Ecology of Food and Nutrition, Vol. 23, pp. 91-108
Reprints available directly from the publisher
Photocopying permitted by license only

FOOD AND NUTRITIONAL IMPACT OF ONE HOME GARDEN PROJECT IN SENEGAL

THIERRY BRUN, JACQUELINE REYNAUD, and SIMON CHEVASSUS-AGNES

Division of Nutritional Sciences, Cornell University, Ithaca, New York; Unité de Recherche INSERM en Nutrition et Alimentation, Hôpital Bichat, Paris, France and Office de la Recherche Scientifique et Technique Outre-Mer (ORSTOM) Dakar, Senégal

(Received March 24 1988; in final form April 2, 1989)

The opportunity arose to attempt the evaluation of the nutritional impact of a vegetable production project at household level which was initiated in 1969, in Kumbija, a village in West Senegal. This was part of a larger scheme implemented in Experimental Agricultural Units by the Institut Sénégalais de la Recherche Agronomique (ISRA).

The production and sale of vegetables was first demonstrated by extension agents to male farmers. It required drawing water from wells which is typically a female activity. Soon the vegetable production was taken over by female farmers, mostly from the Socé ethnic groups. In 1980, sixty-four women had a plot of land dedicated to dry season vegetable production. Very few projects of this kind have been carefully evaluated for their nutritional impact. In the present study an attempt was made to assess to what extent this project had achieved, after almost twenty years, part of its stated goals.

Results from seven food consumption surveys conducted between 1970 and 1981 were compared. Mean per capita energy intake was 2200 Kcal in 1970-71 and 2400 Kcal in 1981-82. Mean protein intake per capita was close to 75 g/capita both in 1970-71 and 1980-81. There was no significant difference either in energy, protein, vitamin or mineral average intake between the earlier studies (1970-71), and the latter one (1981). Iron, retinol equivalent or ascorbic acid intakes in particular did not appear higher after several years of vegetable gardening than at the beginning of the project. The major reason seems to be that only a small fraction of the vegetables produced is consumed by the family and that the income generated by the sale of the vegetables is almost never used for food purchases. The vegetable gardening project, however, had a marked impact on women's income. It affected their social status and their awareness of urban social and food habits.

KEY WORDS: nutritional impact, dietary pattern, women, home gardens, agriculture, incomes

INTRODUCTION

During the last forty years, several development agencies such as the Food and Agricultural Organization of the United Nations, the United States Agency for International Development, and the International Development Research Center, have supported the introduction or extension of vegetable gardening in the tropics. The aim of most garden projects has been to improve the nutritional status or diversity of the diet of certain target groups and to raise the income of the vegetable growers through the sale of produce. Although a large number of such projects have been initiated (Gershon, 1985; Brownrigg, 1985), very few have been evaluated and it is not clear to what extent home gardens fulfil these expectations and have had a measurable impact on nutrition and income in the project areas. It appears generally assumed that there is a significant link between increased produc-

tion of vegetables, increased income, and improved nutritional status. The complexity of the relationship between those potential changes, as well as many other aspects of garden projects, have often been overlooked.

Recently, Brownrigg (1985) made an extensive review of the literature concerning home gardening, and Sumberg (1986)†, for Oxfam America, made a study on vegetable gardening projects in Gambia and Senegal. He observed that in recent years a growing number of garden projects were focussed on women's groups. He stressed that the agencies promoting vegetable gardening usually have a limited capacity for research and evaluation. O'Brien-Place (1987) suggested a method for the economic evaluation of home garden projects, including direct and indirect nutritional indicators but, to our knowledge, this method has not been tested.
Gueneau (1986) studied six gardening projects initiated by non-Government organizations, two in Burkina Faso and four in Senegal. She observed that when farmers could sell the whole vegetable crop there was no self-consumption. Only the unsold quantities are consumed by villagers.

Near St. Louis (Senegal), in 1982, the Foster Parents Plan project designed gardens which produced throughout the year. It was observed that 90% of the families consumed vegetables. They also had an impact on seasonal migration: during the drought 60% of the men decided to remain in the villages. But when the drought ended, the villagers came back to their traditional crops of groundnuts and millet and virtually abandoned gardening (Brownrigg, 1985).

These studies shed some light on the potential nutritional and social impact of home vegetable gardening projects, but to our knowledge the true nutritional impact of the majority of vegetable gardening projects in West Africa has not been evaluated.

The opportunity to attempt an evaluation of the nutritional impact of home gardening arose in 1980, when we were invited to conduct a survey in Senegal in a vegetable gardening project which had been initiated in 1969 in two experimental units for agricultural development: Kumbija and Ciise-Kaymor. In the second unit, the project did not survive. But in the Experimental Unit of Kumbija, which includes several villages, the production and sale of vegetables proved to be quite commercially successful. It was part of a larger program which included the increased use of fertilizers, of improved seed varieties for the traditional crops of millet and groundnut, and the introduction of maize, combined with primary health care and nutrition education activities.

We were able to use the results from seven separate foods and nutrition studies[2-5] which had been conducted in the project area between 1970 and 1983. Five of the surveys were conducted by the authors. Their aim was to measure the food, energy and nutrient intake of different ethnic groups of farmers and determine the changes occurring in food consumption patterns. Those surveys did not follow a strict evaluation of nutritional impact procedure. However, they include two baseline studies in 1970 and 1971. The survey techniques of six of the seven studies were identical: they were conducted by weighing both raw and cooked food. The remaining study, the fourth† which was performed in 1980, was conducted by a combination of observations, recall and calculations based on food prices. The objective of this report is to contribute by this case study to the determination of the effectiveness of home gardens as means of nutritional improvement in Sahel countries.

DESCRIPTION OF THE VILLAGES AND THEIR POPULATION

Geographic Location and Ethnic Groups

The village of Kumbija is located in the Southeast of the Sine-Saloum region (Senegalese groundnut basin), in the department of Kaffrine, district of Kungël, at about 10 km from Kungël, where the community clinic and the maternity hospital are located. It is close to the Northern border of Gambia. Kungël is a town of about 3,600 people, located on the Dakar-to-Bamako (Mali) railway and the road between Dakar and Tambacunda. It is thus a local trade center, with a daily market which attracts the population of surrounding villages.

Kumbija is constituted of several quarters where ethnic groups (Socé, Pël and Wolof) are separated into homegeneous groups. The village gets a fair amount of rain (800 to 1000 mm a year) and did not suffer excessively from the drought in the seventies. The major crops are groundnut, mostly for sale, and millet, mainly for home consumption. There are only two seasons: the rainy season, from June to October, during which the fields are cultivated; and the dry season, the rest of the year. Only in recent years has home gardening been practiced by a limited number of families during the dry season, using water from wells for irrigation.

Food Habits

The daily food intake is divided into three meals. The morning meal is constituted from the leftovers from the previous day's evening meal (most often millet gruel or "couscous"). In 1970, lunch and dinner consisted in most cases of a millet paste made of loose grains of semolina, which had been steam-cooked and then cooked a second time in a small amount of water. Steam-cooked "couscous" was traditional for dinner.

The staple food is traditionally home-grown millet but its consumption declines progressively, especially in the cities, to be replaced by imported broken rice. The staple food is cooked with small quantities of ground green leaves or vegetables, and even smaller quantities of smoked fish, which together constitute the sauce. Meat and poultry are seldom consumed and only on special occasions such as ceremonies and visits.

HOME GARDENING IN KUMBIJA

Home gardening as a dry-season activity was introduced in 1969 by the Senegalese Institute for Agricultural Research (ISRA), but only a small number of farmers were interested in practicing it. The Socé ethnic group was the most receptive to this innovation. During the first years young plants were grown in nurseries and distributed free of cost to the peasants. Then the external assistance was limited to the sale of seeds and pesticides, and to some technical advice. In addition, a special stand was obtained at the market of Kungëel where the vegetable producers from Kumbija could sell their produce.

The initial purpose of introducing gardening was to diversify agricultural production, to give peasants an occupation during the dry season, and to improve nutrition, especially of weaning children. In Kumbija, vegetable gardening survived in only one ethnic group: the Socé hamlets of Kër Lamin, San-San, and Silakunda.

Extension agents had contacted men first. Male farmers appeared interested,

started gardening, then stopped. This was, in part, because they were embarrassed to fetch water from the well, which is an activity specific to women. Soon women took over. Only one hamlet has a well equipped with a system of animal traction. In the other hamlets, women get water from the wells manually. The cultivated acreage per household is small, 32 to 51 m^2.

The Socée ethnic group adopted the new techniques much more rapidly than the others (Pël and Wolof). Both Pël and Wolof are known to be more conservative.

The vegetable gardens are usually installed after the millet harvest on the plots of land which are closest to the huts. Men build fences and plough, women cultivate and sell the products. The vegetables which are most frequently grown are, in decreasing order: tomato (sweet and bitter), onion, cabbage, lettuce, eggplant, bissap (Guinean sorrel), okra, turnip, cowpea, parsley, beets, peppers and carrots.

The gardens are weeded frequently and watered twice a day. Watering and water drawing from the wells are the most strenuous chores "four women draw as much water as two oxen do," declared the men during an interview). Often, women do not wait for the full maturation of their vegetables. For some plants, such as turnips, they sell the leaves instead of the root itself. This is related to the tradition of preparing sauces for "couscous" or rice from green leaves. Cultivated leaves are gradually replacing picked wild leaves.

Women organized marketing at the Kungël market where they own a particular spot for sale. In order to sell their products they must get up early (5 a.m.) and walk eight miles with their heavy tin bowls of vegetables on their heads.

METHODS

The 1970 and 1971 Surveys

The initial surveys[2,3] were conducted by the *Organisme de Recherche sur l'Alimentation et la Nutrition Africaines* (ORANA). Both surveys were conducted in May and June of successive years in 15 villages housing 3 ethnic groups: Wolof, Pël ("Pël" is the same as "Peuhl" or Fulani), and Socé. Households were selected by a random sampling from the lists of households by ethnic groups in order to have a representative sample. The surveys were carried out by the systematic weighing of raw foods, cooked dishes and leftovers. Each surveyor stayed 5 days in a family. The total sample included 660 individuals in 1970. Almost the same families were surveyed in 1971. The number of individuals surveyed was then 802 and the number of consumer x days 3,376[2,3].

The 1980 Survey

In 1980, a broader study was conducted by the Institut Sénégalais de la Recherche Agronomique (ISRA), the "Groupe de Recherche et d'Echange Technologiques" (GRET), and the Institut National de la Santé et de la Recherche Médicale (INSERM) from Paris (France).[4]. This multidisciplinary study included a food consumption survey.

Selection of households Four categories of consumers were investigated for food consumption data: home gardeners, previous home gardeners, non-home gardeners and town dwellers. Selection was made from the list of household classified by the above categories using a table of random numbers. The sample was as follows:

Home gardeners: 12 families from the village of Kumbija.
Ex-home gardeners. 10 families from Kumbija. They had stopped home gardening mostly because of the lack of water.
Non-home gardeners. 10 families who had never grown vegetables were surveyed in a nearby village from the region.
Town dwellers. 25 families from Kungël. They were classified into three socio-economic categories: state employees, shopkeepers and farmers.

Technique of survey This survey was conducted with the use of a questionnaire combining dietary recall and food frequency records. There was no systematic weighing of all foods. Three female interviewers, from Kungël, visited the families and asked questions of the women who prepared the meals that day. The interviewers spent between two and four hours with each family. The technique used for the food survey included recording recipes and a food frequency questionnaire. Some of the quantities of foods were established from the value in cash paid by the housewife at the market; these values were later converted into grams according to mean prices from the market of Kungël.

The 1981 and 1982 Surveys

The 1981 survey In 1981 a nutritional survey was again conducted by the Office de la Recherche Scientifique et Technique Outre-Mer (ORSTOM) and ORANA for ISRA.[5] In the village of Kumbija, which includes several sections inhabited by different ethnic groups, the sampling was: 12 Socé families, 6 Pël families and 2 Wolof families. This survey was conducted in April of 1981.

The 1982 Survey The following year, in 1982, the survey was repeated in Kumbija at three different periods of the year: January-February, May-June, August-September, in order to analyze the seasonal variations of food intake and nutritional status of the populations. January-February corresponds to the gardening season, and an increased consumption of vegetables was expected to be observed. The gardening season ends in March. May-June is an intermediate period at the end of the dry season. August-September is part of the "hungry season", just before the harvest which takes place in October at the end of the rainy season.

Technique of survey Four male investigators, natives from the region, conducted the survey following strictly the protocol in all households. Each investigator stayed for 5 days in a family and weighed all the food prepared for meals and eaten in between meals. Food was weighed before and after meals. Usually, only one cook prepared the family meals, generally made of only one dish at every meal. Whenever necessary, the leftovers were subtracted. The number of persons present at each meal was recorded.

Besides food weighing, each investigator collected other information concerning the consumption unit: ethnic group, religion, presence or absence of each consumer, physical activity of every permanent consumer of the household above 15 years of age, annual income of the group, etc. Data processing of the results used a computer program from ORANA. Nutrient intake was computed from a food composition table with 270 items derived from tables applicable to Africa (FAO, 1968). Energy requirements were calculated according to age, sex, weight,

and physical activity based on the WHO (1973) manual: light, moderate, very and exceptionally active.

The average level of activity was determined from the observations of the interviewers who recorded the approximate number of hours, or questioned each adult participant engaged in physical work. Brun, Bleiberg, and Goihman (1981); and Bleiberg, Brun, and Goihman (1980) have measured energy expenditure in male and female farmers in Burkina Faso, and their results were used to classify adult participants in the appropriate categories of activity.

RESULTS

The 1970 and 1971 Studies

These surveys were conducted when vegetable gardening had barely started in Kumbija and long after the end of the gardening season, thus no direct impact of home gardening was expected to be found. Rather they were used as baseline studies.

Results from the 1970 nutrition survey are shown in Tables I and II. The average per capita energy intake in 1970 and 1971 is approximately 2200 Kcal. Retinol equivalents intake was twice as high in 1970 compared to 1971. Average per capita ascorbic acid intake was adequate in Kumbija both in 1970 and 1971. In Kumbija, in 1970, only 4% of the calories and 5% of protein intake came from vegetables and fruits, but 97% of retinol equivalents and 99% of vitamin C intake came from wild leaves and fruits. If the recommendations for vitamin intake used in this survey (Latham, 1978) are valid, the only vitamin seriously deficient in the diet was riboflavin. This is due mainly to the low consumption of foods of animal origin (2.5% of the calories, 9.4% of the protein). Wild leaves and fruits provided 21.6% of the riboflavin intake and were consumed in greater quantities than in the later studies.

The results of the 1971 survey are also shown in Tables I and II. Average energy protein and lipid intakes were higher in the Socé group than in other ethnic groups (Table III). This is attributable to a higher consumption of legumes, mainly groundnuts. Only the Socé have a sufficient calcium intake. Its sources are mainly fruits and vegetables. The other groups show a marked deficiency in calcium. All three groups have a low intake in retinol equivalents and riboflavin; however, this is less marked in the Socé group.

1980 Study

As indicated previously, the study conducted in 1980 used a different technique based on home visits and interviews. In order to assess how vegetable production effects food consumption patterns, the quantity and frequency of consumption by vegetable producers was compared to urban consumers and rural farmers who did not produce vegetables. The frequency of consumption of major food items is indicated in Table IV, and expressed in terms of how frequently the foods appear per one hundred meals.

Vegetable producers consumed fresh vegetables significantly less frequently than Kungël town dwellers. This is due in part to the ample vegetable supply in the market in Kungël, which is supplied by the market-gardeners from Kumbija but also from Kaolack and Dakar.

Home gardeners, on the other hand, consumed fresh vegetables more frequently than the ex- and non-home gardeners (for example: fresh tomato, okra, bitter

TABLE I

Per capita nutrient intakes measured in several surveys conducted in Kumbija between 1970 and 1982

Date	Food energy Kcal	Protein g	Fat g	CHO g	Ca mg	Iron mg	Retinol Equivalents mg	Thiamin mg	Ribo-flavin mg	Niacin mg	Ascorbic Acid mg	Folates mg
May-June 1970	2311	78.4	60.0	382.0	447	45.3	2,254	2.2	0.70	27.6	53.3	NA
May-June 1971	2067	68.6	68.7	317.0	306	32.2	807	1.7	0.50	21.5	35.9	NA
Mean (1970-71)	2189	73.5	64.3	349.5	376	38.7	1,530	1.9	0.60	24.5	44.6	NA
Mar-Apr 1981	2408	71.0	58.0	401.0	479	35.6	306	1.74	0.65	38.5	39.0	260
Jan-Feb 1982	2376	73.4	70.0	363.0	476	31.1	265	1.85	0.72	21.9	41.0	267
May-June 1982	2468	74.3	67.0	392.0	550	37.2	546	1.96	0.75	40.7	70.0	301
Aug-Sept 1982	2418	75.0	55.8	404-0	943	40.1	955	1.08	1.22	97.3	75.0	307
Mean (1981-82)	2417	73.4	62.7	300.0	612	40.0	518	1.66	0.83	49.4	56.2	284

NA = Not available in original publication.

Note: The numbers of subjects observed in the 1970-71 surveys are 660 and 802 respectively. For the four surveys conducted in 1981-2 the numbers of subjects and households surveyed were 273(20), 349(25), 352(24) and 360(24) respectively.

TABLE II

Energy and nutrient intake as percentage of requirements measured in surveys conducted in 1970, 1971, 1981 and 1982

	Energy %	Protein %	Ca %	Fe %	Vit. A %	Thiamin %	Ribo-flavin %	Niacin %	Ascorbic Acid %	Folate %	Vit. B_{12} %	Zn %	Mg %
Kumbija 1970	107	125	*86*[a]	406	107	239	55	180	191	NA	NA	NA	NA
Kumbija 1971	95	108	*59*	196	*38*	210	*48*	158	128	NA	NA	NA	NA
Kumbija 1981	106	162	*84*	245	*14*	172	*50*	266	138	*65*	190	*45*	851
Kumbija 1982	106	166	111	249	*28*	161	*68*	367	219	*73*	NA	NA	NA

[a]Low levels of nutrient intake are in italics

TABLE III
Average dietary intakes[a] found in different ethnic groups in the 1971 survey in Kumbija

	Wolof	Pël	Socè
Number of households	30	12	8
Number of consumers × day[b]	2,153	750	472
Energy (Kcal)	1,954	1,987	2,710
Protein (g)	69.4	65.2	88.4
Lipids (g)	43.9	44.9	76.9

[a]The dietary intake was measured for 5 consecutive days. The total number of participants was 437 men and 365 women. However, a proportion of them were present at certain meals only. The average household had 16 members, including guests and visitors.

[b]The number of 'consumers × day' is the total number of meals measured during the survey period.

tomato and egg-plant). However, these are found only in 10 to 30% of the meals. The non-gardeners consumed more wild leaves and fruit; Guinean sorrel, fermented locust bean, dry sap from gum trees (scientific names are given in Table XI). It appears that among vegetable growers, to a large extent, home grown vegetables have replaced the picked leaves and fruits previously used in sauces. Only the foods found in measurable quantities have been listed in Table IV.

The statistical analysis of the frequency of appearance of foods is given in Table V and explained in footnote. It appears that home gardeners ate millet and sorghum more frequently than town dwellers, more grounduts, cowpeas, smoked fish, "bissap" leaves, netetou (fermented locust beans) and okra. Urban consumers in turn ate rice, meat, vegetable oil, tomato paste, onions, chili peppers, and garlic more frequently. However, compared to ex-vegetable growers or non-vegetable growers, home gardeners consumed bitter tomato, cabbage and okra significantly more frequently.

Table VI and VII indicate the daily consumption of most foods by category of consumer. It is apparent that in 1980 consumption of cultivated vegetables was more than twice as high among town dwellers as among vegetable growers. Home gardeners, in 1980 consumed on the average almost four times as much as non-vegetable growers. In 1981, home gardeners consumed the same quantity as non-vegetable growers in 1980. In comparison to the situation in the same villages in 1970, consumption of cultivated vegetables has increased markedly and that of wild fruits and leaves has declined also markedly (Table VII). Most of the decline seems to be due to the lower intake of "dimb" fruit (Moringa pterygosperma) which was frequently used to prepare the sauces.

The study conducted in 1980 attempted to measure accurately women's income from the sales of vegetables and the expenditures during and after the cultivation season. Results are indicated in Table VII and Table IX.

The average income of the sixty-four women practicing home gardening for sale was $29(US) per season. Only 12% of their income was spent during the marketing activities of the season, mostly for edible treats for their children. The rest of their income, $25(US), was spent at the end of the vegetable season: half of it on clothes and cloth and the rest on miscellaneous supplies, as indicated in Table IX. It is noteworthy that no women mentioned spending any income on drugs or medicine for their children, themselves or other family members. The total amount spent on food is very small.

TABLE IV
Frequency of appearance of specific foods for one hundred meals recorded in the 1980 survey (Kungël and Kumbija)

Food	Kungël	Kumbija		
	Town dwellers *N=317	Home gardeners N=154	Ex-home gardeners N=116	Non-home gardeners N=138
Millet and sorghum	41	85	91	86
Rice	56	15	9	17
Groundnut:				
paste	35	38	69	50
flour	10	51	28	46
Cow pea	16	34	37	—
Meat (all kinds)	55	1	2	—
Smoked fish	16	75	90	91
Oil	41	4	1	1
Curdled milk	1	1	2	—
Fresh tomato	36	29	19	—
Tomato paste	62	4	7	41
Onions	98	84	69	86
'Bissap' leaves[a]	16	27	28	34
Chili pepper	68	16	85	78
Garlic	26	2	1	—
'Okra'	10	13	—	—
'Diakhatou'[b]	23	18	—	—
Eggplant	14	10	—	—
Cabbage	51	2	—	—
Carrots	24	—	—	—
Turnips	19	—	—	—
Potato	14	—	—	—
Yam	5	—	—	—
'Netetou'[c]	36	47	31	61
'Dimb' fruit[d]	—	—	—	23
Picked leaves	—	—	—	15
'Lalo mbep'[e]	5	—	—	43

*N = number of meals analyzed
[a]Hibiscus sabdarifera
[b]Bitter tomato
[c]Parkia biglobosa
[d]Cordylia pinnata
[e]Sterculia setigera

Results of the 1981 Survey

The 1981 survey was conducted in the month of April, after the end of the gardening season. Thus the quantities of fresh vegetables were very low (Table VI and VII). The total of cultivated vegetables consumed is as low as among non-home gardeners in 1980, and the daily consumption of wild fruits and leaves is also low (5.5 g/capita), confirming the sharp decline already observed in 1980 (2.4 g/capita) as compared to 1970 (33.9 g/capita).

The cereals account for a major proportion of the energy and protein intake: comprising 69% of the food energy and 51% of the protein in Kumbija. The other important sources of energy and protein are legumes, mostly groundnuts. Legumes

TABLE V
Foods consumed more or less frequently by home gardeners than by other categories (statistical degree of significance)

	Home Gardeners compared to: N = 154					
	Town dwellers N = 317		Ex-home gardeners N = 116		Non-home gardeners N = 188	
Food	Eat more frequently	Eat less frequently	Eat more frequently	Eat less frequently	Eat more frequently	Eat less frequently
Millet & sorghum		+++			+	NS
Rice		+++	+		NS	
Groundnuts	+++			++		+
Cowpeas	+++			+++	+++	
Meat		+++	NS		+++	
Smoked fish	+++			++		+++
Oil		+++	NS		NS	
Fresh tomatoes	NS		NS		+++	
Tomato paste		+++	NS			+++
Onions		+++	++		NS	
Bissap leaves	++		NS			+
Chili pepper		+++		+++		+++
Garlic		+++	NS		+++	
Bitter tomato	NS		+++		+++	
Cabbage			+++		+++	
Netetou	+		++			+
Okra	+++		+++		+++	

N: number of meals recordings used to calculate the frequency of consumption of specific foods.
+++: $p < 0.001$
++: $p < 0.01$
+: $p < 0.05$
NS: not significant
Statistical analysis: we used the normal deviate value for the sample results:
$Z=(p_1-p_2)[(p_1(1-p_1)/n_1) + (p_2(1-p_2)/n_2)]^{-1/2}$
Where p = frequency of consumption of foods as recorded in dietary records
N = number of meals
p_1 and n_1 correspond to the values found for home-gardeners in Kumbija in 1980
p_2 and n_2 correspond successively to the values of Kungël dwellers, the ex-home gardeners and the non-home gardeners.
Z is approximately normally distributed, so reference can be made to a normal table to obtain a p-value

provide 23.9% of the energy and 35% of the protein. The rest of the protein intake comes from small quantities of fish, milk, vegetables and meat.

Satisfaction of the Nutritional Requirements (1981)

Table II shows the averages of the percentages of satisfaction of the requirements for different nutrients. Protein intake, when compared to recommendations was apparently adequate (WHO, 1973). No family was below the arbitrary critical intake threshold of 80% of the energy requirements. The energy requirement of the household was calculated from estimates of activity levels of adult members (see methods section).

Using the FAO recommendations as standard (Latham, 1979), the apparent

TABLE VI
Daily food intake in Kungël and Kumbija: comparisons between 1970, 1980 and 1981

Food (in grams per capita)	Kungël	Kumbija			
	Town dwellers (average) 1980	Home Gardeners 1980	Home Gardeners 1981	Non-home gardeners 1980	1970 survey
Millet flour	9.5	252.5	233.7	—	NA
Millet wet flour	0.2	109.1	89.3	151.4	NA
Millet couscous	167.0	178.0	92.6	336.8	NA
Total millet	176.7	539.6	403.8	488.2	501.7
Rice	248.7	66.0	84.1	110.0	40.8
Groundnut whole	NA	—	10.9	—	NA
Groundnut flour	5.2	54.0	54.3	—	NA
Groundnut paste	6.4	31.8	26.0	44.0	NA
Total groundnut	11.6	85.8	91.2	44.0	116.9
Curdled milk	—	13.8	26.8	66.6	5.4
Red meat	61.3	2.8	1.9	—	—
Poultry	—	—	3.3	—	—
Fresh fish	77.4	—	—	—	—
Smoked fish	1.1	5.5	7.0	6.6	5.9
Groundnut oil	58.6	5.7	1.8	4.8	—
Palm oil	1.5	—	—	—	—
Sugar	—	1.4	1.6	5.0	2.7
Cultivated vegetables and tubers (total)	124.9	53.1	14.4	15.8	5.2
Wild fruits and leaves (total)	2.2	2.4	5.5	4.6	33.9

NA: not available in original study

intake of retinol equivalents, riboflavin, folate and zinc are below 75% of the recommended dietary allowances (Table II). Increased consumption of vegetables could have reduced markedly those deficiencies.

Results of the 1982 Study

The results from the food consumption survey conducted in January-February, then May-June and August-September are shown in Table I. There is a striking similarity in both average energy and protein intake between results of each season. Contrary to our expectations, no clear seasonal variation was observed in either energy or vitamin intakes. Surprisingly, average retinol equivalent and ascorbic acid intakes were lower during the vegetable cultivation than during the rainy season, when mangoes are usually consumed.

DISCUSSION

In order to assess the food and nutritional impact of the home garden project, we took advantage of the possibilities offered by the successive surveys to make both chronological and cross-sectional comparisons. The average dietary intake of 1970-71 can be compared to the average of the four surveys conducted ten years later in

TABLE VII
A comparison of daily consumption of vegetables in Kungël and Kumbija

Foods (in grams per capita)	Kungël	Kumbija			
	Town dwellers (average) 1980	Home gardeners 1980	Home gardeners 1981	Non-home gardeners 1980	1970 Survey
Fresh tomato	21.9	18.6	5.0	—	—
Tomato paste	10.2	0.6	0.3	2.0	—
Cowpea	2.0	4.0	2.8	—	—
Onions	25.5	11.6	4.6	11.6	4.0
'Bissap' leaves[a]	3.0	4.9	0.9	1.4	—
Chili pepper	2.8	0.2	0.6	2.8	1.2
Gombo (okra)	2.0	1.3	0.2	—	—
Diakhatou (bitter tomato)	7.8	8.0	0.2	—	—
Eggplant	2.0	3.1	0.1	—	—
Cabbage	27.7	1.4	—	—	—
Carrots	5.7	—	—	—	—
Potatoes	13.5	—	—	—	—
Cassava	11.0	—	—	—	—
Total cultivated vegetables and tubers	124.9	53.1	14.4	15.8	5.2
'Netetou'	1.2	1.8	2.8	2.8	1.36
'Dimb fruit'	—	—	—	—	31.05
Baobab fruit	—	—	0.9	—	1.5
'Lalo mbep'	1.0	0.6	1.8	1.8	—
Total wild fruits and leaves	2.2	2.4	5.5	4.6	33.9

[a]English and Latin names are given in Table XI

TABLE VIII
Cash expenditures from vegetable sales during the vegetable cultivation season (1980)

Type of expenditure	Percentage of total yearly expenditure from gardening (%)	Number of women involved in this expenditure	Average expenditure (US $)
Edible treats	6.0	64	$1.75
Cooking ingredients (spices, etc.)	3.0	64	1.00
Clothes	2.0	26	1.30
Household goods	0.6	17	.75
Cooking implements	0.2	8	.70
Toilet articles	0.2	5	.28
Total market expenditures	12.0		$3.75

Note: Because of calculation methods, average expenditures by item does not coincide exactly with total average expenditures. These are all separate averages for those who gave a positive answer for this item.

TABLE IX
Cash expenditures from vegetable sales at the end of the vegetable cultivation season

Type of expenditure	Percentage of total yearly expenditure	Number of women involved in this expenditure[a] (%)	Average expenditure (US $)
Clothes and cloth	43.0	60	$13.25
Rainy season cash savings, for purchase of:			
smoked fish			
seeds			
fertilizers	16.0	39	7.50
Gifts and marriage celebrations	9.5	38	11.50
Cooking utensils (pots, pans, etc.)	4.5	25	3.25
Soap	2.5	10	4.25
Purchase of small animals (goats, sheep)	4.5	6	16.25
Payment to shepherd	2.5	13	3.25
Repayment of rainy season borrowings	2.5	4	13.75
Food purchases	1.0	6	1.75
Toilet articles	1.0	6	2.50
Trips	1.0	3	3.75
Total end of season expenditure	88.0		$25.00

[a]The total number of women interviewed in 1980 is sixty-four.

1981-82. On the other hand, the study conducted in 1980, using a different survey technique, provides data allowing cross-sectional comparison of dietary patterns between vegetable growers, non-grower and urban dwellers.

It should be stressed that the five-day weighing technique used both in 1970-71 and 1981-82 for the measurement of food intake was identical. It was conducted by different investigators but they worked for the same institution, ORANA which has not modified, in a significant manner, its techniques nor food composition tables between these two series of surveys. However, the families investigated in 1970-71 were not the same as in 1981-82. Even if they had been, their composition would have changed markedly. This would have reduced the validity of our comparison even more than the random selection adopted in these surveys both in 1970-71 and in 1981-82.

Since these studies were conducted by experienced investigators, we must assume that the accuracy of scales was checked and the calculations made according to standard procedures. It is not possible, however, to avoid various sources of errors which limit the validity of this kind of comparison. For example, interannual variations of rainfall which may have affected harvest and hence income, consumption and nutritional status in the year before, or during, the food intake surveys. In 1970-71 Kumbija had a lower average rainfall than 1981-82 and, therefore, we should observe an improvement in the dietary intake between the two series of surveys, which is not the case. The composition of the population sample in term of ethnic origin was not strictly the same and we know that food consumption patterns vary from one group to another. Similarly it was not possible to ascertain that the average income of the different groups compared were similar.

Between 1970-71 and 1981-82, the overall economic situation of Senegal has

changed and this might have affected food consumption patterns more markedly than the mere practice of vegetable gardening. This global change in the economic environment would have affected all categories of farmers in a rather similar way. It is clear that the urban food consumption model itself induces an increase in vegetable consumption even in rural areas which do not produce vegetables.

The successive surveys conducted in Kumbija and in relation to vegetable cultivation were not organized in such a way as to elicit the effects of all or part of these factors. However, comparisons of the data presented in Table I suggest that nutrient intake which would have been raised significantly by a marked increase in vegetable consumption (retinol equivalent, iron, calcium, ascorbic acid) are not altogether higher, on the average, in the eighties than in the seventies. And this holds true if we compare the intake of those nutrients during the vegetable cultivation season of January-February 1982 either to the non-cultivation periods of 1970-71 or to the nutrient intake recorded in other seasons of 1970-71 such as May-June or August-September in 1982.

A close look at household income and expenditure reveals that women are able to earn some income from vegetable sales as early as mid-December. Groundnut sales, a major source of income, do not take place before mid-January and last usually until mid-February. Therefore, vegetables provide a modest but early income which comes on top of the sale of their own harvest of groundnut and cereals.

In 1980, women drew from gardening an annual income which varied from $US 2.5 to $US 95 by woman, with an average of $US 29 (new income). Sixty-one per cent of the women earned between $US 15 and $US 35. This income is in general a complement to the rainy season income (from main crops), but in an average year and a fortiori, a bad year, it may exceed this rainy season income and play a critical role in the household budget.

> Unlike the rainy season income, obtained and kept by the husband, the income from gardening is kept by the wife. This change from the custom is very appreciated by women, who are now able to spend money without asking their husband. This increase in purchasing power allows women to spend more and finally to perform better their duties in the family.[4]

As indicated in Tables IX and X only a small portion (10%) of the income from vegetable sales is spent on food and apparently nothing is spent on medicine or drugs. Therefore, it is not surprising that it affects only marginally family food intake and nutritional status.

As indicated previously, women cook for their families only the unsold part of their vegetable production. Because of the lack of techniques to preserve any excess production, vegetable cultivation does not seem to have any dietary impact beyond the end of April when all vegetable sales are terminated.

Brownrigg (1985) suggested that a number of dietary surveys omit consideration of wild food sources, thus reaching the erroneous conclusions that people are deficient in specific vitamins or that they need to eat more vegetables. And according to May (1968): "The bush foods are invaluable and it is a matter of doubt whether Africans would have survived without them, especially during the hungry season."

Kuhnlein (1985) has stressed the importance of the contribution of wild plant species in the diet of rural dwellers where there is a limited availability and variety of marketed foods. It was apparent during our study in Kumbija that there is a need for ethno-nutritional studies to review the changing role of local indigenous foods. A better understanding of the past and potential contribution of wild fruits and leaves, in particular, might help identify local wild species suitable for horticultural

TABLE X
Vitamin and mineral content of some fruits and vegetables, per 100g

Foods	Calcium mg	Iron mg	Retinol equivalents µg	Ascorbic acid µg
Traditional foods[a]				
Dark green leaves (bissap)	250	4.0	500	100
Dried baobab leaves (lalo ngouye)	2750	19.0	1764	35
Baobab fruit	299	2.4	—	352
Mango	10	0.5	317	41
Fermented locust beans (netetou)	529	31.7	—	—
Introduced foods				
Pale green leaves (cabbage, kohlrabi)	40	0.5	5	40
Tomatoes	10	0.7	42	24
Eggplant	10	1.0	—	5
Onion	30	0.5	—	10
Lettuce	35	1.0	50	15
Carrot	40	0.7	500	6

[a]Some Latin names are given in Table XI
Sources: Latham (1978), Sai (1965)

TABLE XI
Description or English and Latin names of some common or wild leaves, vegetables and fruits

Local name	English name	Latin name
Lalo ngouye	Dried baobab leaves	Adansonia digitata (Bombacaceae)
Bissap	Guinean sorrel	Hibiscus sabdarifera (Malvaceae)
Dimb	Wild fruit	Condylia pinnata (Caesalpinaceae)
Gombo-Kandia	Okra	Hibiscus esculentus Abeimoschus (Malvaceae)
Lalo mbep	Dried sap from gum tree	Sterculia setigera (Sterculiaceae)
Nere-netetou	Fermented locust bean	Parkia biglobosa (Mimosaceae)
Niebe	Cowpea	Vigna unguiculata (Papilionaceae)
Gouye	Baobab fruit	Adansonia digitata (Bombacaceae)
Thiakhat	Wild leaves	Leptadenia lancifolia
Soto	Wild leaves	Ficus gnaphalocarpa (Moraceae)
Kani	Chili pepper	Capsicum frutense
Neverdaye	Neverdie	Moringa pterygosperma, or Corolyla africana (?)

Source: Sai (1965), FAO (1968), Purseglove (1968)

experimentation. The same author (Kuhnlein, 1986) has also published guidelines for such ethno-botanical studies.

The consumption surveys reported here (Table I) and the interviews of farmers show clearly that traditional vegetables as well as wild leaves and fruits have played up to now an essential role in the supply of minerals and vitamins. The nutritional value of cultivated vegetables recently introduced should be compared to the nutritional value of picked wild leaves and fruits. Fresh cultivated vegetables are rich in minerals and vitamins, but often not as rich as the wild leaves and fruit that they tend to replace.

In Table X are shown the composition of some traditional or introduced fruits

and vegetables. It appears that the more concentrated sources of calcium, iron, retinol equivalents and ascorbic acid are found among the wild fruits and leaves. The fruit and dried leaves of the baobab tree (Adansonia digitata), for example, are of major nutritional value in the diets of West Africans. It would be detrimental for populations to stop consuming them or to replace them by European vegetables. Only carrots are of comparable value in regard to β-carotene. Calcium from wild leaves is particularly important because West Africans (except herders) consume very small quantities of milk. Ascorbic acid from wild fruits is very important too, because fruits are eaten raw, whereas vegetables and leaves are often cooked for long periods of time, resulting in the destruction of a large portion of the vitamin C originally present.

CONCLUSIONS

Home gardening in Kumbija was first initiated with the purpose of improving the income and nutritional status of the villagers. The Socé ethnic group, whose women cultivate the household garden, was the first to adopt this innovation. At the beginning of the extension program, home gardening was expected to be mainly a male activity; but rapidly, men stopped and women took over. Socé women seem to be the most enterprising members of the social group.

Surprisingly, vegetables are used only in minimal quantities in the diet of the villagers, and gardening has had apparently no measurable impact on the food intake of children after weaning. In April, 1981, the best source of vitamin C was green mangoes, eaten by children long before maturation. Whereas there is no evidence of direct nutritional impact, gardening may have an indirect impact on nutritional status by increasing the income of the female farmers. Although women dedicated only 7% of their income from vegetables on food, they might have saved part of their main income from grounduts and cereals thanks to winter vegetable sales.

In a scale of progressive change of food habits, the Socé vegetable gardeners are located midway between other ethnic groups living in a traditional environment (non-gardeners) and the urban population. They are adopting progressively the urban food consumption model. The exchanges between the villages and the cities have been greatly improved by the introduction of the horse-drawn cart. This is relatively recent. Taxis or bus fares are too expensive to be affordable to most of the villagers.

In order to improve markedly nutritional status, home gardens should be productive throughout the year, and especially during the hungry season. It appears essential to develop local technologies of preservation of vegetables that women could operate themselves. The production of vegetables seems limited because of the lack of such processing techniques, women growing only the quantities of vegetables that they are able to sell on the market. In 1981, an experiment of drying onions by solar energy was initiated by GRET and gave good results.[4]

Good training in gardening and nutritional education is required for the mothers. In Nigeria, the Ilesha gardens are an example of the successful project since the majority of home garden produce was consumed by the households. Nutrition training and cooking demonstrations were given on site, and the children's diet was supervised in a Mothercraft Center. As a result death from malnutrition was reduced from 10% to 6% in 3 years (Brownrigg, 1985). Unlike Nigeria, in Kumbija mothers did not seem to understand that vegetables were good for their children;

most of them stopped growing carrots because children, who liked them, would sneak through the fences into the gardens and eat them raw.

Aid agencies are often more concerned by the nutritional contribution of home gardens to the well-being of the families than by the economic impact of this activity. However, it is clear from the present study that the primary motivation of the women who engage in horticulture is to increase their income. While some produce is consumed by the gardener's household, most of the vegetables are grown for sale. Although the economic contribution of vegetable gardens to the household income is small, it allows women to purchase items that are specifically important to the improvement of their social status in society where men have a dominant social position. Even in the absence of measurable nutritional impact, household gardens can play an important part in promoting social change.

ACKNOWLEDGEMENTS

We are grateful to Dr. Tonia Marek for collecting and analyzing the 1980 data used in this study. Thanks also to the interviewers from Kungël and to the kind cooperation of villagers. We are indebted to Jacques Faye (ISRA) and Mark Levy (GRET) for inviting us to participate in this joint research.

BIBLIOGRAPHY

Bleiberg, F.M., T.A. Brun, and S. Goihman (1980). Duration of activities and energy expenditure of female farmers in dry and rainy seasons in Upper-Volta. *Br. J. Nutr.* 43, 71-82.

Brownrigg, L. (1985). *Home Gardening in International Development: What the Literature Shows.* League for International Food Education, Washington.

Brun, T., F. Bleiberg, and S. Goihman (1981). Energy expenditure of male farmers in dry and rainy seasons in Upper-Volta. *Br. J. Nutr.* 45, 67-75.

FAO (1968). *Food Composition Table for Use in Africa.* A Research Project Sponsored Jointly by U.S. Department of Health, Education, and Welfare and FAO, Rome. AGILE, ARPA Order No. 580.

Gershon, J. (1985). Alleviating vitamin A problems with home gardens. *Journal of Plant Foods* 6, 117-124.

Gueneau, M.C. (1986). *Afrique: les Petits Projets de Développement Sont-ils Efficaces?* Editions L'Harmattan, Paris.

Kuhnlein, H.V. (1985). Wild foods for modern diets. In Weininger, J. and G.M. Briggs (eds.) *Nutrition Update* Vol. 2. Eiley, NY, pp. 153-173.

Kuhnlein, H.V. (1986). Food sample collection for nutrient analyses in ethnobiological studies. *J. Ethnobiol.* 6 (1), 19-25.

Latham, M. (1978). *Human Nutrition in Tropical Africa.* FAO Food and Nutrition Series No. II, FAO, Rome.

May, J.M. (1968). *The Ecology of Malnutrition in French Speaking Countries of West Africa and Madagascar.* Hafner Publishing Company, NY, London.

O'Brien-Place, P. (1987). *Evaluating Home Garden Projects USDA.* Office of International Cooperation and Development. Nutrition Economic Group. Washington.

Purseglove, J.W. (1968). *Tropical Crops. Dicotyledons 2.* John Wiley and Sons, Inc., New York.

Sai, F.A. (1965). Nutritional value of West Africa fruits and vegetables. In H.D. Tindall (Ed.), *Fruits and Vegetables in West Africa,* FAO, Rome.

WHO (1973). *Energy and Protein Requirements: A Report of a Joing FAO/WHO ad hoc Expert Committee.* Tech. Rep. Ser. No. 522, World Health Organization, Geneva.

NOTES

1. Sumberg, J. (1986). Consultant's Report on Vegetable Gardening Projects in West Africa, submitted to Oxfam America (Mimeo).
2. Hellegouarch, R.J., J. Pelé, and J. Toury (1970). *L'Enquête de consommation alimentaire dans l'Unité Experimentale de Kumbija* ORANA (Mimeo).
3. Pelé, J., R. Hellegouarch, and J. Toury (1971). *Enquête Alimentaire dans l'Unité Experimentale de*

Kumbija. Organisme de Recherche sur L'Alimentation et la Nutrition Africaines (Mimeo).

4. Groupe de Recherche et d'Echange Technologique (1982). GRET *Développment d'une Activité Maraîchère Villageoise dans le Sine Saloum, Sénégal* (Mimeo).

5. Chevassus-Agnes, S. (1983). *Situation alimentaire et nutritionnelle dans les Unités Experimentales. Enquête ORANA*. ORSROM, ISRA (Mimeo).