The impact of drought on energy intake patterns in Central Kenya

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Introduction

Nutritional status is a highly sensitive indicator of the aggregate influence of the various components of the environment. Those components include the physical, political, cultural, historical, social, economic, biological and climatic settings. Together they function as an intricately designed force dictating the quality of life and the ways in which an individual or family can respond to disruptions in the normal pattern of existence. An individual's nutritional status is a reflection, albeit often a subtle one, of that complex interaction of settings. To ferret out the particular casual relationship between one element of the environment and a specific change in nutritional status is difficult and risks missing the roles of complicity played by other, sometimes more critical, elements. With regard to food crises, extraordinary disruptions in the normal food acquisition pattern, the literature abounds with causal variations ranging from over-population to climatic capriciousness to economic deprivation to political disempowerment. (Wisner, Okeefe and Wienner, 1987; deJanvry, 1978)

Policies set to obviate the impact of disruptions in the food supply must find their roots of rationality within this complex fabric of causation. The process of identifying which spheres of the environment are most critical to the determination of where best intervention is prescribed is initially guided by an ideological conception. That conception is polemical in its nature and yet it is critical to the design of proposed solutions to the issue of food insecurity. The fact that excessive and disproportional vulnerability is a reality grounded in the design of many societies cannot be overlooked. To the extent that we are not willing to review this reality our competence in being able to interdict the ravages of natural disasters such as drought is open to serious question. This paper contributes to the debate by providing accurate descriptive data concerning the degree to which the food supply is disrupted during the climatic perturbation of drought. This information provides an impact baseline from which exploration of various causes and solutions, bourne of different perspectives, can be tested.

The data analyzed in this study was collected during a research project entitled the Kenyan Nutrition Collaborative Research Support Program (CRSP) on "Energy Intake and Human Function" which was part of larger three country study[1]. The purpose of the project was to investigate the functional consequences of mild to moderate malnutrition. The project was a collaborative effort between the University of Nairobi, the University of California at Los Angeles (UCLA), and the University of California at Berkeley. The core data were collected over a two year period starting in January of 1984 and running through December of 1985.

The Kenyan research site is located approximately 120 kilometers northeast of Nairobi in Eastern Province, Embu District, Kyeni South Location. Embu District is rural and comprises a total area of 256,000 hectares, of which 78.6 percent (201,400 ha) is considered suitable for agriculture or livestock production. (Jaetzold and Schmidt, 1983) The study site (approximately 60 sq. kilometers) is located near the northeastern border of the District on the slopes of Mt. Kenya. The site ranges in altitude from approximately 920 meters (3,000 ft) to 1540 meters (5,000 ft) above sea level. The largest town in the district is Embu with a 1979 population of 15,986. The closest municipality to the study site is the town of Runyenjes with a population of 1,566. These towns have markets for the sale and purchase of food and other necessities. There are also other smaller markets spread throughout the study area.

Rainfall varies considerably throughout the district. Altitude and aspect (exposure to wind) are the principal determinants of rainfall levels and agricultural zonation. Rainfall is the most significant climatic factor as it is the major consideration with regard to land use and thus the level of economic development. Rainfall is concentrated into two distinct seasons (the long rains and the short rains) which dictate the structure of food production. Table 1 shows the timing of the rains and the major agricultural events for the area.

Embu agriculture is entirely rainfed and is primarily a struggle to provide enough food for family consumption and secondarily a source of cash income. The average farm size is about 1.76 hectares (standard deviation = 1.52; farms range from .05 to 6.2 ha). Most farmers produce a combination of food and cash crops. The primary food crops are maize, beans, millet, sorghum and to a lesser extent arrowroot, potatoes, bananas, and

[1] The Nutrition Collaborative Research Support Program included Kenya, Egypt and Mexico and was sponsored by the United States Agency for International Development under Contract Grant Nos. DAN 1309-G-SS-1070-00 and DAN 1309-A-66-9090-00.

Table 1 Timing of the rainy seasons and the major agricultural events* in Embu District

	Period of rainfall	Planting	Harvesting
Long rains	March-May	February-March	June-August
Short rains	October-December	August-September	January-March

* Timing of various events is based on maize production

cassava, while the major cash crops are coffee, cotton and tobacco. Maize occupies approximately 24% of cultivated land, beans 24.5% and coffee 12.5%. The average yearly household yield of maize is 720 kilograms (standard deviation = 629) and the bean yield is 606 kilograms (standard deviation = 639). (Baksh, Trostle and Neumann, 1989)

Production in excess of consumption needs is sold through local markets or the National Cereals and Produce Board with the income being used to purchase food items not provided by the farm or to pay other expenses such as school fees and the cost of agricultural inputs. Since the mid-1970s food crop production in Kenya has been on the decline and agriculture has been expanding into the country's dryer zones, increasing the threat from drought. (Kliest, 1985) Indeed drought has been a major contributor to the reduction in food production. (Ojany and Ogendo, 1987; Downing et al, 1988)

The general nutritional status of the area can best be described as mild to moderate malnutrition. Studies as early as 1925 have noted inadequacies within the Kenyan diet. (Wilson, 1925) The food and Agriculture Organization of the UN conducted a detailed food consumption survey in 1964-66 and concluded that while the overall diet appeared sufficient, there were serious problems due to poor regional and household distribution. (FAO, 1971)

Long term malnutrition is best demonstrated through anthropometry. In 1974 Blankart, using weight-for-age and weight-for-height data concluded that 30 percent of all children under the age of five suffered from mild to moderate protein energy malnutrition (PEM). (Blankart, 1974) In a study conducted between 1974 and 1977 in Machakos District, it was noted that 16 percent of the children "...in the 1-5 year period are considered to be at special risk for malnutrition and should receive extra attention and care." (Jansen, Horelli and Quinn, 1987, p. 161)

Data collected during the Nutrition CRSP study provides an even more detailed picture of the nutritional status within the area. Neumann and Bwibo report that lead males are thin for their age and have low body fat. Twenty eight percent of lead females were reported as underweight with six percent being classified as wasted. Children were much the same as adults. Data indicate that between 27 to 48 percent (depending on the season) of all school age children are considered moderately malnourished with only one percent being identified as severely malnourished(.

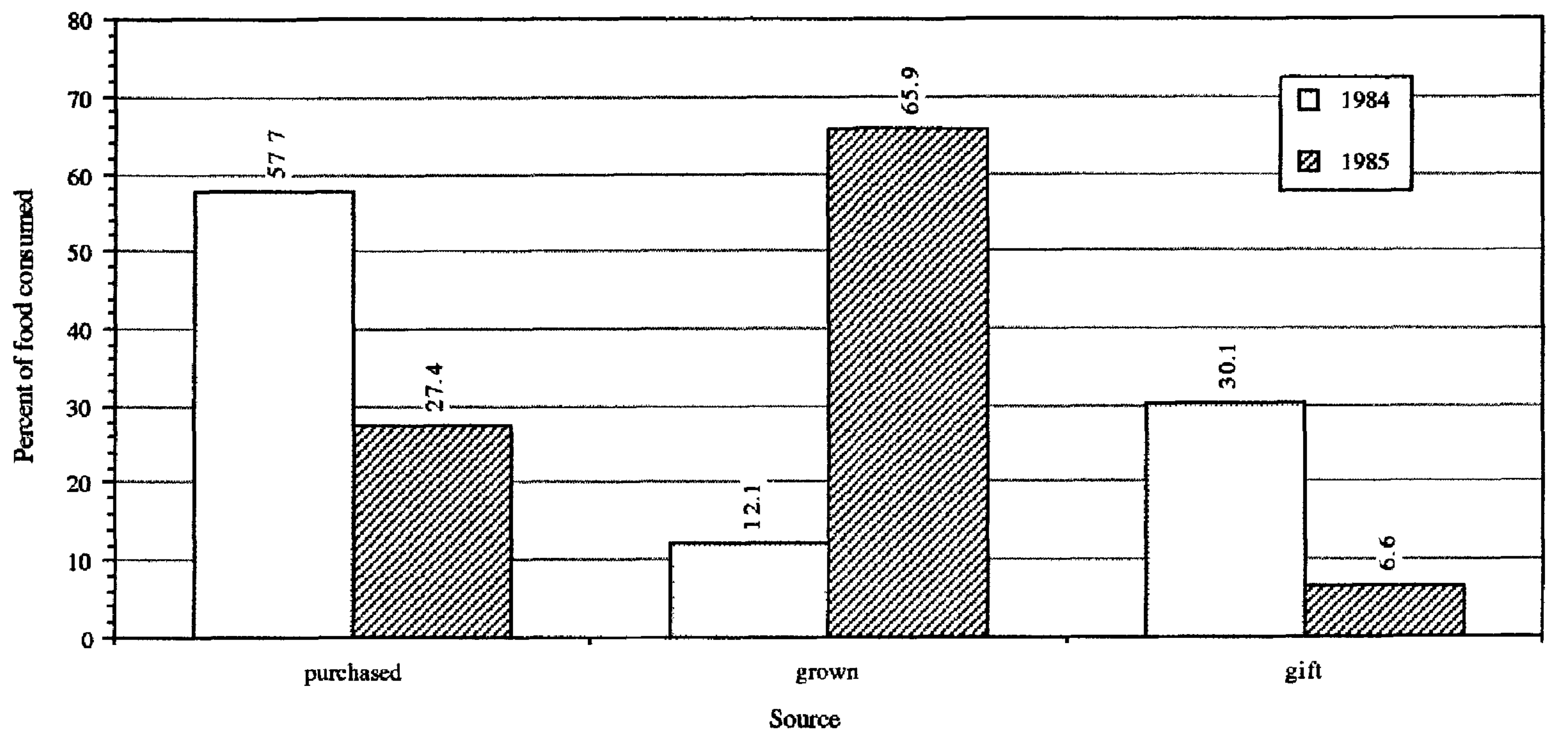
Toddlers, age 18-30 months, demonstrate very little severe malnutrition but 30 percent are moderately underweight (71 to 80 percent of median weight for age) and 37 percent are mildly underweight (81-90 percent of median weight for age) for their age. Finally, infants are generally appropriate concerning weight at birth but are slightly below the standard regarding length. They grow normally until about the third month and then begin to drop below the standard growth curve. (Neumann and Bwibo, 1987)

The patterns of malnutrition are not strikingly severe, and they are rather typical for most rural African areas. They represent a rather fragile level of existence which is highly vulnerable to disruptive events such as drought. As Figure 1 shows, during periods of normal productive conditions, nearly 60% of the kilocalories consumed by the family are produced at home. During the drought, however, this figure fell to 27.4%. (Trostle,1990) This dependence on home production, if not countered with a viable alternative during drought, makes a family's intake very vulnerable to disruption. The primary alternative sources of food, purchasing power and relief, were not viable alternatives for a prolonged disruption in the food supply. The consequence being that intake levels for individuals would have to be adjusted downward to compensate for the loss of food production.

Drought in the study area

Drought is one of the most common and most severe of the variations in climate that affects the production of food. Greater attention needs to be given to the duration of the drought and the particular vulnerability of those affected. Baker has noted that drought is "undoubtedly the most impressive climatic anomaly in all Africa." (Baker, 1977, p. 74) While not being the basic cause of a food crisis, drought is a common triggering event

Figure 1 Average household consumption (percent of all kilocalories consumed by the family) of twelve selected food items for the time periods of Sept., Oct. and Nov. of 1984 and 1985 by source.



Food items include: yellow maize, white maize, sugar, english potatoes, sweet potatoes, rice, yellow maize flour, white maize flour, raw sukuma leaves, whole cow's milk, meat, and kidney beans

source: Trostle, 1990

which places stress on a population by severely limiting its access to a basic source of food.

From a policy perspective, however, the generic use of the term 'drought' can be misleading. The most common meaning for drought with regard to food production is a rainfall deficiency which restricts the conditions needed to produce food. (Barger, 1949) The Glossary of Meteorology defines drought as:

> "A period of abnormally dry weather sufficiently prolonged for the lack of water to cause a serious hydrologic imbalance (i.e., crop damage, water supply shortage, etc.) in the affected area. Drought severity depends upon the degree of moisture deficiency, the duration, and (to a lesser extent) the size of the affected area. In general, the term should be reserved for periods of moisture deficiency that are relatively extensive in both space and time." (Huschke, 1959, p. 180)

Drought is usually marked by a non-distinct beginning and may occur for some time before it is realized. The perception of drought is dependent on the discipline from which it is viewed. Dracup and Kendall point out that the view of a drought by a hydrologist may be considerably different from that of a water resource engineer or of an agriculturalist. (Dracup and Kendall, 1988) Sandford applies an agricultural definition as he assesses drought by its impact on the production of crops or livestock. The severity of a drought is measured by the difference between the amount of a good required and the amount of that good actually supplied under specific climatic conditions. (Sanford, 1979)

Meteorological drought, rainfall below the climatological norm due to a failure in the region's rain-producing mechanisms, is a fairly common occurrence in this part of Kenya. The rain-producing mechanisms of East Africa are largely influenced by 1) regional circulation patterns, 2) the intertropical convergence zone (the meeting of the northeast and southeast trade winds), 3) latitude, 4) topography and aspect, and 5) inland lakes which supply a local source of moisture. Downing has computed the probabilities of different levels of drought in Embu District. He notes that during the long rains a mild (or worse) drought could be expected to occur every 2.7 years; a moderate (or worse) drought every 4.5 years; and a severe drought every 12.5 years. For the short rains a mild (or worse) drought can be expected every 2.4 years; a moderate (or worse) drought every 3.4 years; and a severe drought every 5.6 years. (Downing, Mungai and Muturi, 1985)

The 1984 drought in Embu primarily impacted only the long rains. It was, however, a widespread event as it affected twenty-one African nations in the Sub-Sahelian region. (Cohen and Lewis, 1987) Downing reports an average rainfall for Embu district for the 29 year period between 1951 and 1980 of 549.1 mm for the long rains and 400.6 mm for the short rains. (Downing, Mungai and Muturi, 1985) Data collected in Embu reports that the long rains of 1984 only attained a level of 286.2 mm (52.1 percent of average). On a nationwide scale this was the greatest deviation from the normal rainfall level since 1933. (Farmer, 1989)

Besides the low total amount of precipitation that fell during the 1984 long rains, the distribution of that rain over the three month season was not conducive to agricultural production. Daily rainfall data from the Embu Experimental Agricultural Station indicates that 46 percent of all rain during the season fell during a four day period in April, and of the 92 days that make up the rainy season, 73 (79%) saw no appreciable rainfall whatsoever.

Agricultural production throughout Kenya was severely affected by the long rains drought. The United Nations Disaster Relief Organization gave the 1984 Kenyan harvest its lowest rating. (Office of the United Nations Development Coordinator, 1984) A survey by the National Cereals and Produce Board (NCPB) of the national maize yield showed the long rains yield of 1984 to be 1,352 kg/ha. In comparison, the long rains of 1983 gave a yield of 2,908 kg/ha. Thus on a national basis the 1984 yield was only 46.5 percent of the 1983 yield. The situation was even more extreme in certain areas. The NCPB report shows that in agricultural zone 5 (which includes the study site) the maize yield was only 608 kg/ha in 1984 compared to 3,031 kg/ha in 1983. This is a decline of nearly 80 percent. (Murage, 1989) A more extensive Crop Forecast Survey (CFS) was conducted by the Central Bureau of Statistics (CBS). It revealed that in Embu District the confirmed maize harvest during the long rains of 1984 was only 48 percent of the harvest for the following year. (Maganda, 1989)

Agricultural production data collected by the Nutrition CRSP Project during 1984 and 1985 presents an even more dramatic view of the crop failure. The long rains harvest of hybrid maize for 1984 was only 2.1 percent of the 1983 short rains harvest and 3.3 percent of the 1984 short rains harvest. Local variety maize fared even worse. The 1984 long rains harvest was 1.0 percent of the 1983 short rains harvest and 0.8 percent of the 1984 short rains harvest. Beans seemed to respond better to the drought than did maize. The 1984 long rains harvest of beans was 29.8 percent of the 1983 short rains harvest and 47.7 percent of the 1984 short rains harvest.

Data collection methods

The study sample used in this analysis consisted of 247 households and approximately 1,800 individuals, taken from a sampling universe of 2,059 households and 11,810 individuals. (Republic of Kenya, 1981) Approximately half of the households completed the entire two years of observation. The data presented in this paper is on individual intake. Five categories of individuals are represented.

- Lead males - adult males considered as the heads of the household. Mean age is 37.0 years.
- Lead females - wives of the lead males. Mean age is 31.5 years. This group is further subdivided by the women's pregnancy status at various time periods of interest.
- Schoolers - children between the ages of 7 to 9 years who are enrolled in school.
- Toddlers - children between the age of 18 to 30 months.
- Infants - children between the age of 0 to 6 months.

Food intake observations were made on each on these individuals for a minimum of one year. The intakes presented in this paper represent the mean daily intake during four three-month periods. Those periods are defined as follows:

- Pre-shortage - March, April and May of 1984
- Shortage - September, October and November of 1984
- Post-shortage I - January, February and March of 1985
- Post-shortage II - September, October and November of 1985

Food intake data were collected for every individual using direct measurement of food quantities to determine the level of intake. Intake was assessed quantitatively for each individual on two successive days per month by trained observers who watched cooking procedures, measured volumes, and weighed all ingredients as well as portions given to each individual from 7:00 AM to 6:00 PM. Foods eaten outside of the household or foods consumed between 6:00 PM and 7:00 AM were obtained by recall methods.

A nutrient data base was created to allow for the conversion of foods to nutrients. Since no single food composition table was appropriate for Kenya, the CRSP Project conducted laboratory analysis of local foods and established a new nutrient data base for this area. This allows for the calculation of extremely accurate kilocalorie contents for all meals consumed. The kilocalorie values presented represent the mean of the six days of observation in the particular three month period.

Results

The consequence of the drought was the almost complete loss of one harvest. Daily household energy intake during the pre-shortage period was 11,834 kilocalories. During the drought that intake fell to 9,700 kilocalories per household, an 18% decrease. The intake pattern for lead males was consistent with that of the household as a unit. Figure 2a shows male intake expressed as the distance between the monthly mean and the grand mean, measured in units equal to the standard deviation of all monthly means for the period from February, 1984 to November, 1985. The period of greatest hardship can clearly be seen in the last quarter of 1984. While the drought occurred in March, April and May of 1984, the greatest impact of the lost harvest did not come until approximately four months later. This was the period when energy intake would normally be supported by the long rains harvest that should have occurred in July and August. The end of the food shortage was brought about by the harvest which took place in January and February of 1985.

Comparisons were made between the various non-shortage periods and the shortage period to determine the impact of the drought. Table 2 provides the results of those comparisons. Lead males showed a decline of 22% of their pre-shortage intake during the food shortage months (statistically significant at $p = .0001$). The actual loss of intake was approximately 456 kcals per day. In order to place the level of energy intake in better perspective, Table 3 shows intake for all periods as the percent of the recommended dietary allowance (RDA). (National Research Council, 1989) Pre-shortage intake for lead males was only 71.6% of the RDA with this level falling to 55.9% during the food shortage. This means that during the shortage period male adults were consuming just over half of the food energy that was necessary to balance an energy expenditure level consistent with good health and an economically and socially adequate level of physical activity.

Lead females present a more complicated picture. Figure 2b shows the pattern of their intake over the full course of the study. As with males, their intake drops significantly

Table 2 Daily kilocalorie intake during four periods by target individual

	N	Pre-shortage		Shortage		Post-shortage I		Post-shortage II	
		mean	std	mean	std	mean	std	mean	std
Lead males	112	2077	595	1621	479	2026	575	2069	553
Lead females	121	1727	451	1298	458	1725	462	1801	455
Schoolers*	117	78.2	19.3	60.2	17.0	75.8	24.1	na	na
Male	62	81.2	18.6	62.3	17.1	78.8	21.6	na	na
Female	55	74.7	19.6	57.8	16.7	72.4	26.5	na	na
Toddlers*	91	82.1	30.1	78.4	24.0	82.4	26.6	na	na
Male	41	78.7	28.9	81.0	24.5	81.4	25.5	na	na
Female	50	84.9	31.0	76.4	23.7	83.2	27.7	na	na

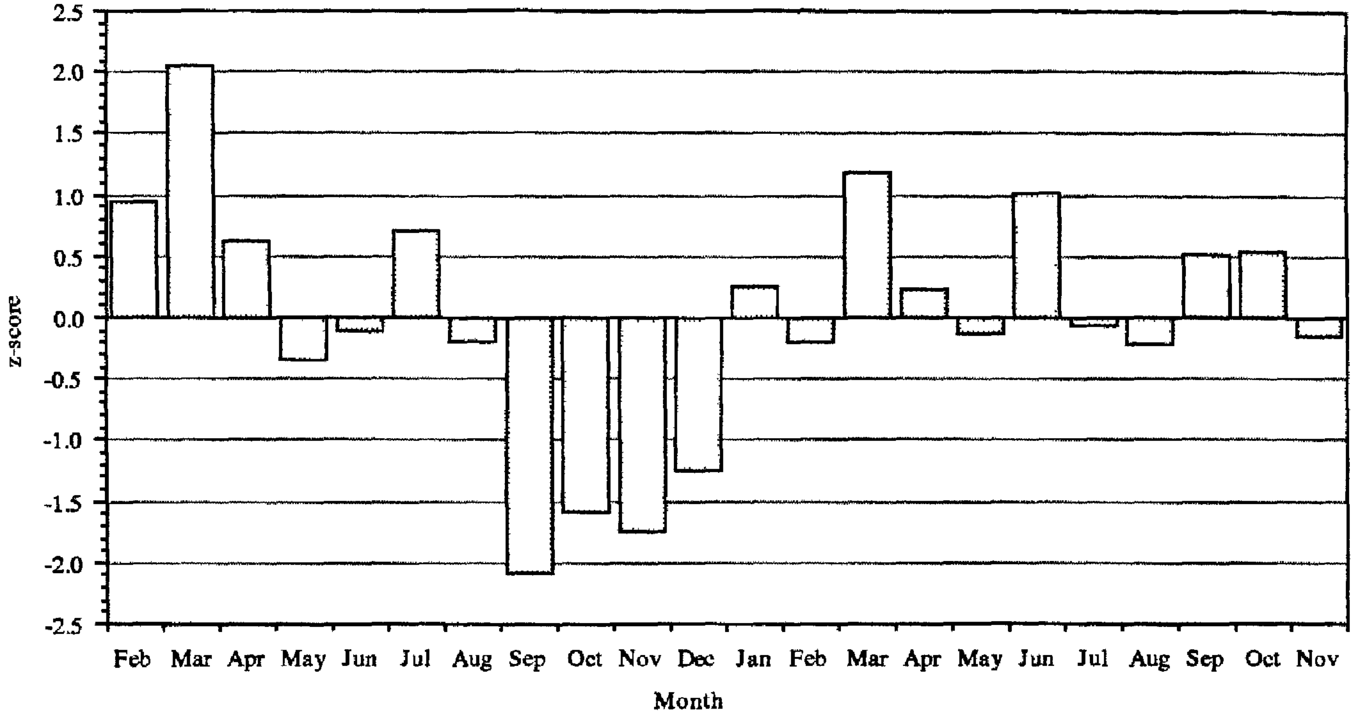
* Schooler and toddler intake is expressed as kilocalories per kilogram of body weight
Pre-shortage = Mar., Apr. and May of 1984
Post-shortage I = Jan., Feb. and Mar. of 1985
Shortage = Sep., Oct. and Nov. of 1984
Post-shortage II = Sep., Oct. and Nov. of 1985

Statistical significance of differences between time periods using paired ttests

	N	Pre-shortage to Shortage		Shortage to Post-shortage I		Shortage to Post-shortage II	
		% Pre-shortage intake lost to Shortage	p =	% Post-shortage I intake lost to Shortage	p =	% Post-shortage II intake lost to Shortage	p =
Lead males	112	-22.0	.0001	-20.0	.0001	-21.6	.0001
Lead females	121	-24.8	.0001	-24.7	.0001	-27.9	.0001
Schoolers	117	-23.0	.0001	-20.6	.0001	na	na
Male	62	-23.3	.0001	-20.9	.0001	na	na
Female	55	-22.6	.0009	-20.2	.0001	na	na
Toddlers	91	-4.5	NS	-4.9	NS	na	na
Male	41	+2.9	NS	-0.5	NS	na	na
Female	50	-10.0	NS	-8.3	NS	na	na

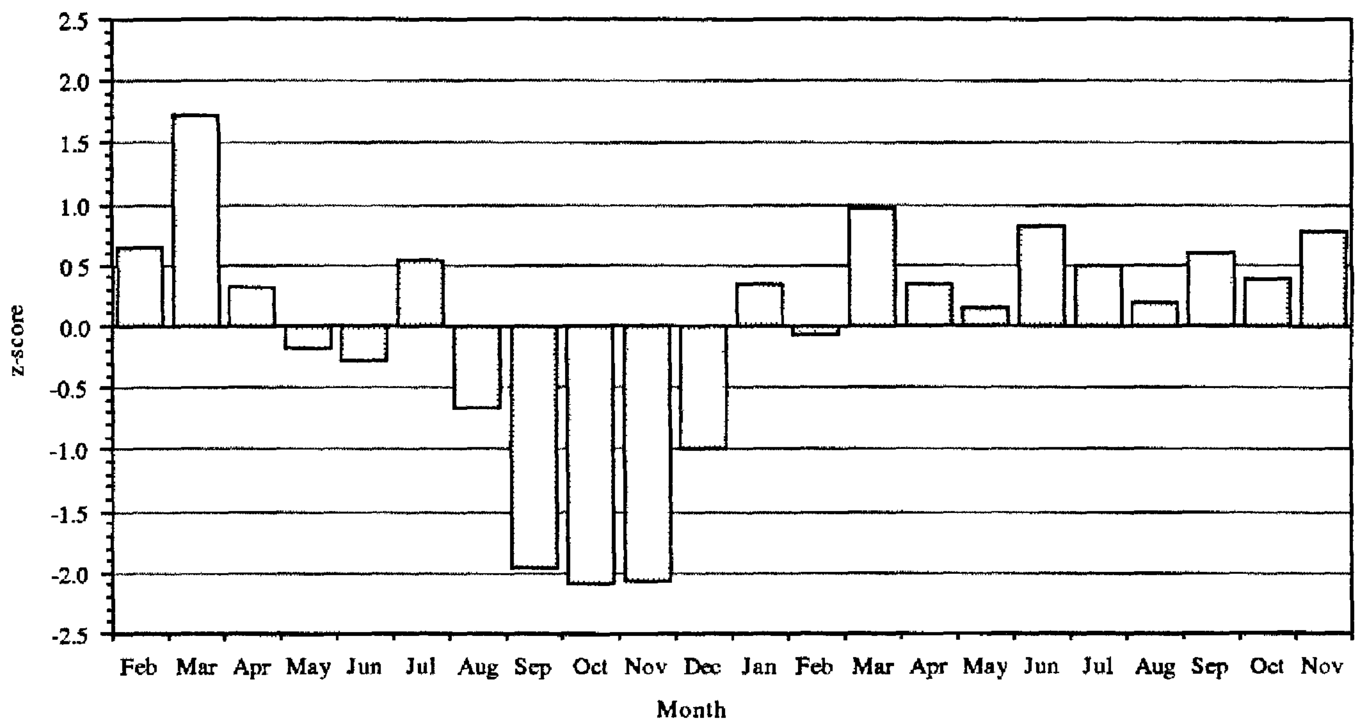
NS = $p > .10$
na = insufficient data for a statistical comparison

Figure 2a Mean daily energy intake for lead males by month (intake expressed as z scores)



Mean intake = 1978 kcal, standard deviation = 174 kcal

Figure 2b Mean daily energy intake for lead females by month (intake expressed as z scores)



Mean intake = 1726 kcal, standard deviation = 165 kcal

Table 3 Daily kilocalorie intake expressed as percent of recommended dietary allowances for selected time periods

	Pre-shortage	Shortage	Post-shortage I	Post-shortage II	RDA[1]
Lead males	71.6	55.9	69.9	71.4	2900
Lead females[2]	78.5	59.0	78.4	81.9	2200
NPNL	89.8	66.2	84.5	84.7	2200
Pregnant	64.7	46.9	61.5	na	2500
Trimester 1	76.1	53.0	74.0	na	2200
Trimester 2	61.6	49.7	58.0	na	2500
Trimester 3	61.0	46.2	62.6	na	2500
Lactating	73.6	51.5	70.1	na	2700
Schoolers	111.7	86.0	108.3	na	70[4]
Male	116.0	89.0	112.6	na	70
Female	106.7	82.6	103.4	na	70
Toddlers[3]	80.5	76.9	80.8	na	102[4]
Male	77.2	79.4	79.8	na	102
Female	83.2	74.9	81.6	na	102

Pre-shortage = Mar., Apr. and May of 1984
Shortage = Sep., Oct. and Nov. of 1984
Post-shortage I = Jan., Feb. and Mar. of 1985
Post-shortage II = Sep., Oct. and Nov. of 1985

1 RDAs are taken from the National Research Council, Recommended Dietary Allowances, 10th Edition, 1989.
2 Includes all females regardless of pregnancy status.
3 Kilocalorie intake includes supplementation only and does not include kilocalories derived from breast-feeding.
4 RDA expressed as kilocalories per kilogram of body weight

during the final quarter of 1984 and then recovers during the harvest of early 1985. Overall they had an intake decline from a pre-shortage level of 1727 kilocalories/day to a shortage level of 1298 kilocalories/day. (see table 2) This represents a 24.8% decrease (statistically significant at p = .0001). With regard to their recommended dietary allowances, females fell from a pre-shortage level of 78.5% to 59% during the food shortage. Female intake, however, must take into account the pregnancy status of the woman to more accurately reflect the impact that the drought had on her energy intake performance.

Table 4 provides information on the intake of lead females according to whether they were non-pregnant and non-lactating (NPNL), pregnant (by trimester), or lactating (only observations within the first six months of lactation are included). Women who were not pregnant and not lactating during the shortage period were compared to similar women during the pre-shortage period. These women had their intakes decline from 1976 kcals/day (89.8% RDA) during the pre-shortage period to 1457 kcals/day (66.2% RDA) during the food shortage. This gives a loss due to the drought of 25.8% of daily intake (statistically significant at p = .0001). For women who were pregnant during the food shortage the impact was even greater. Pregnant women during the pre-shortage period had an intake of 1617 kcals/day (64.7% RDA), during the shortage period they had an intake of only 1172 kcals/day (46.9% RDA). Pregnant women, therefore, suffered a 27.5 % decrease in their daily intake due to the drought (statistically significant at p = .0001). When pregnancy is divided by trimesters, the situation is even more alarming. Women who spent their third trimester during the shortage period showed the most substantial reduction in terms of their recommended dietary allowance. This group was able to consume only 46.2% of the amount of energy that is recommended for them. While their consumption level is still low during non-shortage periods (61% of RDA), the decline to less than half of the recommended level of intake during this critical period of growth for the child is reason for concern.

With regard to women who were in their first six months of lactation during the food shortage the situation is equally distressing. Energy intakes for these women decreased 30% from their pre-shortage levels (statistically significant at p = .0004). During the pre-shortage period, lactating women were consuming 73.6% of the 2700 kcals/day that is recommended. During the food shortage, however, that level fell to only 51.5% of the RDA.

Table 4 Daily kilocalorie intake for pregnanat, non-pregnant non-lactating (NPNL), and lactating women during four periods

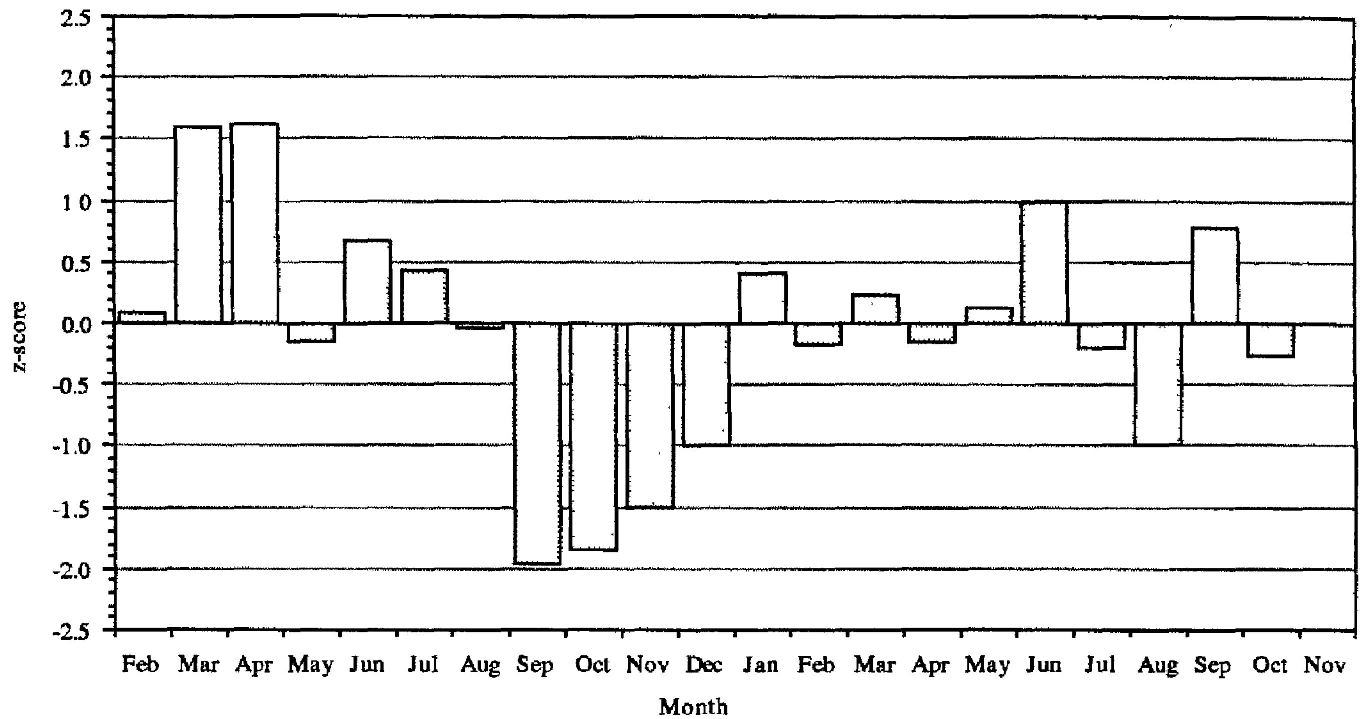
	Pre-shortage			Shortage			Post-shortage I			Post-shortage II		
	N	mean	std	N	mean	std	N	mean	std	N	mean	std
NPNL	129	1976	515	131	1457	499	128	1860	559	116	1863	489
Pregnant	109	1617	531	78	1172	395	52	1537	570	na	na	na
Trimester 1	45	1675	602	18	1166	509	21	1629	609	na	na	na
Trimester 2	56	1540	588	31	1242	419	21	1449	551	na	na	na
Trimester 3	44	1524	626	53	1154	411	28	1565	653	na	na	na
Lactating	28	1986	727	85	1391	467	82	1892	529	28	1944	776

na = insufficient data for a comparison
Pre-shortage = Mar., Apr. and May of 1984
Post-shortage I = Jan., Feb. and Mar. of 1985
Shortage = Sep., Oct. and Nov. of 1984
Post-shortage II = Sep., Oct. and Nov. of 1985

Statistical significance of differences between time periods using non-paired ttests

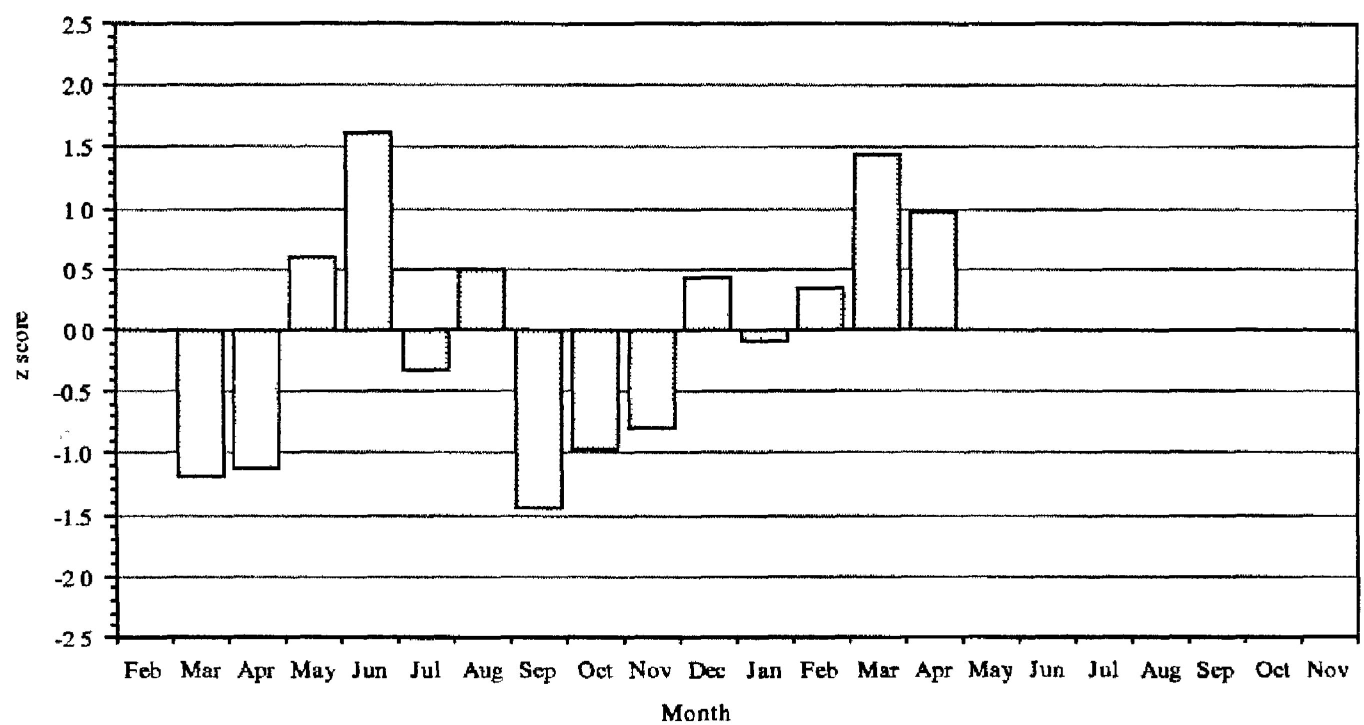
	Pre-shortage to Shortage		Shortage to Post-shortage I		Shortage to Post-shortage II	
	% Pre-shortage intake lost to Shortage	p =	% Post-shortage I intake lost to Shortage	p =	% Post-shortage II intake lost to Shortage	p =
NPNL	-25.8	.0001	-21.8	.0001	-22.0	.0001
Pregnant	-27.5	.0001	-23.7	.0001	na	na
Lactating	-30.0	.0004	-26.5	.0001	-28.4	.0011

Figure 3a Mean daily energy intake for schoolers by month (intake expressed as z scores)



Mean intake = 73.0 kcal/kg, standard deviation = 6.4 kcal/kg

Figure 3b Mean daily energy intake for toddlers by month (intake expressed as z scores)



Mean intake = 80.5 kcal/kg, standard deviation = 4.4 kcal/kg

School age children responded to the food shortage much the same as did adults. They experienced sharp declines during the last quarter of 1984 (see figure 3a) and as Table 2 shows, they suffered a 23% decline from their pre-shortage intake (statistically significant at p = .0001). Both male and female schoolers experienced similar patterns of decline in their energy intake levels. With regard to their RDA, school age children were the only group who surpassed the RDA during non-shortage periods. During the shortage, however, they dropped to 86% of the recommended intake level.

Toddler intake presents an interesting situation. Unlike older members of the family, toddlers seemed to be somewhat protected against the full impact of the food shortage. No statistically significant declines in intake were detected between the shortage period and either the pre-shortage or the post-shortage periods. Female toddler intake did show a 10% decline from their pre-shortage level but it was not significant at p = .10.[2] It must be noted that the intake represented on table 1 does not include breastfeeding. While the practice of breastfeeding was usually terminated prior to age 18 months, some of the toddlers were breast-fed during the period of observation.[3] Figure 3b shows the pattern of toddler intake (sexes combined) over the period of observation. The primary shortage months of September, October and November of 1984 do indicate reductions in intake compared to the overall average. When compared to the pre and post-shortage periods, however, the decline during the shortage period was not statistically significant.

Finally infant supplemental intake was examined. Infant supplementation is highly age determinant. The older a child the more supplementation, therefore, it is necessary to control for age in order to conduct valid comparisons. As table 5 shows, when the sample is stratified by age, there are no statistically significant differences between intake during the shortage period and during the non-shortage periods. As with toddlers, however, this intake does not include kcals derived from breast-feeding.

Also of concern is the pattern of food distribution within the household. Figure 4 indicates that the burden of decreased intake was relatively evenly spread among the target individuals throughout the period. Figure 4a shows the food distribution pattern for a hypothetical family of four given the prescribed intakes in the recommended dietary allowances. Figures 4b, 4c and 4d indicate how such a household might have performed

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[2] The actual p value for this comparison was .11.

[3] Less than 5% of toddler food observation days involved any breastfeeding.

Table 5 Daily energy intake (kilocalories/kilogram of body weight) for infants before, during and after the shortage by age(intake represents supplemental feeding only)

	Pre-Shortage			Shortage			Post-Shortage I		
Age	N	mean	std	N	mean	std	N	mean	std
1-2 months	23	6.8	9.9	42	7.1	10.8	27	9.4	15.2
3-4 months	na	na	na	37	33.3	28.2	46	35.4	28.7
5-6 months	na	na	na	37	39.2	29.8	49	33.2	25.2

na = insufficient data for a comparison
Pre-Shortage = Mar., Apr. and May of 1984
Shortage = Sep., Oct. and Nov. of 1984
Post-Shortage I = Jan., Feb. and Mar. of 1985
Note 1 - there was no data available for the post-Shortage II period.
Note 2 - none of the differences between time periods within the same age group were statistically significant at $p > .10$ using non-paired ttests.

over the course of the food shortage period. Schooler and toddler intake increase as a percent of total intake during the shortage period. Lead male and lead female intake decrease slightly. This enforces the observation that the intakes of younger children were somewhat protected during the shortage while the intake of adults, especially lead females, suffered the most.

Even though the intake distribution closely follows the recommended pattern, the low total amount of energy intake suggests that the pattern be altered to meet the critical intake needs of some members of the family. The issue of intra-household food distribution is very complex and deserves closer examination than is offered in this paper. The issue regarding limited food supplies during a food shortage is whether some members of the family should receive preferential treatment. Careful attention needs to be given to the criteria which determines preference in food distribution and what type of distribution pattern bests favors the continued productivity and vitality of the household.

Figure 4a Distribution according to recommended dietary allowances

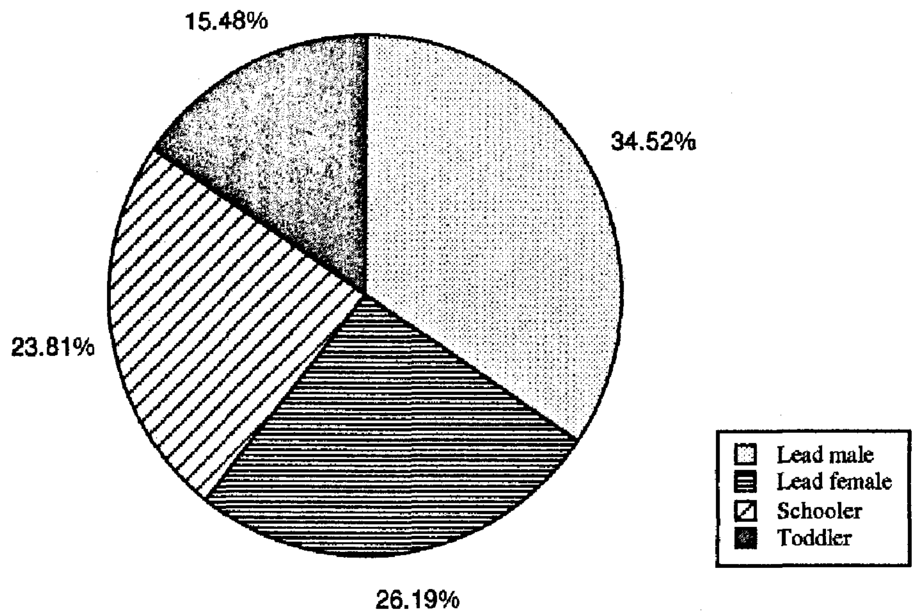

Figure 4b Distribution according to pre-shortage intake

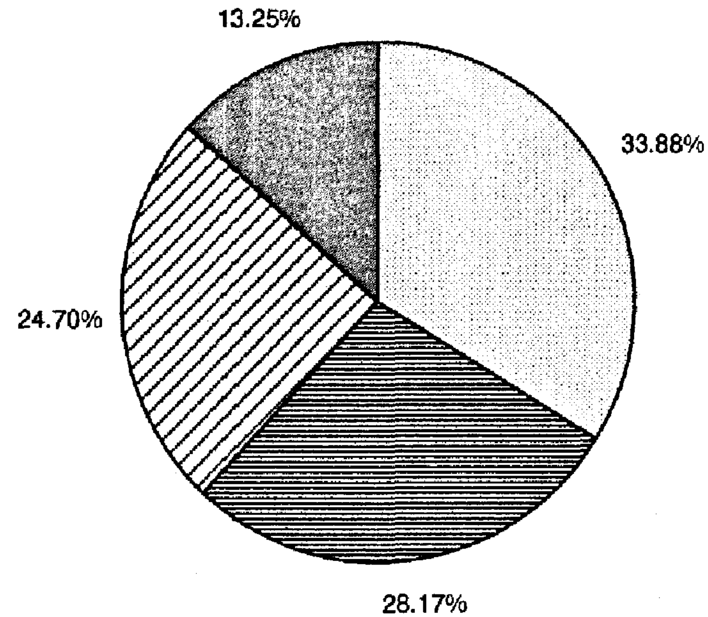

Figure 4c Distribution according to shortage intake

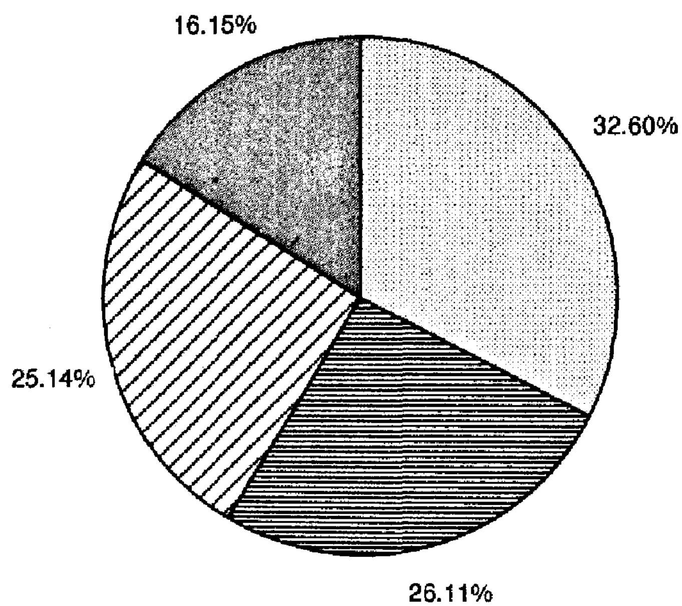

Figure 4d Distribution according to post-shortage I intake