Evaluation of a "Traditional Food for Health" Intervention in Pohnpei, Federated States of Micronesia

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Abstract

Federated States of Micronesia (FSM) faces increasing rates of non-communicable diseases related to the neglect of the traditional food system and the shift to consumption of imported food and adoption of sedentary lifestyles. To reverse this trend, a two-year, food-based intervention in one Pohnpeian community in FSM promoted local food production and consumption using a variety of approaches including education, training, agriculture and social marketing following a "Go Local" message. Foods promoted were banana, giant swamp taro, breadfruit and pandanus varieties, green leafy vegetables and fruits for their provitamin A and total carotenoids, vitamins, minerals and fiber content. An evaluation was conducted in a random sample of households (n=47) to examine the extent of dietary changes following the intervention. Results indicated increased (110%) provitamin A carotenoid intake; increased frequency of consumption of local banana (53%), giant swamp taro (475%), and local vegetables (130%); and increased dietary diversity from local food. Exposure to intervention activities was high and there were positive changes in attitudes towards local food. The intervention approaches appear to have been successful in this short period. It is likely that similar approaches in additional communities in Pohnpei and other parts of the Pacific would also be successful in promoting local food. Evidence gathering should continue to document the long-term health outcomes of increased reliance on local food.

Introduction

Around the world, high, middle and low-income countries are experiencing a nutrition transition. Changes in diet and lifestyle have resulted in increased obesity rates and the appearance of nutrition-related, non-communicable diseases[1]. As in many parts of the world, obesity and non-communicable diseases in the Pacific are increasing as a result of economic and dietary transitions and changes in physical activity levels[2,3]. Obesity, heart disease, type 2 diabetes mellitus (DM2) and vitamin A deficiency are major health concerns in Federated States of Micronesia (FSM)[4].

It is estimated that at least 80% of premature heart disease, stroke and DM2 as well as 40% of cancer could be prevented through healthy diet, regular physical activity and avoidance of tobacco products[5]. Food-based approaches can be used to reverse the nutrition transition trend by improving micronutrient status, improving diet quality and diversity, reducing consumption of less nutritious carbohydrate and fat-rich foods, increasing essential fatty acids and phytonutrients (bioactive plant-derived compounds associated with positive health effects[6]) intake and increasing physical activity[7,8].

Locally-grown food crops in Micronesia include many diverse species and cultivars of root crops (taro, yam), starchy fruits (breadfruit, banana), other fruits (such as mountain apple, pineapple and papaya), vegetables, coconuts, fish and other seafood; this diet is rich in fiber, vitamins and minerals[4]. A nutrition survey conducted in 1954 showed a strong reliance on local foods[3,a]. However, since the 1960s, there have been numerous social, economic and cultural changes in FSM[2,4]. Current consumption patterns indicate that imported foods have replaced many local foods in the average daily diet[9,10] and these foods are often processed, high in fat and/or refined sugar or flour and have little fiber or micronutrients (vitamins and minerals essential for health)[3,11].

Nutrition-related disorders are serious problems in Pohnpei, the second most populated state in the FSM. The World Health Organization STEPs survey of the Pohnpei state in 1999 found that 44% of men and women (ages 25-64 years) were obese (Body Mass Index ≥ 30 kg/m^2) and 32.8% were diabetic as diagnosed by high blood sugar[12]. The shift in diet from traditional food to imported food combined with a more sedentary lifestyle is understood to have contributed to these current health problems[4,12].

These circumstances prompted the Island Food Community of Pohnpei (IFCP) and other Pohnpei agencies to work with the Mand community on the island of Pohnpei and the Centre for Indigenous Peoples' Nutrition and Environment's (CINE) Indigenous Peoples' Food Systems for Health program. Community selection was based on several criteria set by CINE: a community that was rural, accessible from the main center of the island and willing to participate.

The aim of this research was to describe community dietary practices and to promote the benefit of local food in improving long-term health[10,13]. By using a participatory, food-based approach, the goal was to "assist the residents of Mand to meet their food needs, increase self-reliance, improve health and nutrition, economic savings and protect agricultural biodiversity"[14]. Strong partnerships were formed with Pohnpei Agriculture of the Office of Economic Affairs and Pohnpei Department of Health.

At the beginning of the project, a thorough documentation of the traditional food system was completed[10]. Intervention activities were then held for two-years, from September 2005 to June 2007, with significant community involvement and inter-agency collaboration to promote locally-grown foods that had high

potential health benefits and good acceptability[10,15]. Activities in the community focused mainly on education and agriculture. Several educational activities targeted youth and women, while others were open to the entire community. Agricultural activities promoted home gardens and agroforestry by providing planting materials and training workshops. Social marketing and media were also used to publicize the project within Mand and on the greater Pohnpei Island, with the "Go Local" promotional message[a]. "Go Yellow" was also a common theme of activities; the majority of banana planting materials distributed were yellow-fleshed and media messages promoting local starchy staples consistently mentioned the additional nutritional benefits of eating carotenoid-rich, yellow-fleshed varieties.

Methods

An evaluation was conducted to assess changes in diet and health that may have been impacted by the two-year intervention. Only the dietary results are presented here; results from the full evaluation are presented in another manuscript[17]. Consistent with the requirements of the CINE Indigenous Peoples' Food Systems for Health program, a single-group, pretest-posttest design was used[18].

Baseline and follow-up surveys were conducted from June to August, during the breadfruit season, in 2005 and 2007, respectively. Dietary assessments and interviews were completed in the same randomly-selected households in both years. The random sample of 47 households was selected in 2005 using a random number table and a list of all households in Mand (n=71) with the objective of sampling more than half. These 47 households were not targeted by the two-year intervention any more than other households; rather, intervention activities were open to the entire community. Principles of participatory health research were used[19]; research agreements explaining the purpose, methodology, dissemination of results and benefits to the community and researcher were signed by the Mand Community Leader, IFCP and the McGill University collaborator. Ethics approval for this research was obtained by the McGill University Faculty of Agriculture and Environmental Sciences Research Ethics Board. Informed consent was obtained verbally from each participant in 2005 and 2007; verbal consent was deemed more appropriate than written consent given the oral culture of Pohnpei[20].

The focus of the dietary assessment was to document differences in nutrient and food intake between baseline and post-intervention follow-up. For each assessment, a seven-day Food Frequency Questionnaire (FFQ) and two, non-consecutive 24-hour recalls were administered during face-to-face interviews in 2005 and 2007 to assess average individual intake. These interviews were conducted with one adult woman from each household responding about her own diet. Pohnpeian women primarily purchase and prepare household food[10] and thus are the most knowledgeable about the foods they eat. Dietary assessment tools and methodology were kept consistent between 2005 and 2007. Completed forms were reviewed in the field for omissions and inconsistencies and corrected by interviewer recall or by returning to the participant.

The 24-hour recalls provided estimates of average daily nutrient intake. Interviewers explained the 24-hour reference period and then asked about all food and drink consumed during this period using a standardized protocol. Responses were recorded one food item per line with details on raw or cooked form, cooking method, cultivar, maturity and brand names. Visual aids of commonly consumed foods and household portions were provided to assist with portion size estimation. Interviewers alternated to reduce interviewer bias.

a. Social marketing is a marketing approach used to achieve specific behavioral goals for social good[16].

The FFQ was used to examine the consumption frequency of selected foods and to assess dietary diversity. This tool was modified from other FFQs previously used in FSM[9,21,22] to represent the Pohnpeian traditional food system and to distinguish between imported and locally-grown foods. Thirty-three food items (e.g. local vegetables) and 200 sub-items (e.g. kangkong) were included.

There were 40 households with complete dietary records in 2005 and 2007 used for subsequent data analysis. Recall data were entered by food and quantity into FoodWorks Professional Edition (Xyris Software, Australia, Version 4.0). Nutrient content was based on Pacific Islands Food Composition Tables[23]. Seven recalls were excluded to control for underreporting using the Goldberg cutoff method[24] and an additional seven recalls were excluded due to lactation; the 24-hour recall data set was reduced to a sample size of 26. FFQ and recall data were entered into Microsoft Excel (Edition 2003) and then SAS statistical software (Windows version 9.1, SAS Institute Inc., USA) was used to examine for statistically significant changes in nutrient intake, quantity consumed, consumption frequency and dietary diversity between 2005 and 2007. A classification model with a randomized complete block design (outcome = $household_i + year_j$ + error) was used to analyze these dietary outcomes; household was considered as a random 'block' effect and year (2005, 2007) as a fixed effect. A P-value of <0.05 was considered significant. Variance estimates results are provided in Kaufer (2008)[17].

An evaluation questionnaire was administered in 2007 to the same randomly-selected households to examine qualitative effects of the intervention including awareness, exposure and attitude. Responses (n=42) were combined and examined for repeated themes.

Results

The average household diet in 2007 had significantly higher micronutrient intake, increased consumption frequency of promoted foods and greater dietary diversity than in 2005. Increased consumption of local food contributed to these changes.

Energy and Nutrient Intakes (Table 1)

The total estimated average daily energy intake decreased significantly by 11% (P=0.04). This was predominantly due to a significant decrease in total average carbohydrate intake (P=0.03); total average daily intake of protein and fat did not change significantly. These significant changes reflect the significant decrease in average carbohydrate intake from imported food. Indeed, average daily rice consumption per individual decreased significantly from 847 grams in 2005 to 544 grams in 2007, while sugar and wheat flour-based products (including bread, doughnuts and instant noodles) did not vary significantly between survey years (data not shown).

The average daily consumption quantities of total vitamin A, beta-carotene equivalents (BCE, the active equivalent of provitamin A carotenoids in plant foods), retinol (the form of vitamin A in animal foods), vitamin C and calcium were higher in the 2007 survey compared to 2005; however, only the increase in average BCE intake was statistically significant. Local food contributed 36-98% of all micronutrient intakes. Total average BCE intake increased significantly by 110% between 2005 and 2007 (P=0.02). This significant

change was predominantly due to a significant increase in intake of local sources of BCE (P=0.02). The top five contributors to total BCE intake in 2007 were local green leafy vegetables (GLVs), banana, vegetables (excluding GLVs) and breadfruit as well as imported vegetables (data not shown).

Average total retinol intake and retinol intake from imported food sources did not change significantly between 2005 and 2007. However, the average daily retinol intake from local food sources decreased significantly (P=0.02). This was likely due to decreased local fish (mostly tuna) consumption, which fell from being the top contributor to retinol in 2005 to the third top contributor in 2007 (data not shown).
Local foods contributed 97%, 44% and 36% to vitamin C, calcium and iron intake, respectively; there was no significant difference between 2005 and 2007. Top local food sources of vitamin C were banana, breadfruit, giant swamp taro, local fruit and GLVs. Giant swamp taro was the top contributor to calcium intake in 2007 and banana, fish and giant swamp taro contributed to iron intake.

Table 1: Average daily energy and nutrient intake in one Pohnpeian community in 2005 and 2007 by repeat, non-consecutive 24-hour recall (26 households/yr; 1 individual/ household)

		2005		2007			
		Mean	% of energy	Mean	% of energy	% change	P-value
Total	Energy (KJ)	9,879.3		8,833.4		-10.6	0.04
	Carbohydrate (g)	354.6	59.8	303.7	56.5	-14.4	0.03
	Protein (g)	100.7	17.0	92.7	17.3	-8.0	0.39
	Fat (g)	61.3	23.3	62.6	26.2	2.0	0.82
	Vitamin C (mg)	43.2		61.8		43.1	0.08
	Vitamin A (µg)	176.5		193.2		9.4	0.59
	Retinol (µg)	176.0		148.1		-15.8	0.30
	Beta-carotene equivalents (µg)	226.6		475.7		109.9	0.02
	Calcium (mg)	246.0		326.4		32.7	0.16
	Iron (mg)	9.9		9.2		-7.0	0.39
			% of total		% of total		
Local Food Contribution	Energy (KJ)	2,286.2	23.2	2,127.6	24.3	-6.9	0.71
	Carbohydrate (g)	51.1	14.8	70.3	24.6	37.7	0.24
	Protein (g)	31.9	33.9	20.1	23.5	-37.2	0.06
	Fat (g)	18.6	33.3	11.3	20.1	-38.9	0.04
	Vitamin C (mg)	42.0	97.6	55.0	97.0	31.0	0.21
	Vitamin A (µg)	92.3	52.8	80.4	46.1	-12.9	0.59
	Retinol (µg)	53.4	43.1	19.0	18.1	-64.4	0.02
	Beta-carotene equivalents (µg)	202.1	68.6	511.6	79.7	153.2	0.02
	Calcium (mg)	89.9	40.5	137.9	47.5	53.5	0.25
	Iron (mg)	3.4	35.7	3.1	36.4	-9.2	0.67
Imported Food Contribution	Energy (KJ)	7,587.7	76.8	6,624.5	75.7	-12.7	0.09
	Carbohydrate (g)	294.5	85.2	216.1	75.4	-26.6	0.0007
	Protein (g)	62.2	66.1	65.2	76.5	4.8	0.68
	Fat (g)	37.1	66.7	45.0	79.9	21.2	0.10
	Vitamin C (mg)	1.0	2.4	1.7	3.0	67.1	0.54
	Vitamin A (µg)	82.3	47.2	94.1	53.9	14.4	0.55
	Retinol (µg)	70.6	56.9	85.8	81.9	21.6	0.42
	Beta-carotene equivalents (µg)	92.3	31.4	130.0	20.3	40.8	0.64
	Calcium (mg)	131.9	59.5	152.2	52.5	15.4	0.41
	Iron (mg)	6.2	64.3	5.4	63.6	-11.8	0.16

Consumption Frequency (Table 2)

Giant swamp taro and all banana types were consumed significantly more frequently in 2007 compared to 2005 ($P<0.01$ for both). No significant change was found in consumption frequency of breadfruit or other local starches (including dryland taro, yam, cassava and sweet potato).

Weekly rice consumption decreased significantly from being eaten seven days per week in 2005 to six days per week in 2007 ($P<0.008$). Consumption of flour products (such as instant noodles, doughnuts and pancakes) was significantly more frequent in 2007 than 2005 ($P<0.01$).

Consumption of local vegetables was significantly higher in 2007 than in 2005 ($P<0.01$); popular choices included GLVs (chaya, Chinese cabbage and spinach), cucumber, bell pepper and eggplant. Frequency of imported vegetable consumption did not change significantly.

Frequency of all fruit consumption was significantly higher in 2007 ($P<0.01$). However, when asked about separately, local fruit consumption did not change significantly and imported fruit consumption decreased significantly ($P<0.01$). Local fruits like mountain apple, pineapple, papaya, guava and citrus were eaten an average of four days per week in 2007, whereas imported fruits such as apples, oranges and canned pineapple were consumed an average of less than one day per week. Pandanus was not consumed during the survey period; it is seasonal and most available between November and February[10].

Local drinks (drinking coconut, madeu and lemon grass tea) and snacks (sugar cane, coconut husk and chestnuts) were consumed significantly more often in 2007 ($P=0.01$ for both). The frequency of sugar consumption (from imported foods such as doughnuts, ice cream and cookies as well as sugar (sucrose) added to local food or local drink) decreased significantly from three days a week in 2005 to two days a week in 2007 ($P<0.01$). Conversely, consumption frequency of imported drinks with sugar (including soft drinks, Kool-Aid and sucrose added to tea and coffee) increased significantly ($P<0.01$).

Chicken eggs, liver and imported meat consumption frequency increased significantly ($P\leq0.03$). While these are good sources of retinol (vitamin A), there was not enough of an increase to result in a statistically significant increase in retinol intake as captured by two 24-hour recalls.

Table 2: Food consumption frequency in one Pohnpeian community by 7-day Food Frequency Questionnaire (FFQ) (n=80, 40 households/yr; 1 individual / household

	Food Item	Weekly Consumption (7-day FFQ, 1 count/day)		
		Means		P-value
		2005	2007	
Local	banana, all	2.6	3.9	0.0001
	banana, white-fleshed	2.9	2.9	0.86
	banana, yellow-fleshed	0.5	0.7	0.13
	breadfruit	4.0	3.8	0.41
	coconut fat	1.7	1.3	0.15
	drink, local	2.4	3.2	0.01
	fish, local	3.9	4.2	0.42
	fruit, local[a]	3.5	4.0	0.10
	meat, local	1.5	1.1	0.06
	nut, local	0.2	0.6	0.01
	pandanus	0.0	0.0	1
	snack, local	0.3	0.7	0.01
	starch, all	4.7	4.8	0.78
	starch, other[b]	0.1	0.3	0.07
	taro, giant swamp	0.2	0.9	<0.0001
	vegetable, local	1.4	3.3	<0.0001
Imported	dairy[c]	0.6	0.8	0.25
	drink, imported with sugar[d]	2.0	3.6	<0.0001
	egg	1.1	1.6	0.03
	fish, imported	2.4	2.7	0.46
	flour product	4.1	5.0	0.008
	fruit, imported	0.8	0.2	0.0004
	meat, imported	1.7	2.6	0.003
	rice	6.8	6.1	<0.001
	snack, imported	0.3	0.4	0.4
	sugar (imported product or added to local food)[e]	3.2	1.9	0.0002
	turkey tail	0.2	0.2	0.65
	vegetable, imported	0.5	0.6	0.32
Imp and Local	fat, imported/animal	2.1	2.4	0.46
	fried food	2.1	2.3	0.45
	fruit, all	3.0	4.5	<0.0001
	liver	0.1	0.5	0.001
	vegetable, all	1.5	3.4	<0.0001

Notes: Food item categories defined as appear on questionnaire. Bold denotes significant difference.

a) Includes ripe banana; excludes pandanus
b) Includes dryland taro, yam, cassava, sweet potato
c) Includes butter, margarine, cheese, milk
d) Includes soft drinks, koolaid and sweetened tea and coffee
e) Includes doughnuts and sugar added to local food and/or local drink.

Dietary Diversity (Table 3)

Dietary diversity was measured in three ways: the number of different food groups (food group score), different species (species diversity score) and food items, including cultivars, (food variety score) consumed over a seven-day, consecutive period. All three measures indicated that dietary diversity was significantly higher in 2007 than in 2005 ($P \leq 0.04$). Dietary diversity of local food was also significantly higher in 2007 for all three categories ($P<0.01$). By imported foods, only the food variety score was significantly higher in 2007 ($P<0.01$).

A 'promoted foods score' was calculated to examine changes in consumption of the key micronutrient-rich foods promoted during the intervention (data not shown). These main promoted foods were yellow-fleshed banana, giant swamp taro, breadfruit, yam and GLVs. The increase in the number of key promoted foods consumed per week was small but significant, from two in 2005 to 2.5 in 2007 ($P<0.01$).

Table 3: Dietary diversity in one Pohnpeian community in 2005 and 2007 by 7-day Food Frequency Questionnaire (40 households/yr; 1 individual/ household)

Food Group Score	2005		2007		P-value
	Mean	Range	Mean	Range	
Total (n=14)	10.1	6 - 13	10.9	6 - 14	**0.04**
Local (n=6)	4.8	2 - 6	5.5	4 - 6	**0.001**
Imported (n=8)	5.3	2 - 7	5.4	2 - 8	0.74
Species Diversity Score					
Total (n=72)	12.4	7 - 18	18.1	9 - 29	**<0.0001**
Local (n=51)	12.3	3 - 11	17.3	5 - 23	**<0.0001**
Imported (n=21)	5.2	2 - 8	6.0	3 - 11	0.14
Food Variety Score					
Total (n=166)	21.3	11 - 31	32.5	14 - 66	**<0.0001**
Local (n=100)	11.8	4 - 19	19.5	8 - 43	**<0.0001**
Imported (n=66)	9.4	3 - 16	12.8	5 - 24	**<0.0001**

Attitudes toward Local Food

By questionnaire, The Community Working Group, Charcoal Oven Project, Youth Drama Club, Planting Material Distribution, Cooking Training and the Breastfeeding Support Group intervention activities were well-known with awareness levels over 80% (data not shown). Half or more-than-half of the sampled households had participated in these activities. Participants reported having learned the following: the connection between eating local food and health, the practice of mixing home-grown vegetables with rice and instant noodles, the ability of regular physical activity to improve health and the transfer of information from youth to adults.

Discussion

Significant changes in nutrient intake, consumption frequency and dietary diversity reflected increased local food consumption and may provide evidence of the intervention's impact on behavior and attitude toward local food. However, the single group, pretest-posttest evaluative design used for this research is limited by reduced internal validity due to the influence of external events, maturation of the subjects and the educational effect of the pretest[25]. Thus, the results of this research cannot be applied to any cause and effect statements or conclusions regarding the intervention's impact on diet. Also, while numerous dietary effects were found, a two-year period may not have been sufficiently long enough to observe all agricultural effects of the intervention, as planting materials may require a two-year or longer cultivation period. Rather, this evaluation attempts to highlight the community's effort in the past two years to make their health and well-being a priority[18].

Sources of bias and confounders in this study were controlled for in the following ways. Both surveys were completed in the same season to reduce seasonal variation. Interviewer bias was addressed by alternating interviewers. Response bias was controlled in part by surveying the same people in each household in 2005 and 2007 in all but five cases and excluding recalls that were underreporting dietary intake. Loss to follow-up was 8.5% (4/47), which occurred due to migration and death. Potential study confounders were minimized by using the same interviewers (except for one additional interviewer in 2007) and keeping the methodology as consistent as possible between 2005 and 2007. External confounding factors such as changes in food accessibility and affordability were not examined in this study.

Weekly consumption of giant swamp taro and banana increased significantly between 2005 and 2007. In addition, the consumption quantity and contribution of giant swamp taro to BCE, vitamin C and calcium was higher in 2007 than 2005. However, while banana consumption quantity and contribution to vitamin C was slightly higher in 2007 than 2005, the contribution of banana to BCE decreased. This is likely due to increased white-fleshed and decreased yellow-fleshed banana consumption. While yellow-fleshed banana cultivars had been promoted by the intervention, the lack of increase in yellow-fleshed cultivar consumption may be due to the fact that they are rarer and harder to find, the cultivation period is frequently longer than two years and these varieties are more difficult to grow than white-fleshed varieties. It may have been the case that women were taking better care of and harvesting more of what they already had, which were white-fleshed varieties.

Imported rice consumption decreased significantly in 2007 compared to 2005, both in frequency and average daily consumption quantity. Decreased rice consumption likely explained the significant decreases seen in average energy and carbohydrate intake. This change may have been affected indirectly by the intervention; rice was compared to local foods in intervention messages as the commonly consumed imported food without micronutrient or fiber content. If this was the case, it could reflect an important behaviour change of replacing rice with local starches during mealtime. However, changes resulting from external factors including rising rice prices cannot be ruled out. The significant increase in consumption frequency of flour products may have offset some of the decrease in rice consumption, yet there was still an overall significant decrease in total and imported average daily carbohydrate intake.

Weekly consumption of local vegetables was higher in 2007 than in 2005. The significant increases in frequency of local vegetables and giant swamp taro consumption produced the significantly higher average

daily BCE intake seen in 2007. In particular, the contribution of GLVs to BCE intake increased 10-fold between 2005 and 2007. Home-grown vegetable production had been directly encouraged by training workshops, demonstration plots, plant material distribution, a community seedling nursery and planting competitions.

Frequency of local fruit consumption did not change significantly between survey years. Pineapple, soursop, guava and citrus were distributed for planting during the intervention and fruit consumption was promoted at Mand Community Working Group meetings. However, the time needed for these to grow to maturity and bear fruit is greater than two-years.

Weekly consumption of local snacks and drinks increased significantly which may represent additional reliance on local foods outside of meal times. While weekly consumption of sugar (from imported products or added to local food) decreased significantly between 2005 and 2007, the consumption frequency of drinks containing sugar, including soft drinks, increased significantly. Local snacks and drinks had been promoted and served at the bimonthly Mand Community Working Group meetings in place of doughnuts and soft drinks, which were served at community meetings and gatherings prior to the intervention. Additional messages specifically targeting soft drinks and sugar added to tea and coffee may be required.

Dietary diversity has been found to be a valid proxy for evaluating dietary quality[26] and nutritional adequacy of diet[27,28] and it was a particularly valid measure given the large amount of biodiversity on the island of Pohnpei[10]. An average number of six different local food groups, seventeen different local species and twenty different local food varieties were consumed over a seven-day period in 2007; each local diversity score had increased significantly compared to 2005. Local diversity had been promoted during the intervention in posters, community discussion and education intervention activities.

Conclusion

Faced with the pandemic of obesity and obesity-related conditions that coexist with malnutrition, it has been recommended that nutrition and health programs adopt food-based approaches that employ agricultural biodiversity, reintroduce indigenous staple and non-staple foods known to be rich in micronutrients and phytonutrients and improve the well-being of rural and urban populations[29]. The intervention by IFCP and other collaborating agencies in Mand met this recommendation; the participatory, inter-agency, community-based approach used education, social marketing and agriculture to increase local food production and consumption, while also incorporating concepts of local culture, environmental sustainability and long-term food security.

The evaluation results indicated successful changes in this direction. It appears that the social marketing and education activities may have been influential in increasing local food consumption. The breadth of local food promotion through cooking demonstration, local gardening and cultivation, cultural gatherings featuring local food recipes and social marketing likely led to improved accessibility, acceptance and self-efficacy surrounding local food. Provision of smokeless charcoal ovens may have made local food preparation more feasible compared to the traditional earth oven *(uhmw).* The study period may have been insufficient to substantiate the impact of agricultural plant distribution on diet; however, there does seem to have

been a more immediate impact from small, home garden production of GLVs and other vegetables. Lateral promotion of physical activity also occurred through education, exercise, agriculture and competitions and compliments the food-based approach for overall, long-term improvement of health. As documented in the literature and implemented by this intervention, food-based approaches are most successful when methods of practical agricultural and food preparation training occur in tandem with educational workshops and social marketing[30].

Strong partnerships and collaborations were integral parts of many activities and likely contributed to the success of the intervention. Community leaders and residents were involved and consulted regularly. Partnerships were made with Pohnpei Agriculture of the Office of Economic Affairs, Pohnpei Department of Health, Conservation Society of Pohnpei, Mand Elementary School, College of Micronesia-FSM Cooperative Extension Service and Natural Resource Conservation Service. Implementation of all intervention activities proposed by the community working group in 2005 was evidence of the successful participatory nature of the intervention process[10].

It is recommended that the intervention continue to work with community members, leaders, youth and women to promote local food consumption and production. A continued integrative approach that includes promotion of physical activity and weight maintenance is also encouraged. IFCP has already begun working to increase availability of micronutrient-foods on Pohnpei by developing commercial production of locally-processed banana products and preservation techniques.
Study limitations notwithstanding, evaluation results were promising and suggested that dietary quality and diversity could be improved over a two-year period. This research provides evidence and methodology that may be helpful in planning future food-based initiatives and in evaluating the impact of local dietary practices on long-term health outcomes.

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Figure and Tables

Figure: The 12 CINE Indigenous Peoples' Food Systems for Health program sites

Here Mand Elementary Schoolchildren in the Pohnpei, FSM case study in a global health project happily pose for a photo with ***Karat****, the State Banana of Pohnpei, (middle of photo), and other banana varieties. This was taken in 2006 during one of the classroom activities for learning about the health and other benefits of these tasty foods.*