Considering Household Food Security and Diet at the Classic Period Village of Cerén, El Salvador (A.D. 600)

MICHELLE R. WOODWARD
University of Colorado

ABSTRACT

At the Classic Period site Cerén, El Salvador, it has been possible to identify and quantify plant remains excavated in milpas, gardens and structures. The variety of plant species identified including maize, legumes, cucurbits, manioc and cacao indicates ancient villagers were concerned with household food security. When combined with additional data concerning the seasonality, storability and nutritional value of these plants, it is possible to consider more fully the relative proportions of the day-to-day diet of the ancient inhabitants of Cerén. In conclusion, this information is related to the research of gradually abandoned households.

Key words: Subsistence studies, agriculture, nutrition.

RESUMEN

En el sitio del período Clásico de Cerén, El Salvador, ha sido posible identificar y cuantificar restos de plantas excavados en milpas, jardines y estructuras. La variedad de especies de plantas identificadas incluyendo maíz, legumbres, curcubitáceas, mandioca y cacao, indica que los antiguos aldeanos se preocuparon por la reserva de alimentos del conjunto habitacional. Al combinar estos datos con informaciones adicionales acerca de la estacionalidad, el almacenamiento y el valor nutricional de estas plantas, es posible considerar más completamente las proporciones relativas de la dieta diaria de los antiguos habitantes de Cerén. En conclusión, esta información está relacionada con la investigación de los conjuntos habitacionales abandonados gradualmente.

Palabras clave: Estudios de subsistencia, agricultura, nutrición.

As research results concerning ancient subsistence practices accrues, mesoamerican archaeologists have developed a more sophisticated view of the complex techniques the Maya used in the collection, production and storage of food (Sharer 1994). Scholars fully embrace the idea that the Maya gathered, grew and relied upon a great diversity of foods in addition to maize (corn), legumes (beans) and cucurbits (squash). However, archaeologists rarely have the opportunity to consider if these diverse food resources supplied Maya households with nutritionally adequate foods over time. The ancient village of Cerén provides an unique opportunity to consider the concepts of household food security and diet, because excavations and research have revealed a broad variety of plant foods were being gathered, grown and stored there (Lentz *et al*. 1996; Reyna de Aguilar 1991). The Cerén data also contribute to our understanding of the ancient available diet in relation to seasonality and proportions of plant resources. Ultimately, it is shown how the examination of household food security and diet at Cerén provide insight to the research of subsistence patterns at gradually abandoned households.

INTRODUCTION TO THE CEREN SITE AND HOUSEHOLD FOOD SECURITY

Due to its extraordinary preservation resulting from a catastrophic volcanic eruption, the ancient village of Cerén is an ideal location to consider the concept of household food security within an archaeological context. As a result of the Loma Caldera eruption around A.D. 600, Cerén was rapidly covered in three to five meters of tephra and pyroclastic debris. Although the inhabitants were able to escape, their belongings and buildings were sealed in place. The scarcity of skeletal and other biological data concerning the ancient inhabitants of Cerén frustrates the full consideration of the household food security model, because only one incomplete skeleton has been recovered from the Cerén site. Fortunately, the presence of plants found in milpas, gardens, living/activity as well as storage areas clearly reflects the effort by people living in these households not only to maintain household food security but to ensure their nutritional health as well.

The Food and Agriculture Administration of the United Nations defines the concept of household food security as, «...adequate access by the household to

amounts of food of the right quality to satisfy the dietary needs of all its members throughout the year» (Latham 1997: 341). Of the issues that affect household food security, several can be addressed through the archaeological data recovered from the ancient village of Cerén. These issues include local food supplies and maize productivity, continuous supplies of food, and the diversification and intensification of cultivation.

LOCAL FOOD SUPPLIES AND MAIZE PRODUCTIVITY

Using data collected by Lentz (1999 personal communication) and others, Payson Sheets and I have estimated maize productivity of the average or estimated agricultural fields contiguous to Cerén households to be 3,120 ears for the first planting. This amounts to a projected yield of 5,280 kilograms of maize per hectare (Sheets and Woodward n.d.), which is comparable to some of the higher figures found within the ethnographic data (Sheets 1982), but high in comparison to others. See Table 1 for ethnographic comparisons to the Cerén yield estimates.

The initial explanation for this high productivity estimation is related to the rich volcanically derived soils located within the root zone for maize (Sheets 1999, personal communication) combined with adequate water resources available at the site. Furthermore, the closeness of milpas [1] to household compounds facilitated the inhabitants' ability to maintain these crops (e.g., weeding, water and pest control). Adams, Muenchrath and Schwindt (1999) report the amount of water that maize receives during its watering period has a significant effect on the total yield that maize produces at any given growing period. Given that the Cerén site was buried during the month of August (during the rainy season) combined with its proximity to a river source of water the ample availability of local water supplies also support these high maize productivity projections for the infield milpas of this site. We have no estimates for outfield milpas.

The identification of milpa fields excavated at Cerén indicates that maize provided the staple food supply for ancient inhabitants. From a nutritional perspective, maize is a good source of carbohydrates (energy) and provides significant amounts of oil, vitamin A, thiamine and phosphorus (Roosevelt 1980: 141). Maize as a staple crop is also an advantage, because its storability helps to offset seasonal scarcities in the availability of wild fauna (Roosevelt 1980: 144) or other animal protein sources.

CONTINUOUS SUPPLIES OF FOOD

Although maize served as the staple crop for Cerén, the inhabitants clearly invested both time and

Table 1. Maize Yields from various regions in Central America (Wilk 1985).

Group/Area	Source	R Valeu	Average Yield kg/ha	Range Yield kg/ha
Keckchi/Toledo	Wilk 1985	< 7	1,515	1,097-2,820
Jacaltec/Highlands	Stadelman 1940	< 9	1,845	1,024-3,102
Yucatec/Yucatán	Morley 1946	16.7	1,303	1,054-1,551
Ladino/La Venta	Drucker and Heizer 1960	20.0	1,050	800-1,100
Mopan/Petén	Cowgill 1962	c. 30.0	877	Not given
Mam/Highlands	Stadelman 1940	c. 36	1,024	620-1,240
Kekchi/Izabal	Carter 1969	11-67	846	Not given
Keckchi/Toledo	Wilk 1985	64	839	234-1,943

R = Number of years of cultivation of a plot × 100 divided by the number of fallow years plus the number of years of cultivation. The smaller the R value, the less intensive the agricultural system (after Joosten 1962).

[1] I define milpa in the context of this article as any agricultural field where maize is the predominate crop with beans and other species interplanted. In this context milpa does not delineate between infield and outfield locations.

Table 2. Months of Harvest and Storage for Selected Plants Identifield at the Cerén Site.

Plant name	Common Name	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
A. aculeata	Palm	1	1	1	1	2	2	2	2	2	2	2	1
A. americana	Agave	1	1	1	1	1	1	1	1	1	1	1	1
B. crassifolia	Nance			1	1	2		1		2			
C. annuum	Chile	2	2				1	1	1	2	2	2	2
C. moshata	Squash	2							1	2	2	2	1
C. pepo	Squash	2	2	2	2						1	2	2
G. Hirsutum	Cotton	2	2	2	2	2	2	2	2	2	2	2	2
M. esculenta	Manioc	1	1	1	2	2	2	2	2	2	2	2	2
M. calabura	Cherry					1	1	1	1	1			
P. americana	Avacado						1	1	1	1			
P. Lunatus	Lima beans	2	2	2	2	2						1	2
P. vulgaris	Beans	2	2	2	2	2			1	2	2	1	2
Prunus sp.	Cereza					1	1	1	1				
P. guava	Guava						1	1	1	1			
T. cacao	Cacao	1	1	1	1	1	2	2	2	2	2	1	1
Z. may	Corn				1	1	2	1	1	2	2	2	2

Months of Harvest ▭ Months of Storage ▭ Not availabe for Harvest or Storage ▭.

energy to cultivate and gather a wide variety of additional plants for consumption. These plants include: legumes, cucurbits, manioc, chile, cacao, nance, hackberry, cotton, gourds, capulin, avocados, pine, guava and more (Lentz *et al.* 1996). The inhabitants of Cerén facilitated the continuous or intensive cultivation of these various plants in organized areas (Cackler *et al.* 1997) defined by Sheets as biodiversity zones[2] (Sheets 1999, personal communication). In general, maize, legumes and cucurbits can be found in the 'broad biodiversity zones' or in larger milpa fields (both infield and outfield), while the various fruits and vegetables mentioned previously are found within the 'narrow biodiversity zones' or kitchen gardens found in smaller plots in close proximity to the household structures (Sheets and Woodward n.d.).

The presence of specific plants within the milpas and gardens of Cerén reflect the efforts of the ancient inhabitants to secure a continuous supply of nutritionally adequate food. As Table 2 demonstrates, the seasonal productivity and storage capabilities of identified plants excavated from agricultural, domestic and storage areas of the site, it is clear they were collecting and cultivating specific plants to provide year-round supplies of food. Furthermore, the combination of various plants found at Cerén indicate that the ancient inhabitants were engineering their gardens and milpas to take calculated risks, as well as to provide sustenance during difficult periods such as drought.

The cultivation of legumes requires a great deal of energy expenditure, and they are sensitive to both drought and flooding thus being prone to crop failure (Rubatzsky and Yamaguchi 1997: 492; Wilk 1991: 123-4). However, Cerén has the largest collection of legumes recovered from an archaeological site (Lentz 1993: 174), and we can assume that the ancient inha-

[2] The term zoned biodiversity is used to describe the organization of plant and tree species within agricultural plots of land including gardens and infield/outfield milpas. Refer to Sheets and Woodward (n.d.) for a more detailed discussion.

bitants spent time both gathering and growing this food resource in spite of the risk it represents. Cultivating legumes is also advantageous, because certain species help to fix nitrogen into the soil thus promoting the agricultural productivity in that location (FAO 1992; Roosevelt 1980: 150; Rubatzky and Yamaguchi 1997: 476). In addition to legumes, the identification of drought resistant plants such as squash and manioc illustrates how the ancient inhabitants of Cerén put forth both effort and energy toward securing their food supply during inhospitable climatic events.

Another integral contribution to overall household food security is the storage and stabilization of food supplies. Without enacting strategies to store food, the ancient villagers of Cerén would have endured a 'hand-to-mouth' subsistence, which defeats many of the advantages of plant cultivation over basic hunting and gathering subsistence strategies. From the archaeological record, it is apparent they were using several techniques to preserve food including pottery vessels and grain bin storage techniques. The inhabitants of Cerén also were drying and processing foods to stabilize them during storage, and may have been storing manioc roots within their house gardens as well.

The evidence for food storage is most clearly illustrated by the high numbers of pottery vessels found within the kitchen and other storage buildings excavated at the site. Research conducted by Lentz *et al.* (1996) identified the contents of twenty-nine pottery vessels recovered from the Cerén site. Significant plant identifications include maize (*Zea mays*), legumes (*Phaseolus vulgaris*), cucurbits (*Cucurbita moshata*), chile (*Capsicum annuum*), cacao (*Theobroma cacao*) and cotton (*Gossypium hirsutum*). Furthermore, the discovery of maize cob cavities preserved within a grain bin within Structure 4 also substantiates the efforts of ancient inhabitants to preserve food. From estimates made by Andrea Gerstle (1990: 116-117), the bin contained at least 0.5 cubic meters of maize at the time of the volcanic eruption and subsequent burial of Cerén.

The archaeological evidence also indicates they were drying and processing food supplies to stabilize and prolong their storage. For example, maize cob cavities found within the grain bin indicate each cob had been dried and shucked before being placed in the bin (Gerstle 1990: 116-117). In addition, the remains of legumes, cucurbit and cacao seeds found stored in pottery vessels appeared to have been processed and dried before their initial storage (Lentz *et al.* 1996). Chile peppers were found not only as dried seeds stored in vessels, but also archaeological evidence indicates they were dried, tied into ristras and hung from roof beams for storage as well (Lentz *et al.* 1996: 254).

Perhaps the least substantiated means of food storage evident at the Cerén site is the storage of developed manioc roots (*Manihot esculenta*) in house gardens. The storage of plant roots in the ground is practiced by modern populations (Roosevelt 1980) including the Kekchi Maya (Wilk 1991: 108), and the small numbers of manioc plants were found growing in house gardens at Cerén indicate this practice may have occurred in prehistoric times as well (Sheets and Woodward n.d.).

DIVERSIFICATION AND INTENSIFICATION OF CULTIVATION

At Cerén, the identification of home gardens and the production of specific crops indicate these people took deliberate action to maintain household food security. Not only were they actively engaged in growing crops for consumption through home gardens and small-scale arboriculture, but they were producing surpluses of some crops that may have been used for exchange (e.g., agave plants for fiber). This represents an important subsistence strategy in that ancient households could exchange surplus goods for food supplies during times of crop failure.

Diversification of plant species is also evident at Cerén where a small garden excavated between Structure 6 and Structure 11 of the Cerén village. From the research of Reyna de Aguilar (1991), we see evidence for the small-scale cultivation of a variety of edible, medicinal and ornamental plants. In addition to home gardens, the ancient inhabitants of Cerén engaged in arboriculture to enhance household food security. According to Lentz (1993: 174) «It appears that Cerén inhabitants had orchards of avocado, nance and guava growing adjacent to and even within their house compound boundaries».

Clearly, the villagers of Cerén were actively pursuing household food security through food production near to and within their household compounds. It is also evident they were engaging in the surplus production of certain crops that may have provided a means for commodity exchange. The discovery of a large maguey (*Agave americana*) field containing an estimated seventy plants, which is more than one household would need to provision themselves, indicates the ancient people of Cerén were engaged in crop production for exchange (Sheets and Woodward n.d.). Archaeological data indicates these plants were exploited for fiber pro-

duction, but no direct evidence for the consumption of *Agave americana* has been found at the site to this date.

The cacao trees (*Theobroma cacao*) found at the site may indicate another attempt by ancient villagers to produce a surplus commodity. A mature cacao tree over five years old can produce up to one hundred pods each containing twenty-eight to thirty cacao seeds (Feldman 1985: 84). The identification of at least five cacao trees found near Structure 4 of the Cerén village (Lentz 1993) might be evidence for the production of cacao beyond household consumption. It is known from both ethnohistoric accounts that cacao had great spiritual and economic significance for the Maya (Sahagún 1964: 256), and the presence of cacao at Cerén presents an intriguing question of villager access to a commodity once thought to be under the control of elite groups only.

Although the remains of wild animal and plant species found within the domestic and storage contexts of the site indicate the inhabitants were still engaged in hunting and gathering to some degree (Brown 1996; Lentz *et al.* 1996), the presence of milpas and house gardens at Cerén is a strong indicator the ancient villagers actively pursued the improvement of their own food production. At Cerén, we find evidence for permanent and intensive agriculture, including the moving and manipulating of soil to foster growth and to control erosion, the regulation of water, the maintenance of soil fertility, and the representation of a diversity of plant species (Netting 1993: 28). The research at Cerén shows how ancient farmers created ridges and furrows within their milpas not only to foster the stability and growth of their maize plants, but to facilitate water absorption and run-off within the fields as well (Zier 1992). Evidence from eight excavation locations that exposed ancient milpas, indicates the inhabitants of Cerén practiced both fallowing and field burning/clearing to improve food production in the fields adjacent to their household compounds (Sheets and Woodward n.d.).

DISCUSSION: THE CONTRIBUTION OF HOUSEHOLD FOOD SECURITY ISSUES TO THE AVAILABLE DIET AT CEREN

The issues that affect household food security inform archaeologists on what foods might have contributed in what proportions to the available diet for the ancient inhabitants of Cerén over time. Considering the nutritional content of foods grown and stored at Cerén and comparing this information to the standard nutritional requirements for humans facilitates the consideration whether the foods gathered, grown and stored by ancient inhabitants were capable of maintaining human health.

The nutritional requirements of humans have not changed significantly in the fourteen hundred years since people lived at Cerén. To maintain health, humans need a balance of carbohydrates, protein, fat and select micronutrients, and these figures vary according to a person's age, gender, activity level (FAO 199: 255) and their surrounding environment. Although this article must focus upon the typical adult requirements, other individuals such as children, pregnant and lactating women, require increased levels of nutrition that will not be discussed here. Table 3 presents a summary of nutrients required by adult males and females. The following nutrients also contribute to overall human health including fiber, beta carotene, vitamin D, vitamin E, vitamin K, vitamin B6, vitamin B12, thiamine, riboflavin, niacin, zinc, calcium, iodine, fluoride and sodium.

Although maize provides a significant source of protein per weight, when consumed by itself, it is deficient in certain key amino acids including lysine and trytophan (FAO 1992: 26; Latham 1997: 258; Roosevelt 1980: 139-40) and other key nutrients. This is substantiated by Latham (1997: 420) when he notes that cereals such as maize, rice, millet or wheat provide sufficient amounts of energy and B vitamins, but humans must supplement these staple food with others to provide the extra protein, fat, calcium, iron, and vi-

Table 3. The Recommended Daily Amount of Nutrients for Active Adults.

	Adult Males	Adult Females
Protein (g)	55 g	49 g
Fat (g)	48-113 g	37-86 g
Carbohydrates (g)	140-190 g	140-190 g
Calcium	1200 mg	1200 mg
Iron (mg)	23 mg	48 mg
Vitamin A (µg retinol)	600 µg	500 µg
Thiamine	1.7 mg	1.3 mg
Riboflavin (mg)	1.8 mg	1.3 mg
Niacin (mg)	19.8 mg	14.5 mg
Foliate (µg)	200 µg	170 µg
Vitamin C (mg)	30 mg	30 mg

tamins A and C required for daily health. Considering the large collection of legumes and other plant species found at the Cerén site, it appears the ancient inhabitants were actively supplementing their staple crop with legumes and other forms of nutrition.

Much has been written concerning the positive interaction of maize and beans not only in agricultural production but also in simultaneous consumption by animals and humans (see FAO 1992 for more discussion). What maize lacks in terms of amino acids (lysine and tryptophan), legumes can provide (Roosevelt 1980: 140) when they are consumed together. Maize and legumes provide a nutritionally adequate balance of primary nutrients — protein, carbohydrate and fat (FAO 1992: 122; Latham 1997: 271; Roosevelt 1980: 143). Perhaps the most limiting factor of a maize-legume diet is the bulkiness of the foods, which prevents large intakes that would be necessary to sustain human health on such a diet alone (FAO 1992: 127).

The Cerén data support the reliance of ancient villagers upon a maize and legume diet through the following lines of evidence: the projection of high maize yields (5,850 kg/hectare), evidence for maize storage in Structure 4, the field identification of legumes growing in milpas, the laboratory identification of stored legumes (domesticated and wild) in at least three excavated structures (Lentz *et al.* 1996). According to the FAO, to maximize the protein quality of a maize-legume diet requires people to consume these foods in proportions ranging from the ideal 70:30 ratios (Latham 1997: 122) to the acceptable ratio of 87:13 with additional nutritional supplementation (FAO 1992: 13). Although it is impossible to reconstruct the exact amounts of maize and legumes that were consumed on a daily basis, the archeological record at Cerén indicates the consumption within these proportions would have possible, especially when supplemented with small amounts of additional plant and animal foods.

The FAO states a reasonably balanced diet for adults should include 500 grams maize and 100 grams legumes when supplemented with 100 grams of animal protein (Latham 1997: 422). Without animal protein a balanced diet must contain approximately 500 grams maize and 225 grams legumes with additional supplementation. An ethnographic study in the early twentieth century (1932-35) reported that traditional Maya men living in the Yucatan consumed approximately 700 grams of maize and 150 grams of legumes per day in addition to small amounts of animal protein and other foods (Benedict and Steggerda 1936: 171). Generally, these diets provide a sufficient amount of protein, carbohydrate and fat, but the human body requires small amounts of vitamins and ot-

Table 4. The Nutritional Values of a Maize-Legume Diet and Additional Supplements Needed for Daily Human Health.

	Required Adult Per day	**500 g Maize + 225 g Legumes Diet**	**Additional Supplements Needed**
Energy	2895 kcal	2514 kcal	381 kcal energy
Protein	55 g	99.60 g	—
Fat	48-113 g	20.8 g	27.2-92.2 g Fat
Carbohydrates	140-190 g	463.20	—
Calcium	1200 mg	371.75 mg	828.25 mg Calcium
Iron (mg)	23 mg	30.95 mg	—
Vitamin A (µg)	600 µg	250 µg	350 µg Vitamin A
Thiamine	1.7 mg	2.43 mg	—
Riboflavin (mg)	1.8 mg	4.50 mg	—
Niacin (mg)	19.8 mg	9.73 mg	10.07 mg Niacin
Folate (µg)	200 µg	405 µg	—
Vitamin C (mg)	30 mg	11.25 mg	18.75 mg Vitamin C

Table 5. Food Resources Available at Cerén to Supplement a Maize Diet organized by the FAO Categories of Required Foods.

Energy-Rich Foods	Protein-Rich Foods	Foods Containing Vitamins and Minerals
• Oil	*Vegetable origin* • Legumes *Animal origin* • Meta (deer, duck and dog) • Fish and Mollusks • Insects	• Dark leafy green vegetables • Orange and yellow fruits and vegetables • Fruits (guava, nance, capulin, etc.)

her nutrients to maintain health. Table 4 indicates what FAO nutrients are needed beyond a simple maize-legume diet. Our research at Cerén indicates the inhabitants were collecting and cultivating additional plants to supplement their diet.

In addition to maize and legumes, there is evidence to suggest the ancient inhabitants of Cerén were able to exploit small amounts of animal protein, including deer, dog, duck and mollusks (Brown 1996; Lentz *et al.* 1996). However, when animal protein was not available, ancient inhabitants could rely upon a diversity (over twenty have been identified) of plant resources available to supplement their diet over the course of the year. In fact, the consumption of specific plant species found at the site, would have allowed ancient villagers to maintain nutritional health without consuming animal protein on a daily basis.

According to the Food and Agriculture Organization, a balanced diet based upon a staple crop such as maize must be supplemented with food from each of the following groups: energy rich foods, protein-rich foods and foods containing vitamins and minerals (Latham 1997: 42). Examples of food resources available to the ancient villagers of Cerén are provided in Table 5. The following section briefly presents and discusses specific plant resources from Cerén that were available for consumption. They have been organized into the FAO categories of Table 5 to demonstrate how the ancient inhabitants would have been able to fully supplement their maize and legume diet. Because legumes have been addressed in this chapter already, and the focus of this paper is upon plant species identified at Cerén (not animals), only the categories of 'Energy-Rich Foods' and 'Foods Containing Vitamins and Minerals' will be considered here. Finally, this section will conclude with an additional category of 'Other Plants Identified at Cerén' to facilitate the reader's understanding of how manioc, cacao, chile and achiote contribute to our understanding available diet at Cerén.

Energy Rich Foods (Oil)

Cotton (*Gossypium hirsutum*): In his research of the paleobotanical remains recovered from Cerén, David Lentz (Lentz *et al.* 1996) identified both cotton fibers and seeds. The presence of seventy-four cottonseeds found on a metate at Structure 4 indicates the ancient inhabitants were processing the seeds perhaps for extracting oil for cooking (Lentz *et al.* 1996: 255) or medicine (Coe 1994: 36). Cottonseed oil would provide nutritious amounts of fat (Latham 1997: 292) to the typically low-fat diet of Pre-Columbian Mesoamericans (Coe 1994: 45).

Foods Containing Vitamins and Minerals

Avocado (*Persea americana*): The presence of avocado remains at the Cerén site indicates ancient inhabitants could supplement their diet with avocados. Not only are avocados high in fat, but also they contain high amounts of protein and select nutrients (Coe 1994: 45) including vitamins A and C. Although ethnographic accounts describe avocados as a source of oil (Coe 1994: 45), no evidence for the extraction of avocado oil from the fruit pits has been found at Cerén.

Gourds (*Crescentia* sp. and *Lagenaria siceraria*): Tree and vine gourds are known for their use as containers in ancient Mesoamerica. However, the young fruits and seeds can be eaten (Coe 1994: 37) and might have provided the ancient inhabitants of Cerén a supplemental resource of calories and calcium.

Maguey (*Agave americana*): Although there is no evidence for the consumption of maguey by the ancient inhabitants of Cerén, there are ethnohistoric accounts of the consumption of maguey buds and leaf bases in nearby locations (McBryde 1947: 142). With the number of maguey plants found growing near Structure 4, it seems plausible these plants might have served as source of food in desperate times.

Palm (*Acronomia sp.*): Although the importance of this resource at Cerén is not well known, the palm tree is considered a critical resource according to ethnographic accounts (Coradin and Lleras 1988; Feldman 1985; McBryde 1947; Wilk 1991). Not only does palm supply construction materials, many parts of this tree can be consumed including the tender stems and leaves (Rubatzky and Yamaguchi 1997: 644), the buds and flowers (Feldman 1985: 46. McBryde 1947: 145), the heart of palm (Rubatzky and Yamaguchi 1997: 643), and the nuts (Lentz 1991; Wilk 1991: 150). Evidence exists for palm being grown and used for construction purposes at Cerén (Sheets and Woodward, n.d) but none exists for its consumption at the site; however, this food resource should not be discounted due to the lack of evidence.

Squash (*Cucurbita sp.*): Not only do cucurbits provide flowers and fruits that provide food (Rubatzky and Yamaguchi 1997: 580), but also their nutritious seeds may be dried and stored for long periods. Ethnographic accounts relate how cucurbit seeds were dried and served like almonds (Feldman 1985: 26). This resource provides an excellent source of vitamins A and C; furthermore, cucurbits are resistant to both drought and excessive temperatures due to their deep root system (Rubatzky and Yamaguchi 1997: 614).

Assorted Fruits and Berries- capulin (*Muntingia calabura*), *cerezo* (*Prunus* sp.*), guava* (*Psisium guajava), hackberry* (*Celtis* sp.) and *nance* (*Byrsonima crassifolia*): Remains of these plants have been identified at Cerén through the research of Reyna de Aguilar (1991) and Lentz *et al.* (1996). Each of these species provides edible flowers and fruits that could have supplemented the daily diets of the ancient villagers of Cerén. Most notably, these fruit resources represent vital nutrients not provided for by maize-legume diet only. These nutrients include vitamins A and C as well as some calcium.

Other Plants Identified at Cerén (achiote, cacao, chile and manioc)

Achiote (*Bixa orellana*): Structure 10 contained a pottery jar with a «caiman» modeled on its neck and upper body (Gerstle 1992: 47), and the seed contained within this vessel have been visually identified as achiote seeds. While these seeds would not contribute significantly to the overall nutrition of ancient inhabitant, undoubtedly it would have been an important resource linked to their consumption practices. According to Coe (1994), achiote was added to many prehispanic dishes including maize dough for drinks, cacao drinks, bean dishes and sauces.

Cacao (*Theobroma cacao*): Not only is cacao significant both religiously and economically to both ancient and modern Maya populations, cacao seeds can provide a source of both calories and nutrients including protein, fat and some calcium. Cacao seeds were found stored in pottery vessels in Structure 4 of the Cerén site; however, it is not clear from the archaeological record whether these cacao stores were for private consumption, for community rituals or for exchange.

Chile (*Capsicum annuum*): The evidence for chiles at the Cerén site is considerable with both the seeds and fruits being preserved in archaeological context (Lentz *et al.* 1996). This is not surprising considering the evidence for widespread consumption in Mesoamerica during both prehispanic and historic times (Andrews 1996; Coe 1994). As Coe (1994: 62) relates, «...chilies were omnipresent...the natives ate nothing without them...» The supplement of chiles to the every day diet of ancient inhabitants would have provided a good source of pro-vitamin A and vitamin C (Rubatzky and Yamaguchi 1997: 557).

Manioc (*Manihot esculenta*): Manioc roots provide an excellent source of carbohydrates while its leaves provide vitamin A and C as well as roughage (Roosevelt 1980: 129). In addition, manioc plants are quite productive, drought resistant, able to grow in poor soils and can be stored for long periods underground (Latham 1997: 262; Roosevelt 1980: 121). For instance, a mature manioc plant can yield five to ten roots each weighing three hundred grams to fifteen kilograms (Rubatzky and Yamaguchi 1997: 148).

IDENTIFYING HOUSEHOLD FOOD SECURITY AND AVAILABLE DIET DURING THE CLASSIC PERIOD AT CERÉN

The data indicate that the inhabitants of Cerén had a nearly continuous and nutritionally adequate food supply to maintain health and an active lifestyle (or household food security). In fact, this diversity has led David Lentz to comment, «It appears that the Cerén

farmers had at least as varied a diet as the Maya nobility living in the Sepulturas district of Copan (Lentz *et al.* 1996: 259)».

The evidence also suggests that inhabitants of Cerén had access to nutritionally adequate foods to supplement their daily diet. The FAO data corroborates this statement, «A diet containing good quantities of legumes and occasional animal protein foods in addition to a cereal, banana or root staple probably satisfies the family's requirement for energy, iron and B vitamins (Latham 1997: 420).» Continuing (Latham 1997: 420), «...such a diet is only lacking in vitamins A and C, which can be best be supplied by fresh fruit and vegetables... [furthermore, the supplementation of]... dark green leaves also provide much iron and some calcium». More specifically, it has been hypothesized the maize-legume diet of the ancient villagers of Cerén was deficient in the following nutrients: fat, calcium, niacin as well as vitamins A and C. The plants identified at Cerén such as avocados, leafy greens (manioc and squash) and guava could have supplemented the diet of ancient villagers to ensure their nutritional health.

It is not absolutely certain the Classic Period households of Cerén had adequate access to quality food resources to satisfy the dietary needs of all its members throughout the year. However, the archaeological record does indicate they worked to maintain household food security through various means including hunting, gathering, intensive agriculture and food storage, which in turn suggests they strove to maintain daily nutritional health over time as well.

CONTRIBUTIONS OF HOUSEHOLD FOOD SECURITY AND THE CERÉN SITE TO THE STUDY OF GRADUALLY ABANDONED MESOAMERICAN HOUSEHOLDS

Cerén represents a unique connection between the ethnographic literature of the present and the archaeological record of the past. As stated in previous research by Sheets (1992) and others (Cackler *et al.* 1997; Sheets and Woodward n.d.; Zier 1983), the milpas of Cerén resemble Wilken's description (1971) of a «high-performance milpa,» and the gardens of Cerén relate directly to descriptions detailed in ethnographic works including McBryde (1947), Feldman (1985) and Wilk (1991). Gillin (1951) reflects their findings by noting the, «...enormous variety of squashes, gourds, root and leafy vegetables, condiments, and medicinal plants» found in cultivated plots of Maya living in Eastern Guatemala.

This tangible connection between past and present households contributes greatly to our understanding of ancient Mesoamerican households. Cerén provides the link between the ethnographic evidence and the archaeology of ancient households. Data from Cerén can be 'fleshed-out' in more detail using ethnography, which in turn helps to interpret the less obvious situation of gradually abandoned houses. Formulating a strategic research design for studying gradually abandoned households will facilitate the comparison of the Cerén data and ethnographic resources to sites with less preservation. The judicious use of chemical analytical techniques also can help this connection, and these approaches include analysis of soils (structure and chemical constituents), macroscopic and microscopic plant remains as well as residues (amino acids and lipids).

Scholars studying gradually abandoned sites should examine ancient soil horizons to help understand the nature of the local soil in relation to subsistence strategies. For example, Olson (1983) revealed how stratographic profiles from Cerén combine a thicker, older, more fertile Preclassic soil capped with 20-30cm of young less-fertile soil. Chemical analyses of these differing soils reveal the older to be more fertile, while the younger horizon has a comparably high organic matter content supporting the possibility that agricultural productivity and other subsistence activities continued during the Classic Period habitation of the area.Table 6 lists the chemical constituents of the Cerén soil profile including samples 27-29, which are from deeply buried Preclassic soil horizons that still retain relatively high percentages of organic material. Samples 30-38 are from several depths in the volcanic overburden and indicate the modern accumulations in the upper horizons. Note the high levels of key elements such as Potassium (K) combined with a neutral pH level, which indicates the soil had the capacity to support agricultural activities during the Preclassic and Classic periods.

Soil sampling and flotation continue to be excellent strategies that have been used to identify plant and animal remains at the Cerén site and gradually abandoned sites as well. For instance, much of the work that has positively identified many plant remains at Cerén have been macroscopic studies of pottery vessel contents as well as soil samples conducted by David Lentz (1993; Lentz *et al.* 1996). Another avenue of techniques that archaeologists can use to determine the subsistence and agricultural practices of gradually abandoned household inhabitants are residue analysis

Table 6. Table showing Available Nutrients for Plant Growth for Analyzed Soil Samples from the Cerén Site (Olson 1983: 58).

#	Org %	Ex PH	H	P	K	Mg	Ca	Mn	Fe	Al	NO N	NH N	Zn	S. Sal
27	1.3	7.4	10	35	850	1200	3800	36	1	15	5	2	0.5	5
28	.8	7.5	10	21	1500	1300	4100	24	3	35	5	1	0.5	5
29	0.5	7.6	7	4	1150	1100	3000	22	5	50	5	1	0.5	5
30	2.2	7.2	6	12	1150	350	2300	16	4	30	10	2	2.0	5
31	2.8	7.0	9	30	900	450	3300	7	1	25	5	1	1.0	5
32	1.6	7.1	9	3	1500	700	2600	17	19	70	5	2	5.0	5
33	0.1	7.2	5	3	1450	450	2600	9	10	25	5	1	3.0	5
34	0.1	7.2	3	2	370	550	2300	8	8	25	5	1	2.0	5
35	0.1	7.6	2	3	370	500	1900	3	8	30	5	1	1.0	5
36	0.1	7.2	2	2	380	700	2000	5	5	25	5	1	1.0	5
37	0.1	7.4	3	4	400	700	1900	10	9	30	5	1	1.0	5
38	0.2	7.5	3	14	260	300	800	35	6	15	5	1	0.5	5

(amino acids and lipids). Although few artifacts from Cerén have been tested for residues, the value of these techniques is recognized and future analyses are planned.

Cerén has provided archaeologists with an exceptional opportunity to research what was once virtually unknown in the archaeological record. If we consider a hypothetical situation where the ancient village of Cerén was gradually abandoned, what would the archaeological record reveal about the subsistence strategies? Undoubtedly, our knowledge of how people were positioning specific plant species in gardens and milpas would be lost, and our detailed understanding of the diversity of plants used by the ancient villagers would be compromised. Perhaps, we would be able to recover residues of plants and animals in domestic activity areas of the site, but our knowledge would be limited to only a glimpse of their subsistence strategies.

Ultimately, there is much that can be gleaned from the subsistence patterns studies of Cerén. The link between well-preserved households and gradually abandoned households can be made with the strategic application of analytical techniques that can help to identify the locations milpas, gardens and storage areas in archaeological sites. Although it may not be possible to see the kitchen garden at a gradually abandoned household, using what is known about Cerén and other well-preserved sites (i.e., garden location and presence of particular plant species), it will become more feasible to search for this information at gradually abandoned households.

The central focus of this paper has been to illustrate how complex issues of household food security and diet can be addressed in the archeological record of Cerén and compared to data from gradually abandoned archaeological sites. Hopefully, this will encourage archaeologists to consider more fully the sophisticated techniques used by the ancient Maya in the collection, production and storage of food. While this research may seem more plausible at the well-preserved households of Cerén, these issues must also be considered at gradually abandoned households, if we are to advance our understanding of daily life within ancient mesoamerican households.

REFERENCES

ADAMS, Karen R., Deborah A. MUENCHRATH and Dylan M. SCHWINDT. 1999. «Moisture Effects on the Morphology of Ears, Cobs and Kernels of a South-western U.S. Maize (*Zea mays* L.) Cultivar, and Implications for the Interpretation of Archaeological Maize». *Journal of Archaeological Science* 26: 483-496.

ANDREWS, Jean. 1996. «The Peripatetic Chili Pepper: Diffusion of the Domesticated Capsicums Since Columbus». In *Chiles to Chocolate: Food the Americas gave the world*, Eds. N. Foster and L. Cordell, pp. 81-94. University of Arizona Press. Tucson.

BENEDICT, Francis G. and Morris STEGGERDA. 1936. *The Food of the Present-Day Maya Indians of Yucatán*. Contributions to American Archaeology n.º 18. Carnegie Institution of Washington. Washington D.C.

BROWN, Linda A. 1996. *Animal-As-Artifact/Animal-As-Representation: An Exploration of Household and Village Animal Use at the Cerén Site, El Salvador*. Unpublished Master's Thesis. University of Colorado. Denver.

CACKLER, Paul R., Linda A. BROWN and Inga E. CALVIN. 1997. «The Cultigens of Cerén: New Discoveries». Paper presented for the 62th Annual Meeting for the Society for American Archaeology. Seattle, Washington.

COE, Sophie D. 1994. *America's First Cuisines*. University of Texas Press. Austin.

CORADIN, Lidio and Eduardo LLERAS. 1988. «Overview of Palm Domestication in Latin America». *Advances in Economic Botany* 6: 175-189.

FELDMAN, Lawrence. 1985. *A Tumpline Economy: Production and Distribution Systems in Sixteen-Century Eastern Guatemala*. Labyrinthos. Culver City.

F.A.O. (Food and Agricultural Organization of the United Nations). 1992. *Maize in Human Nutrition*. Food and Nutrition Series n.º 25. Food and Agricultural Organization of the United Nations. Rome.

GERSTLE, Andrea I. 1990. «1990 Operation 4 Preliminary Report». *In 1990 Investigations at Cerén: A Preliminary Report*, Eds. P.D. Sheets and B. R. McKee, pp. 108-137. Department of Anthropology. University of Colorado. Boulder.

—. 1992. «1992 Excavations at Structure 10, Joyá de Cerén (Operation 8)». In *1992 Investigations at the Cerén Site, El Salvador: A Preliminary Report*, Eds. P. Sheets and K. Kievitt, pp. 30-54. Department of Anthropology. University of Colorado. Boulder.

GILLIN, John. 1951. *The Culture of Security in San Carlos*. Middle American Research Institute, Publication 16. Tulane University. New Orleans.

JOOSTEN, J. H. L. 1962. *Wirtschaftliche und Agrarpolitische Aspekte Tropischer Land Bausysteme*. Institut für Landwirtschaftliche Betriebslehre. Gottingen.

LATHAM, Michael C. 1997. *Human Nutrition in the Developing World*. Food and Nutrition Series n.º 29. Food and Agriculture Organization of the United Nations. Rome.

LENTZ, David. 1991. «Maya Diets of the Rich and Poor: Paleoethnobotanical Evidence from Copán». *Latin American Antiquity* 2: 269-287.

—. 1993. «Paleoethnobotanical Remains: Fieldwork and analysis during the 1993 season». In *1993 Report of Cerén Excavations*, Eds. P. Sheets and S. Simmons, pp.173-174. Department of Anthropology. University of Colorado. Boulder.

LENTZ, David, Marilyn BEAUDRY-CORBETT, M.ª Luisa REYNA DE AGUILAR and Larry KAPLAN. 1996. «Foodstuffs, Forests, Fields and Shelter: A Paleothnobotanical Analysis of Vessel Contents from the Cerén Site, El Salvador». *Latin American Antiquity* 7 (3): 247-262.

MCBRYDE, Felix Webster. 1947. *Cultural and Historical Geography of Southwest Guatemala*. Institute of Social Anthropology, Publication n.º 4. Smithsonian Institution. Washington D.C.

NETTING, Robert McC. 1993. *Smallholders, Householders: Farm Families and the Ecology of Intensive, Sustainable Agriculture*. Stanford University Press. Stanford.

OLSON, Gerald W. 1983. «Appendix 4-A. Soil Test Laboratory Data». In *Archaeology and Volcanism in Central America: The Zapotitlan Valle of El Salvador*, Ed. P. Sheets, pp. 56- 61. University of Texas Press. Austin.

REYNA DE AGUILA, M.ª Luisa. 1991. «Una Verdadera Joya...Joya de Cerén; Flora Autóctona Salvadoreña». *Pankia* 10: 2:3-9. Jardín Botánico. San Salvador.

ROOSEVELT, Anna Curtenius. 1980. *Parmana: Prehistoric Maize and Manioc Subsistence along the Amazon and Orinoco*. Academic Press. New York.

RUBATZKY, Vincent E. and Mas YAMAGUCHI. 1997. *World Vegetables: Principles, Production, and Nutritive Values*. International Thomson Publishing. New York.

SAHAGÚN, Friar Bernardino de. 1969. *The General History of the Things of New Spain. The Florentine Codex, Book 6-Rhetoric and Moral Philosophy*, translated by C. E. Dibble and A. J. O. Anderson. University of Utah Press. Salt Lake City.

SHARER, Robert J. 1994. *The Ancient Maya*. Stanford University Press. Stanford.

SHEETS, Payson D. 1982. «Prehistoric Agricultural Systems in El Salvador». In *Maya Subsistence Studies in Memory of Dennis E. Puleston*, Ed. K.V. Flannery, pp.99-118. Academic Press. New York.

—. 1992. *The Cerén Site: A Prehistoric Village Buried by Volcanic Ash in Central America*. Harcourt Brace College Publishers. New York.

SHEETS, Payson and Michelle WOODWARD. n.d. «Agricultural Fields, Kitchen and Special Gardens, and the Classic Period Landscape». In *Before the Eruption: The Ancient Cerén Village in Central America*. University of Texas. Austin. In press.

WILK, Richard R. 1985. «Dry season agricutlure among the Kekchi Maya and its implications for prehistory». In *Prehistoric Lowland Maya environment and subsistence economy*, Ed. M. Pohl. Papers of the Peabody Museum, Vol. 77. Harvard University Press. Cambridge, Mass.

—. 1991. *Household Ecology: Economic Change and Domestic Life Among the Kekchi Maya in Belize*. University of Arizona Press. Tucson.

WILKEN, Gene.197. «Food-Producing Systems Available to the Ancient Maya». *American Antiquity* 36: 432-448.

ZIER, Christian. 1983. «The Cerén Site: A Classic Period Maya Residence and Agricultural Field in the Zapotitán Valley of El Salvador». In *Archaeology and Volcanism in Central America: The Zapotitán Valley of El Salvador*, Ed. P. D. Sheets, pp. 119-143. University Press. Austin.

—. 1992. «Intensive Raised-Field Agriculture in a Posteruption Environment, El Salvador». In *Gardens of Prehistory: The Archaeology of Settlement Agriculture in Greater Mesoamerica*, Ed. T. W. Killion, pp. 217-233. University of Alabama Press. Tuscaloosa.