han and Powell (2013), researchers assessed sugar sweetened beverage consumption in children, adolescents and young adults (N-16, 456) over ten years through the National Health and Nutrition Examination Survey and found that the most prevalent source of energy from sugar sweetened beverages (SSBs) is fruit drinks among children and sodas among adolescents and adults . Though there has been a modest decrease in energy contribution from fruit drinks and soft drinks, the average consumption of these beverages still contributes approximately 150 extra kcal per day (Kit, Fakhouri, Park, Nielsen, & Ogden, 2013). A new contribution to sugar intake, for which consumption has increased in the last decade, is that of energy drinks (Han & Powell, 2013).

Not only are SSBs a concern in term of weight gain, but they are also associated with an increased risk of co-morbidities. After conducting a 6 month randomized intervention study, Maersk et al. (2012) found that participants consuming 1 liter of sugar sweetened cola per day had a larger increase in liver, skeletal muscle and visceral fat than those who consumed 1 liter of other beverages, such as milk or diet cola.

Food Systems Change

Nutritional outcomes depend on many elements, but food systems, along with the policies that shape them, play a fundamental role in determining nutritional health (FAO, 2013). Food systems determine the “quantity, quality, diversity and nutrition content of the foods available for consumption” (FAO, 2013). Due to modern food distribution and sales, super and megamarket companies have infiltrated the developing world, causing fresh markets to disappear due to their lack of competitive edge (Reardon, Timmer, Barrett, & Berdegue, 2003). In Latin America, supermarkets' share of all retail foods sales increased from 15% in 1990 to 60% by 2000 (Reardon et al., 2003). Though the introduction of modern food distribution to the developing world has had a positive impact in terms of food safety and items available, shifts in the food environment can enhance intake of processed, higher calorie, lower nutrient density foods. The reason for this is because most supermarkets in Latin America are packed with cheap, canned and processed goods that are produced in mass quantities, at a lower price, increasing their availability, convenience and affordability (Asfaw, 2011).

The increasing availability of processed foods, at a lower cost, is leading to an abundance of energy dense foods, high in sugar and fat, which are staples in the diets of people living in developing countries. Low income individuals tend to purchase more processed, refined grains and empty calories due to their energy density and low cost (Drewnowski, 2003; Drewnowski & Specter, 2004; Wilde, McNamara, & Ranney, 2000). Asfaw (2011) found that a 10% increase in the share of highly processed food items from the total household expenditure is related to an increase in BMI by 4.25% (Asfaw, 2011). The researchers found that the price of highly processed food items is negatively related to the BMI of individuals, meaning that as price decreases, BMI increases.

Food Security

The relative price change of food is what affects the food choices of families of lower socioeconomic status (Popkin et al., 2012). Families who are unable to grow food or have an inadequate income will likely opt for the cheapest cost per calorie in the choices provided. Therefore, if the prices of fatty foods, oils, sugar and animal-source foods go down relative to legumes, fruits and vegetables, the former options are the more attractive ones (Popkin et al., 2012). Because of this, problems of underweight, stunting and micronutrient deficiencies are present alongside obesity in developing countries, causing a dual burden of both undernutrition and obesity (Misra et al., 2010; Popkin et al., 2012). The American Public Health Association has defined a sustainable food system as "one that provides healthy food to meet current needs while maintaining healthy ecosystems that can also provide food for generations to come with minimal negative impact to the environment". A sustainable food system also encourages local production and distribution infrastructures that makes nutritious food available, accessible and [most importantly], affordable to all"(APHA, 2007). It is imperative to not only focus on calories provided to undernourished populations, but to also ensure quality of these foods to avoid the issues of both obesity and malnutrition that are currently present around the world.

Energy Cost

Energy cost, as defined by Drewnowski (2003), refers to the cost of a macronutrient per millijoule of energy it provides ($/MJ). In terms of food costing and energy, the energy cost of fat and sweets in comparison to other foods is low (Drewnowski, 2003). Added fats and sugar provide energy at the lowest cost. Due to the revolutionary advances in alternating fat sources, the cost of vegetable oils has drastically been reduced since the 1950s, making their energy cost $0.50/10 MJ or less (Drewnowski, 2003; Popkin et al., 2012). The energy cost of potato chips is approximately $2.00/10 MJ and that of a soft drinks is $2.20-$3.70/10 MJ. In comparison, the energy cost of fresh carrots is approximately $9.50/10 MJ and $14.00/10 MJ for frozen orange juice (Drewnowski, 2003). These cost are also subject to increases due to price surges. Food price increases between 1982 and 1997 were 93% for vegetables and fruit, compared to 52% for sugar and sweets and 47% for fats and oils (Putnam & Allshouse, 1999). The energy cost of food plays an important role in people's food choices. As stated by Breslow (2006): "What people choose to eat depends largely on culture and economics. People can choose freely from available foods only if they can afford them".

CARRIBEAN COUNTRIES

Obesity in the Caribbean

The prevalence of obesity in the developing world has doubled and even tripled in the past decade (Misra & Khurana, 2008; WHO, 2003). The issue of obesity in the Caribbean is now deemed as an "epidemic, which is escalating almost silently"(CCHD, 2006). Obesity and overweight have emerged as major public health problems in the Caribbean Community and Common Market (CARICOM). CARICOM is an economic grouping of 15 developing and primarily small states, which have a combined population of 7 million (CCHD, 2006). Obesity is the common risk factor associated with chronic non-communicable diseases (NCDs), such as cardiovascular disease, hypertension and diabetes. NCDs are also the leading causes of mortality among CARICOM populations (CCHD, 2006). The major NCDs in the Caribbean share common underlying risk factors such as unhealthy eating habits, physical inactivity, obesity, tobacco and alcohol use and inadequate use of preventive health services (CCHD, 2006). In the 2006 report of the Caribbean Commission on Health and Development (CCHD), they identified chronic NCDs as the major contributor to morbidity and mortality in CARICOM populations during the 20th century (CCHD, 2006). The four leading causes of death from 1985-2000 were heart disease, cancers, cerebrovascular disease and diabetes mellitus (CCHD, 2006) (CARICOM, 2007a). Data from the Caribbean Epidemiology Centre (CAREC) and Pan American Health Organization (PAHO) show that the Caribbean is the region of the Americas affected worst by the epidemic of chronic disease (CARICOM, 2007b). Food and diet are related to more than 53% of deaths in the Caribbean over a 25 year period (CAREC, 2007), and data published from the World Bank (2006) reveals that heart disease, diabetes, stroke and cancer account for over 50% of all deaths and illnesses (World Bank, 2006).

Some CARICOM countries also find themselves in the paradoxical position of experiencing both obesity and under-nutrition (FAO, 2010). It is common to see problems of underweight, stunting and micronutrient deficiencies present along with increasing rates of obesity (Popkin et al., 2012). Dual-burden households are most common in countries undergoing the nutrition transition (Popkin et al., 2012). A challenge for low income countries such as those that are part of CARICOM, is addressing food insecurity and hunger without adding to the issues surrounding overweight and obesity.

A recent study in St. Kitts-Nevis, a CARICOM member state, reported combined prevalence of overweight and obesity at 74% and 83% among men and women, respectively; the prevalence of obesity alone was 38% among men and 53% among women (Henry, 2004). Estimates of average energy availability in Latin America and the Caribbean, also known as "national average apparent food consumption", were made by the Food and Agriculture Organization (FAO) based on national food balance sheets. Calories available per capita per day increased from 2400 kcal/day in 1961 to 2800 kcal/day in 2000 (WHO, 2003). What is more concerning is the source of the increase in caloric intake, with fat availability increasing from 50g/day in 1960 to above 75g/ day in 2005 (WHO, 2003). The Caribbean region has available more than 160 percent of average requirements for fat and above 250 percent for sugars (CCHD, 2006). This means that overall, there is an overabundance of foods high in fat and sugar that are available to Caribbean populations.

This shift in energy availability has caused an explosion in obesity rates, both in adults as well as children (CFNI, 2009). Food balance sheets from the Caribbean region show that energy from fats and sugars has exceeded the population goals from the 1960s and has increased consistently and is still increasing, with supply of fat per capita increasing from 54g per capita per day in 1969 to 79g in 1999 (CFNI, 2009; WHO, 2003). Because the contribution of local imports continues to outweigh that of local production, increased consumption of fats, sugars and decreased consumption of fruits and vegetables holds for most of the countries in the Caribbean, with some variations (FAO, 2002).

It is particularly challenging for countries to address the issue of both malnutrition and obesity due to the low cost and high availability of foods that are energy dense, but low in nutrient content (Popkin et al., 2012). For example, Chile developed feeding programs to address issues of malnutrition in young children, but the programs were not revised to deal with energy imbalance issues until sometime after undernutrition was successfully reduced (Uauy & Kain, 2002).

Childhood Obesity in the Caribbean

There has been an increasing trend of obesity in children and adolescents in Caribbean populations. Data from the Caribbean Food and Nutrition Institute (CFNI) provide evidence that 15% of children are overweight or obese (CARICOM, 2007a). The prevalence of overweight children aged less than 5 years rose from 6% to 14% during the decade of 2001-2010 and the combined prevalence of overweight and obesity for boys (11-13) was 27% and 33% for girls (Henry, 2011). The prevalence of childhood obesity in some CARICOM countries is greater than that of the global average (CCHD, 2006). Though data in Caribbean countries are scarce, a study conducted by Doak, Adair, Bentley, Monteiro, and Popkin (2005) found that the dual burden of overweight and undernutrition is most likely to occur in middle-income countries and lowest prevalence occurs at both ends of the spectrum. This study documented the prevalence of households suffering from the dual burden of overweight and undernutrition in Vietnam, China, Kyrgyz Republic, Indonesia, Russia, Brazil and the United States; ranked in order of lowest to highest gross national product (GNP), a measure of national income (Doak et al., 2005). Because

Caribbean countries tend to differ in GNP, researchers cannot assume that all countries are affected by this dual burden. That being said, in a report published by the United Nations Standing Committee on Nutrition (UNSCN, 2010), prevalence of anemia in children aged less than 5 years in Latin America and the Caribbean was reported at 36% and stunting was reported at 15% (UNSCN, 2010).

The Caribbean Commission on Health and Development (CCHD) stated in 2005 that obesity must first be addressed in schools, concentrating on nutrition and physical activity (CARICOM, 2007a). The rising obesity rates in the population and in children can be attributed to consumption of fatty foods, snacks, soft drinks and high calorie foods (CARICOM, 2007a). A recent study in St. Kitts showed that children, who were either normal weight or overweight, were often anemic (Unpublished data (Farm to Fork), 2012). Although traditional research has mainly focused on individual behaviors leading to obesity, attention is needed in terms of the social and environmental contexts that facilitate these behaviors.

The childhood obesity trend, particularly in low and middle-income countries could be related to “the mismatch theory of early nutritional deficits followed by later excesses” (Gluckman et al., 2009). This theory refers to mothers suffering from undernourishment during their pregnancies, triggering fetal nutritional insufficiency thereby causing hormonal and physiological changes, which enhance biological survival in an environment characterized by a lack of resources. That being said, the child is born into a society providing an abundance of calories and fat, leading to the development of obesity and related diseases (Gluckman & Hanson, 2006).

One of the reasons for the current obesity epidemic is the nutrition transition experienced in the Caribbean. This population has transitioned away from diets high in grains, starchy vegetables, local fruits, vegetables and legumes towards a diet high in energy dense, processed and imported foods due to the increase in commercial markets and globalized dietary sources (Asfaw, 2011; Monteiro, 2009; Popkin et al., 2012). A recent study conducted in Barbados highlights an issue that may be experienced by several countries in the Caribbean, which is one of increased energy consumption, specifically from total fat, saturated fat and sugar (Gaskin et al., 2012). When compared to the Recommended Dietary Allowance (RDA) from the Food Based Dietary Guidelines for Barbados, the percent of energy from total fat, saturated fat and sugar were much higher than the recommendations; the RDA being 10-15% for total fat, <10% for saturated fat and <10% for sugar and the average intake per child being 29% for fat, 10.5% for saturated fat and 27% for sugar (Gaskin et al., 2012).

Economy

The estimated cost of obesity and its comorbidities in CARICOM is about US $1 billion per year (CCHD, 2006) which is an enormous economic burden for small developing countries. Obesity incurs cost at both an individual and societal level and includes direct and indirect costs. Direct costs, which result from treatment interventions, total over $200 million per year, based on a study conducted in five Caribbean countries. Indirect costs, resulting from loss of work productivity due to illness, total over $800 million (Barceló, Aedo, Rajpathak, & Robles, 2003).

Nutrition in the Caribbean is based on a few main staples, such as wheat, corn, potatoes and rice (Goddard, 2009). Amongst these items, most are being grown outside of the country and/or being imported, contributing to the increasing food import bill. Nine out of ten meals eaten in the Caribbean are prepared from imported goods (Goddard, 2009). Since 1971, the Caribbean has been a net food importer, with food imports costing over $4 billion US/ year (CFNI, 2009). In order to offset this level of expenditure, the economy in the Caribbean is largely based on tourism and export goods, with crops that are grown that have a global market.

The economy in CARICOM regions is extremely vulnerable due to their dependence on imported foods for tourism and the local population (Goddard, 2009). The Food-Fuel-Financial crisis, which hit in the new millennium, caused food prices to soar worldwide. Caribbean countries were particularly affected, with the Consumer Price Index increasing by 22-30% in some Caribbean islands, such as St. Lucia, St. Kitts/Nevis and St. Vincent/ Grenadines, but increasing as high as 133-230% in Jamaica, Dominican Republic, Suriname and Haiti (IMC, 2008). Although governments try to support their agricultural sector through subsidized inputs, the beneficiaries of these subsidies are farmers producing cereals, grains and fresh fruits and vegetables for export, rather than small producers of fruits and vegetables for local markets (Nugent, 2004).

Agriculture

Agricultural policies have a large impact on the health and food consumption of a population by influencing what foods are produced and which are imported and exported (Nugent, 2004). In the past, primary agricultural production had been the major source of food supply and was largely used for exportation in order to finance the cost of imports (IICA, 2009). That being said, in the past 2 decades, food imports in CARICOM have grown 73 times as fast as similar exports (IICA, 2009). Agriculture is critical to both food security and the growth of the economy in the Caribbean. A further emphasis has been placed on its role due to the increasing rates of diet-related chronic disease (IICA, 2009).

Another factor that may hinder the supply of healthy foods is the lack of food diversity (Nugent, 2004). Food diversity is influenced by climate and geography, which present major obstacles in Caribbean countries (Nugent, 2004). The Caribbean is prone to natural disasters such as hurricanes, floods, drought and earthquakes (Henry, 2012). This also affects domestic food supplies and foreign exchange earnings (Henry, 2012). Strategies proposed to combat chronic NCDs through the diet have been aimed at procuring food sources for the community at a local and regional level and using extra-regional imports (IICA, 2009). The issues behind this are that agriculture in developing countries is dominated by smallholder farmers and the production of crops is not growing fast enough to keep up with rising demand for food and to provide farmers with adequate incomes (Fan & Pandya-Lorch, 2012).

Strategies proposed to combat chronic NCDs also aim to promote greater use of local agricultural foods and produce, in order to reduce the effects of globalization on the Caribbean food supply (IICA, 2009). That being said, based on current dietary preferences within Caribbean communities, it is expected that the majority of countries in this region will depend on food imports as a source of nutrition for their populations (IICA, 2009). This means that food security within a region will depend on whether or not the country is able to generate the proper income to pay for these imports. Binger (2008) summarized the issue by saying this: "We have never been a culture of food producers. We have been a culture of export commodity producers, cash crops. And the logic has always been that we grow what we grow best for which there is a market. We sell and we import. Question is- is that paradigm still valid or do we need to change the paradigm…We are the most dependent region in the world on tourism, which makes for a very vulnerable economy. So we are 90 percent plus dependent on imported energy for our energy services and we are more than 90 percent dependent on imported food for our nutrition. That does not spell a future full of promise" (Binger, 2008)

Cost

Food security, as defined by the Food and Agriculture Organization (FAO) is when "all people at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life" (FAO, 2006). Within this definition, is that individuals who are food secure have economic access to nutritious food. Without adequate income, food choices amongst individuals are limited (IICA, 2009). Eighty percent of deaths from chronic disease occur in low and middle-income countries, where most of the world's population lives (CARICOM, 2007a). The increasing burden of the chronic diseases in these countries can be related to underlying determinants such as globalization, urbanization and rapid population ageing (WHO, 2005). In the Latin American Region, it is estimated that approximately 50% of all potential years of life lost are related to NCDs, whereas 30% are related to communicable diseases and 20% to injuries (Anderson et al., 2009). Research has shown that these diseases tend to cluster around the poorest communities due to issues with accessibility to education and health care services to prevent or treat NCDs (Anderson et al., 2009; Barreto et al., 2012).

In addition to issues surrounding accessibility, food cost plays a large role in the nutrition choices of low-income families. Food prices, which are subject to change based on the global economy, have a major effect on the purchasing behaviors of individuals who are of lower socioeconomic status. A law of economics, devised by Engel in 1857 demonstrates that the proportion of income spent on food diminishes as income increases (Drewnowski, 2003). Therefore, households of low socioeconomic status spend a larger proportion of their income on food. Because their main priority is to obtain sufficient dietary energy at a low cost, families spend their limited resources on fats and sweets in the form of snacks, beverages or fast foods due to their convenience and ease of use (CFNI, 2009; Drewnowski, 2003). Research has shown that energy-dense foods normally represent the lower-cost option as compared to fruits and vegetables (Henry, 2004). In a study conducted by Henry (2004) most individuals restricted fruit and vegetable consumption at most meals due to concerns of cost and value-for-money. Parents may also be more likely to purchase processed, energy dense food, high in fat and sugar to ensure that children will eat them and no food will be wasted (Finney Rutten et al., 2012; Henry, 2011). In a study conducted by Basiotis and Kramer-Leblanc (1998), a participant stated that "the most important factor in choosing and preparing foods was to ensure that no-one would complain they are still hungry". Therefore, poor diets are as much a food economic issue as they are a health education one (CFNI, 2009).

When referring back to the definition of food security, it is important to highlight the significance of "safe and nutritious" foods. Though the problem of undernutrition has been brought forward and is beginning to receive government attention in Caribbean countries, this does not necessarily mean that populations are food secure (MacDonald, 2012). Within the past 50 years, there has been an economic shift associated with increased imports and liberalized trade models, threatening local food production and increasing caloric availability (MacDonald, 2012). In other words, though access to food has improved, Caribbean countries have been importing foods from the west, high in fat and calories and low in fibre, vitamins and minerals (Henrya, 2004).

Aside from providing nutritional advice to consume "healthier" diets, changes must be made at both the public level, in terms of policy, and at the agricultural level, to ensure that healthier foods represent an affordable option. Among other factors, income, culture and education play a role in determining consumer tastes and preferences (FAO, 2006). These factors, along with relative prices, determine the demand for foods (FAO, 2013). Demand then influences production, processing and marketing of these products through food systems, causing a continuous cycle (FAO, 2013).

Lifestyle

During the decade of the 1960s, the Caribbean people suffered from under-nutrition due to an overall lack of energy intake (CCHD, 2006). Since the 1970s, there has been a shift, where average caloric intake is increasing well beyond the recommended daily allowance (CCHD, 2006). The recent shift of Caribbean populations from malnutrition to overnutrition can be related to two major things: a diet overtaken by processed, energy dense foods and a decrease in physical activity. The increase in caloric intake is mainly due to global and local forces driving consumption of fats and sugars. The modern diet in the Caribbean has certain characteristics attributed to it such as: the use of processed foods instead of natural ones, excessive sugar intake, reduced fruit and vegetable and a greater consumption of animal fat and cholesterol (Goddard, 2009; WHO, 2003). For example, consumption of livestock products increased from 32 kg per capita per year in Latin American and the Caribbean in the 1960s to 54 kg per capita per year in the 1990s (WHO, 2003). This number is estimated to rise to 77 kg per capita by 2030 (WHO, 2003). In contrast, the global annual average per capita vegetable supply taken in 2000, from highest to lowest was Asia (116 kg), Developed countries (112.8 kg), Europe (112.5 kg), Developing countries (98.8), North and Central America (98.3), Arica (52.1) and South America (48 kg) (WHO, 2003). This nutrition transition is characterized by a shift away from diets based on locally grown staples such as grains, starchy roots, fruits, vegetables and legumes to a more "westernized diet", which consists of processed foods, more foods of animal origin, added sugars and fats (CFNI, 2009).

The main drivers behind consumer demand for new foods are convenience and novelty (Goddard, 2009). Foods that fall within this category are ones that are processed, highly refined and closely linked to CNCDs. Grocery shelves within Caribbean regions are filled with packaged goods, such as processed meats which are filled with nitrates, snack foods which are high in salt and trans fat and sodas whose main constituents are sugar, water and artificial flavors (Goddard, 2009). Efforts have been made to reduce the abundance of highly processed foods and increase the consumption of fresh fruits and vegetables in developing countries, such as Mexico, Thailand, Brazil and Chile. These efforts include strategies to address energy intake from beverages, removing food with high sugar and saturated fat content from schools, inclusion of healthy food labels on foods with reduced sodium, sugar and saturated fats, increasing the promotion of fruits and vegetables and providing 1.5% milk instead of whole milk (Kain, Leyton, Cerda, Vio, & Uauy, 2009; Rivera et al., 2008). Though these efforts may be beneficial, little attention has been paid to their effect on people's choices outside the controlled environment (Nugent, 2004).

Social Norms

The sociocultural food environment refers to social and cultural norms, such as values, beliefs and attitudes about food, which are held by a community or society (Henry, 2011). The issue of undernutrition and obesity in countries undergoing the nutrition transition could be related to differences in food allocation in households as well as social norms in certain countries (Popkin et al., 2012).

An interesting feature of obesity in Caribbean populations is the consistent gender difference, with higher prevalence occurring amongst females (CFNI, 2009; Henry, 2011; Popkin et al., 2012). This gender difference begins from young adulthood. More than 55% of Caribbean women are overweight or obese, which is almost double the number of men who suffer from this burden (Henry, 2011). This could be attributed to cultural and social norms within Caribbean populations. The Caribbean Food and Nutrition Institute studied values and perceptions of populations in four Caribbean countries: Belize, Jamaica, St. Kitts and Nevis and Trinidad and Tobago. The results of the study are noteworthy when compared to North American standards. For example, being thin or slim was not ideal or culturally normative in the Caribbean culture (CFNI, 2003). Women preferred "having size" or "being solid" and males' perceptions of their appearance were extremely important in influencing ideal weight and shape (CFNI, 2003).

SCHOOL-BASED INTERVENTIONS

"The physiology of energy balance is determined proximally by behaviors and distally by environments" (Swinburn et al., 2011). In order to reduce childhood obesity, interventions must target both behaviors and environments. Schools are a key setting for obesity prevention because 95% of children aged 5-17 spend approximately 6 hours each day at school (Foltz et al., 2012). School feeding programs established in developing countries can increase school enrolment, attendance, cognition and education achievement as well as improving child nutrition outcomes (Bundy, Drake, & Burbano, 2012).

A recent Cochrane systematic review showed that improving the nutrition quality of the school food supply and providing training for teachers on implementing health promotion strategies are effective school-based strategies to address or prevent childhood obesity (Waters et al., 2011). The United States has made strong efforts to prevent obesity through school-based interventions. The Institute of Medicine (IOM) has provided dietary guidance for school meals in order to make them more healthy and nutritious. Their recommendations include increasing requirements for fruits, vegetables and whole grains, providing only fat free and low fat milk, and decreasing the amount of sodium and trans fat in school meals (Stallings, Suitor, & Taylor, 2010).

One of many examples of healthy school food programs implemented in the United States is the Child and Adolescent Trial for Cardiovascular Health (CATCH). One of the components of this program was training the food service staff at schools to provide meals lower in total fat, saturated fat and sodium. Obesity rates grew at a slower pace in schools where CATCH intervened (Foltz et al., 2012). Another example is the Riverside Unified School District

Farmers Market Salad Bar Program, where students had access to a daily salad bar, consisting of fresh and local produce provided by local farmers. The results of the program showed an increased consumption of fruits and vegetables for lunch (No data on weight even from the specific program) (Foltz et al., 2012). The program was evaluated on two occasions; once in 2005 and once in 2008. In the 2005 evaluation, students eating at the salad bar had a mean intake of 2.36 servings of fruits and vegetables, in comparison to 1.49 servings for those who ate from the hot bar. In the 2008-2009 evaluation, the schools receiving the salad bar were compared to control schools and no increase in fruit and vegetable consumption was found overall. That being said, students who chose the salad bar increased consumption of fruits and vegetable intake at lunch by 0.5 servings compared to those who ate the hot meal and therefore did not eat at the salad bar (Center TRT, 2011).

There have also been efforts to reduce the consumption of sugar-sweetened beverages by children across the globe. Mexico is one of the few developing countries to move forcefully against sugar-sweetened beverages and other less healthy beverages, such as high fat milk. The Mexican Ministry of Health developed a set of guidelines, which were used to alter procedures in schools, as well as feeding and welfare programs (Rivera et al., 2008). Recently, major Mexican food companies and the Ministries of Health and Education came to an agreement to remove foods and beverages with high sugar and high saturated fat content from schools (Rivera et al., 2008). The European Commission (2012b) approved health food labels, which would identify foods with lower amounts of sugar, sodium and saturated fats (Rivera et al., 2008). In Asia, Thailand has led efforts to begin infant feeding and school initiatives related to obesity prevention. The country has revised food labeling, promoted fruits and vegetable consumption and worked on reducing fat and oil content in foods (Popkin et al., 2012). One of the most aspiring school food programs is the EU's School Fruit Scheme, which was initiated in 2008. The program supports initiatives throughout the country that aim to provide fruits and vegetables to school-aged children, ranging from ages 6-10, by 2011 (European Commission, 2012a). Evaluations of this program deemed it a success, whereby it did increase fruit and vegetable consumption among children (European Commission, 2012b). For example, Poland recorded a 21% increase in consumption of fruits and vegetables (European Commission, 2012b). In some cases, such as Romania and the Netherlands, encouraging increased fruit and vegetable consumption carried over to areas such as after school programs or on days where fruit distribution was not planned (European Commission, 2012b). Differences were observed in relation to gender, with girls consuming more fruit and vegetables than boys. It was also noted that children preferred fruits to vegetables (European Commission, 2012b)

Though not all food programs that are implemented are further evaluated, some show that school-feeding programs can affect child nutritional status, especially when certain types of food are incorporated. In developing countries, where malnutrition is often an issue efforts are being made through the use of school food programs to improve child nutritional status. In South Africa, incorporating biofortified orange-fleshed sweet potato, high in beta-carotene, into a school feeding program, increased vitamin A consumption in children (Van Jaarsveld, Faber, Tanumihardjo, Lombard, & Benadé, 2003) and reduced prevalence of vitamin A deficiency by up to 60 percent (Arimond et al., 2011). In Kenya, children who received milk and/or meat supplements with the morning snack, had an increased intake of nutrients such as vitamin A, vitamin B_{12}, calcium, iron and zinc (Murphy et al., 2003; Neumann et al., 2003). In India, rice served in schools was fortified and led to significant declines in iron-deficiency anemia. Researchers noted that iron-deficiency anemia declined from 30% to 15% (Moretti et al., 2006).

In Latin American countries, such as Peru, researchers evaluated the impact of the school breakfast program, launched in 1993, on children's dietary and micronutrient status (Jacoby, Cueto, & Pollitt, 1996). The breakfast provided to 5-10 year old schoolchildren consists of a cake and an instant milk beverage and meets 30% of their daily energy requirements (Jacoby, Cueto, & Pollitt, 1998). Children in schools where the breakfast was served consumed more energy, protein and micronutrients such as zinc, iron, vitamin A and iodine compared to students in control schools (Jacoby et al., 1998). The significant increased iron intake led to a drop in the incidence of anemia from 66% to 14% amongst the children within 6 months (Jacoby et al., 1998). Although Latin American countries, such as Brazil and Chile are initiating a number of healthful measures, the efforts have not been fruitful to date, as processed and low quality foods are still found in schools (Kain et al., 2009). For example, in a study conducted by Kain et al. (2009), the intervention group, who received contents on healthy eating from trained teachers as well as nutritionist supervision had a decreased BMI Z score in the first school year (from 0.62-0.44), but it then further increased by 0.12, whereas BMI remained unchanged in the two time periods.

Researchers have found that holistic school-based approaches, which aim to improve diet as well as the food environment, are the most successful in impacting child health status (Jaime & Lock, 2009; Mozaffarian et al., 2012). Efforts that seem to be most effective are those that increase availability of fruits and vegetables and reduce fat content of school meals (Jaime & Lock, 2009). Because school lunches in St. Kitts, Trinidad and Tobago and St. Lucia are provided to children daily, targeting schools as a first-step in a health intervention strategy is ideal. Data collected from the school food program in St. Kitts shows that fifty percent of children eat the school lunch everyday and 25% of the children eat the school lunch 2-4 times a week (Unpublished data, 2012). By targeting the school food programs, a healthy school lunch menu could play a role in the reversal or prevention of childhood obesity in approximately 75% of the child population.

Home Grown School Feeding

Linking school feeding programs to agricultural development is essential if efforts implemented in developing countries are to be maintained. Home Grown School Feeding (HGSF) is a program which provides food produced and purchased within a country, and links school feeding programs to agriculture and development (Sumberg & Sabates-Wheeler, 2011) (Gelli, Neeser, & Drake, 2010; Sumberg & Sabates-Wheeler, 2011). The difference between HGSF and Farm to School Projects is that HGSF programs are not necessarily centered primarily around education and nutritional objectives, but rather stimulating the local economy or local production as well (World Food Programme, 2009). Three beneficiary groups were identified for HGSF, schoolchildren, smallholder farmers and community-based groups delivering support services to school feeding (Bundy et al., 2012). The greatest challenge to date with these programs is to develop new ways for the agriculture and educational sectors to work together, as well as a way to properly evaluate the specific outcomes in both areas (Bundy et al., 2012). Because HGSF is a relatively new concept, there is a lack of research on their impact on the local economy (World Food Programme, 2009). That being said, many high and middle-income countries have already published papers on the impact these programs have had on their economy. For example, in the United Kingdom, a pilot school meals program was initiated in 2004 in 12 schools and to date, has benefited the economy by £160,000 from local sales and provides 70% of its food from local sources (Sonnino, 2007).

Farm to School Projects

The United States began its first Farm to School program in 1997 in California and by

2007, there were over 85 school districts who implemented farm to school programs (Joshi & Beery, 2007). Farm to school programs in the United States often include the use of a salad bar in the schools (Joshi & Beery, 2007). Upon evaluation of farm to school programs, researchers found that not only does school meal participation increase, but students consume more fruits and vegetables if products are fresh, locally grown and picked at the peak of their flavor (Joshi, Azuma, & Feenstra, 2008; Joshi & Beery, 2007). When meals were analyzed in the farm to school program in the Compton Unified School District, children eating farm fresh salad bar lunches consumed between 90-144 percent of recommended daily servings of fruits and vegetables (Feenstra & Jeri, 2005). In comparison, children who continued to eat hot lunches, only consumed 40-60% of the recommended servings (Feenstra & Jeri, 2005). Both groups consumed close to the recommended amounts of protein and carbohydrates. In addition to consuming adequate amounts of vegetables and fruits, one study reported a reduction in total calories, cholesterol and total fat in student's daily diets in 8 different salad bar programs as a result of the farm to school programs (Slusser, Cumberland, Browdy, Lange, & Neumann, 2007).

Though these programs are primarily school-based interventions, research has shown that they impact children's nutrition knowledge outside the school environment. For example, the Food Trust (2007), is a program that has been developed to help kindergarten aged children learn in interactive ways about nutrition and agriculture, along with providing them with local and nutritious foods such as squash, pumpkin bread, and apple blueberry sauce. When the program was evaluated in 2007, authors reported that before the farm to school program, only 50% of the students were aware of the daily recommendation for vegetables and fruits, whereas after the program, 80% of students were aware of this (The Food Trust, 2007). Another change noted was that 90% of students participating in the program could identify healthier options to buy in the supermarket as well as identify high sugar products by reading food labels, as compared to only 62% and 72%, respectively in the pre program (The Food Trust, 2007). The goals of this initiative were to increase consumption of nutritious food by children and to also increase student and parent awareness through an educational component. Anthropometric measures, nutrition intake and weight were not assessed (The Food Trust, 2007).

Cost- Effectiveness

School feeding programs that occur in low-income countries, exhibit large variation in cost (Bundy et al., 2012). For example, the cost per year per child for a school feeding program in Kenya was found to be US $28, whereas the cost of feeding a child in Lesotho for a year was US $63 (Galloway et al., 2009). The cost of the commodities made up the largest share of the school feeding budget in all countries studied by Galloway et al. (2009): Kenya (57%), Lesotho (74%), Malawi (54%) and Gambia (51%).

In terms of Farm to School programs established in developed countries; specifically those in which a salad bar is provided at school, an initial investment is often required for the program to thrive. This investment can range from $3,400-$7,000 per school site, which includes salad bar equipment and additional labor costs (Christensen, 2003). In addition to those costs, produce may be more expensive and therefore, farm to school meals may cost more than the alternative lunch. Data from the Compton Farm to School Program shows that in the 24 elementary schools where salad bars were implemented, a budget deficit occurred (Feenstra & Jeri, 2005). Farm to School programs may not be sustainable in the long term due to their cost associated with fresh produce as well as the additional labor cost; therefore, outside funding may be required to ensure their financial viability (Feenstra & Jeri, 2005). According to Bundy et al. (2012), government financial support is needed for program sustainability in order to transition away from relying on external support and encourage national programs. Evidence shows that farm fresh produce contributes only a small amount of the increased cost, and that the challenge in keeping costs low lies within the additional labor cost associated with these programs (Feenstra & Jeri, 2005). Data from Christensen (2003) indicated that the total cost of the salad bar lunch per student, excluding protein sources of food, was $1.19 and the cost of the standard lunch was $1.20 per student, excluding labor costs (Christensen, 2003). These calculations also did not include start up costs, and salaries of the additional staff hired for the salad bar program. Taking these into account, one can assume that the cost of the salad bar lunch would be higher.

Farm to Fork Project

One of the most common objectives of healthy eating policies in developing countries is to increase fruit and vegetable consumption (Lachat et al., 2013). That being said, most policies focus on education and information giving, whereas very few "upstream" actions, such as those working with agrifood systems, are used (WHO, 2013a). In order to create a healthier environment for Caribbean populations several sectors must be involved, must collaborate and be effectively engaged (Henry, 2011). The sectors include "agriculture, trade, education, finance and other governmental ministries" (Henry, 2011). This is currently what the McGill "From Farm to Fork" project has aimed to do.

This project targets four specific CARICOM countries, which are Trinidad, Guyana, St Lucia and St. Kitts. The goal of the CARICOM project "From Farm to Fork" is to encourage smallholder farmers to produce foods that can be sold school meal centers and contribute to the prosperity of the society (Unpublished data, 2012). The project is aimed at changing infrastructure as well as meal preparation by targeting key stakeholders at every level. Over a one year period, researchers who were part of the Farm to Fork project examined the feasibility of increasing the contribution of vegetables and fruits, grown locally by 22 smallholder farmers, to the school feeding program. The main individuals involved in the project are local health education and agriculture government departments, farmers, school workers and school-aged children. The project lies in a systems approach of linking agriculture to health. As stated by Hawkes et al. (2013) “agricultural and food system policies shape incentives for the production of healthy food”, therefore increasing incentives for consumers to purchase these foods by influencing the availability, affordability and acceptability of the foods, also creates an incentive for producers and manufacturers.

The specific project, which was evaluated in this thesis, is the school-based intervention in St. Kitts. There are a total of seventeen schools in St. Kitts participating in the “Farm to Fork” project. In four of these schools, changes were made to the school menu, while the other thirteen schools served as the control group. The name of the four schools where changes were made to the menus are: Beach Allen, St. Paul, Saddler Primary and Edgar T. Morris.

Knowledge Gap

Since this intervention to improve school meals was one of the first projects implemented in the Caribbean, there is no past literature on school-based interventions in this population. The evaluation of the intervention is important in order to identify the drivers and barriers that may influence its success. Three specific knowledge gaps needed to be filled in terms of the new menu implementation in St. Kitts elementary schools. These were: 1. The compliance of the kitchen staff to the modified menus. 2. The organizational and economic barriers associated with the sustainability of the project. 3. The acceptance of the new menus in intervention schools. The project specifically collected data from kitchen staff and questionnaires given to school children, attending the four intervention schools.

Research Questions and Objectives

Given that the new menu program has been implemented in four schools, it is important to evaluate its impact, both on structure, cost and at an individual level. The questions that this study aims to address are:

1. Are the lunches prepared for the intervention schools compliant with the lunches planned?
2. What is the difference in the total cost of a meal and the cost per child for one meal between the control schools and intervention schools
3. If a difference in price exists, what is driving this cost up or down?
4. Is there a nutritional difference between the intervention school lunches and the control schools, specifically in terms of calories, macronutrients and micronutrients provided per portion.
5. What portion of the lunch are children consuming and what components of the lunch are being left?

Methods

Research Orientation and Design

The type of research used in this project is descriptive and applied and is referred to as a process evaluation. A process evaluation is conducted in order to assess whether an intervention is being carried out as planned (Hulscher, Laurant, & Grol, 2003; Linnan & Steckler, 2002). Process evaluations allow researchers to describe the current activities of the project, to check exposure to the intervention and to describe the feelings and opinions of those being affected by the intervention at hand (Hulscher et al., 2003). The process evaluation conducted in this instance is a formative evaluation (Linnan & Steckler, 2002), meaning that its goal is to assess whether specific elements of the intervention are being provided such as services, staff and proper meals. The evidence gathered was obtained through kitchen workers, nutritionists working at the schools and researchers that were part of the “Farm to Fork” project

The goal of measuring the implementation of an intervention is to avoid what Basch et al. (1985) call type III errors. A type III error occurs when one evaluates a program that has not been adequately implemented (p.316) (Basch et al., 1985). This will cause faulty conclusions to be drawn from the project and affect the accuracy and reliability of the information being given. In order to avoid this, a process evaluation was conducted to evaluate the project in its current state.

Population and Sample

The program that is being evaluated is the school meals program, implemented in St. Kitts, as part of the Farm to Fork project. What were specifically studied in this evaluation were the intervention school meals and the control school meals. Control schools and intervention schools were compared in terms of the cost of the meals and the nutritional value of the meals on the same days. These measures were taken over two time periods. In addition, secondary data, which were collected by interviewers working in the intervention schools, were assessed in terms of food waste at the schools. No individual data were collected; rather, components of the school meals program were evaluated.

Quantitative Methods Design

This research project has evaluated the existing Farm to Fork project from a quantitative perspective in order to answer questions of economic feasibility, sustainability, and adherence to the menus, and acceptability by the students.

Procedure

Five days were spent at the food preparation site in St. Kitts, from May 6 to May 11, 2013. Data were gathered in terms of meals prepared, ingredients used and the total cost of meals for the time period of April 23 to May 3, 2013. During the same time, questionnaires that were completed by the interviewers at the intervention schools after every meal, assessing the acceptability of the meal by the children, were collected. In September 2013, a new set of data were gathered, including the recipes, ingredients and costs for a second time period in the project. This time period occurred between September 30 and October 11, 2013. In this instance

The data analyzed in this project addressed the cost of the new intervention, the macro and micronutrient distribution of the new menu and how much waste was occurring at the schools each day. Data were gathered from the commencement of the intervention (January 2013), until January 2014.

Menus Summarized

Eight hundred children were fed with the recipes designed for the intervention schools. During two 10 day periods, the first in April/May 2013 and the second in September/October 2013, the foods prepared for children in the intervention schools were ascertained from the record of foods issued from the food supplies to the preparation area and these were compared to the new menus developed locally with the input of the researchers. Meals were deemed to match the planned menu based on the following criteria: 1. Was the main meal that was planned for the day truly served. 2. Was the meat that was planned for the meal the same meat that was served. If overall, the meal that was served was the same as the one planned, with a few items missing, these meals were deemed to "match" and the missing food items were stated.

Drink

Every meal served, both to the intervention schools and control schools, is accompanied by a fruit drink, which is composed of sugar powdered flavoring, Sunquick and water. The fruit drink is prepared by the kitchen staff and is divided into coolers for each school. The fruit drink was analyzed separately in terms of cost and nutritional value. The reason for this is because it is given to all the schools and therefore is not a variable that differs between control and intervention schools. The cost and caloric content of the fruit drink was therefore not included in the comparison of the meals. The total cost and total nutritional value of the fruit drink were divided by 3200 children to get the cost and nutrition per portion.

Cost Effectiveness

Cost effectiveness is defined as "economical in terms of tangible benefits produced by money spent" (Merriam-Webster, 2014). The tangible benefit in terms of this project is the nutritional value of the meal. The data were collected in two time periods: April 2013 and October 2013. The data collected represented the ingredients and their cost for both the control schools and the intervention schools. The data were entered into excel, comparing the cost of the usual school menus, which are prepared for the control schools, with the intervention meals, prepared for four schools. In order to calculate the cost of providing a meal on a per child basis, the control school meals were divided by 2400 and the intervention school meals were divided by 800.

The goal for the cost analysis was to uncover whether or not the intervention meal was significantly more costly than the control schools meal. This may allow researchers to address cost issues that the project may be experiencing and examine how to reduce cost, while delivering the same amount of nutrients to the children.

Macronutrient and Micronutrient Analysis

Meals from the period April 27, 2013 until May 3, 2013 and the period of September 30 to October 11, 2013 were analyzed using The Food Processor SQL Version 10.8.0 (Copyright 2011) ESHA Research. Ingredients that were measured and recorded by kitchen staff for both control and intervention schools were entered into the program and divided by 2400, which is the number of children fed by the control school meals or 800, which is the number of children fed by the intervention school meals in order to receive a nutrient analysis per portion. Macronutrient content of each meal was analyzed per serving; total calories, fat, carbohydrates, sugar and protein content were analyzed. The meals were also analyzed for micronutrient content; vitamin A, vitamin B_{12}, vitamin C, vitamin D, vitamin E, calcium, iron and potassium content were assessed. These were then compared between control and intervention schools daily, for both time periods. This allowed researchers to identify whether or not the intervention meals were providing more nutrients to children compared to control meals.

Comparison to 1/3 percent RDA

The micronutrients were compared to 1/3 of the percent RDA for children aged 4-8 years, and males and females aged 9-13 years. One third of the RDA was chosen, assuming that children were consuming balanced meals at breakfast and lunch. The RDA is the average daily dietary intake of a nutrient that is sufficient to meet the requirement of nearly all (97-98%)

healthy persons and is the number to be used as a goal for individuals. The RDAs used for the comparison of micronutrients were taken from Health Canada. Below is a value of the RDAs per age group and gender. The RDA for both genders aged 9-13 are the same, therefore, values were not compared based on gender and only was value was used.

Table I- Recommended Dietary Allowances for children aged 4-13 from Health Canada

	RDA children (4-8 years)	**RDA males and females (9-13 years)**
Vitamin A (IU)	400	600
Vitamin B_{12} (mcg)	1.2	1.8
Vitamin C (mg)	25	45
Vitamin D (mcg)	15	15
Vitamin E (mg)	7	11
Calcium (mg)	1000	1300
Iron (mg)	10	8
Potassium (mg)	3800	4500

Waste

Questionnaires were collected by staff following every meal and rated how much of the food was eaten on a sample of children's plates. The sample was one of convenience Questionnaires from the first time period in which ingredients and recipes were collected (April 2013) were examined. Percentages of food consumed were divided into 4 different categories: 0-25%, 26-50%, 51-75% and 76-100% and were estimated by eye by a nutritionist at the school. If a child consumed 0-25% of the portion, it is assumed that the child consumed practically none of it, whereas if the child consumed 76-100% of the portion, it is assumed that the child consumed all of it. Two additional categories were added to the percentages of portions consumed, which were “Did not receive” or “Missing”. The former refers to a child not receiving a serving of that particular food item, assuming that the kitchen ran out. The latter refers to that food item not being mentioned in the questionnaire on a day that it was served. The percent of the portion consumed for each food on the plate was entered into an Excel spreadsheet for each separate school. Averages were calculated for each meal in order to assess acceptance by the children.

Acceptance of the vegetables and fruits that were offered in the intervention schools were also assessed separately to evaluate how many children consumed or discarded the vegetables and fruits provided. The table presented in the results section shows only those who consumed 0-25% of the plate and those who consumed 76-100% of the plate as most responses were in these categories; rejection or acceptance of the food.

Data Analysis

The recipes from both time periods were transcribed into spreadsheets using Microsoft Excel 2010. Ingredients for each recipe were compiled, and total cost for each meal was calculated, excluding the cost of the beverage, which was a standard cost for all schools, daily. The total cost of each meal was then divided by the estimated number of children it served. This was done for both control and intervention schools for both time periods. Control and intervention schools were compared in terms of cost and ingredients and recipes were analyzed to identify what was contributing to the differences. The difference in cost between the control schools and the intervention schools during the first time period and the difference in cost between the control schools in the first time period and the intervention schools in the second time period were analyzed statistically using SPSS version 22 (Copyright 2013). All data were tested for equality of variances using Levene's Test for Equality of Variances. If data were not equal in variances, the appropriate statistical value was reported.

Nutritional analysis was conducted on each recipe using The Food Processor SQL Version 10.8.0 (Copyright 2011) and nutrients provided per portion were determined. The values were then entered into Microsoft Excel 2010 and averages were calculated for control schools and intervention schools. The values were then analyzed statistically using SPSS version 22 (Copyright 2013) to see if a significant difference in nutrient composition was found between both groups.

The average waste in all school meals was calculated per portion served and by separate ingredient, based on the four categories described above. Because the quantity consumed was presented in definite categories, the true quantity of waste was not calculated, but rather how many children were found in each category. In addition, waste for vegetables and fruits were analyzed separately to assess the acceptance of these new menu items. As stated earlier, the categories included in this assessment were the 0-25% and 76-100% as most children were found in these two categories.

Ethical Approval

Because this process evaluation is part of the larger "Farm to Fork" project, which began under the direction of Dr. Leroy Philip, approval from the Research Ethics Board at McGill University was granted to the primary investigator of the larger project and was therefore valid for this specific research project as well (See Appendix A).

Results

Comparison of planned intervention meals and served meals

A two-week rotation menu was planned for the intervention meals based on availability of vegetables and meats (Appendix A). Meals that were made in the two time periods were compared to the planned meals and whether or not these were similar was assessed.

During the period of April 23, 2013- May 3, 2013, 67% (6/9) of the meals served matched what was planned for the intervention schools. The meals that did not match often had a change in the meat provided or the meat simply was not present in the meal, though this only happened on one occasion (May 2nd, 2013) (Appendix C). Even in the meals where the food provided matched what was planned, there were often certain foods missing, specifically fresh fruits or vegetables.

During the period of September 30, 2013- October 11, 2013, 78% (7/9) of the meals served matched what was planned for that day in the intervention schools. Only one of the meals had a different serving of meat than what was planned and the other instance where it did not match was the lack of pink beans in the meal. Though there are more vegetables provided in the second period, these are still lacking, based on the recommended dietary intake for this age group. The vegetables that present a particular problem are the string beans and fresh fruit is often lacking in the meals as well (Appendix B)

Ingredients and cost

In this section cost is presented in East Caribbean dollars (EC). One EC is equal to 0.41 Canadian dollars (CAD) at the time of the analysis. The costs were calculated from purchase orders from the supermarket and from bills for foods from local farmers for the same two weeks as the menu matching above.

Sweetened beverage

Ingredients and caloric content of sweetened beverage

The juice served to the children on the island of St. Kitts contains bottled Sunquick which is a sweetened orange beverage that contains 63g of sugar per bottle, 96 lbs of sugar, sweetened powder called Tang and ice, mixed with water. The energy content of this beverage per serving is 80 kcal and it contains 13g of sugar.

Cost

The total cost of the sweetened beverage per day is 1,031.92 EC. Per child, this is approximately 0.32 EC. This is approximately 17% of what the intervention lunch costs per child, including the cost of the juice. What is driving up the cost of the juice are the 28 bottles of Sunquick used. The other large cost is the 25 bags of ice that were purchased daily when the ice machine was broken.

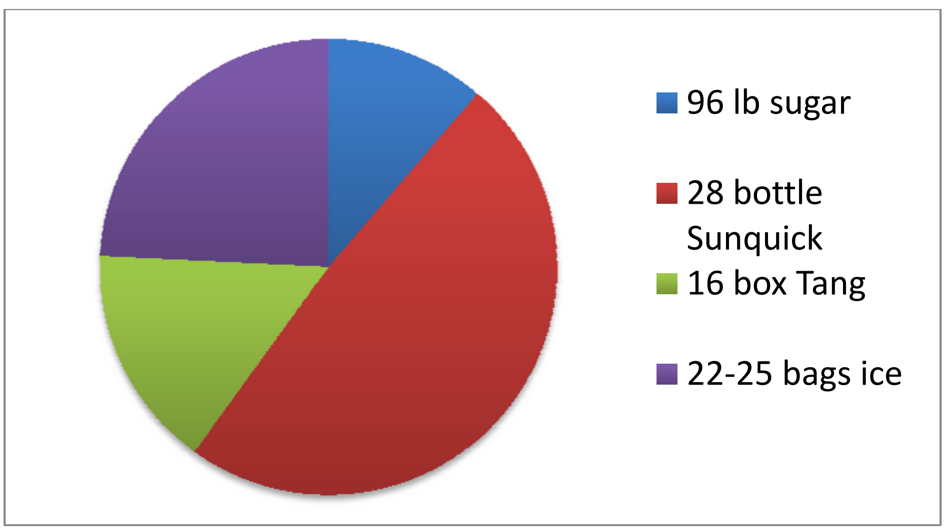

Figure 1- Total cost of ingredients used for juice served to all schools on the island.

Meals and cost

The meals were divided based on time period; the first time period being from April 23, 2013- May 7, 2013 and the second one being from September 30, 2013-October 11, 2013. The table below summarizes the total cost and the cost per portion for both the control and intervention schools throughout the time period of April 23, 2013- May 7, 2013.. Note that the control school meals feed 2400 children, whereas the intervention school meals feed 800 children.

Table II- Total cost of school meals recipes and cost per child from April 23, 2013-May 7,2013

Date	**Control School Total cost EC**	**Control school Cost per child**	**Intervention school Total cost**	**Intervention school Cost per child EC**
23-04-13	Spaghetti 3012	1.26	Oven baked chicken 1860	2.33
24-04-13	Stewed wings 2764	1.15	Stewed turkey wings 1487	1.86
25-04-13	Cook up 2520	1.05	Spaghetti 1216	1.52
26-04-13	Hot dogs 2282	0.95	Hot dogs 759	0.95
29-04-13	Cook up 2079	0.87	Stewed turkey wings 1272	1.60
30-04-13	Spaghetti 3049	1.27	Baked chicken 1058	1.32
01-05-13	Stew and rice 3408	1.42	Fish bread 2290	2.86
02-05-13	Soup[1] 1499	0.62	Soup[1] 500	0.62
03-05-13	Grilled cheese 1245	0.52	Hamburgers 1078.70	1.35
07-05-13	Cook up 2025.38	0.84	Stewed turkey wings 1255.40	1.57
Average cost	**2282**	**0.96**	**1260**	**1.57**

[1]Soups on 02-05-13 was prepared for both control and intervention schools

The table below indicates that the prices for the intervention meals have not decreased during the two time periods and have actually increased in some instances, particularly on Tuesday, October 8, 2013, where they served chicken, mash potato sate and pumpkin, and Friday, October 11, 2013, where they served hamburgers. The reason for the high cost of these meals can be attributed to the quantity of meat provided in the recipe. For example, on the 11^{th}, 900 hamburger patties were provided for the intervention meal recipe, though there are only 800 children to feed.

Table III- Total cost of school meal recipes and cost per child from September 30, 2013-October 11, 2013

Date	Intervention School Total cost	Intervention School Cost per child
30-09-13	Rice and spinach stew chicken 1528	1.91
01-10-13	Mashed potato, hot slaw and baked chicken 2405	3.00
02-10-13	Rice and pink beans, hot slaw and stew turkey 1139	1.42
03-10-13	Spaghetti- minced meat pumpkin satay 2060	2.57
04-10-13	Hot dog creole sauce 1264	1.58
07-10-13	Rice, turkey and carrot mix 1191	1.49
08-10-13	Mash potato sate, pumpkin, baked chicken 3692	4.61
09-10-13	Hot slaw, creole sauce, baked fish, hamburger bread 2277	2.85
10-10-13	Soup 2753	0.86
10-11-13	Hamburger, custard sauce and sliced tomato 3473	4.34
Average cost	**2294**	**2.46**

Comparison of mean cost between control schools and intervention schools in first time period and second time period

The mean cost of the control school lunch is 0.96 EC with standard deviation of 0.35. The average cost of the intervention school lunch for the first time period is 1.57 EC with standard deviation of 0.70. There is a significant difference ($p<0.05$) between the cost of the control school lunches and the intervention schools in the first period. The average cost of the intervention school lunch for the second time period is 2.46 EC with standard deviation of 1.26. There is a significant difference ($p<0.05$) between the cost of control school lunches and the intervention schools in the second time period.

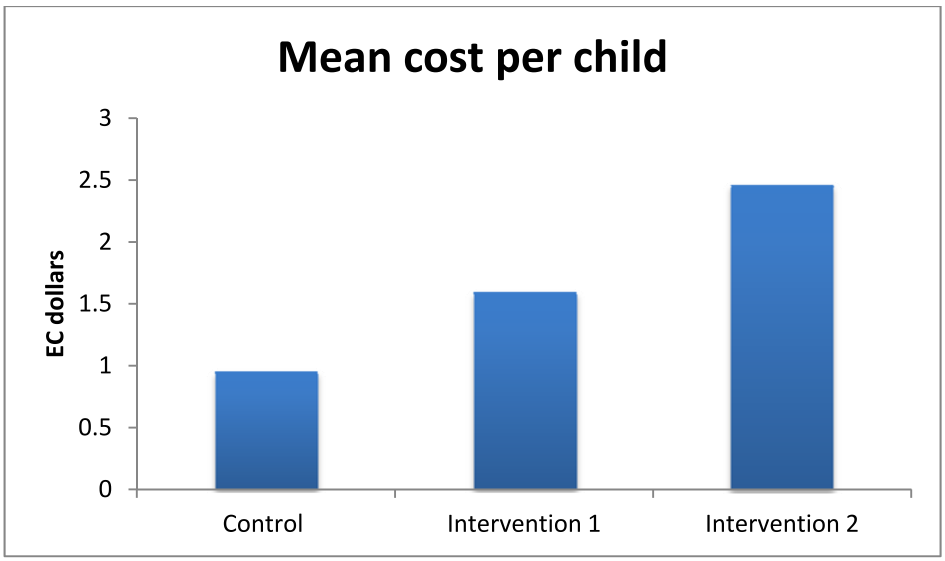

Figure. 2- Mean cost of meal per child for the control schools in the first time period compared to the intervention schools in the first time period (p<0.05) and second time period (p<0.05)

Average cost of meat per child

The average cost of meat per child for the intervention schools in the first time period compared to the control schools is not statistically significant. . Comparing the cost of meat in the intervention schools in the second time period compared to the control schools indicates a higher average cost for meat per child ($p<0.05$). The quality of the meat did not change from the first time period, but hamburger meat and fish were provided on two days, which drove up the average cost of meat (See Appendix C). The average cost for the intervention schools in the second time period was 1.23 EC and the average cost of the control schools was 0.70 EC.

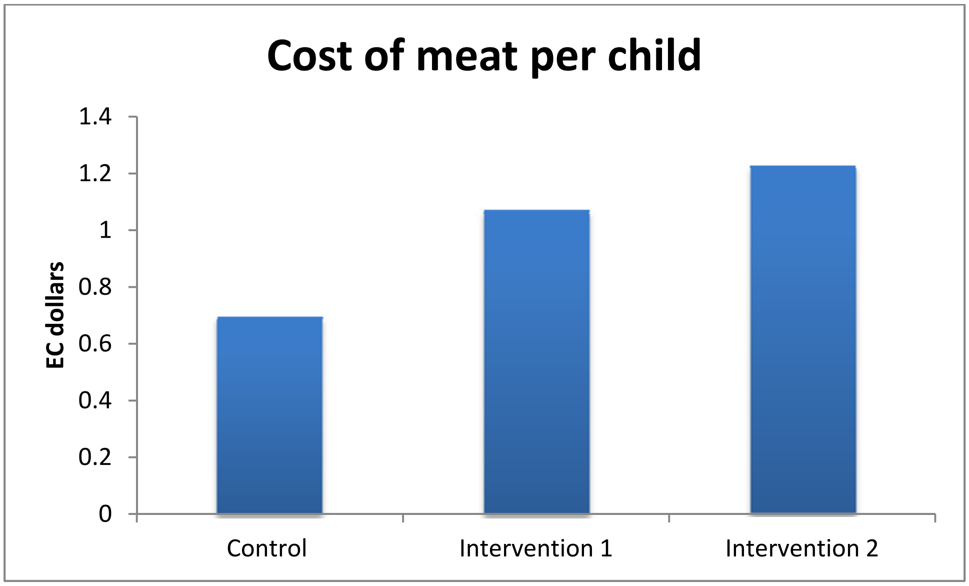

Figure 3- Average cost of meat per child for control schools and intervention schools in the first time period and the second time period (p<0.05)

When compared to the average total cost of the meal for the second time period, 1.26 EC represents 51% of this cost. The other 49% can be attributed to the vegetables and fruits provided in the meals (See Appendix C). The vegetables that presented the largest cost to the meals were the white potatoes, representing up to 38% of the total cost of the meal (October 8, 2013). The other large costs incurred in terms of vegetables were the sweet potatoes, representing up to 19% of the total cost of the meal.

Total energy and energy from fat

The average level of total energy provided in the control school was 319 kcal, with 67 kcal coming from fat. In the intervention schools in the first period, the average total energy provided was 369 kcal, with 89 kcal coming from fat. In the second period, the calories were higher; the average was 413 kcal and 110 kcals coming from fat. Differences between total energy and energy from fat were not different between control and intervention schools in both time periods.

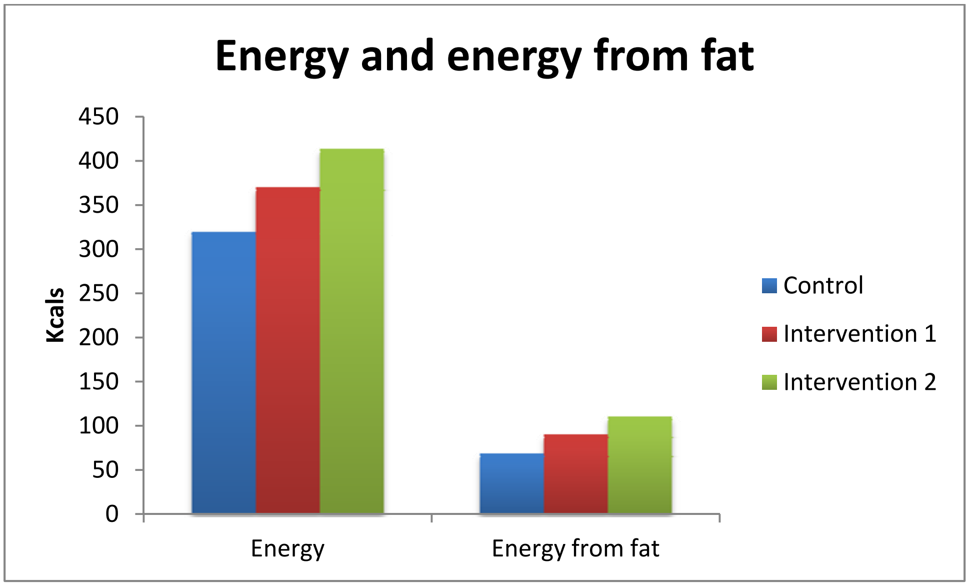

Figure 4- Average total energy and energy from fat in control schools in the first time period and intervention schools in both time periods ($p>0.05$)

Macronutrient distribution in control and intervention schools for both time periods

The macronutrient content in the control school lunch was compared to the macronutrient content in the intervention school lunches for the first time period and the second time period. In the control schools, children received on average 15g of protein per day, whereas in the intervention schools the average was 25g in the 1st time period and 28g in the 2nd time period, per day. The difference in protein content was significant between the control schools and the intervention schools in the second time period ($p<0.05$), but was not significant between the control schools and the intervention schools in the first time period. No other macronutrient was significantly different.

When observing the average macronutrient distribution within the control schools and intervention schools, it further emphasizes that the largest change between the two meals is the amount of meat provided per portion, as evidenced by the increased percent of cost for the meat in the intervention schools as well as the protein content of the lunches (Appendix D).

Average total sugar content in the control school meals was 1.74 g, whereas in the intervention schools the average was 4.20 g in the 1st time period and 5.15 g in the 2nd time period. There is a significant difference ($p<0.05$) between total sugar content in the control schools and the intervention schools for the second time period only. This sugar content does not include the 13g of sugar provided in each serving of juice. Average total sugar content in the control school, intervention 1 and intervention 2 school meals, including the juice is represented below. Increased sugar content in the intervention school meals can be attributed to the inclusion of fruits, such as watermelon. This fruit offers 6.20g of sugar per 100g edible portion. The children received between 50-80g of watermelon per serving, which was dependent on the amount of watermelon that was available on that date (Appendix E)

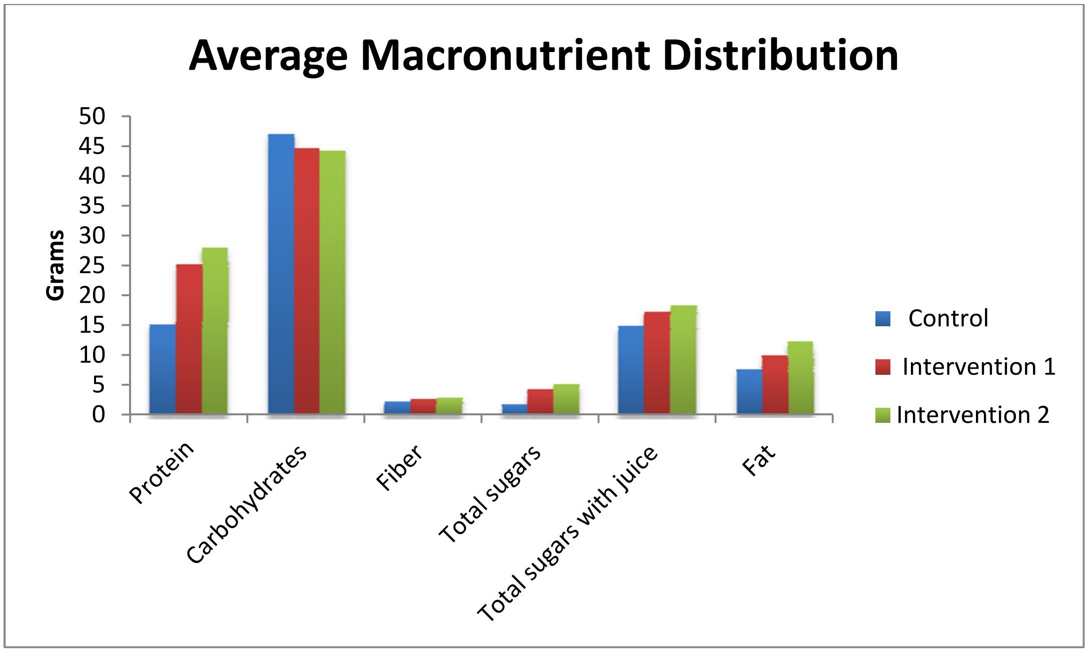

Figure 5- Comparison of macronutrient content and sugar in grams, between control and intervention schools for two time periods. (p>0.05)

Comparison of average micronutrient distribution between control schools and intervention schools for both time periods

The average vitamin C content in the control schools was 3.68 mg, whereas the average content in the intervention schools was 8.72 mg for the first time period and 16.17 for the second time period. There was a significant difference between the vitamin C content in the control school meals and the intervention school meals in both time periods ($p<0.05$). The potassium content in the control schools was 275 mg, whereas the average content in the intervention schools was 479 mg for the first time period and 635 mg for the second time period. The potassium content was significantly different between the control schools and the intervention schools in the first time period only ($p<0.05$). There was no significant difference between all other micronutrients.

Table IV- Average micronutrient content in the control schools for the first time period and the intervention schools for the two time periods.

	Control	Intervention 1	Intervention 2	Standard deviation
Vitamin A (IU)	1077	2527	3988	6152
Vitamin B_{12} (mcg)	0.21	0.41	0.5	1.08
Vitamin C (mg)	3.67	8.72	16.2	17
Vitamin D (mcg)	0.12	0.31	0.24	0.32
Vitamin E (mg)	0.19	0.37	1.1	1.20
Calcium (mg)	41.2	42.7	64.9	5.34
Iron (mg)	2.87	2.76	3.36	1.07
Potassium (mg)	275	479	635	522

Micronutrient distribution in control and intervention schools for both time periods in comparison to percent of 1/3 RDA

When comparing the micronutrients provided by the control school and the intervention schools for the two time periods to 1/3 of the Recommended Dietary Allowance (RDA), vitamin A is significantly high, representing up to 3000% of the RDA in the intervention school. The lowest percent of the RDA for vitamin A was the control school at already 500%. Nutrients that do not meet 1/3 of the RDA for children in both age groups: 4-8 years and 9-13 years are potassium, calcium, vitamin E and vitamin D in both control and intervention schools. Vitamin B_{12} and vitamin C do not meet 1/3 of the RDA in control schools, but the requirements are met in intervention schools in both time periods. That being said, requirements for these micronutrients for children aged 9-13 was not met in intervention schools in the first time period, providing 58% and 69% of 1/3 of the RDA, respectively.

Micronutrients that continue to remain extremely low, despite changes to the menu are vitamin D, vitamin E and calcium. Vitamin D consumption only meets 2% of 1/3 of the RDA for children in both age groups. Calcium and vitamin E intake increased in the intervention schools in the second time period providing 47% and 19% of 1/3 of the RDA for children aged 4-8 years and 30% and 15% of the RDA for children aged 9-13. The reason for the increase can be attributed to the use of evaporated milk in some recipes (calcium) and the pumpkin in the recipes (vitamin E). Despite these increases, these micronutrients were still lacking.

Iron intake was adequate in the control schools; meeting 86% of the 1/3 RDA in children aged 4-8 years and 100% of the RDA in children aged 9-13. In intervention schools in the first time period, only 83% of 1/3 of the RDA was met for children aged 4-8, but 100% was met for children in the other age group. In the intervention schools in the second time period, 100% and 126% of 1/3 of the RDA were met for children in both age groups, respectively.

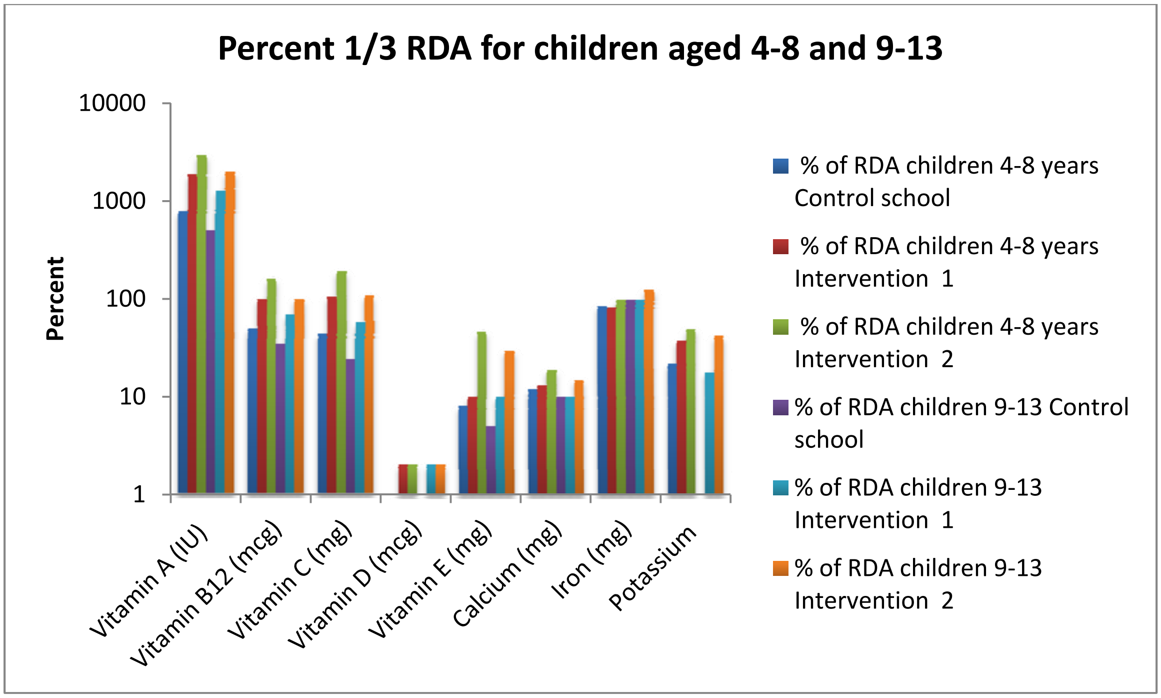

Figure 6- Comparison of the percent of 1/3 of the RDA for vitamins and minerals between control and intervention schools for both time periods.

Vegetable and fruit consumption

The consumption of fruits and vegetables increased from the control school meals to the intervention school meals, as evidenced by the increased in vitamin A, vitamin C and potassium. The vegetables that were provided the most consistently were carrots, cucumbers, tomatoes and potatoes. The only fruit provided throughout the two time periods was watermelon. Though there was an increase in vegetables and fruits provided in intervention schools in both time periods, the goals have still not been met. This is further discussed below.

Meal Acceptance in Schools

Average consumption of portions given were calculated and compared for each time period and their respective dates (Appendix E). Below is an example.

In the meal of April 23, 2013, the least accepted foods were the carrots and string beans, with 11 and 14 children out of 43, respectively, only consuming 0-25% of the portion of vegetables served. The consumption of the meat and the potatoes in this meal are high.

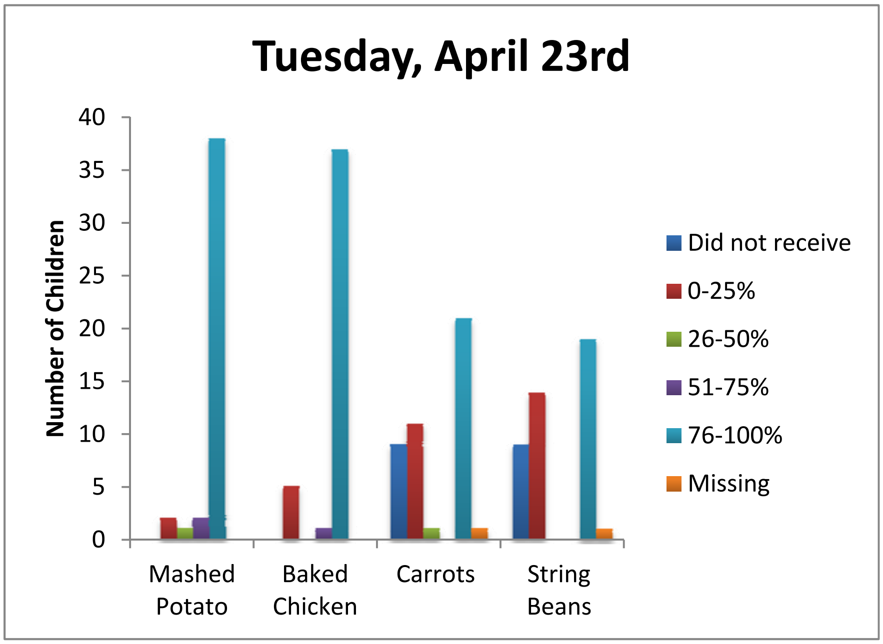

Figure 7- Average percentage of individual portions consumed in intervention school meals on April 23rd, 2013

Average meal acceptance of all schools from April 23-May 3, 2013

When examining the average waste in all the schools for each meal served, more than half of the students consumed 76-100% of their portion on average (37/60). In addition, 8 out of 60 students did not receive a serving and 7 out of 60 consumed 0-25% of their portion. The other 8 were found in the categories of those who consumed 26-75% of their portions.

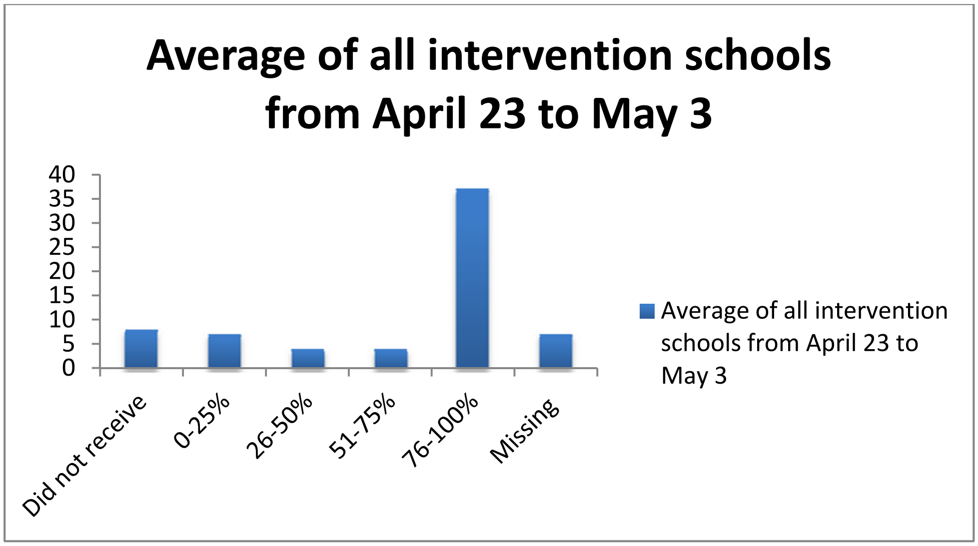

Figure 8- Average meal acceptance for all intervention schools from April 23 to May 3

Table V- Percent portion consumption of portions of vegetables and fruits served to the intervention schools during the two time periods.

Food	Total days served	Did not receive	% of total	0-25	% of total	76-100	% of total	Total portions served
Watermelon	3	21	13	4	2	137	85	162
Tomato	1	11	19	13	23	32	56	57
Hot slaw	2	0	0	34	27	84	67	125
Carrots	3	13	8	36	22	83	51	162
String beans	2	14	14	28	28	52	51	101
Tomato and cucumber	2	19	35	6	11	25	46	54

- The total includes children who were given the food and is a total of 0-25 , 26-50, 51-75, >75

The food item that is leastconsumed by the children is the hot slaw, with 17% of the children consuming 0-25% of their portion. In addition the string beans are not widely consumed with 28% of the children only eating0-25% of their portion. Overall, the vegetables and fruits served are widely accepted, especially the watermelon, with 85% of the children eating 76-100% of their portion.

Discussion

Process Evaluation

The process evaluation conducted on the Farm to Fork project is the first of its kind to be completed in a developing country, and in the Caribbean. Though interventions often overlook the process evaluation, this component is a vital part of the project and overall success of the implementation for several reasons. Process evaluations enable researchers to describe the intervention in detail, assess the current exposure to the intervention and evaluate the experience of those exposed (Hulscher et al., 2003). When an intervention leads to a specific outcome, it is necessary to describe which components of the intervention led to its success or failure (Linnan & Steckler, 2002). This process evaluation specifically measures the implementation of a new menu in four schools in St. Kitts, assessing the menus in terms of ingredients, cost, nutrients and waste and comparing it to control schools. This has allowed researchers to evaluate the intervention from multiple perspectives and in the future, will allow them to introduce changes where issues were identified. Though several school food programs have been implemented around the world, the implementation process of the programs is rarely evaluated and it is therefore difficult to identify what leads to specific changes in behavior or dietary intake.

Menu Compliance

Compliance with the intervention menu was fair during both time periods, with 6/9 meals and 7/9 meals matching the planned menu. Often the reason why a meal did not match the planned menu was due to the lack of vegetables and fruits served (Appendix C). Observations conducted during the week of May 5, indicate the problem to be of product availability, rather than the lack of compliance from kitchen staff with the new menus. In a report submitted in January 2014 on the productivity and diversity of the farmers in the Farm to Fork project, it was indicated that the estimated school food procurement needs for fruit, vegetables, pulses and roots in intervention schools were met at levels ranging from 8%-52% over the school year (Unpublished data, 2014). Pumpkin, string beans, tomato and cucumber were the produce that were supplied with the most consistency during the 2013 school year (Unpublished data, 2014).

Research conducted on Farm to School projects in California, found that local produce distribution was one of the greatest challenges associated with the program (Joshi & Beery, 2007). Though schools have tried to address this issue by accessing locally grown produce through different channels, such as farmers, farmers' markets, and farm stands, the sources have difficulty meeting the demand (Joshi et al., 2008). One way that the Farm to School programs in California have increased availability of local produce is through the formation of the Gold Coast Grower's Collaborative (GCGC), which began in 2003, which now supply all schools in Ventura County (Joshi & Beery, 2007). This could be a possibility in St. Kitts. It is also imperative to establish a distribution model for the farmers on the island and base menus on the availability of produce. Purchasing directly from farmers also allows the kitchen staff to have a direct relationship with farmers and be most closely connected to the food (Joshi & Beery, 2007).

Sweetened Beverage

Juice is served to children daily with their meal. The cost of this sweetened beverage, which is 1,032 EC, represents approximately 17% of the cost of an intervention meal, including the cost of the juice. The ingredient that represents the largest cost is the Sunquick, costing 503 EC, daily. Per serving, the juice provides 80 kcal and 13g of sugar. According to WHO (2014), there is increasing concern that consumption of free sugars, particularly those that are provided in sugar-sweetened beverages, such as fruit juices, may lead to reduced intakes of other foods that may be more nutritionally adequate and may lead to an increase in total caloric intake. WHO (2014) is currently working on guidelines to provide recommendations on the consumption of free sugars to reduce the risk of Non Communicable Diseases (NCDs) in adults and children. Their current recommendation from 2002, is that sugars should make up less than 10% of total energy intake per day (WHO, 2014). The new draft guidelines also propose this, but further suggest that reducing sugar consumption below 5% of total energy intake per day would have additional benefits (WHO, 2014).

Five percent of total energy intake is equivalent to approximately 25g of sugar per day for an adult with a normal Body Mass Index (BMI). For children aged 4-13, who are moderately active, the recommended caloric intake for males is 1450-2250 and females 1350-2000. In order to satisfy the WHO recommendations for sugar consumption, males should be consuming 18-28g of sugar and females 17-25g of sugar daily (based on recommendations that sugar be 5% of total energy intake). If one assumes that the juice provided by the school represents 1/3 of a child's dietary intake of sugar, this means that the child's sugar consumption is significantly above the recommendations.

In a study conducted by Crawford, Woodward-Lopez, Gosliner, and Webb (2013), The California Fresh Start Program, implemented in the 2006-2007 school year, was evaluated. During the program, whole fruit, rather than juice which was previously the primary source of fruit, made up the majority of fruit available at break (Crawford et al., 2013). Findings show that when offered a greater variety of fruits and less juice, students will increase their intake of fruit (Crawford et al., 2013). These results are significant for the Farm to Fork program in St. Kitts for several reasons. Firstly, in terms of cost, eliminating the juice provided with the meal and serving a glass of water in its place, would save the program 1,032 EC per day. Assuming a 40 week school year, this would save the program 206,400 EC per year, which is translated to $84, 624 CAD. Secondly, this would allow more space for fresh fruits in the trucks that deliver the lunches to the schools. Thirdly, based on the data presented by Crawford et al. (2013), this may also increase consumption of fruit by the children.

An option that may have seemed feasible was to provide the children with juice freshly squeezed from a fruit. When the matter was further researched, however, it seemed as though the children would be receiving even more added sugar from these juices than they are currently receiving. For example, a recipe that makes approximately six glasses of lemonade, calls for 6 lemons, 6 cups of cold water and 1 cup of sugar. Translated into the bigger picture, this means approximately 42g of sugar per serving of lemonade. In addition, juicing the lemons will increase the labor for preparation.

Cost of control school meals and intervention school meals

The control school meals currently feed 2400 children, whereas the intervention school meals feed 800 children. The cost of the intervention school meals in both time periods is significantly higher than the cost of the control school meals. That being said, the average cost for the intervention school meals in the first time period is 1.57 EC, whereas the cost for the intervention school meals in the second time period is 2.46 EC. What is driving up the cost of the intervention school meals in the second time period is the added meat, rather than the increased amount of fruits and vegetables. There was a significant difference between the average cost of meat per child between the control schools and the intervention schools in the second time period, with the average cost of the control schools being 0.70 EC and the average cost in the intervention schools being 1.23. This is nearly double the cost. Though the quality of the meat offered has not changed, it is the quantity provided that is different. In the hamburger lunch, provided on October 11, 2013, 900 hamburger patties were used by the kitchen, incurring a cost of 1733.94 EC, which drove up the cost of the meal enormously, to 3473.15 EC. What is interesting to note is that these 900 hamburgers were meant to serve 800 children.. In order to address issues of cost and distribution, strategies need to be developed as well as a record keeping system to track the food service process and quantify the ingredients based on adequate portion sizing to avoid waste and added food costs. The added 100 hamburger patties cost the kitchen approximately 193 EC.

Contrary to what was just discussed, the average cost of meat between the control schools and intervention school in the first time period is not significantly different. What is driving up the cost in the intervention schools in the first time period is the added vegetables and fruits, such as potatoes and watermelon. For example, on Tuesday, April 23, 2013, the intervention menu used 360 lbs white potatoes (Appendix C), costing 577.60 EC out of a total of 1860.47 EC, representing 31% of the total cost and adding 0.72 EC to the total cost of the meal per child. On Wednesday, April 24, 2013, 275 lbs of watermelon contributed 412.50 EC to the total cost of 1487.48 EC of the intervention meal. This represented 28% of the total cost and contributed 0.52 EC to the cost of the meal per child. The fruit, however, may replace other starches. That being said, standardizing of the menus and their ingredients is necessary in order to control the cost and portion sizing in intervention schools. For this to take place, proper communication between the buyer, the supplier and the schools needs to take place.

Nutrient Content of Meals

Macronutrients

The energy content of the intervention school meals compared to the control school is not significant. These results imply that the intervention school meals may provide more nutrients for their caloric content compared to the control schools. This is emphasized in the protein content per meal in intervention schools in the second time period. Compared to the average 15g provided by the control school lunches, the intervention school in the first time period and second time period provide 25g and 28g, respectively. This is also related to the increased portion of meat offered to the intervention schools. The RDA for protein macronutrient is 19g per day in children aged 4-8 and 34g per day in children aged 9-13, indicating that the children already receive an abundant amount of protein, considering this number only represents 1/3 of their daily intake (assuming that they consume a balanced breakfast and dinner daily).

In the evaluation of the Child and Adolescent Trial for Cardiovascular Health (CATCH) macronutrients content of the school meals was evaluated on different occasions. When looking at the protein content of the meals provided to 56 of the CATCH schools, mean protein content varied between 29.8g, and 31.7g over the 8 year period (Osganian et al., 2003). This is considerably higher than the protein provided in St. Kitts lunch meals, but the average caloric content of the CATCH school lunches is also 720 kcal (Osganian et al., 2003).

The sugar content of the intervention school meals significantly increased when fruit, such as watermelon was provided. That being said, the average sugar content of approximately 5g in the intervention schools is still very low in comparison to other school food programs, such as CATCH. In the CATCH study, average sugar content increased in the intervention schools from 38.6 g in 1991 to 50.2g in 1998 (Osganian et al., 2003). However, the lunch meal analyzed was defined as the sum of one average serving of each of the following: entrée, vegetable, fruit and milk and up to two average servings of bread, one average serving of condiments and one average serving of dessert when offered (Osganian et al., 2003)

Micronutrients

In general, most micronutrients were consistent across control and intervention schools as well as time period, with exception to vitamin C and potassium. The increased vitamin C content in the intervention school meals can be related to the availability of potato (19.7mg/100g of edible portion), pumpkin (9 mg/100g edible portion), carrot (5.9mg/100 g edible portion), watermelon (8.1 mg/100 g edible portion), and tomato (16mg/100g edible portion). These food items also contain potassium between the ranges of 250- 420mg/100 g of edible portion (with the exception of watermelon), with white potatoes providing the largest amount of potassium at 420 mg/100 g of edible portion. Sweet potatoes also contain a high amount of potassium at 327 mg/ 100g of edible portion. In the CATCH intervention, average vitamin C content over the 8 years was approximately 25 mg (Osganian et al., 2003), whereas the average vitamin C content in the intervention meals in St. Kitts is approximately 13mg.

Percent RDA

The nutrient content of the school food was compared to 1/3 of the percent of the Recommended Dietary Intake (RDA) for children aged 4-8 and 9-13 (male and female values were the same) in order to assess the adequacy of the meals provided. The nutrients that surpass the RDA are protein and vitamin A. The excess protein content in the school meals has been discussed above. The large availability of vitamin A is due to the large use of carrots and pumpkin in the school meals. Three thousand, one hundred UI of vitamin A are provided in 100g of pumpkin. The RDA for vitamin A is 600 IU for children aged 4-8 and 9-13. Vitamin A is also found in abundance in sweet potatoes, which are sometimes provided. In the evaluation for the CATCH program, the mean nutrient content of school lunches for energy, protein, vitamin A, vitamin C, calcium and iron, all exceeded 1/3 of the RDA at all three time periods for both intervention and control schools (Osganian et al., 2003)

Meal Acceptance

Overall, more than half of the students eat the food that is served to them. It is important to note that not many children were found in the 26-75% of portions consumed, which highlights that children either eat the food that is served to them or they don’t, which one can assume is based on their liking of the food. In terms of vegetables, the specific items that were examined were watermelon, tomato, hot slaw, carrots, string beans and the tomato and cucumber salad.

The least preferred items were the hot slaw, carrots and string beans, with 27%, 22% and 28% of the children, respectively, consuming 0-25% of their portion. In a school food intervention, implemented in two schools in Scotland from October 1999-June 2000, the impact on fruit and vegetable intake was assessed by collecting food diaries or interviewing the younger children daily. Findings from this study show that fruit intake increased, but vegetable intake showed no significant change (Anderson et al., 2005). This may be relevant in terms of food acceptance in St. Kitts as watermelon consumption is not an issue, yet the acceptance of vegetables has been more challenging. That being said, several studies report increased consumption of both fruits and vegetables after Farm to School programs were implemented (Paxton, Baxter, Fleming, & Ammerman, 2011; Schmidt, Kolodinsky, & Symans, 2006; Slusser et al., 2007).

One option that may encourage the children to consume more vegetables and fruits is by adding an incentive. In a study conducted by Hendy, Williams, and Camise (2005), children who received positive reinforcement in the form of a token consumed more fruits and vegetables than those that did not receive reinforcement. Not only did consumption of fruits and vegetables increase, but results showed that fruit and vegetable preference ratings also increased (Hendy et al., 2005). This may be an option to reinforce vegetable consumption in St. Kitts schools.

Another problem that seems to be affecting the intervention schools is one of delivery, with 13%, 19%, 14% and 35% of students not receiving watermelon, tomato, string beans and tomato and cucumber salad, respectively. It is unclear in the questionnaire whether or not the children chose not to take a serving of the fruit or vegetable or if the kitchen had run out of these items and they were no longer available. If the latter is the case, this is once again related to an issue of supply and by implementing specific guidelines for portion control and ordering from the farmers, it may allow schools to provide lunches in the proper quantities.

Implications

The evaluation of the Farm to Fork project to date demonstrates positive progression towards the goals and objectives of the program. The kitchen has made positive attempts in providing meals that were developed for the intervention schools. At times, there were issues with supply from local farmers, which is currently being studied by another researcher. The results of this study highlight that the added cost of the intervention school meals is related to the addition of vegetables and fruits in the first time period and to the larger portions of meat served to the children in both time periods. In order to save on cost, it is important for the kitchen staff and other key stakeholders to work together to make a standardized menu, which includes standardized portions and costs.

Eliminating the sweetened beverage from the school meals is also a viable option, but one that may not be well accepted by the kitchen staff or the school children. Before attempting to transition away from the sweetened beverage, it would be important to ensure the acquisition of more fruits from local farmers. If enough fruits are being grown so that a portion of fruit can be provided to the children daily, the elimination of the beverage can be presented in a way where we are providing the children with an extra food item, which is refreshing and sweet, instead of the sweetened beverage. It would be important to discuss this change with the staff in the kitchen and at the schools so that the participants feel like we are working with them to satisfy their cultural needs, instead of deciding what is best, based on our recommendations.

Nutritionally, the control schools and intervention school meals do not differ greatly, with the exception of protein, vitamin C and potassium. The reasons for this have been discussed above. The lack of differences in the meals emphasizes the need for more vegetables and fruits. Though efforts have been made to increase the availability of these items, it is imperative that the intervention meals provide more variety of vegetables and fruits. Studies that have evaluated

Farm to School projects in the past fail to discuss the supplying of food from farmers and whether or not issues exist in this component of the process or not. A review conducted by Joshi et al. (2008) highlights the fact that the definition of local, used widely in programs in the United States, often varies by 50-100 miles between projects, making comparisons of results difficult.

This evaluation is the first of its kind to take place, looking at several aspects of a Farm to School Program and looking at the larger picture, rather than simply assessing outcomes or cost. In addition, because little research exists in Caribbean countries, this evaluation will serve as a guide for future program implementations by highlighting key issues that were addressed and presenting areas of the intervention that were more successful.

Limitations

Due to limited time, the overall process of the intervention was observed over only a one week time period, with observations made in the kitchen and at the four school locations, where the intervention took place. Data such as meals, dates, ingredients and costs were collected for this time period as well. A secondary party collected the data for the second time period. That being said, because the data were collected at two different time periods, and observations were made in the kitchen over 5 consecutive days, it is assumed that the comparisons are reliable and capture the larger picture of the school lunch program in St. Kitts. In the future, however, it would be beneficial to gather data over as large a time period that the funding provided permits. This would allow researchers to conduct more detailed observations as well as have a larger sample of data.

Because the intervention has been implemented in a developing country, where the culture and standards are extremely different from those in Canada, it was difficult to ensure accuracy and validity of the recipes and their cost. Measures were used to control for this such as confirming assumptions that were made with kitchen staff and supervisors.

The presence at the site of meal preparation has proved to be difficult due to the geographic location of the project which makes it difficult to trace the path of the food from the farmers, to the kitchen and then to the child's plate. For this reason, assumptions need to be made about the availability of certain vegetables and fruits, instead of basing this on concrete facts. In the future, it would be important to trace the life of the produce and accurately identify whether the issue lies within the supply of the produce from the farmers end or if there is an issue within the kitchen or delivery of the lunches. In addition, the number of students in both the intervention schools and control schools are estimated values from the kitchen staff. Based on observations made during the time period of May 5-May 11th, 2013, it was noted that the kitchen staff does consume a portion of the daily lunch. Therefore, this may affect the estimated cost of the portion per child as well as the nutrients delivered per lunch. In the future, it would be important to take into account the portions consumed by kitchen staff in order to subtract them from calculations made with regards to the school lunches. For example, on Friday, October 11, 2013, 900 hamburger patties were ordered to feed 800 children. This made the cost of the lunch on this day particularly high. In the future, it would be important to verify portions per child in order to properly quantify the cost for each.

When assessing the nutrient content of the meal, the program used (The Food Processor SQL Version 10.8.0) is based on the Canadian Nutrient File. Often, the Canadian Nutrient File will not account for certain vitamins and minerals and sometimes, a specific food item does not exist in this database, which can make it difficult to accurately assess the nutrient content of certain recipes. An example of this is the use of Sunquick in the juice served to the children daily. Because this beverage is not widely used in Canada, the nutrition values for this beverage were not available through the Food Processor. The nutrition value of the beverage was determined using the brand's information. An orange juice, which had similar nutrition values was input in the program to estimate the caloric and sugar content of the juice. Another example of the program's limitations is that often, the fibre content of certain foods are not entered into the Canadian Nutrient File and therefore, when comparing recipes, it seems as though the fibre content of both meals is similar, but it is simply due to the lack of information provided.

Meal acceptance by the children was based on questionnaires that were filled out by nutritionists who were employed by the Ministry of Education to be present during the lunch hour at each of the intervention schools. Based on feedback received from team members, the nutritionists were often absent and it seemed as though some were unclear as to what their specific role was within the project. These nutritionists were responsible for filling out the questionnaires of percent of portion consumed by each child at every lunch hour and discuss with the child their opinion about the lunch. That being said, questionnaires were often unclear, blank or missing. It is also difficult to base meal acceptance based on a percentage of portion consumed because there are a lot of factors that can affect the accuracy of these data. General findings can be discussed based on these questionnaires, but in order to get accurate measures of food waste, Taylor and Johnson (2013) recommend using weighted plate waste, where the exact weights of all foods served are measured before and after a meal. This method, however, is rarely adopted because it is labor and time intensive (Kirks & Wolff, 1985).

Future Research

A process evaluation, as described by Hulscher et al. (2003), enables implementers to: describe the intervention in detail, check the actual exposure to the intervention and describe the experience of those exposed. The current process evaluation of the Farm to Fork project in St. Kitts allowed researchers to address two of these points, but did not have the opportunity to study the experience of those involved. In the future, it would be ideal to perform a qualitative research project as a case study on the population in St. Kitts and consider the experiences of kitchen staff, school children, teachers and other stakeholders that have been affected by this intervention. Quantitative methods lead to objective results and allow researchers to quantify the success or failure of an intervention in terms of numbers, but qualitative methods allows the researcher to understand the context, setting and research participants.

Another aspect that may be pertinent to study and address is the availability of snack items, sold by outside vendors, at all school locations. Though this was not discussed or studied in the current thesis, there are vendors on the island of St. Kitts that sell high sugar snacks to the children at a low cost during their lunch hour. Whether or not children consumed these food items was discussed briefly in questionnaires, but was not further studied. This is an area that may affect the overall success of the school interventions and could skew the results.

Conclusions

The implementation of the new menus on the island of St. Kitts has been a challenge for kitchen staff in several ways. Firstly, the new menus have increased the cost attributed to the lunches, which has been difficult on budgets provided. In addition, due to issues with produce availability, it is often difficult for the kitchen staff to meet the demands for vegetables and fruits on a daily basis. This evaluation has brought forward key aspects that need attention, such as procurement of fresh produce from farmers, decreasing the servings of meat in the elementary schools and perhaps eliminating the sweetened beverage from the lunch. The nutrient analysis of the lunches also presented evidence that the lunches do not significantly vary, with the exception of protein content, sugar content, vitamin C content and potassium. This may have been due to the limited amount of produce served in the intervention school lunches. The lunches were similar in terms of energy content, energy coming from fat, fibre, carbohydrates, fat and most vitamins and minerals (See results). The fact that the energy content of the meal did not increase, but some vitamins and nutrients did is a positive sign that countries can address issues of malnutrition without increasing energy intake. That being said, efforts now need to be directed towards portion sizing and standardization of the intervention meals in order to reduce protein and fat intake and increase intake of vitamins and minerals.

The evaluation has also showed that this intervention is promising in several ways: The kitchen staff has regularly followed the planned meals with a few exceptions. On the occasions when the menus are not followed, it is usually due to a supply issue. Children also generally like the food that is being served, with the exception of some vegetables. Perhaps changing the preparation methods to increase variety may help with the acceptance of these food items. Overall, the Farm to Fork project has been successful in its efforts and the issues that have been highlighted in this thesis will be addressed to allow better quality of the intervention school menus at a decreased cost.

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Appendices

Appendix A: Research Ethics Board (REB) approval

MCGILL UNIVERSITY

FACULTY OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES REB
ETHICS REVIEW - **RENEWAL** REQUEST/**CLOSURE** FORM

Continuing review of research involving humans requires, at a minimum, the submission of an annual status report to the REB. This form must be completed to request renewal of ethics approval. If a renewal is not received before the expiry date, the project is not considered approved and no further research activity may be conducted. When a project has been completed, this form can also be used to officially close the study. To avoid expired approvals and, in the case of funded projects, the freezing of funds, this form should be returned 2-3 weeks before the current approval expires.

REB File#: 971-0611
Project Title: Socioeconomic analysis of food security in the CARICOM and Peru
Principal Investigator/Department: Leroy E. Phillip/Animal Science
Email: **leroy.phillip@mcgill.ca**
Faculty Supervisor (if student is the PI):

1. Were there any significant changes made to this research project that have any ethical implications? If yes, and these have not already been reported to the REB, describe these changes and append any Relevant documents that have been revised. ___Yes X___No

2. Are there any ethical concerns that arose during the course of this research? If yes, please describe. ___ Yes X___ No

3. Have any participants experienced any unanticipated issues or adverse events in connection with this research project? If yes, please describe. ___ Yes _X__ No

4. Is this a funded study? If yes, list the agency name and project title and the Principal Investigator of the award if not yourself. This information is necessary to ensure compliance with agency requirements and that there is no interruption in funds. IDRC (CIFSRF) _X__ Yes ___ No

5. Did this project require REB approval from another Institution/Board? If yes, and the project is continuing, attach a copy of the current approval. __X_ Yes ___No

__X___ Check here if this is a request for renewal of ethics approval.

_____ Check here if the study is to be closed and continuing ethics approval is no longer required. A study can be closed when all data collection has been completed and there will be no further contact with participants.

Principal Investigator Signature: [signature] Date: Aug. 19/2013

Faculty Supervisor Signature: ______________________ Date: ____________
(If PI is a student)

For Administrative Use:

_____ The closing report of this terminated project has been reviewed.

_X_ The continuing review for this project has been reviewed and approved. ___ Delegated Review ___ Full Review

Signature of REB Chair or designate: [signature] E. GEORGES, FAES Date: Aug 29/2013

Approval Renewal Period: SEPT. 5, 2013 to SEPT. 4, 2014

Submit to FAES/Macdonald Research Office, Raymond Building, Room R3-032a ; Fax: 398-8732or lynn.murphy@mcgill.ca. Electronic submissions with scanned signatures are accepted but must come from the PI's McGill email.
(July 2013)

Appendix B: Planned intervention menu

St. Kitts lunch menu for intervention schools only

WEEK 1				
MONDAY	**TUESDAY**	**WEDNESDAY**	**THURSDAY**	**FRIDAY**
urried Mutton/Beef 'omato/Carrot Rice Beverage esh Fruit in Season	en Baked Chicken in it gravy isoned Baked Sweet ato ite'ed String Beans l Carrots/Cubed npkin* anana OR Fresh Fruit Season	Stewed Turkey Wings Rice and Pink Beans Cubed Pumpkin) mato & Cubed Cucumber Salad Watermelon Slices/ Fresh Fruit in Season	Minced Beef a Chunky Tomato Sauce ith cubed Pumpkin and String Beans) Spaghetti emonade Drink **lternate Menu** **(Sheppard's Pie)**	ot Dog (in Creole uce) Hot Slaw ute'ed Cabbage & rots) k Beverage OR sion Fruit & Orange Juice Drink
WEEK 2				
MONDAY	**TUESDAY**	**WEDNESDAY**	**THURSDAY**	**FRIDAY**
ewed Turkey Wings Stewed Pink Beans ith cubed Pumpkin OR Rice and Pink Beans Sliced Tomato Fruit Drink OR esh Fruit in Season	aked Chicken in light gravy Seasoned Mashed Sweet Potato Saute'ed *Carrots or bed Pumpkin & String Beans) Watermelon Slice	ked Fish Sandwich Hot Slaw asoned Carrot & abbage) k Beverage OR ce Drink or Fresh Fruit in ison	Split Pea Soup tton/ Turkey Neck eadfruit, Sw. Potato, een Banana, Pumpkin, mplings, Carrots) esh Fruit in season **lternate Menu** **(Goat Water)**	mburger (in a ole sauce) Hamburger Bun Hot Slaw ute'ed Cabbage and Carrots) sion Fruit & Orange Juice Drink

List of local fruits in season

- Banana
- Five finger
- Watermelon
- Cantaloupe
- Papaya/pawpaw
- Orange
- Tangerine
- Wax apple

Substitute menus

- When tomatoes are in season, substitute the carrot in carrot rice with tomatoes. Similarly, when pumpkin is in season alternate the tomato with pumpkin.

- When there is a shortage of sweet potatoes, irish potato can be combined with sweet potato or breadfruit if available.

- When pumpkin is in season replace carrots with pumpkin. See Asterisk * on menu plan.

- Monday menu of Week 2 (pumpkin rice can be substituted with spinach rice when spinach is available).

- **Sheppard's pie:** Replace spaghetti with potato using the same filling **(**minced beef in a chunky fresh tomato sauce with chopped carrots and string beans)

- **Goat water: alternate split pea soup with goat water.**

Ingredients: mutton, dumplings, green papaya/pawpaw, breadfruit, carrots & pumpkin

Appendix C: Planned menus vs. delivered menus

Comparison of planned intervention meals with what was served to the children. Period of April 23, 2013- April 26, 2013

Date	Tuesday, April 23	Wednesday, April 24	Thursday, April 25	Friday, April 26
Planned	Oven baked chicken in light gravy Seasoned baked sweet potato Sautéed string beans and carrots/cubed pumpkin* Banana OR fresh fruit in season	Stewed turkey wings Rice and pink beans (cubed pumpkin) Tomato & cubed cucumber salad Watermelon slices/ Fresh fruit in season	Minced beef (in a chunky tomato sauce with cubed pumpkin and string beans) Spaghetti Lemonade drink Alternate menu (Sheppard's pie)	Hot dog (in Creole sauce) Hot slaw (Sautéed cabbage & carrots) Milk beverage OR passion fruit & orange juice drink
Delivered	360 lb white potatoes 1.5 head celery 14 lb onion 10 c/s thighs 1 kit Season All 2 gallon vinegar 2 lb string beans 50 lb carrots 6 lb onions 0.5 head celery 3 tin tomato sauce 3/4 lb margarine 1 lb sugar 1 oz cumin 1 oz tumeric 1 bottle gravy browning 14 tins milk (14.5) 3 lb tomatoes 2 kit margarine	6 tins tomatoe sauce 12 lbs pink beans 2 oz Cumin 1 oz turmeric 10 c/s turkey wings 275 lbs watermelon 3 tin tomato sauce 1 oz yellow coloring 1 pk clove 1oz tumeric 1 oz curmin 2 kit season all 2 gallon vinegar 80 lb rice (Assumed)	2.5 case spaghetti 8 cups vegetables 2 oz margarine 1/2 lb salt 1250 m tomato sauce? 1/4 lb sugar 5 oz garlic 10 c/s turkey wings 2 lb garlic	4 lb onion 2 lb sweet pepper 4 bottle ketchup 0.5 lb sugar 1/4 lb salt 2.5 cup vegetable oil 1 lb garlic 3 c/s hot dog 225 bread 4 tin tomato sauce
Missing Foods	Fresh Fruit	Tomato and Cucumber Salad	Minced beef with tomato sauce Replaced beef with turkey No lemonade drink No pumpkin No string beans	Hot Slaw No vegetables in meal

Comparison of planned intervention meals with what was served to the children. Period of April 29, 2013- May 3, 2013

Date	Monday, April 29	Tuesday, April 30	Wednesday, May 1	Thursday, May 2	Friday, May 3
Planned	Stewed turkey wings Stewed pink beans with cubed pumpkin OR rice and pink beans Sliced tomato Fruit drink OR fresh fruit in season	Baked chicken in light gravy Seasoned mashed Sweet potato Sautéd *carrots or cubed pumpkin & string beans) Watermelon slice	Baked fish sandwich Hot slaw (Seasoned carrot & cabbage) Milk beverage OR Juice drink or fresh fruit in season	Split pea soup Mutton/ turkey neck (Breadfruit, sweet potato, green banana, pumpkin, dumplings, carrots) Fresh fruit in season	Hamburger (in a Creole sauce) Hamburger bun Hot slaw (Sautéd cabbage and carrots) Passion fruit & orange juice drink
Delivered	2 kit season all 2 gallon of vinegar 7 oz tumeric 1 pk black pepper 8 lb onion 24 lb pink beans 80 lb rice 10 c/s leg quarters 1/2 hd celery 12 tin tomato sauce 25 lb pumpkin 6 lb tomatoes 4 lb onion 2 oz cumin 2 oz tumeric 5 sq cube 2 lb flour	12 tin tomato sauce 1 pk. black pepper 16 tin milk 2 kit margarine 1/2 lb garlic 1 box salt 20 lb pink beans 1 oz cumin 285 lb white potatoes 7 oz tumeric 3 kit season all 2 gallon vinegar 10 c/s chicken back 25 pumpkin	1 lb garlic 4 lb onion 4 lb season all 1/2 gallon vinegar 225 bread Sauce 6 lb onion 1 lb sweet pepper 1/2 pound garlic 1/2 head celery 12 tins tomato sauce 40 lb cabbage 35 lb carrot 1 pk black pepper 1 bottle morton 1/4 lb sugar 2 oz cumin 2 oz tumeric 1 lb flour Fish	2 lb onion 5 lb sweet pepper 4 lb garlic 4 head celery 395 lb sweet potatoes 6 box salt 3 kit margarine 200 lb flour 44 lb split peas 175 pumpkin 200 white potatoes 6 lb season pepper 3 pk black pepper	24 lb tomatoes 27 lb cucumber 200 lb water melon 619 hamburger patties 650 hamburger buns 4 bottle ketchup 4 tins tomato sauce 1 lb sugar
Missing Foods	Turkey wings replaced with leg quarters No fresh fruit	Watermelon slices Carrots String beans	Milk beverage (optional)	Meat Fresh fruit	Hot slaw- Cucumber instead

Comparison of planned intervention meals with what was served to the children. Period of September 30, 2013- October 3, 2013

Date	Monday, September 30	Tuesday, October 1	Wednesday, October 2	Thursday, October 3
Planned	Curried mutton/beef Tomato/carrot rice Beverage Fresh fruit in season	Oven baked chicken in light gravy Seasoned baked sweet potato Sautéd string beans and carrots/cubed pumpkin* Banana OR fresh fruit in season	Stewed turkey wings Rice and pink beans (cubed pumpkin) Tomato & cubed cucumber salad Watermelon slices/ Fresh fruit in season	Minced beef (in a chunky tomato sauce with cubed pumpkin and string beans) Spaghetti Lemonade drink Alternate menu (Sheppard's pie)
Delivered	1 head celery 6 lbs onion 1 oz white pepper 1/2 lb garlic 1 lb salt 2 lbs season all 2 lbs sweet pepper 1 oz tumeric 1 oz cumin 10 C/s Chicken thighs 80 lbs rice 4 pack Tang 10 Sunquick 25 lb sugar 8 cups vegetable oil 1/2 gal vinegar 8 large tomato sauce 1 bottle gravy browning (150 ml) 20 lbs tomato 14 lbs cucumber	30 lbs carrots 1 head celery 40 lbs cabbage 6 lbs onion 1 oz white pepper 1 lb garlic 3/4 lb salt 1 lb season all 8 c/s chicken thighs 150 lb white potato 19 lg tins milk 4 Tang 10 Sunquick 25 lb sugar 2 lbs margarine 2 cups vegetable oil 1/2 gal vinegar 2 bottles ketchup 3 tins tomato sauce 218 lbs sweet potato	20 lbs carrots 1 head celery 10 lbs cabbage 6 lbs onions 1 oz white pepper 1 lb garlic 1 lb salt 2 lbs season all 1 oz tumeric 1 oz cumin 6 c/s turkey drumstick 80 lbs rice 3 lbs flour 12 lbs pink peas 4 tang 10 Sunquick 1/2 gal vinegar 16 lg tins tomato sauce 1 bottle gravy browning (150 ml) 30 lbs pumpkin	6 lbs onion 1 oz white pepper 1 lb garlic 0.5 lb salt 1/4 lb season all 1 lb sweet pepper 140 lbs ground beef 3 c/s spaghetti 4 Tang 10 Sunquick 25 lb sugar 8 cups vegetable oil 5 bottles ketchup 18 Lg tins tomato sauce 7 lbs tomato 68 lbs pumpkin
Missing Foods	Replaced mutton with chicken Carrot Fresh fruit	Watermelon String beans (replaced string beans with cabbage?)	Tomato and cucumber salad (Cabbage and carrots instead) Fresh fruit	String beans

Comparison of planned intervention meals with what was served to the children.
Period of October 7, 2013- October 11, 2013

Date	Monday, October 7	Tuesday, October 8	Wednesday, October 9	Thursday, October 10	Friday, October 11
Planned	Stewed turkey wings Stewed pink beans with cubed Pumpkin OR rice and pink beans Sliced tomato Fruit drink OR fresh fruit in season	Baked chicken in light gravy Seasoned mashed sweet potato Sautéd *carrots or cubed pumpkin & string beans) Watermelon slice	Baked fish sandwich Hot slaw (Seasoned carrot & cabbage) Milk beverage or juice drink or fresh fruit in season	Split pea soup Mutton/ Turkey neck (Breadfruit, sweet potato, green banana, pumpkin, dumplings, carrots) fresh fruit in season	Hamburger (in a Creole sauce) Hamburger bun Hot slaw (Sautéd cabbage and carrots) Passion fruit (Watermelon) & orange juice drink
Delivered	40 lbs carrots 1 head celery 50 lbs cabbage 6 lbs onion 1 oz white pepper 1 lb garlic 1 lb salt 2 lbs season all 1 oz cumin 1 oz tumeric 6 c/s Turkey Drumstick 80 lb rice 3 lbs flour 8 cups vegetable oil 1/2 gal. vinegar 2 bottles ketchup 12 lg tins tomato sauce 1 bottle gravy browning	1 head celery 6 lbs onion 1 oz white pepper 1 lb garlic 1.5 lb salt 1 lb season all 1 oz tumeric 1 oz cumin 10 C/s chicken thighs 404 lbs white potato 25 lg tins tomato sauce 2 lbs margarine 2 cups vegetable oil 1/2 gal vinegar 5 bottles tomato ketchup 4 small tins tomato sauce 4 big tins tomato sauce 70 lbs pumpkin 204 lbs sweet potato	25 lbs carrots 1 head celery 30 lbs cabbage 6 lbs onions 1 oz white pepper 1 lb garlic 1 oz salt 1 lb season all 10 C/s Chicken thighs 2 c/s Fish 2 cups vegetable oil 5 bottles tomato ketchup 4 lg tomato sauce 250 lbs Watermelon Missing bread?	15 lbs carrots 1 head celery 10 lbs cabbage 6 lbs onions 1 oz white pepper 1 lb garlic 0.5 lb salt 2 oz season all 1 lb sweet pepper 6 c/s turkey neck 25 lbs flour 150 lbs white potato 14 lbs split peas 2 lbs margarine 0.5 gal vinegar 322 lbs Pumpkin 75 lbs carrots 300 lbs sweet potato 60 lbs cabbage	6 lbs onion 1 oz white pepper 5 oz garlic 5 bottles ketchup 4 lg tins tomato sauce 40 lbs tomato 176 lbs watermelon 900 Hamburger patties 900 Hamburger buns
Missing Foods	Pink beans Fresh fruit	String beans Watermelon	Chicken in menu (10 c/s)		Hot slaw

Appendix D: Percent added cost of meat

Total cost of meals, cost per child and percent cost contribution of ingredients to control schools and intervention schools in both time periods

Percent added cost refers to how much more the meat cost in the intervention school compared to the control school. For example, on April 23rd, the meat cost 50% more in the intervention school per child, than for the control school. This is to highlight that the increased amount of meat in the recipes is what is driving up the cost and not the added fruits and vegetables.

Date	Control school total cost	Percent cost contribution to cost of meal	Cost per child (2400 kids)	Intervention school total cost	Percent cost contribution to cost of meal	Percent added cost per child	Intervention school cost per child (800 kids)
Tuesday, April 23 2013	Spaghetti 3012.52	Corned beef- 63% Spaghetti- 33%	1.26 EC	Oven baked chicken 1860.47	10 cs chicken= 50% cost 360 lb white potatoes= 31%	Meat: 50% added cost	2.33 EC
Wednesday, April 24 2013	Stewed wings 2764.02	Turkey wings- 59% Rice- 28%	1.15 EC	Stewed turkey wings 1487.48	10 c/s turkey wings= 55% cost 275 lbs watermelon= 28%	Meat: 47% added cost	1.86 EC
Thursday, April 25 2013	Cook up 2519.79	Turkey wings- 65%	1.05 EC	Spaghetti 1216.8	10 c/s turkey wings= 67%	Meat: 50% added cost	1.52 EC
Friday, April 26, 2013	Hot dogs 2282.26	Hot dog- 64%	0.95 EC	Hot dogs 759.10	Hot dogs- 52%	Meat: 22% added cost	0.95 EC
Monday, April 29, 2013	Cook up 2079.36	Chicken- 59% Rice- 25%	0.87 EC	Stewed turkey Wings 1272.22	10 c/s leg quarters= 69%	Meat: 150% added cost	1.60 EC
Tuesday, April 30, 2013	Spaghetti 3048.52	665 lbs Chicken legs- 55% Spaghetti- 33%	1.27 EC	Baked chicken 1058.50	350 lbs leg quarters= 41% Potatoes= 49%	Meat: 22% less cost for intervention	1.32 EC
Wednesday, May 1, 2013	Stew and rice 3408.09	805 lbs chicken wings: 65% 460 lb rice: 23%	1.42 EC	Fish bread 2290.20	120 lbs fish= 75% 225 bread= 15%	Fish: 132% added cost	2.86 EC
Thursday, May 2, 2013	Soup 1499		0.63	Soup 500			0.63
Friday, May 3, 2013	Grilled cheese 1200.39	825 bread: 1159.17	0.50 EC	Hamburgers 1078.70	619 patties= 53% Hamburger buns= 34% 200 lb watermelon= 13%	No meat in control school (grilled cheese), therefore no comparison	1.35 EC
Tuesday, May 7, 2013	Cookup 2025.38	630 lbs chicken: 63%	0.84 EC	Stewed turkey wings 1255.40	10 c/s turkey wings- 76%	Meat: 134% added cost	1.57 EC
Average cost	**2281.975**		**0.961**	**1259.797**			**1.57**

Appendix E: Quantities of food used

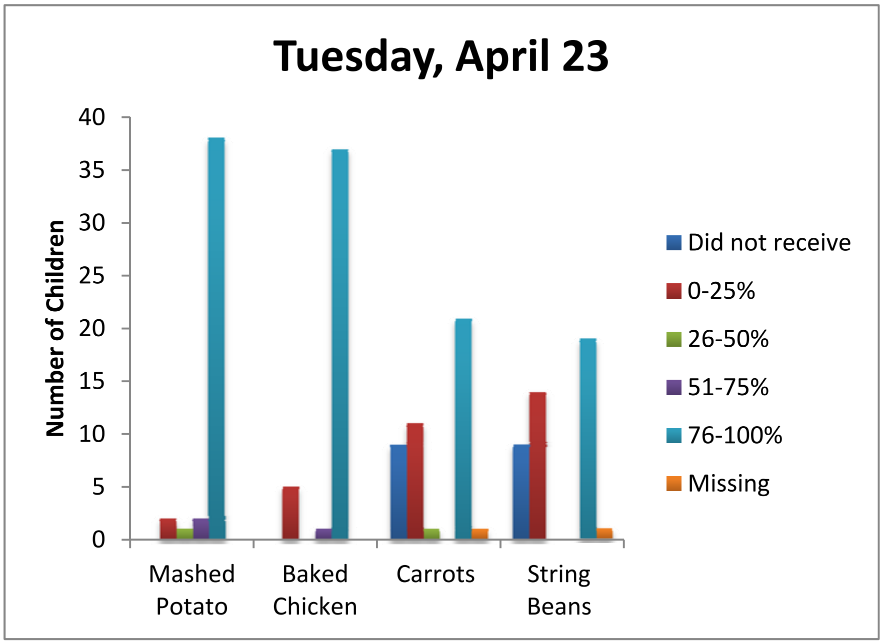
Date		Food item	Waste (%)	Edible portion (lbs)	Weight/recommended serving (g)	Serving provided (g)
April 23	Intervention	360 lb white potato	0	360	170	204
		50 lb carrots	11	44.5	68	25.23
		3 lb tomatoes	9	2.73	83.5	1.5
April 24	Intervention	275 lbs watermelon	48	143	80.3	81
April 25	Intervention	8 cups vegetables	0	3.3	96.2	1.92
April 29	Intervention	25 lb pumpkin	30	17.5	61.3	9.92
		6 lb tomatoes	9	5.46	83.5	3.1
April 30	Normal	6 c/s mix vegetable	0	12	96.2	6.8
	Intervention	285 lb white potatoes	0	285	170	161.59
		25 pumpkin	30	17.5	61.3	9.92
May 1	Intervention	40 lb cabbage	20	32	94	22.68
		35 lb carrot	11	31.15	68	17.67
May 2	Control + intervention	395 lb sweet potatoes	28	284.4	70.3	40.31
		175 pumpkin	30	122.5	61.3	17.36
		200 white potatoes	0	200	170	28.35
		6 lb season pepper	18	4.92	78.7	0.7
May 3	Intervention	24 lb tomatoes	9	21.84	83.5	12.38
		27 lb cucumber	3	26.19	62.9	14.84
		200 lb water melon	48	104	80.3	58.96
May 7	Intervention	40 lb carrot	11	35.6	68	20.18
September 30	Intervention	20 lbs tomato	9	18.2	83.5	10.32
		14 lbs cucumber	3	13.58	62.9	7.69

October 1	Intervention	30 lbs carrots	11	26.7	68	15.14
		40 lbs cabbage	20	32		
		150 lb white potato	0	150	170	85.03
		218 lbs sweet potato	28	156.96	70.3	89
October 2	Intervention	20 lbs carrots	11	17.8	68	10.08
		10 lbs cabbage	20	8	94	4.53
		30 lbs pumpkin	30	21	61.3	11.91
October 3	Intervention	7 lbs tomato	9	6.37	83.5	3.61
		68 lbs pumpkin	30	47.6	61.3	26.99
October 4	Intervention	40 lbs tomato	9	36.4	83.5	20.64
		176 lbs watermelon	48	91.52	80.3	51.89
October 7	Intervention	40 lbs carrots	11	35.6	68	20.18
		50 lbs cabbage	20	40	94	28.35
October 8	Intervention	404 lbs white potato	0	404	170	229
		70 lbs pumpkin	30	49	61.3	27.78
		204 lbs sweet potato	28	146.88	70.3	83.28
October 9	Intervention	25 lbs carrots	11	22.25	68	12.61
		30 lbs cabbage	20	24	94	13.61
		250 lbs watermelon	48	130	80.3	73.7
October 10	Intervention	90 lbs carrots	11	80.1	68	45.41
		10 lbs cabbage	20	8	94	4.53
		150 lbs white potato	0	150	170	96.39
		322 lbs pumpkin	30	225.4	61.3	127.8

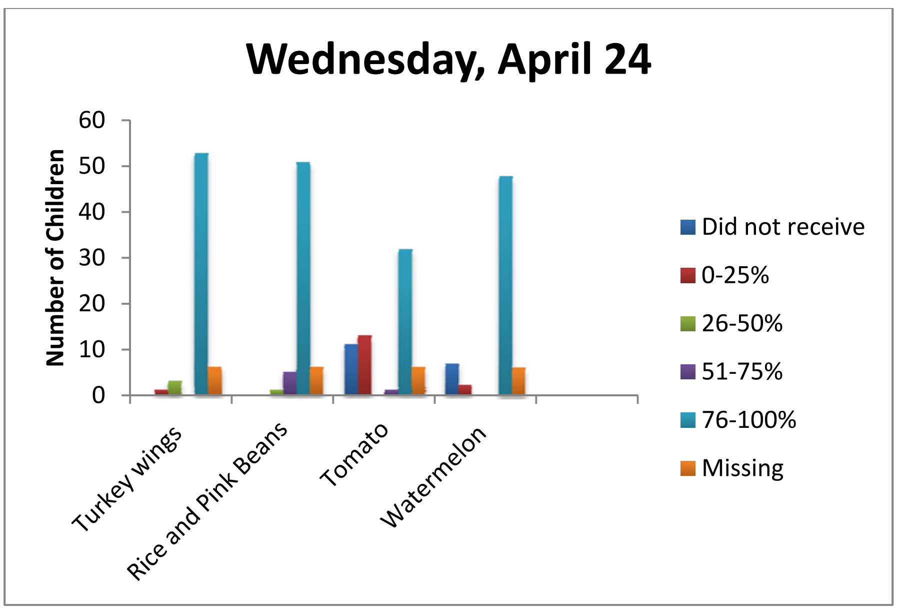
		300 lbs sweet potato	28	216	70.3	122.48
		60 lbs cabbage	20	48	94	27.22
October 11	Intervention	40 lbs tomato	9	36.4	83.5	20.64
		176 lbs watermelon	48	91.52	80.3	51.89

Appendix E: Average of portion consumption for intervention schools by date

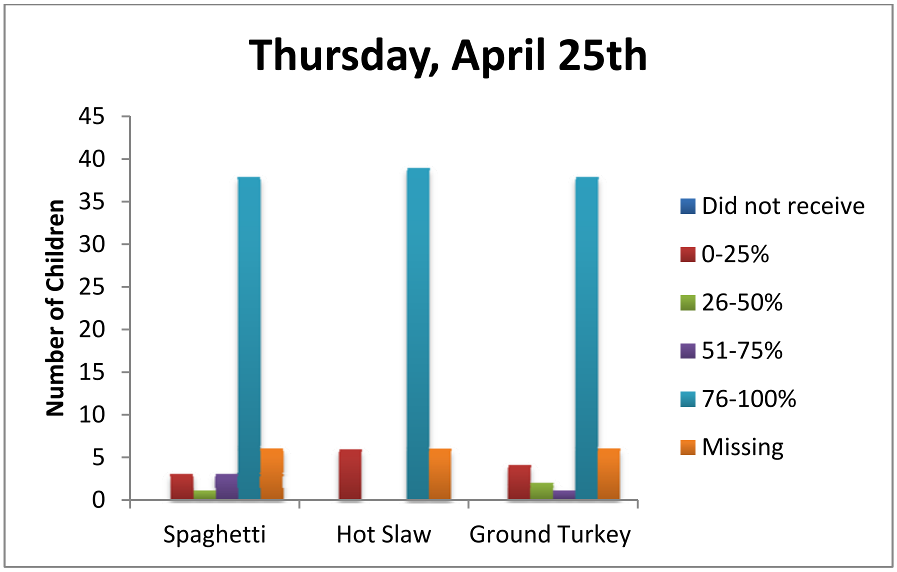
Average percentage of individual portions consumed in intervention school meals on April 23, 2013



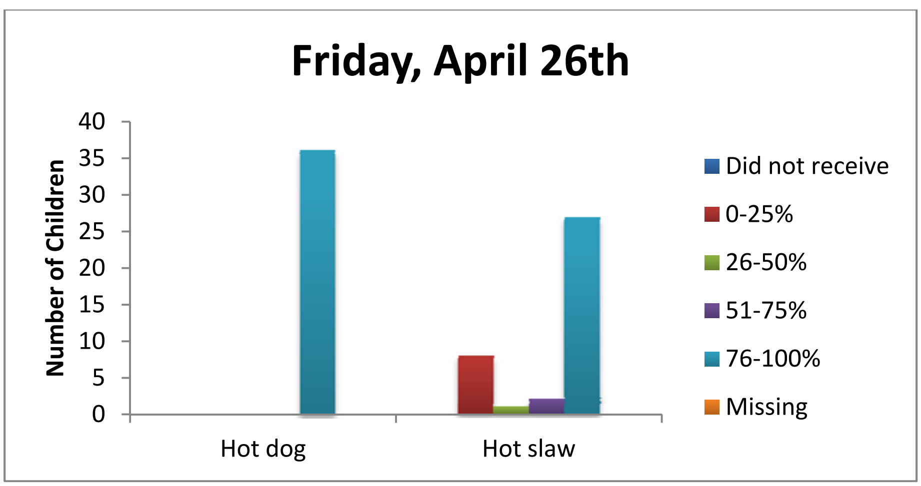
Average percentage of individual portions consumed in intervention school meals on April 24, 2013



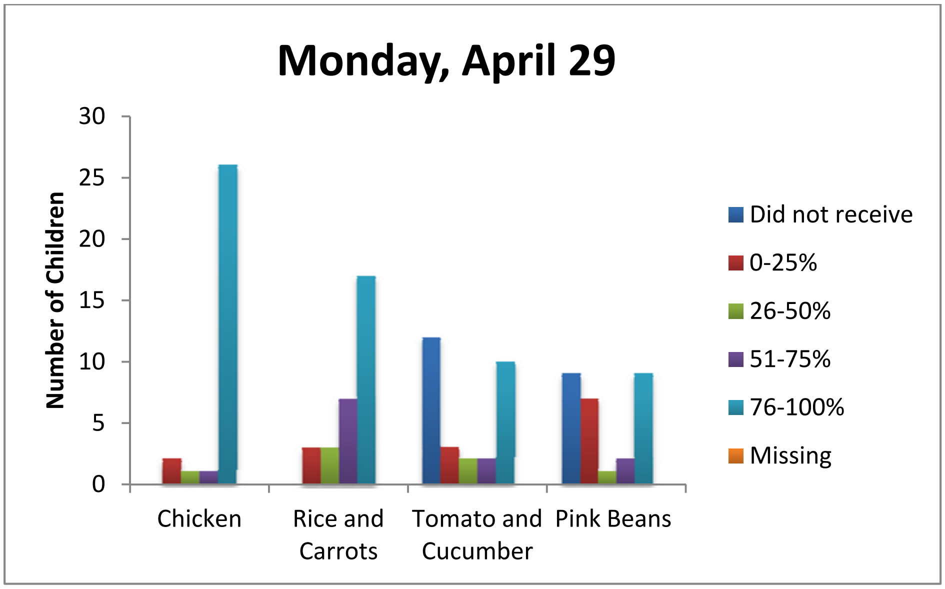
Average percentage of individual portions consumed in intervention school meals on April 25, 2013



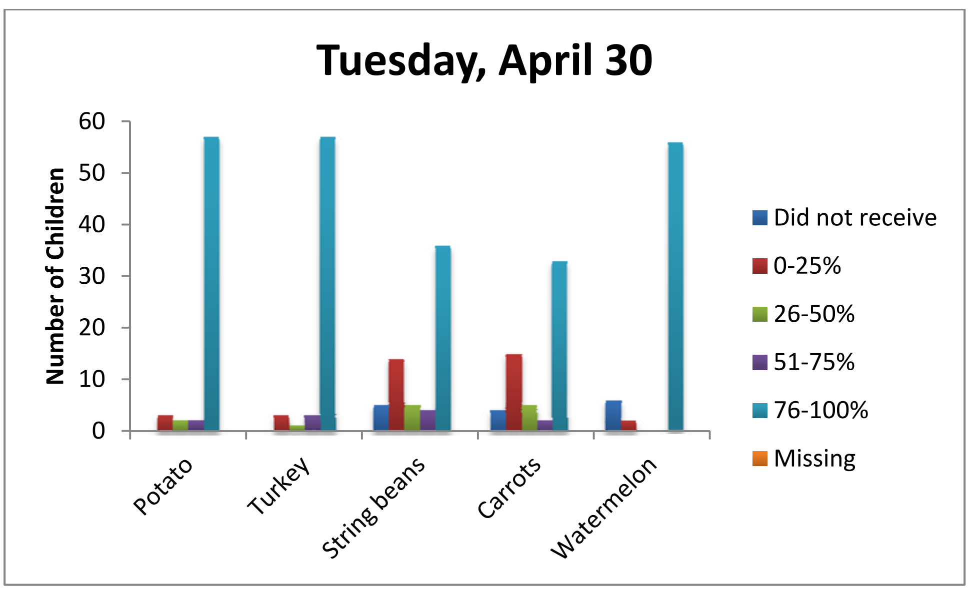
Average percentage of individual portions consumed in intervention school meals on April 26, 2013



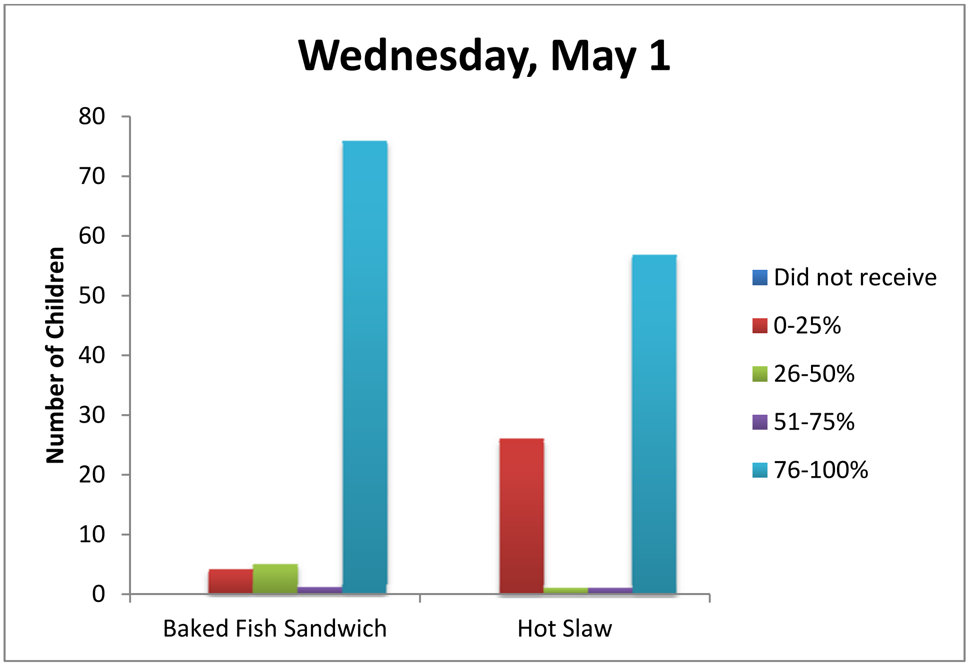
Average percentage of individual portions consumed in intervention school meals on April 29, 2013



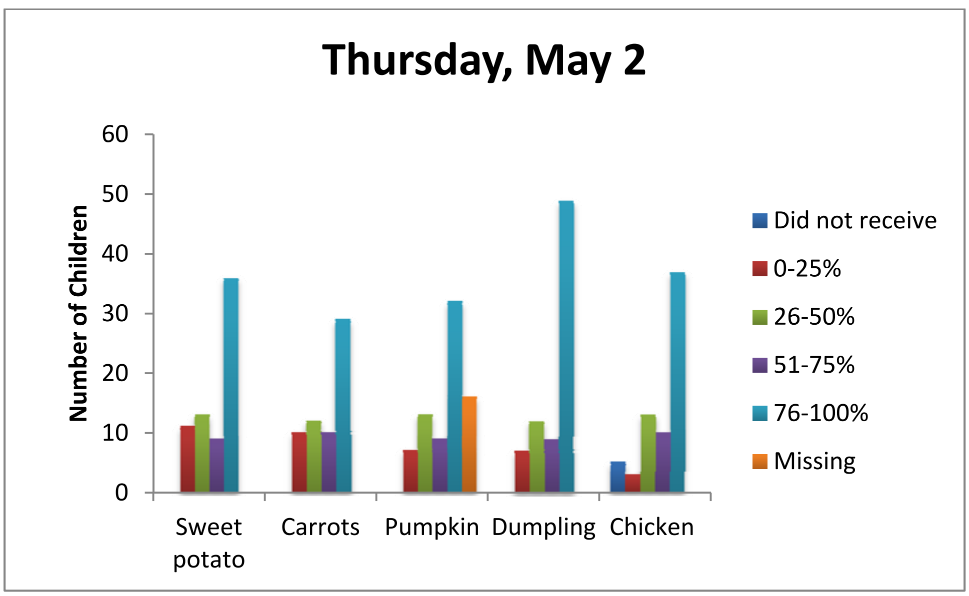
Average percentage of individual portions consumed in intervention school meals on April 30, 2013



Average percentage of individual portions consumed in intervention school meals on May 1, 2013



Average percentage of individual portions consumed in intervention school meals on May 2, 2013



Average percentage of individual portions consumed in intervention school meals on May 3, 2013