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Food Security in Egypt: The Socio-Economic Implications of Dietary Protein-Energy Interrelationships

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Problem Analysis and Objectives

The topic of "Food Self-Sufficiency" is very discrepant. It is narrow enough to permit economists, statisticians and political scientests to think that they are makng precise statements, yet broad enough to encompass almost anything an author has to say. In long term planning, food production targets are generally based on projections of demand. However, attention has to be given to the nutritional needs of the population, especially, the vulnerable groups. Attention should be given to kind, quality and quantity of food consumed by these groups.

It is unlikely that an increase in food production will automatically result in a higher average consumption, and a reduction in the protein and/or energy deficiency. This is because of the inequitable nature of food distribution and consumption. Variations in both intakes and requirements must be considered in estimating adequacy of protein supplies, and planning should be based on studies of individual and household food consumption rather than on overall production targets. National per-capita projections of food consumption provide little or no information about the situation that exists among those at risk and no information about the situation among those at high risk or the malnourished segments of the population. These projections totally ignore the problem of regional distribution of food intake and nutrient intake among the members of the population. Using such estimates in evaluating the food gap and food sufficiency could be misleading and may have inappropriate implications for planning.

A number of international conferences and several recent publications have contributed to the belief that malnutrition and ill health are widespread manifestations of poverty and at the same time obstacles to national development. Also, the difficulty of raising the often miserably low returns to labor and of reducing inequalities in the distriubtion of income accentuate the problem of poverty, (Berg, 1973 and Berg et al., 1973; FAO/WHO, 1976 and World Bank, 1975).

The term malnutrition is used to refer to the physical effects on the human body of dietary intakes that are inadequate in quantity and/or quality. In addition, the high prevalence of infection in developing nations exacerbates malnutrition by decreasing nutrient utililzation and enhancing disease susceptibility (Johnston & Martorell, 1977). However, malnutrition also embraces "overnutrition" contributing to obesity, diabetes and heart disease, but that is a problem associated with affluence rather than poverty.

The narrow concentration of agricultural research, extension, and government subsidies for cereals is an unintended byproduct of the present wave of statements that protein is not a problem if people receive enough calories. Indeed, the major food security programs in developing countries including Egypt stem from this belief (FAW/WHO, 1973). However, throughout the 1960's it was emphasized by international and bilateral agencies that, while increased cereal production, utilizing modern techniques, might ensure adequate dietary calories, there was a parallel need to ensure production of foods providing more protein relative to calories.

Many attempts have been made to estimate the prevalence of malnutrition. According to FAO estimate, in 1977, the number of persons in developing countries thought to have less than a "critical minimum energy intake" increased from 400 million in 1969-71 to just over 450 million in 1972-1974. Reutlinger and Selowsky (1976), on the other hand, have estimated that 56 percent of the population in developing countries, or some 840 million persons had calorie deficient diets. Inspite of the differences between these estimates, they underline the basic fact that protein-calorie malnutrition and deficiencies are widespread problems which adversely affect the quality of life for many individuals throughout the world and often impair their ability to learn and work productively. Does the famished world include the Egyptian economy or at least the low income segments of it, and if not, does the nature of the nutritional deficiency problem in Egypt support the feasibility of the current price subsidy policies, particularly for grains.

Data Base and Methodology

Data Base. The sample for the Family Budget Survey in 1974/1975 conducted by the Central Agency for Public Mobilization and Statistics was used for purposes of this study. The survey involved four visits over one year. It included 12,000 households from the urban and rural areas of Egypt with a ratio of two of the former to one of the latter.

Food consumption by annual household expenditure class, and sex and age structure of households were used in this study to estimate energy and protein consumption and requirements per capita per day.

Estimation of Energy Requirements. The energy requirements of individuals depend on several interrelated variables, including physical activity, body size, sex and environment. Individuals of the same size, living in the same environment and with the same mode of life have similar energy requirements, whatever their ethnic origin.

Table 1 presents daily energy requirements per person by sex and age group for moderate activity and average weights presented in the table. These requirements were adapted from FAO/WHO estimates in 1973. They were applied for the urban and rural sub-samples according to the age and sex group classification.published in the 1974/75 Family Budget Survey. Requirements per capita per day for each household expenditure class was weighted by numbers of each age and sex group included in the sample for a given expenditure class.

Protein Requirements. More is known about energy needs than protein needs under varied conditions. Accordingly, protein requiremets are discussed in more detail. For many policy purposes it is desirable to know the percent of total calories that should come from protein. This is frequently referred to as the protein/energy ratio (P:E) ratio. It is a more practical way of determining the adequacy of diets than by separately examining requirements for nutrients that are so interrelated.

Initially, the concept is to compare "Net Dietary Protein Calories Percent" (NDPCa percent) with the percent of calories represented by "The Safe Protein Allowance", corrected for protein quality, relative to the age and sex-specific average daily calorie requirements (Platt et al., 1961). The problem lies in the fact that, even if the estimates for mean protein requirements on which the calculation is based are correct, the resulting figure, by definition, is sufficient for only half of the population. Using a protein to calorie ratio based conceptually on the protein needs sufficient for 97.5 percent of the population (NDPCal requirements plus + 2SD over energy requirements + 2SD) ensures that statistically the protein needs of 97.5 percent of the normal population will be met when energy needs are met.

Table 1: Energy Requirements Per-Capita Per-Day in Calories for Moderately Active Persons by Age and Sex Group.

Age Group	Males		Females	
	Average body weight (kgs)	Calories	Average body weight (kgs)	Calories
Less than one year	7.3	820	7.3	820
1-4 years	14.5	1,455	14.4	1,430
5-9 years	25.9	2,132	25.1	2,004
10-19 years	51.6	2,877	48.1	2,473
20-39 years	65.0	3,000	65.0	2,200
40-59 years	65.0	2,775	65.0	2,135
60 years and above	65.0	2,250	65.0	1,650

Source: Adopted from Food and Agricultural Organization and World Health Organization. Energy and Protein Requirements, WHO Chronicle, Vol. 27:481-486, 1973.

Based on the 1973 FAO/WHO "safe allowance" for protein, nearly 7 percent of protein calories would be needed as egg or milk protein.

However, there is strong evidence indicating that the 1973 FAO/WHO recommendations for a protein "safe allowance" are too low for long term maintenance of normal adults, and presumably even less satisfactory if the need for recovery from episodes of stress is taken into account. Acute infections are quite frequent in under-privileged populations, particularly, in young children. The net result of the multiple effects of infections is the need for a margin above normal protein requirements to allow for rapid repletion before the next acute episode worsens the degree of depletion. Accordingly, 30 percent higher requirements for protein above the "safe allowance" by FAO/WHO was suggested. Therefore, the P:E value that would be required to cover 97.5 percent of the population, depending on various additional assumptions would be 8 percent, as egg or milk ND Cal, (Scrimshaw, 1977). Further adjustment is required for the utilization of protein in the diet. For a good quality diet it would be approximately 9-10 percent. For the predominantly vegetable protein diets, as the case of developing countries, it might be 11-12 percent. Therefore protein quality (as the average weighted Biological Value (BV) percent, i.e., the quality score) was taken into consideration in estimating the P:E ratio.

Energy and Protein Dietary Intake. The quantity consumed from each food item recorded in the published family budget survey was calculated in average per-capita daily grams. Daily per-capita energy consumption was clculated on the basis of the calorie content of each food item, as shown in Table 2. Protein intake was calculated as Gross Protein (GP) quantity in grams, using the protein percentage in Table 2. Net protein utilized intake (NPU) was also calculated using corresponding BV percentages in Table 2. NPU-Intake was

Table 2. Nutrient Content of Major Food Items in Egypt

Food Item	KCal/gram	Percent protein	Biological Value (BV) percent	Food Item	KCal/gram	Percent protein	Biological Value (BV) percent
Wheat	3.5	11.7	60	Artificial Ghee	8.84	0.00	0.00
Maize	3.6	9.3	60	Liquid Milk	0.87	3.9	85
Millet	3.43	10.1	60	Full Cream White Cheese	2.02	20.0	73
Wheat Flour	3.7	—	0.52	Fatless Cheese	1.01	19.2	73
Bread	3.66	11.13	60	Butter	7.33	0.6	73
Milled Rice	3.6	6.7	60	Ghee	9.4	0.00	0.00
Macaroni	3.62	0.5	52	Potato	0.81	2.0	67
Broad Beans	3.45	22.2	60	Onion	0.4	1.4	55
Lentils	3.45	22.2	60	Tomato	0.17	1.8	55
Red Meat	2.07	18.8	67	Oranges	0.47	0.9	55
Poultry	1.29	12.6	70	Date	1.13	2.4	55
Fish	0.62	8.8	70	Sugar	2.87	0.00	0.00
Eggs	1.63	12.4	94	Honey	2.9	0.00	0.00
Vegetal Oils	8.84	0.00	0.00	Halawa Tahini	4.81	9.05	78

Source: Collected from:

(1) Ministry of Agriculture - Under Secretary for Agricultural Economics. Food Balance Sheet of Egypt, 1979, Cairo (in Arabic).

(2) Nutrition Institute of Egypt. Food Nutritive Values Tables, Cairo, 1977 (in Arabic).

compared with NPU-requirements i.e., 8 percent of NDPCal out of total energy requirements. GP-requirements were calculated as: ("NPU" requirements + "NPU" intake) x "GP" = intake.

Other food items, particularly some fruits, vegetables, and some milk products. . . etc., that were not explicitly recorded as quantities consumed were imputed by dividing their monetary values by the corresponding average price from the survey data. Each imputed quantity was transformed into calories and protein by the usual procedure and added to the dietary intake.

Dietary Calorie Availability and Adequacy in Egypt

Table (3) and Table (4) show that grains, particularly wheat, are the main sources of energy for per-capita dietary intake. Tables (5) and (6), and Figurès (1) and (2) emphasize that the average calorie intake either in urban or in rural areas of Egypt is higher than the requirements. Although those in progressively lower income categories have dietary energy intakes increasingly below aggregate average intakes, in both the urban and rural areas, all income groups have dietary intakes above normal requirements. However, average energy intakes of lower income categories (less than LE 500 per household per year) are only slightly above average requirements. The ratios of average calorie intake to average requirements are about 118 percent in urban and 115 percent in rural areas. Whatever the average calorie intakes for the population are, relative to estimated requirements, the affluent sector of the population, consume considerably more food than they need. This is more significant in rural than in urban areas. Some of this excess energy contributing to their obesity is a sort of malnutrition, and most of the

Table 3. Aggregate Daily Nutritional Pattern Per Capita in Egypt

Food Item	URBAN		RURAL		NATIONAL AVERAGE	
	Daily Per Capita Intake	Percent of Per Capita Intake	Daily Per Capita Intake	Percent of Per Capita Intake	Daily Per Capita Intake	Percent of Per Capita Intake
Energy Intake (KCal)	2,800	100	2,670	100	2,728	100
Wheat	1,771	69.2	1,198	44.9	1,448	58.1
Rice	246	8.8	267	10.0	258	9.5
Maize	74	2.6	559	20.7	346	12.7
Other Grains	1.0	--	1.0	--	0.8	--
Legumes	80	2.8	72	2.7	76	2.8
Fats and Oils	246	8.8	626	9.8	255	9.3
Suggres	156	5.6	147	5.5	151	5.5
Animal Products	150	5.4	106	4.0	125	4.6
Vegetables and Fruit	76	2.7	64	2.4	69.0	2.5
Protein Intake (gms)	79.1	100	73.1	100	75.7	100
Vegetable Protein	66.2	83.7	63.5	86.9	64.7	85.5
Animal Protein	12.9	16.3	9.6	13.1	11.0	14.5
Protein Quality (BV) percent	--	61.7	--	62.4	--	62.1
NPU (gms)	48.8	--	45.6	--	47.0	--

Source: Calculated from:

(1) Egypt (Arab Republic of) - Central Agency for Public Mobilization and Statistics: Household Budget Sampling Survey in A.R.E.: Aggregate Data of the Four Visits (1974-1975), Ref. 80-12524/78, Sept., 1978 (in Arabic).

(2) Table (1) and

Table 5. Effect of Income Distribution on Per Capita Energy and Protein Availability in Urban Egypt

Annual Household Expenditure in L.E.	Percent of Urban: Population	Percent of Urban: Annual Expenditure	Daily Per-Capita in Kilo Calories: Consumption	Daily Per-Capita in Kilo Calories: Requirements	Daily Per-Capita in Kilo Calories: Net Balance	Daily Per-Capita Protein in Grams: Consumption: Gross Protein	Daily Per-Capita Protein in Grams: Consumption: Net Protein Utilization	Daily Per-Capita Protein in Grams: Requirements in Net Protein Utilization	Daily Per-Capita Protein in Grams: Net Balance in Net Protein Utilization
< 200	5.7	2.62	2,437	2,240	+197	68.2	41.5	44.8	-3.3
200 -	21.4	12.30	2,585	2,324	+261	72.0	43.0	46.5	-3.1
350 -	24.4	17.55	2,681	2,373	+309	75.3	46.2	47.5	-1.3
500 -	12.6	10.97	2,777	2,400	+377	80.0	49.2	48.0	+1.2
600 -	15.7	16.60	2,865	2,406	+459	81.0	50.1	48.0	+2.1
800 -	7.5	10.60	3,136	2,416	+720	88.0	33.1	48.3	+6.8
1,000 -	7.8	13.50	3,201	2,438	+763	91.0	57.3	48.8	+8.5
1,400 +	4.9	15.86	3,427	2,454	+968	100.7	64.4	49.2	+15.2
Urban Mean	100	100	2,800	2,378	+422	79.1	48.7	47.6	+1.1
S.D.:			248.9	50.95	205.5	7.83			
C.V.:			8.9%	2.1%	48.7%	9.9%			

Note: Average protein quantity score = $\frac{\text{Net Protein Utilized}}{\text{Gross Protein}}$ = 61.5% ∓ .09% SD.

Source: Calculated from:

Egypt (Arab Republic of) - Central Agency for Public Mobilization and Statistics: Household Budget Sampling Survey in A.R.E. Aggregate Data of the Four Visits 1974-1975, Ref. 80-12524/78 Sept., 1978 (in Arabic).

Table 6. Effect of Income Distribution on Per Capita Energy and Protein Availability in Rural Egypt

Annual Household Expenditure in L.E.	Percent of Rural: Population	Percent of Rural: Annual Expenditure	Daily Per-Capita in Kilo Calories: Consumption	Daily Per-Capita in Kilo Calories: Requirements	Daily Per-Capita in Kilo Calories: Net Balance	Daily Per-Capita Protein in Grams: Consumption: Gross Protein	Daily Per-Capita Protein in Grams: Consumption: Net Protein Utilization	Requirements in Net Protein Utilization	Net Balance in Net Protein Utilization
< 200	14.39	9.26	2,333	2,257	+176	65.4	39.9	45.1	-5.2
200 -	35.49	27.62	2,449	2,314	+135	67.8	41.3	46.3	-5.0
350 -	23.82	23.62	2,625	2,327	+298	72.4	44.3	46.5	-2.2
500 -	8.45	9.63	2,853	2,358	+495	80.0	49.4	47.2	+2.2
600 -	8.68	11.75	3,042	2,331	+711	83.6	51.4	46.6	+4.8
800 -	4.39	6.77	3,386	2,327	+1058	44.6	58.0	46.5	+11.5
1,000 -	2.80	5.59	3,752	2,376	+1316	109.0	68.2	47.5	+20.7
1,400 +	1.98	5.76	3,947	2,706	+1241	116.3	74.8	54.1	+20.2
Urban Mean	100	100	2,670	2,324	+346	73.4	45.3	46.6	-1.2
S.D.:		367	67.3	372	12				
C.V.:		13.81%	2.6%	107.8%	16.5%				

Note: Average protein quantity score = $\frac{\text{Net Protein Utilized}}{\text{Gross Protein}}$ = 61.3% ∓ .06% SD.

Source: Calculated from:

Egypt (Arab Republic of) - Central Agency for Public Mobilization and Statistics: Household Budget Sampling Survey in A.R.E. Aggregate Data of the Four Visits 1974-1975, Ref. 80-12524/78 Sept., 1978 (in Arabic).

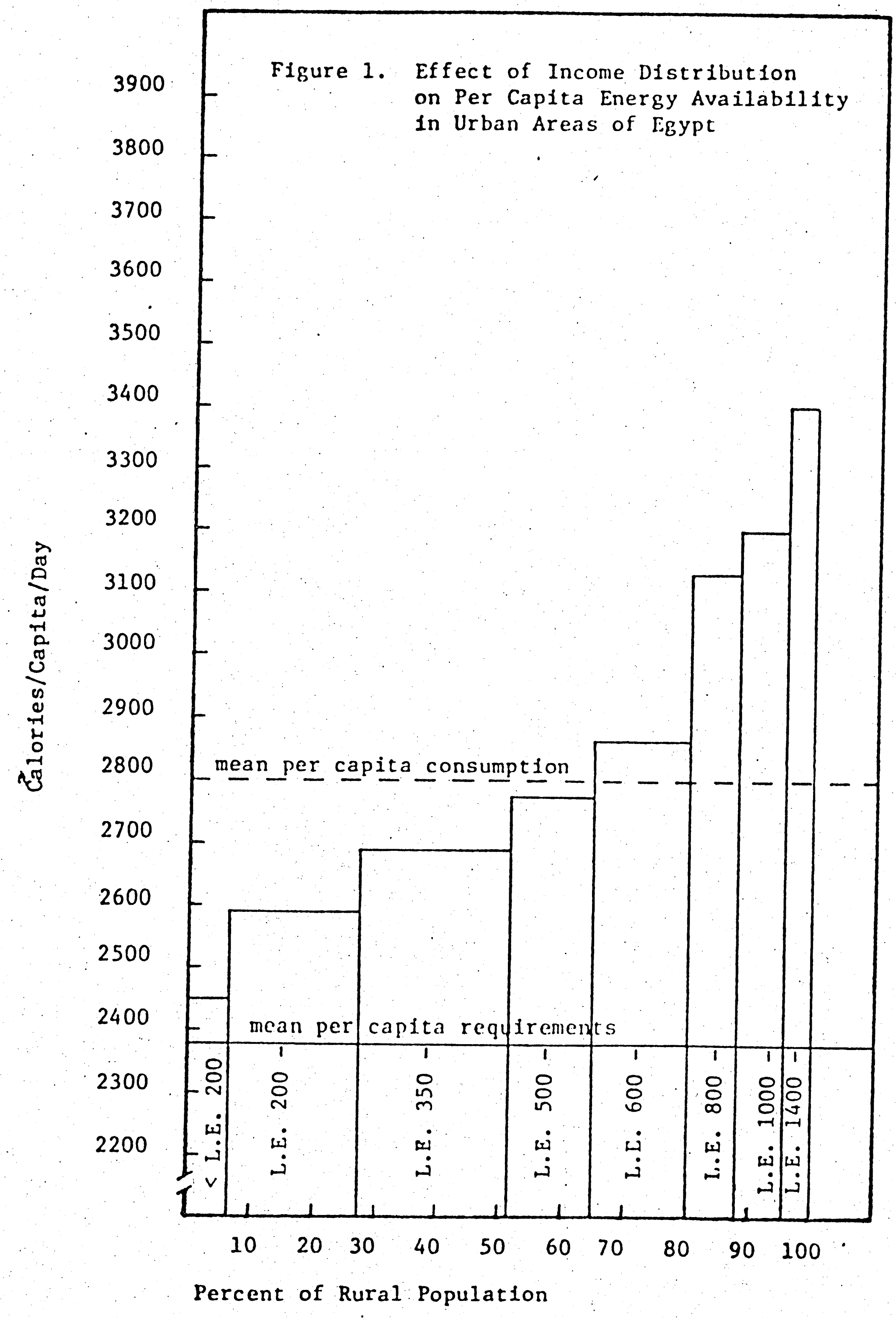
Figure 1. Effect of Income Distribution
on Per Capita Energy Availability
in Urban Areas of Egypt
Calories/Capita/Day
3900
3800
3700
3600
3500
3400
3300
3200
3100
3000
2900
2800
2700
2600
2500
2400
2300
2200
mean per capita consumption
mean per capita requirements
< L.E. 200
L.E. 200 -
L.E. 350 -
L.E. 500 -
L.E. 600 -
L.E. 800 -
L.E. 1000 -
L.E. 1400 -
10
20
30
40
50
60
70
80
90
100
Percent of Rural Population

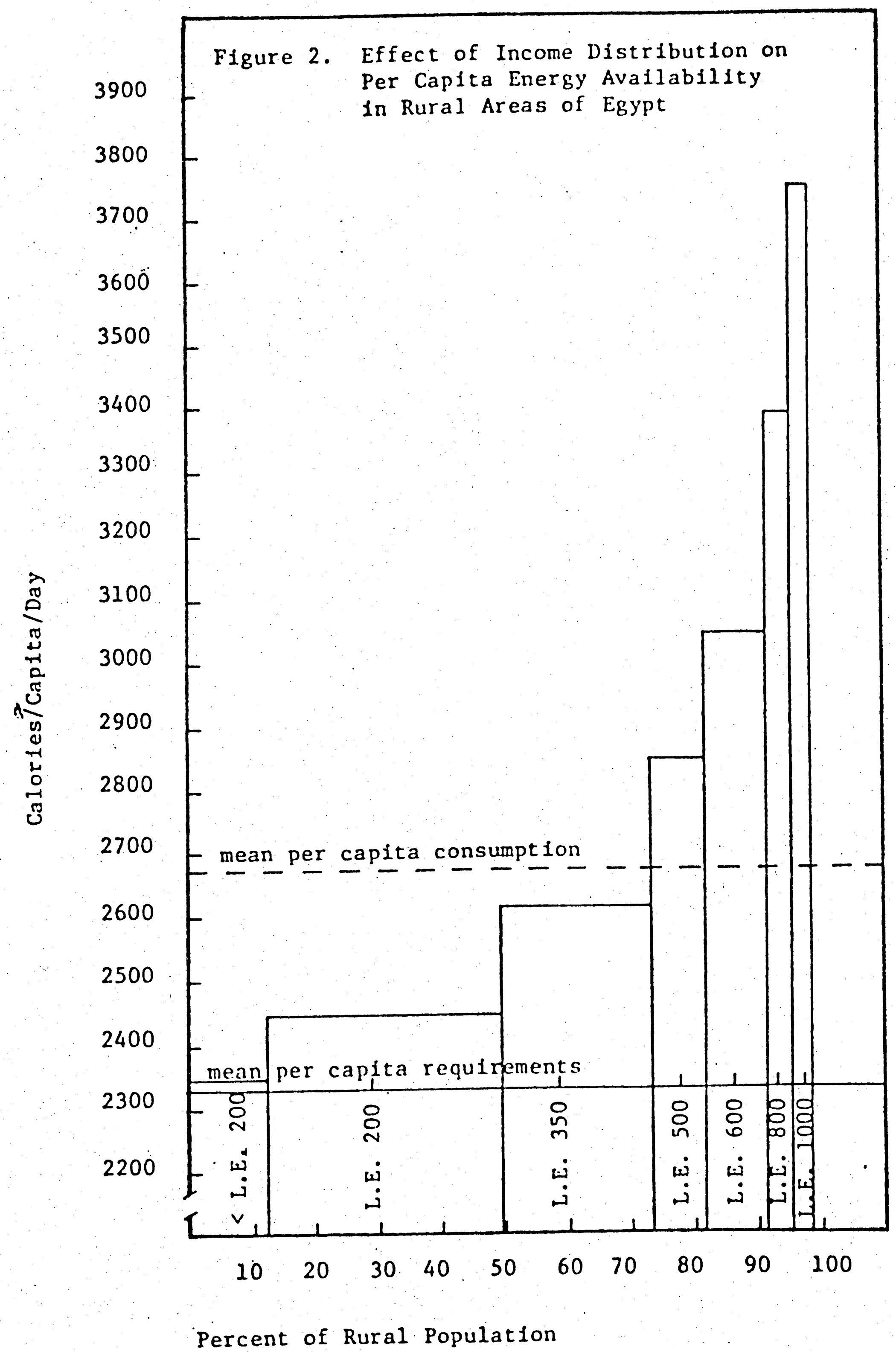
Figure 2. Effect of Income Distribution on Per Capita Energy Availability in Rural Areas of Egypt
3900
3800
3700
3600
3500
3400
3300
3200
3100
3000
2900
2800
2700
2600
2500
2400
2300
2200
Calories/Capita/Day
mean per capita consumption
mean per capita requirements
< L.E. 200
L.E. 200
L.E. 350
L.E. 500
L.E. 600
L.E. 800
L.E. 1000
10
20
30
40
50
60
70
80
90
100
Percent of Rural Population

excess food is simply wasted or utilized as animal feed. Some reviews have missed these points and assumed that all calories, consumed by a household are actually ingested.

Considering an adult man of moderate activity as a consumption unit, "the sex-age structure" of the household is the scale for nutritional requirements. This scale per-capita is almost constant between income classes. Its average is 0.7931 consumption units (I 0.0445 SE) in urban and 0.7725 consumption units (I 0.0036 SE) in rural areas. Due to this similarity in the per-capita "sex-age scale," the variability in requirements (coefficient of variability) is very small between income classes within each sub-population.

The interaction between the income distribution and propensity to consume shows a variability in per-capita calorie intake by income class, around the population average of about 9 percent in urban and 14 percent in rural areas. However, current subsidy policy (mainly devoted to grains) keeps per-capita dietary intake of each income class above normal requirements. It seems that such a policy kept the Egyptian population away from "the World Famine Circle" whereas under-nutrition is severe in Asian and Latin American developing countries. As Reutlinger and Selowesky (1976) indicated, about 47 percent of Latin American population have energy intakes below requirements and those in progressively lower income categories have dietary energy intakes increasingly below normal requirements.

Dietary Protein Availability and Adequacy in Egypt

As shown in Tables 3 and 4 most of the energy intake from Egyptian food comes from grains (vegetable sources). Therefore it was expected that most of the Egyptian protein intake would also come from vegetable sources (Table 7). Although there is no energy gap, it was not expected that, in consequence,

Table 7. Daily Per-Capita Animal Protein Consumption by Annual Expenditure Per Household

Comparative Item	200 L.E.	200- L.E.	350- L.E.	500- L.E.	600- L.E.	800- L.E.	1,000 L.E.	1,400+ L.E.	Mean
				URBAN					
gms/capita/day	7.1	7.3	10.3	11.9	14.3	18.2	21.5	32.2	12.9
Percent Gross Protein	10.4	10.1	13.7	14.9	17.7	20.7	23.6	32.0	16.3
				RURAL					
gms/capita/day	8.2	8.9	10.5	12.0	14.7	16.0	22.9	22.1	9.6
Percent Gross Protein	12.5	13.1	14.5	15.0	20.1	17.0	21.9	19.0	13.1

Source: Calculated from:

Egypt (Arab Republic of) - Central Agency for Public Mobilization and Statistics: Household Budget Sampling Survey in A.R.E., Aggregate Data of the Four Visits 1974-1975, Ref. 80-12524/78, 1978 (in Arabic).

there would also be no protein gap, because in addition to quantity, protein quality determines its adequacy. If one looks at Figure 3 for urban and Figure 4 for rural intakes, and Tables 5 and 6, it is easily concluded that there is no protein gap for the total urban population, where the average per-capita consumption is about 79 grams per day of gross protein (48.7 grams net protein utilized), while the requirements are about 77 grams gross of protein (47.6 grams net protein utilized). For the rural population, there is a gap because consumption is slightly lower than the requirements. However, the same tables and figures show the distribution of protein with income. It is clear that large segments of the population have dietary protein intakes below requirements. About 52 percent of the urban population and about 74 percent of the rural population have a protein gap. These segments are the households with less than 500 LE annual expenditure per year. Although the general pattern of the protein distribution according to income brackets shown in Figures 3 and 4 is similar to that for calories in Figures 1 and 2, the issue is still more complicated, because the poorer segments of the population not only consume less protein, but also protein of poorer quality. The inadequacy in intake is most pronounced in the case of animal protein (Table 7). This phenomenon actually stems from consumer behavior and is reflected in the income (expenditure) elasticities of nutrients (Table 8). Thus while total available protein and calories both tend to decrease more or less proportionately with income, this is deceptive because utilizable protein drops faster than calories. Moreover, the poorer the socio-economic group, the more vulnerable they will be to acute and chronic infections and likely to need extra protein for periods of recovery.

However, these are not the types of models with which economists and national planners usually deal. Therefore, it has been very difficult, in

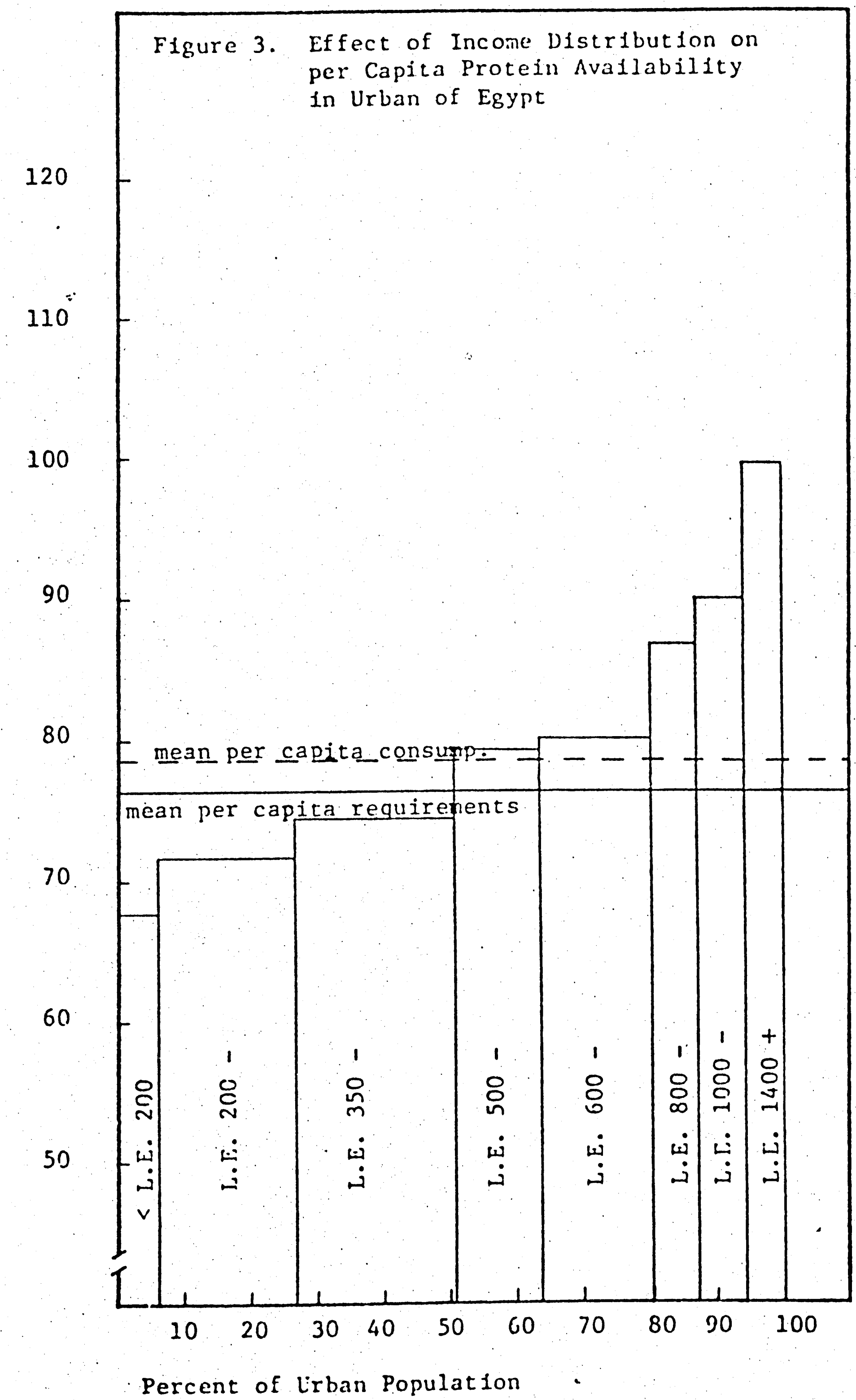

Figure 3. Effect of Income Distribution on per Capita Protein Availability in Urban of Egypt

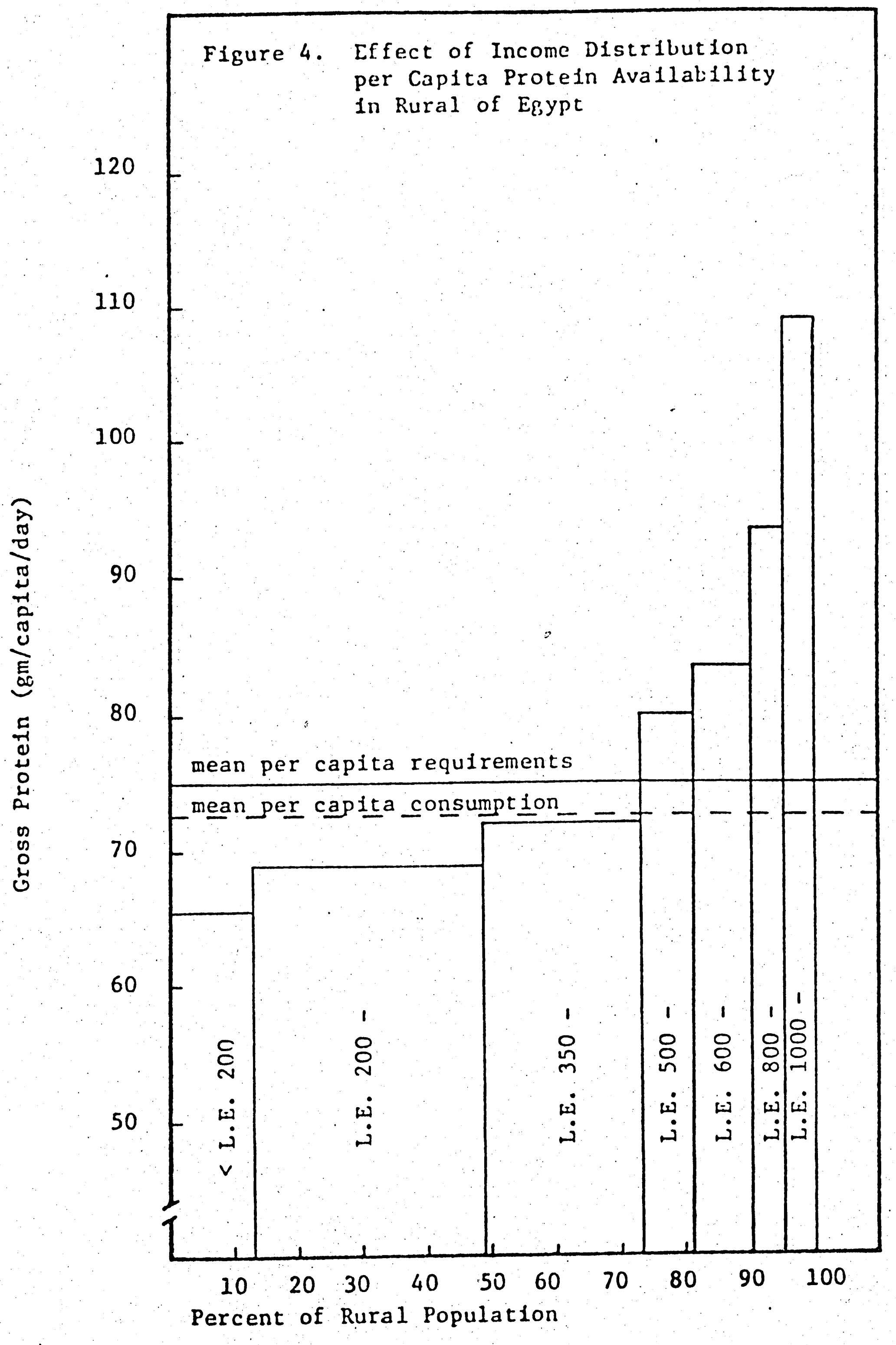
Figure 4. Effect of Income Distribution per Capita Protein Availability in Rural of Egypt
120
110
100
90
80
70
60
50
Gross Protein (gm/capita/day)
mean per capita requirements
mean per capita consumption
< L.E. 200
L.E. 200 -
L.E. 350 -
L.E. 500 -
L.E. 600 -
L.E. 800 -
L.E. 1000 -
10
20
30
40
50
60
70
80
90
100
Percent of Rural Population

Table 8. Estimated Engel's Curve for Per-Capita Daily Consumption of Calories and Protein (Quantity and Quality) in Egypt.

Food Ingredient	Intercept	Average Estimated Elasticity	Coefficient of Determination	Intercept	Average Estimated Elasticity	Coefficient of Determination
Calorie Intake	1139.1864	0.1976	0.7365	617.2873	0.3609	0.9575
Gross Protein	29.2676	0.2188	0.7709	14.7973	0.3981	0.9588
Vegetable Protein	44.9576	0.0817	0.2495	16.2684	0.3376	0.9388
Animal Protein	0.2982	0.8147	0.9717	0.5073	0.7428	0.9602
Net Utilizable Protein	15.8919	0.2463	.8122	8.1297	0.4248	0.9652

Estimated Model is $\hat{C}_{ijr} = \hat{\alpha} Y^{\hat{b}}_{ir}$

Where : $\hat{C}_{ijr}$ denotes daily per-capita intake of ingredient j in region r for an individual i.

$\hat{Y}_{ir}$ denotes annual per-capita expenditure of an individual i in region r.

Source: Estimated from the data of:

Egypt (Arab Republic of) - Central Agency for Public Mobilization and Statistics: Household Budget Sampling Survey in A.R.E., Aggregate Data of the Four Visits 1974-1975, Ref. 80-12524/78, 1978 (in Arabic).

connection with the announced food security strategy, to explain the nature of the protein problem, and the reason for concern about it. It is easy to demonstrate that, on an aggregate per-capita basis, there is almost no protein gap for the total population. This would be generally true if protein were, or could be, distributed according to requirements, but this demands a degree of control over the lives of individuals that is unacceptable in most economic systems.

Succinctly about one-half of the urban population and three-fourths of the rural population in Egypt consume diets that are progressively lower in the percentage of utilizable protein as income drops. And, we must accept the fact that regardless of the economic system, food security programs are not willing to settle for anything but protein intakes well above the currently estimated allowances.

The Protein Quality Problem in Egypt

It is clear from analysis presented above, that the protein quality of Egyptian household diet is in general low in terms of net utilizable protein and biological value [as the percent of net utilizable protein to gross protein], although its quality improves as income increases (Table 8). Therefore, even for population segments that have a dietary gross protein intake which meets requirements, it is mainly from a high proportion of grains consumed in adequate quantities to meet caloric needs. The complementary effect of gross protein may be suitable for adults. However, if there is severe infection or stress of any kind, a diet higher in protein value than that supplied by cereal-based diets is required if the diet is nearly devoid of animal protein and very limited in legumes as it is for the low income segments of the population.

The continuing high prevalence of protein malnutrition among children is quite clear once the utilizable protein content decreases with lower income. The data available indicate that the amounts of protein reaching the preschool child are seriously inadequate in most of the developing countries (FAO/WHO, 1973b). In Egypt, the results of a study, conducted by Nutrition Institute in 1978, showed that about 2-3 percent of preschool children suffer from acute malnutrition and 21.2 percent of them suffer from chronic malnutrition. This provides basic evidence that suitable foods are not provided to these children. For young children under 3 years of age, the traditional diet is frequently so bulky that they have difficulty in eating enough of it to fully meet either caloric or protein needs. They not only need the recommended allowances for healthy children but also enough to meet additional needs since they often suffer from infectious diseases, particularly if they are children from low income groups. In many cases, cultural practices may deny young children sufficient access to protein foods.

Economic Policies and Socioeconomic Concept of Food Security

The two direct policies that serve the socioeconomic concept of food security are: (a) to raise income levels through economic development plans and (b) a price subsidy policy for food items, particularly grains.

Economic growth and protein problem. The net measure of economic growth is the increase in real per-capita income. Now, the question is, will the protein problem be solved by increasing income? As shown from the protein consumption income distributions (Figures 3 and 4, and Table 7), and estimated "Engel's curves" (Table 8) individuals can and do, if they can afford it, consume 150 percent of their estimated requirements. Therefore, it may be expected that the effects of increasing income on the maldistribution of protein would be very pronounced.

General economic development deals with the root of the protein problem and offers an effective long run approach to its solution. However, there are substantial numbers in the vulnerable groups who will not receive sufficient income in the near future. Waiting a generation or two for economic development to do away with protein malnutrition means acceptance of continued high morbidity and mortality and of the impairment of physical and mental performance of future adults upon whom economic and social development depends.

Food price subsidies and the socioeconomic concept of food security. The consumer food price subsidy policy in Egypt is devoted mainly to grains, particularly wheat, as subsistance foods. Wheat consumption represents about 63 percent, 45 percent and 53 percent of calorie consumption for urban, rural, and the total population, respectively (Table 3). The average international wheat price is about 2.5 times its local market price, as estimated from the FAO trade yearbook of 1981. The average international price of wheat was about 150 LE per ton in 1981, while in the local market it was sold at 60 LE per/ton to all income classes. Its main processed product is Egyptian bread.

Under current subsidy policy there is an energy surplus above requirements for all income classes (Table 5 and 6). Such a surplus increases with increasing income levels. It may reach 1.5 times requirements for the highest income class. The equivalent wheat tonage of the energy surplus weighted by 1981/1982 population size is about 1,679.22 thousand tons valued at 251.883 million LE at international prices. Some of this excess contributes to obesity in high income groups, a sort of malnutrition, but most of it is simply wasted or may be devoted to animal feeding. However, a significant part of grain energy sources provide significant portions of protein requirements. Without affecting protein adequacy, this surplus could diminish to about 488 thousand tons valued at 73 million Egyptian pounds, all of these coming only from high income groups (above 500 LE/household/year).

Now, what would the impact on energy and protein requirements be in the absence of the present wheat price subsidy? Assuming that other prices were constant and income was also constant, the consumer would diminsh his wheat consumption at free market prices. The magnitude depends upon the wheat price elasticity of each income class demand curve. El-gendi, in 1973, estimated a national price elasticity for wheat of about -0.08, i.e., wheat is on the average a very inelastic commodity. To obtain an imputed estimate for wheat price elasticity for urban and rural residents and for each income class, a hypothesis is formulated. It is, the higher the income elasticity the higher is the price elasticity. An Engel's curve for wheat calorie consumption was estimated for both the urban and rural regions. The best fitting models for each region were those shown in equation (1) for urban and equation (2) for rural residents. The cross-section data of the household budget survey of Egypt in 1974/75 were used in the estimations.

$$\hat{C}i = 1940.3457 - \frac{15716.9525}{\hat{Y}_i}, \quad R^2 = .8222 \ldots\ldots\ldots\ldots\ldots(1)$$

$$\hat{C}_i = 721.5865 + 489.351 \text{ Ln } \hat{Y}_i, \quad R^2 = .8235 \ldots\ldots\ldots\ldots(2)$$

where: $\hat{C}_i$ denotes per-capita daily consumption of wheat calories for an individual and

$\hat{Y}$ denotes annual per-capita total expenditure for an individual.

The two models show that wheat consumption decreases with increasing income levels in urban areas, while it increases up to a given income level in rural areas and then decreases according to progressively increasing income levels.

Table (9) shows the estimated income (expenditure) elasticity for each region by income class. These estimates were derived from models 1 and 2. It is clear that wheat income elasticity in rural areas is much higher than for urban areas because rural consumers substitute maize for wheat at higher income levels. The weighted aggregate national income elasticity for wheat is about 0.21.

The imputed price elasticity for wheat for each region and for each income class was estimated using model 3.

$$Ep_{ij} = (Ep_o) \frac{Ey_{ij}}{Ey_o} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where: Ep_{ij} denotes the price elasticity coefficient of wheat for an income class of the region j.

$\hat{Ep_o}$ denotes estimated national average price elasticity of wheat from the time series data (-0.8).

Ey_{ij} denotes the income elasticity coefficient of wheat for income class i and the region j.

Ey_o is the aggregate average income elasticity of wheat = 0.21.

Accordingly, imputed price elasticity coefficients are shown in Table 9.

Impacts of wheat free price on wheat consumption. As mentioned earlier the free price of wheat means a 1.5 times relative increase in its price. Demand response to such an increase weighted by the price elasticity coefficient, shown in Table 9, indicates that per-capita consumption decreases by about 12.3 percent and 24.9 percent for the lowest income class in urban and rural regions, respectively, while it decreases by .33 percent and

Table 9. Income and Price Elasticities for Wheat Calorie Consumption by Income Class in Egypt.

Elasticity Coefficient	200 L.E.	200- L.E.	350- L.E.	>500- L.E.	600- L.E.	800- L.E.	1,000 L.E.	1,400+ L.E.	Mean
					URBAN				
Y	46.4	57.9	74.0	89.4	108.2	145.6	177.3	322.2	102.4
E_y	.216	.1570	.1210	.0922	.0825	.0578	.0484	.0274	.0867
E_p	-.0818	-.0591	-.0455	-.0366	-.0311	-.0218	-.0182	-.0022	-.0395
					RURAL				
Y	38.0	47.8	62.5	71.8	85.3	79.1	125.5	182.7	63.0
E_y	.4409	.4485	.4185	.3814	.3779	.3262	.2743	.2607	.4116
E_p	-.1660	-.1668	-.1564	-.1436	-.1423	-.1228	-.1033	-.0981	-.1556

Where Y denotes annual per-capita expenditure in L.E.

E_y denotes income (expenditure) elasticity of wheat.

E_p denotes price elasticity of wheat.

Source calculated from models (1), (2) and (3), and Table (4).

14.7 percent for the highest income class in urban and rural regions respectively. The lower income classes would cut their wheat consumption at a much higher rate than the higher income classes (Tables 10 and 11). In addition, actual wheat consumption at free market prices would save about 472.9 million LE as a difference between the subsidized price and the free market price. Therefore, the Egyptian economy would save about 602.8 million LE from the implementation of a free market price policy for wheat.

Impacts of free market price for wheat on energy and protein availability and adequacy. Since wheat is the main food item involved in energy intake and protein intake from the daily diet, it is expected that decreased quantities of wheat would have a great impact on energy and protein adequacy of the traditional diet. As Tables 12 and 13 indicate, in comparison with Tables 5 and 6, the present protein deficit would be much worse.

The protein deficit would be two fold the present one for population segments with less than 500 LE annual expenditure per household. These segments represent about one-half of the urban population and three quarters of the rural population (Tables 12 and 13). In addition, the protein deficit would expand to include those segments with less than 600 LE in urban areas and less than 800 in rural areas. This raises the proportion of the population suffering from protein malnutrition to about 64 percent of the urban population and about 91 percent of the rural population. To treat this severe deficit with a protein-rich food, (even if it is the cheapest one, i.e., milk with 4 percent fat), about 2.5 million tons are required valued at not less than 370 million LE at the international price of milk (212 LE per ton of dissolved dry milk equivalent). In addition about 3.2 million poor rural persons would suffer from an energy gap and about 1.1 million members of the urban population would be in a critical situation with respect to energy.

Table 10. Decreased Wheat Quantities Due to Implementation of Free Market Price of Wheat in Urban Egypt.

Annual Household Expenditure Class L.E.	Urban Population (000) persons in 1981/82[a]	Decrease in Wheat Consumption Due to Free Market Price Per Year			
		Per-Capita		Total Urban	
		Kilograms[b]	Value (L.E.)[c]	Tons	Value (L.E.)
< 200	1,110.116	19.9	2.8	22,091	3,313,656
200 -	4,361.172	16.6	2.4	69,779	10,4668,850
350 -	4,757.642	12.5	1.9	59,477	8,920.650
500 -	2,497.762	10.4	.6	25,977	3,896,550
600 -	3,112.291	8.6	1.3	26,766	4,014,900
800 -	1,486.763	6.4	1.0	9,515	1,427,250
1,000 -	1,546.234	5.2	.8	8,040	1,206,000
1,400 -	951.528	0.6	.2	571	85,650
Total	19,823.508	11.2	1.7	222,210	33,331,500

a Calculated from population structure on Table (5) and total urban population in 1981/82.

b Calculated from tables (4) and (9).

c Valued at international price of wheat (150 LE per ton), in 1981.

Table 11. Decreased Wheat Quantities Due to Implementation of Free Market Price of Wheat in Rural Egypt.

Annual Household Expenditure Class L.E.	Rural Population (000) persons in 1981/82[a]	Decrease in Wheat Consumption Due to Free Market, Price, Per Year			
		Per-Capita		Total Rural	
		Kilograms[b]	Value (L.E.)[c]	Tons	Value (L.E.)
< 200	3,216.765	28.8	4.3	92,643	13,896,450
200 -	7,933.499	28.8	4.3	250,084	37,512,600
350 -	5,324.763	28.8	4.3	153,353	23,002,950
500 -	1,888.927	28.8	4.3	54,402	8,160,300
600 -	1,940.342	28.8	4.3	55,882	8,382,300
800 -	981.348	28.8	4.3	28,263	4,239,450
1,000 -	625.917	28.8	4.3	18,026	2,703,900
1,400 -	442.613	28.8	4.3	12,747	1,912,050
Total	22,354.169	28.8	4.3	643,800	96,570,000

a Calculated from population structure on Table (5) and total urban population in 1981/82.

b Calculated from tables (4) and (9).

c Valued at international price of wheat (150 LE per ton), in 1981.

Table 12. Effect of Free Market Price of Wheat on Per-Capita Energy and Protein Availability by Income Class in Egypt.

Annual Household Expenditure Class in L.E.	Percent of Urban: Population	Percent of Urban: Annual Expenditure	Daily Per-Capita in Kilo Calories: Consumption	Daily Per-Capita in Kilo Calories: Requirements	Daily Per-Capita in Kilo Calories: Net Balance	Daily Per-Capita Protein in Grams: Consumption: Gross Protein	Daily Per-Capita Protein in Grams: Consumption: Net Protein Utilization	Daily Per-Capita Protein in Grams: Requirements in Net Protein Utilization	Daily Per-Capita Protein in Grams: Net Balance in Net Protein Utilization
< 200	5.6	2.62	2,246	2,240	+6	61.8	38.1	44.8	-6.7
200-349	22.0	12.30	2,432	2,324	+108	66.8	40.3	46.5	-6.2
350-499	24.0	17.55	2,561	2,373	+188	71.3	43.8	47.5	-3.7
500 -	12.6	10.97	2,678	2,400	+278	76.7	47.2	48.0	-0.8
600 -	15.7	16.6	2,783	2,406	+377	78.3	48.5	48.0	+0.5
800 -	7.5	10.6	3,075	2,416	1659	86.0	53.9	48.3	+5.6
1,000 -	7.8	13.5	3,151	2,438	+713	89.3	56.3	48.8	+7.5
1,400 +	4.8	15.86	3,418	2,459	+959	100.4	64.2	48.2	+15.0
Urban Mean	100	100	2,742	2,378	+364	69.0	42.6	47.6	-5.0

Calculated from Tables 4, 5, 6, 9 and 10.

Table 13. Effect of Free Market Price of Wheat on Per-Capita and Protein Availability by Income Class in Rural Egypt.

	Percent of Rural		Daily Per-Capita in Kilo Calories			Daily Per-Capita Protein in Grams			
						Consumption			
Annual Household Expenditure in L.E.	Population	Annual Expenditure	Consumption	Requirements	Net Balance	Gross Protein	Net Protein Utilization	Requirements in Net Protein Utilization	Net Balance in Net Protein Utilization
< 200	14.39	9.26	2,077	2,257	-180	55.1	33.8	45.2	-11.3
200 -	35.49	27.62	2,171	2,314	+143	58.1	35.6	46.3	-10.7
350 -	23.82	23.62	2,348	2,327	+ 21	63.1	38.8	46.5	- 7.7
500 -	8.45	9.63	2,577	2,358	+219	70.8	43.9	47.2	- 3.3
600 -	8.68	22.75	2,766	2,331	+435	73.8	45.9	46.6	- 0.7
800 -	4.39	6.77	3,109	2,327	+782	84.8	52.5	46.5	+ 6.0
1,000 -	2.80	5.59	3,416	2,376	+110	99.8	62.7	47.5	+15.2
1,400	1.98	5.76	2,394	2,206	+965	106.8	68.8	54.1	+14.7
Rural Mean	100	100	2,394	2,324	+ 70	64.2	39.8	46.5	- 6.7

Source: Calculated from Tables 4, 5, 6, 9 and 11.

<u>Burden of free market price for wheat on consumer budget</u>. Since wheat is a subsistance food with an inelastic demand curve, a great burden would be added to the low income consumer's budget under a free market price policy.

Table 14, shows that expenditure for wheat under free market prices may raise the average propensity to consume food (percent food expenditure/total expenditure), to about 100 percent or more, for low income groups, assuming income and other prices are kept constant.

The Agricultural Policy and Socioeconomic Concept of Food Security: An Over-View

It is well recognized that concentration on improving yields of cereals (wheat, corn and rice) has been associated with a decrease in the per-capita production and a rise in the relative price of legumes. Legumes are an important source of concentrated protein to complement cereal diets. The population, however, has been able to afford less of them, relative to cereals. Therefore, the nutritional status of the population has deteriorated in some instances.

If agriculturalists are encouraged by nutritionists and planners to believe that populations can subsist on cereal diets, there will continue to be a lag in the production or development of better sources of protein, and the diets of the poor will deteriorate further.

Another consequence of the lack of concern for maintaining a proportionate availability of legumes, oilseeds, and animal protein has been a loss of foods of greater caloric density than that of cereals. Oilseeds, in particular, are not only good sources of protein but, as their name indicates, are also sources of fats and oils which are the most concentrated sources of food energy. Just as cereal diets are marginal in their protein value

Table 14. Percent Food Expenditure/Total Expenditure Under Present Wheat Price Subsidy Policy and Under Proposed Free Market Price Policy for Wheat.*

Annual Household Expenditure Class in L.E.	Percent (Food Expenditure/Total Expenditure)			
	Urban		Rural	
	Under Subsidy Policy	Under Free Price Policy	Under Subsidy Policy	Under Free Price Policy
< 200	61.7	112.8	67.0	135.9
200 -	54.7	97.6	63.0	115.0
350 -	51.7	80.5	62.5	95.8
500 -	49.0	68.3	60.6	80.9
600 -	47.5	61.9	54.9	67.0
800 -	44.2	55.8	54.4	65.9
1,000 -	40.6	50.6	51.4	62.5
1,400 +	33.6	38.8	43.0	51.1
Total	46.0	62.2	57.9	54.8

* Assuming constant income and other prices.

Source: Calculated from Tables 4, 9, 10 and 11.

relative to both their bulk and caloric density, so also are they marginal in their energy ratio relative to their bulk. In addition, it is useless to suggest that a child can obtain sufficient protein and calories from a cereal diet if he merely eats more of it. Young children on some cereal diets often do not have the capacity to ingest the large quantities of food that would be necessary to satisfy all of their nutrient requirements.

It is also apparent that with the continuing rapid increase in world population it will be far easier and cheaper to provide the basic staple, whether it is a cereal or a starchy root, than it will be to provide the legumes, oilseed or animal protein needed in addition by major vulnerable segments of the population, i.e., infants and young children, pregnant and lactating women, and persons effected by the stress of infections or other diseases. For this reason, the Protein Advisory Group (PAG) of the United Nations continue to emphasize the desirability of genetic improvement in the protein characteristics of cereals and other staple food crops.

Apart from increasing consumption of milk or other protein foods of animal origin, which may not be feasible, the alternatives are: (a) to encourage consumption of more legumes with a smaller proportion of cereals in diets and (b) to supplement cereal consumption with a food with a higher protein concentration such as a peanut or soy-preparation.

The latter alternative raises the question of the importance of evaluating the feasibility of soybeans in two alternative uses: either for poultry feeding as in the present situation or as a processed food for the human diet.

A Proposed Crash Program

The study indicates that to raise income through economic development to do away with protein malnutrition means waiting a generation or two, and relying on a free market price for wheat makes protein malnutrition worse, particularly for low income groups who are the majority of the population. There is therefore a need for specific action programs, "A Crash Program" for the nutritional protection of vulnerable groups. Attention to the nutritional needs of these groups, including the need for suitable protein-rich foods, will continue to be required for many years.

Traditional Egyptian diets may be improved with respect to protein through home preparation of legumes. Food legumes are good sources of protein and the cheapest ones also, when they are used in conjunction with cereal diets (Cameron and Hofvender, 1971). However, there is a concern for adding still other high quality types of protein, because the amounts of legumes consumed relative to cereals is very small (Table 3), and the considerable bulk of a starchy diet with a poor ratio of protein to calories makes it extremely difficult for the young child to eat enough to meet his requirements. Under these circumstances, increasing consumption of milk as the least cost item among animal products in terms of net utilizable protein (Table 15), is recommended. The deficit in utilizable protein among lower income groups in urban or rural areas (less than 500 LE/household/year) should be covered by providing additional milk (enriched with iron) in a proposed crash program. Estimated values for such a program are calculated on the basis of the international price of dissolved imported powdered milk equivalent (4 percent fat) in 1980/1981. The supplemented total milk required for about 10 million persons in urban areas is about 252 thousand tons and for

Table 15. Average Value Per 1-gram Net Protein Utilization From Different Animal Product Substitutes and Wheat and Legumes.

Item	Red Meat	White Meat	Eggs	Liquid Milk Equivalent 4% Fat	Wheat	Legumes
Average Boarder Price Per Ton (L.E.)	1,600	1,280	1,200	212	150	150
Percent Protein Content	18.6	12	12.4	3.5	11.6	22.2
Percent Protein Quality	67	70	94	85	60	60
Net Protein Utilization Per Ton (NPU) Kgs.	124.62	84.0	116.56	19.75	69.6	133.2
Average Border Price Per gm NPU PTT	1.28	1.52	1.03	6.71	0.22	0.11

Source: Calculated from:

Food and Agriculture Organization: Trade Year Book, Rome, 1981.

16.5 million persons in rural areas is about 792 thousand tons (Table 16). Total national cost for such a program will be about 221 million Egyptian pouonds, about 76 percent of it for rural areas. In general this program will provide about 90 grams per day per person of additional milk for about 77 percent of the total Egyptian population, i.e., a total quantity of about one million tons.

Table 16. Additional Milk Required to Overcome Protein Malnutrition in Low Income Classes in Egypt.

Annual Household Expenditure Class (L.E.)	Population in (000) persons	Additional Required Milk Per-Capita Per Year		Total Additional Milk Required		Energy
		Kilograms	Costs L.E.	Tons	Costs L.E.	Net Balance (Calories)
URBAN						
< 200	1,110.116	31.9	6.8	35,413	7,567,556	+273
200-	4,361.172	34.1	7.2	148,716	31,527,792	+342
350-499	4,757.642	14.3	3.0	68,034	14,423,208	+342
S-Total	10,228.93	24.6	5.2	252,163	53,458,556	+329
RURAL						
< 200	3,216.765	65.0	13.8	209,090	44,327,080	+351
200-	7,933.494	57.2	14.2	453,796	96,204,752	+269
350-499	5,324.763	24.2	5.1	128,859	27,318,108	+355
S-Total	16,475.022	48.1	10.2	791,745	167,849,940	+318
Total	32,950.044	31.7	6.7	1,043,908	221,308,496	+261

Source: Calculated from Tables 5, 6 and 15.

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