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AGRICULTURAL DEVELOPMENT SYSTEMS EGYPT PROJECT

UNIVERSITY OF CALIFORNIA, DAVIS

**PATTERNS OF CONSUMPTION AND NUTRITIVE VALUE OF
HUMAN DIETS IN FOUR EGYPTIAN VILLAGES OF THE RICE ZONE**

by

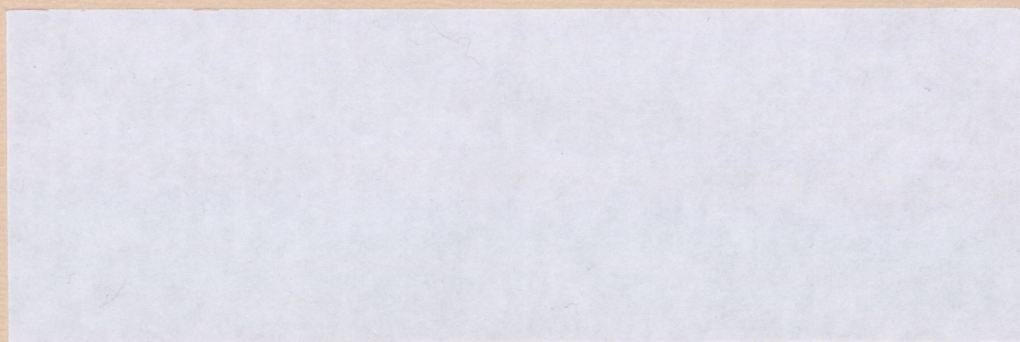
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PATTERN OF CONSUMPTION AND NUTRITIVE
VALUE OF HUMAN DIETS IN FOUR EGYPTIAN
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For various reasons, agricultural performance has failed to keep pace with growing food requirements in Egypt. The rapid growth of the population in recent decades, the prospects of its continuation in the future and the decline in land/per capita ratio from 0.3 feddan/person in the 1950's to 0.15 feddan/person in the 1980's, along with the desire for improved and satisfactory levels of nutrition, has brought food and nutrition problems once again to the center of attention.

Increased food production cannot be achieved through improving physical agricultural inputs alone. The human factor is important in any kind of development, since it is the people themselves who largely determine the rate and direction of development. Factors which contribute to family well-being are often interdependent with agricultural production, and are always related to economic and social progress, as agricultural production is frequently limited by malnutrition and disease in the rural family. Moreover, food shortages could be overcome if farmers were able to work more efficiently. Health and good nutrition are important in determining working capacity.

Studies throughout the world have indicated that inadequate energy intake may have health implications. Inadequate dietary protein affects the health and efficiency of future generations since it may have grave deleterious effects on infants and young children. Malnutrition is widely prevalent throughout the world, particularly in developing countries.

Dietary studies are often conducted to explain the state of health and nutrition for a population, and to investigate whether there is some correlation between health problems, nutritional intake and socio-economic

status. Such studies are also the bases for planning and conducting nutrition education programs aimed at improving the nutritional status of the group. Data on kinds, quantities, and the nutrient content of the food people eat contribute much to the knowledge of food habits and nutritive values of diets.

Information on the nutritional patterns of the Egyptian population, especially the rural population, is lacking. This study therefore was planned to provide information on:

- a) human food intake in four Egyptian villages in the rice zone;
- b) the nutritive value of diets;
- c) general trends of caloric consumption;
- d) the quality of protein intakes; and
- e) the levels of absorbable and available iron in food consumed.

MATERIALS AND METHODS

This work is a part of a program involving a survey of landholders in ten representative Egyptian villages in five agronomic zones. These zones are:

1. the rice zone in the northern delta;
2. the traditional crop zone in lower Egypt;
3. the fruit and vegetable zone which includes the governates of Qualubia, Giza, and the villages near Cairo and Alexandria;
4. the traditional crop zone in mid-Egypt; and
5. the sugarcane zone in Upper Egypt.

Selection of these villages was based on information taken from two previous studies in Egypt: Farm Management Survey (Ministry of Agriculture), and

Egypt: Major Constraints to Increasing Agricultural Productivity (USAID).

The rice zone was chosen for this study at the beginning of the program because its population represents 40 percent of the total study sample.

This particular investigation was conducted in four villages of the rice zone. The one hundred families chosen at random from the four villages were distributed as follows: 25 from El Arimon, 15 from Kamha, 35 from Manshaat El Gamal, and 25 families from Shenou. Information was gathered on: a) relevant socio-economic factors and, b) foods consumed by the family for 24 hours over four days in different seasons of the year. The nutritive value of foods was computed from Food Composition Tables for Use in the Middle East (Pellet and Shadarevian, 1970), and The Amino Acid Content of Foods (FAO, 1970).

For each individual in the sampled households in each of the four villages data were obtained on average food consumption for each of nine food groups. The caloric content of each food and the total number of calories were then calculated and classified as being from: a) separated or unseparated fats of animal or plant origin, b) carbohydrates (distinguishing between starch and sugar), and/or c) animal and plant protein. These values were then expressed as percentages of the total caloric intake. In addition household food intakes were analyzed to assess dietary adequacy and ascertain whether they resulted in desirable levels for energy sources (Perisse, et al., 1969, Passemare, et al., 1979). Intakes of dietary protein were evaluated using the method described in 1973 by the FAO/WHO Committee on protein requirements. The amino acid content of the foods consumed and the resulting amino acid content of the mixed protein were compared using egg protein as a benchmark. The percentage of absorbable iron in the diet was calculated using the method described by Monsen et al., 1978.

RESULTS AND DISCUSSION

1. Food Consumption

Table 1 summarizes mean food intakes in grams for the nine main food groups for the four villages. The data show consumption levels for the food groups differ and are not consistent for the four villages. In general, mean consumption levels for legumes, sugar, and fat are in agreement with values reported by Nawar (1974, 1979) and the Arab Organization for Rural Development (1975), but average consumption levels in the remaining groups are higher than corresponding values in the aforementioned studies.

a. Milk and Milk Products

The mean intake for this group of foods ranged from 109 gm/person-day in Kamha to 75 gm/person-day in Manshaat El Gamal. Consumption of milk, as a drink, was relatively lower than consumption of cottage cheese. This might be due to the general belief that milk is a food for infants and sick people (Nawar, 1974). Also, people prefer to remove the milkfat for butter production, and process the remaining skim milk into cottage cheese for marketing.

b. Animal Protein Group

This group is made up of meat, poultry, fish, and eggs. The highest average consumption level of 221 gm/day was found in Shenou, while the lowest, 103 gm/day, was found in Manshaat El Gamal. In general, consumption is relatively high compared to the levels reported in other studies. Fish constitutes a major animal protein group food in three of the villages and poultry in the other.

c. Legume Group

This group consists mainly of broadbeans, lentils and beans. Average consumption levels ranged from 62 gm/day in Manshaat El Gamal to 26 gm/day in Kamha. Though the major legume in Egypt is broadbeans, no broadbean consumption was reported in El Arimon.

d. Grain and Grain Product Group

This group consists mainly of wheat, maize, and rice as grains, and macaroni as a grain product. Consumption of bread was relatively low in the four villages. This is not surprising since this is the rice zone. Consumption levels ranged from 865 gm/day in Shenou to 620 gm/day in El Arimon and Manshaat El Gamal.

e. Starchy Food Group

This group is mainly composed of potatoes and colcasia. Consumption ranged from 73 gm/day in Shenou to 56 gm/day in El Arimon.

f. Fruit and Vegetable Group

This group consists of citrus fruits, as the major group and tomatoes and onions as the major vegetables. The highest level of consumption of fruits and vegetables was found in Shenou, while the lowest was in Kamha and Manshaat El-Gamal, respectively.

g. Sugar Group

Sugar was consumed mainly in beverages such as tea and coffee. The joint report of FAO/WHO (1973) states that consumption of sugar in eastern Mediterranean countries is largely linked to tea drinking. The highest consumption level (73 gm/day) was found in Manshaat El Gamal, while the lowest was in Kamha.

h. Fat Group

This group consists mainly of oil among the plant fats, and butter, ghee and other fats of animal origin. The latter are mainly consumed on special occasions during the year. The highest consumption of oil was found in Shenou, while El Arimon was highest for animal fat. The lowest consumption level for lipids in general, was found in Manshaat El Gamal.

2. Caloric Intake

The data in Table 2 illustrate intakes and patterns of consumption of energy producing nutrients in the four villages. The results reveal that the mean individual energy intake in the rice zone is relatively high as compared to levels recommended by FAO/WHO (1974). Energy intakes ranged from 4,317 calories/day in the village of El Arimon to 2,789 calories/day in the village of Manshaat El Gamal. Nawar, (1979) reported values of 2,112 calories/day in the Abis zone in the newly reclaimed areas of Egypt.

Average intakes of lipids, sugar, protein, and starch differed among and were not consistent for the four villages. The village of El Arimon had the highest intakes of lipids and starch, while the lowest intakes of both of these food components were found in Manshaat El Gamal. The highest intakes of sugar and protein were found in Manshaat El Gamal and Shenou, respectively. The lowest intakes of sugar and protein were found in Kamha.

Perisse et al. (1969), using food balance sheets for Egypt for 1962, reported values of 30.1 gm/day for lipids, 38 gm/day for sugar, 12.1 gm/day for animal protein, and 66.6 gm/day for plant protein. The Egyptian food balance sheets for 1976 showed higher consumption values than those reported in the last decade. Values from the food balance sheets in 1979 were 3,774 calories, 68.5 gm/day for lipids and 106.1 gm for protein. The mean daily

consumption of separated animal and plant fats were 11 and 17.2 gm/day, respectively, and it was 39.8 gm/day for unseparated fat. Values for animal and plant protein were 13 and 93.1 gm, respectively. Nawar (1979) reported values of 57.5 gm for total calories with 44 gm for sugar, 61.3 gm for total protein, and 293.4 gm for starch.

Dietary intakes were then studied according to landholding class, using the groupings: a) less than one feddan, b) 1-4 feddans, c) and greater than 4 feddans. Results are shown in Table 3. They indicate that the variation in consumption levels is not consistent with the variation in landholdings.

3. The Share of Nutrients in Energy Supply

The contributions of the three main energy sources are shown in Table 4. The data shows some differences in the share of carbohydrates (starch and sugar), lipids and protein in the total energy supply among the four villages. The percent of calories that are from lipids, protein and carbohydrates (starch and sugar) are 19.3 percent, 12 percent, and 68.7 percent, respectively. These values are in agreement with those reported by Francois (1968) and Perisse, et al. (1969), and other studies throughout the world. The developed countries, however, tend to derive more of their calories from fats (Table 4). In Britain, Passmore, et al. (1979) report values of 10.8 percent for protein, 38 percent for lipids, and 51.2 percent for carbohydrates.

In Egypt, Nawar (1979) reported values of 11.6 percent for protein, 24.1 percent for lipids, and 64.3 percent for carbohydrates. In this study, the percentage of calories derived from lipids differed slightly among three of the villages (20.8-21.9 percent), with Manshaat El Gamal being considerably

lower at 11.9 percent. This was due to the low consumption level of lipids, from both plant and animal sources.

Consumption of the milk and meat groups, in general, was relatively low (Table 1). Consumption of milk and meat is required for good health for they are dietary sources of high quality protein. In addition, milk is a good source of calcium. Consumption of oil is needed to furnish the body with the essential fatty acids. These acids have a structural function in cell membranes and are substrates for biosynthesis of prostaglandins which play a regulatory role in many cellular processes. Furthermore, fats that are rich in unsaturated fatty acids are correlated with a decreased degree of atherosclerosis (Vergroensen, 1975).

It is generally advised that a balanced diet provide approximately 25-30 percent of the energy intake in the form of fat with at least 2 percent of the total as essential fatty acids.

Like lipids, the proportion of calories supplied by carbohydrates differed slightly among the villages with values ranging from 66.2 percent to 74.5 percent. This relatively high percentage of calories derived from carbohydrates is due to the relatively high consumption of sugar (Table 1).

Consumption of carbohydrate foods is important as they provide a filling material and are an economic source of energy. In addition, if dietary protein is to be used in the most economic way, it should be accompanied by carbohydrates in the same meal (Davidson and Passmore, 1975).

Carbohydrate is a more efficient fuel for muscular exercise than either protein or fat (Wohl and Goodhart, 1968). Carbohydrates are also needed for complete oxidation of lipids to prevent ketosis. One carbohydrate, specifically glucose, is the principal source of fuel for the nervous system (Nawar, 1976). A starch diet has a lowering effect on plasma lipid, while a

high sugar diet has a lipemic effect (Anter and Olson, 1965). The substitution of sugar for starch in a diet alters the blood lipids and it has been reported that the increased consumption of sucrose may have led to increased arteriosclerosis, diabetes, and is almost certainly an important cause of dental caries (Wohl and Goodhart, 1968). It has been recommended that the diet should contain carbohydrates that furnish from 50 percent to 65 percent of the caloric need of the human body.

The amount of calories derived from total protein ranged from 10.7 percent to 13.6 percent. The results are in agreement with those reported by Howe and Jansen (1964), Francois (1968), Perisse et al. (1969), and Nawar (1974 and 1979). As proteins are needed for growth and maintenance they should be present in the diet to furnish from 10 percent to 12 percent of the total caloric need. The data in Table 5 illustrates mean calories supplied by nutrients as percentages of total calories as compared to other studies reported by Perisse et al. (1969) and Nawar (1979).

The structure of the human diet is partly a function of income. However, each country's diet also differs in ways partly due to its history and dietary heritage. The consumption habits of the developed world should not necessarily be the goal for poorer countries. Passmore, et al. (1979) in Britain recommended that for a better diet 11.3 percent, 34.9 percent and 53.8 percent of total calories should be derived from protein, lipids, and carbohydrates, respectively. They advised people to reduce their consumption of fats, oils, and sugar. Increased consumption of visible fats has been associated with increased incidence of coronary heart disease as there is considerable, though not conclusive evidence that a high fat intake contributes to this disease.

Excessive intake of sucrose is not beneficial to the body either, as it provides the body with empty calories. In addition, it is believed that high intakes of sugar contribute to diabetes and coronary heart disease.

The distribution of households according to their intakes of calories and protein appear in Table 6. The results indicate that almost all households consume more energy and protein than necessary.

The distribution of households according to desirable sources of energy appears in Table 7. The data indicate that the majority of the people in the rice zone derive most of their calories from carbohydrates, with intakes above the desirable level, and only 25 percent of the households consume carbohydrates at a desirable level. Unlike carbohydrates, lipids are consumed by most of the households at a lower level than recommended. In the case of protein, the consumption of 55 percent of the households was at a desirable level and 41 percent consumed more protein than they needed.

4. Protein Quality and Consumption

Mankind faces numerous problems in providing enough food for the world's rapidly increasing population. In many developed countries the diets of most of the people are adequate in both quality and quantity. This is in contrast to conditions in developing countries where hunger and malnutrition are widespread.

Under the rubric of hunger and malnutrition, the greatest problem is that which results from inadequate protein in the diets of a large proportion of the population in the developing countries. This problem concerns the health and the efficiency of future generations because it affects infants and young children. Protein deficiency reduces growth rates and impairs health. There is evidence from studies of experimental animals and of man that shows

that the basic biological processes of growth and development are adversely affected by protein and energy malnutrition.

It is important to study protein nutrition and find the factors that are involved. Information concerning dietary protein intake is needed. Although it is important to verify the quantity of protein, still greater importance must be attached to an evaluation of the quality of the protein.

Table 8 contains average daily intakes of protein in the four villages. Total protein intakes are fairly adequate as compared to amounts recommended by FAO/WHO (1973).

Animal protein consumption is not as low here as earlier studies have found. The average intake is 28 gm, which equals 26 percent of the total dietary protein. Nawar (1979) reported a value of 9.1 gm which equals 14.8 percent of the total dietary protein. In the United States, the mean daily intake of animal protein is 65.4 gm which equals 66.7 percent of the total dietary protein intake (ARS, 1969). How efficiently protein is utilized depends on both the quality and the quantity of the protein and the adequacy of the total diet as well as other physiological and environmental factors. Animal proteins are superior to plant proteins. In addition, animal proteins are the most available for absorption.

Although it is important to determine the quantity of protein, greater importance must be attached to an evaluation of the protein quality. For this reason, the protein quality has been scrutinized more closely herein. The method proposed by FAO/WHO in 1973 has been used for the evaluation.

The quality of the protein was estimated by comparing the amino acid content of the mixed dietary protein to the amino acid pattern of egg protein. The results of the comparisons expressed as scores for the four

amino acids which are apt to be deficient are given in Table 9, in which the first and second limiting factors also appear.

The data reveal the most limiting amino acid is tryptophan, except in Kamha where it is lysine. The second is total sulphur amino acids, except in Kamha where tryptophan is second most limiting. These results are in agreement with results reported by Nawar (1979).

These scores, along with the consumption levels of protein, indicate that protein nutrition among the people needs more consideration. Low levels of dietary protein impair health and reduce bodily efficiency. Excess protein intake above body needs, however, is not stored, as is the case with some other nutrients. There is "a labile store" which does not exceed one percent of the body's protein. Such a small amount is not considered a store. Extra protein is used in energy production, a process which is wasteful both for physiological and economic reasons. First, this process requires more energy than it liberates. Hence, energy derived in this way from the protein is less efficiently used than energy derived directly from carbohydrates ingested as such. In addition, more work is needed to excrete extra nitrogen from high protein intakes which puts a strain on the kidneys. Secondly, most foods rich in protein are more expensive than foods rich in carbohydrates.

5. Iron Consumption and Absorption

Nutritional anemia is widely prevalent in many parts of the world, particularly in developing countries. Although many nutrients and cofactors are involved in the maintenance of a normal hemoglobin concentration, the most common cause of anemia is iron deficiency.

Studies have shown that anemia is associated with: a) an increased risk of maternal and fetal morbidity and mortality (Gatenby and Lillie, 1960),

b) anorexia resulting in a reduced food intake and the possible development of other deficiencies (Judisch, et al., 1966), c) affected bodily function (Dallman et al., 1967), d) increased susceptibility to infection (Elwood, 1970), and e) decreased working capacity (Cifuentes and Viteri, 1972).

Table 10 contains the average daily iron intake as contributed from the food groups. The total iron intake ranged from 37-40 mg in Manshaat El Gamal to 52.2 mg in El Arimon. Nawar (1979) reported an average of 16.1 mg/day in Abis, a new Egyptian village. When comparing the iron intake with recommended levels it was found that values were 290 percent, 260 percent, 207 percent, and 274 percent in El Arimon, Kamha, Manshaat El Gamal, and Shenou, respectively.

The high intake of iron might be due to the high consumption of legumes, whole grains and other foods rich in iron. In the United States, a study done by ARS (1969) showed that the iron intake was on average 167 percent of the recommended levels. There are also large differences in the sources of iron consumed for Egypt and the United States. The data in Table 10 show that in Egypt plant sources furnish from 94.67 percent to 96.94 percent with an average of 95.5 percent. Thus, animal sources contributed only 4.5 percent. In the United States it was 52 percent (ARS, 1969). Nawar (1979) reported a value of 6.6 percent in Abis, a value which is in agreement with that found in this study. This indicates that the ratio of iron furnished by plant to that from animal sources is 21.2:1 while in Abis it was 14:1; in the United States, 0.9:1.

It is not always easy to account for iron deficiency anemia in terms of inadequate iron intake. The wide difference in iron availability in foods may be a contributing factor to the high prevalence of anemia in many countries. In Venezuela, Layrisse (1968) reported that iron deficiency anemia

is widespread, although iron intakes are high but almost entirely from vegetable sources. Nawar (1974 and 1979) found that iron intake in some Egyptian villages was fairly good but anemia was prevalent, especially among women and children. She suspected that this anemia might be due to parasitic infection and/or a lack of iron absorption.

As with all essential nutrients, adequate amounts of iron must be absorbed to maintain optimum body concentrations. The amount of iron which must be ingested to achieve the required daily absorption depends to a large extent on the type of diet. Heme iron in animal foods is much more readily absorbed than iron in vegetables and cereals. Absorption of nonheme iron is blocked by the presence of cereal phytates, phosphates, carbonates, and possibly by other substances common to nonanimal foods. Absorption is enhanced by the presence of ascorbic acid or of animal liver, or muscle from meat or fish (Moore, 1973; Martinez-Torres et al., 1974; Arlin, 1977; and INGAA, 1977). It has been reported that anemia is prevalent in hot climates where parasitic infestation is common and where diets are primarily of vegetable origin (Arlin, 1977). Thus, it is important to determine iron absorption.

Absorbable iron was calculated as described by Monsen et al. (1978). This method required the computation of five variables: total iron intake, heme and nonheme iron, ascorbic acid, and the levels of meat, poultry and fish consumption. On the basis of ascorbic acid concentration and the quantity of animal tissue, the meats were classified as low, medium, or high availability for nonheme iron. Low availability meals are those having less than 30 gm of animal tissue and less than 25 mg of ascorbic acid which decreases the availability of nonheme iron to 3 percent. Medium availability meals are meals having 30-90 gm animal tissues or having 25-75 mg of ascorbic acid

which raises its availability to 5 percent. A meal having more than 90 gm animal tissues or 75 mg ascorbic acids, or 30-90 gm animal tissues plus 25-75 mg ascorbic acid is classified as a high availability meal with 8 percent absorption of nonheme iron. The absorption factor for heme iron is 23 percent as mentioned by Monson et al. (1978).

Table 11 shows that the percentage of absorbable iron ranges from 7.72 percent in Kamha to 8.22 percent in Shenou with an average of 8.07 percent, which is equivalent to 3.65 mg. Modern knowledge of the existence of two categories of iron in foods, i.e., heme and nonheme compounds, and of dietary factors influencing their absorption makes it possible now to replace the previous estimate of an average of 10 percent absorption of dietary iron by a more precise concept. This concept provides a basis for increasing the availability of dietary iron through the selection of appropriate food components of individual meals. Application of this concept promises to improve the iron nutritional status of population groups in need of more iron or with excessive iron absorption (Monson et al., 1978). Therefore, it is recommended that the calculation of absorbable iron as illustrated be used in diet planning and in the evaluation of iron intake. This is a more appropriate method than the calculation of total iron availability which presumes that iron absorption is 10 percent as it depends on source and dietary composition.

In general, dietary surveys should have as adjuncts or be followed by studies of the nutritional and health status of the people. Studies concerning landless workers are also needed. Special consideration should be directed toward food subsidies.

In addition, nutrition education programs are needed to teach people why and how to choose a balanced diet that meets body needs using the

available local resources. The utilization of food resources which may involve changing food habits can be achieved only by education of all the people. Furthermore, many malnutritional diseases whether over or under nutrition could be prevented if the people in general and women in particular knew how to make the best use of the available foods. Food prejudices and false beliefs are known to be impediments in the way of adequate nutrition.

Education is a powerful instrument of national development. By recognizing present and future environmental trends and population needs, education can be designed to transfer knowledge and encourage relevant behaviors required for the continuing health and progress of the society.

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Table 1: Mean Daily Consumption According to Food Groups (gm/person)

Village	Milk Group	Animal Protein Group	Legumes	Grain Product	Starchy Foods	Vegetables	Fruits	Sugar	Fat		
									Plant	Animal	Total
El Arimon	92	115	30	620	56	326	14	62	20	43	63
Kamha	109	188	26	842	69	318	74	45	27	11	38
Manshaat	75	103	62	620	69	280	59	73	23	6	29
El Gamal											
Shenou	80	221	43	865	73	393	452	66	29	25	54
Mean	89	156.75	40.25	736.75	66.75	324.25	149.75	61.50	25	21	46

Table 2: Individual Daily Intake and Pattern of Nutrient Consumption in the Four Villages.

Source	El Arimon	Kamha	Manshaat El-Gamal	Shenou	Mean
I. <u>Energy</u>					
Total intake (calories)	4,317	3,160	2,789	3,892	3,539
Percent of recommended level	144	105	93	130	118
II. <u>Energy Producing Elements (gm)</u>					
Total Lipids	102	77	37	90	76
Sugar	62	45	73	66	62
Total Protein	116	94	95	118	106
Starch	671	477	446	586	562
III. <u>Pattern of Lipids (gm)</u>					
a. <u>Separated</u>					
Animal	43	11	6	25	21
Plant	20	27	23	29	24
b. <u>Unseparated</u>					
	39	39	8	36	31
IV. <u>Pattern of Protein (gm)</u>					
Animal	24	30	25	34	28
Plant	92	64	70	84	78

Table 3. Individual Daily Intake and Pattern of Nutrient Consumption

Village	El Arimon			Kamha			Hannhaat El Gamal			Shenou			Mean		
	1 feddan or less	1-4 feddan	>4 feddan	1 feddan or less	1-4 feddan	>4 feddan	1 feddan or less	1-4 feddan	>4 feddan	1 feddan or less	1-4 feddan	>4 feddan	1 feddan or less	1-4 feddan	>4 feddan
I. Energy	4,317			3,160			2,789			3,892			3,539		
Total Intake (calories)	4,128	4,487	4,335	2,198	3,505	3,777	2,939	2,789	2,640	4,383	4,076	3,216	3,412	3,714	3,492
Percent of recommended level	106	115	111	56	90	97	75	72	68	112	105	82	87	95	89
II. Energy producing food corporate (gm)	114			105			110			118			112		
Protein	116	118	108	61	119	134	117	128	85	127	127	101	105	123	107
Lipids	102			77			37			90			76		
	83	112	111	57	85	88	34	38	38	102	97	72	69	83	77
Carbohydrates	1,087			965			701			988			936		
	1,120	1,069	1,073	1,015	869	1,019	726	709	669	1,073	969	922	984	904	921
III. Protein Intake	97			66			30			85			83		
Plant	95	93	86	29	80	90	101	109	59	90	87	77	79	92	78
Animal	23			38			20			34			79		
	21	25	22	32	39	44	16	19	26	37	40	24	26	31	29

^ - average

Table 4. Contribution of Main Energy Sources

Source	El Arimon		Kamha		Manshaat El Gamal		Shenou		Mean	
	Calories	Percent	Calories	Percent	Calories	Percent	Calories	Percent	Calories	Percent
Lipids	918	21.3	693	21.9	333	11.9	810	20.8	684	19.3
Protein	464	10.7	376	11.9	380	13.6	472	12.1	424	12.0
Sugar	248	5.7	180	5.7	292	10.5	264	6.8	180	5.1
Starch	2,687	62.3	1,911	60.5	1,784	64.0	2,346	60.3	2,251	63.6
Total	4,317	100	3,160	100	2,789	100	3,892	100	3,539	100

Table 5: Calories Provided by Nutrients as Percentages of Total Calories in Different Countries

Country	Total Calories	Separated Edible Lipids	Unseparated Lipids	Sugar	Plant Protein	Animal Protein
This Study	3,539	11.4	7.9	5.1	8.8	3.2
Abis. Egypt	2,112	14.4	9.1	8.1	9.9	1.7
United States	3,100	16.1	25.0	16.0	3.5	8.3
Germany	2,960	21.2	17.8	11.7	4.3	6.6
Kenya	2,118	9.0	14.4	5.6	8.9	4.7
India	1,977	6.3	6.5	2.9	9.5	1.1
Sudan	1,940	9.0	14.4	5.6	8.9	4.7

Table 6: Distribution of Families According to Adequacy of Nutrient Intake as Related to Requirements

Source	El Arimon		Kamha		Manshaat El Gamal		Shenou		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
<u>Energy</u>	-	-	1	6.7	3	8.6	-	-	4	4
Less	-	-	-	-	-	-	-	-	-	-
Adequate	25	100	14	93.3	32	91.4	25	100	96	96
More										
Total	25	100	15	100	35	100	25	100	100	100
<u>Protein</u>										
Less	-	-	-	-	-	-	-	-	-	-
Adequate	-	-	-	-	-	-	-	-	-	-
More	25	100	15	100	35	100	25	100	100	100
Total	25	100	15	100	35	100	25	100	100	100

Table 7: Distribution of Families According to Percentages of Calories Derived from Major Nutrients as Related to Desirable Levels.

Source	El Arimon		Kamha		Hanshaat El Gamal		Shenou		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Energy										
Below	2	8	4	26.7	2	5.7	-	-	8	8
Desirable	6	24	6	40.0	4	11.4	9	60	25	25
Above	17	68	5	33.3	29	82.3	16	40	67	67
Total	25	100	15	100	35	100	25	100	100	100
Protein										
Below	2	8	-	-	1	2.8	1	4	4	4
Desirable	22	88	3	20	15	42.0	15	60	55	55
Above	1	4	12	80	19	45.2	9	36	41	41
Total	25	100	15	100	35	100	25	100	100	100
Lipids										
Below	16	64	10	66.7	32	91.4	19	76	77	77
Desirable	8	32	3	20.0	2	5.7	6	24	19	19
Above	1	4	2	13.3	1	2.9	-	-	4	4
Total	25	100	15	100	35	100	25	100	100	100

Table 8: Daily Protein Intake (gm/person)

Protein Source	El Arimon		Kamha		Manshaat El Gamal		Shenou		Mean	
	gm	percent	gm	percent	gm	percent	gm	percent	gm	percent
Plant	92	79	64	68	70	74	84	71	78	74
Animal	24	21	30	32	25	26	34	29	28	26
Total	116	100	94	100	95	100	118	100	106	100

Table 9: Amino Acid Scores

Village	Amino Acid Score (percent)			Tryptophan	Limiting Amino Acids	
	Lysine	Threonine	TSAA*		First	Second
El Arimon	56	66	49	35	tryp	TSAA
Kamha	54	98	71	62	lys	tryp
Manshaat El Gamal	58	64	45	29	tryp	TSAA
Shenou	65	70	51	36	tryp	TSAA

*Total sulphur amino acids

Table 10: Dietary Iron Intake from Foods Eaten Daily Per Person

Village	Milk Group		Animal Protein Groups		Legumes		Grains		Vegetables		Fruits		Honey and Sweets		Total	
	mg	percent	mg	percent	mg	percent	mg	percent	mg	percent	mg	percent	mg	percent	mg	percent
El Arimon	0.30	0.57	1.30	2.49	1.90	3.64	43.3	82.95	3.3	6.3	0.3	0.57	1.80	3.45	52.20	100
Kamha	0.50	1.07	2.00	4.26	1.10	2.34	39.7	84.64	2.5	5.3	0.3	0.63	0.90	1.91	46.90	100
Manshaat El Gamal	0.30	0.80	1.40	3.74	3.30	9.89	29.5	78.88	1.7	4.5	0.3	0.80	0.50	1.34	37.40	100
Shenou	0.30	0.60	2.20	4.45	2.70	5.47	39.0	78.95	4.1	8.3	0.4	0.81	0.70	1.42	49.40	100
Mean	0.35	0.76	1.73	3.75	2.35	3.97	37.8	81.36	2.9	6.13	0.33	0.70	0.98	2.03	46.48	100

Table 11: Absorbable Iron From Individual Daily meals in the Rice Zone

Village	Iron Intake						Iron Absorbed						Absorption percent
	Heme		Nonheme		Total		Heme		Nonheme		Total		
	mg	percent	mg	percent	mg	percent	mg	percent	mg	percent	mg	percent	
El Arimon	0.52	1.0	51.7	99.0	52.2	100	0.12	2.8	4.13	97.2	4.25	100	8.14
Kamha	0.68	1.5	43.2	98.5	46.9	100	0.16	4.4	3.46	95.6	3.62	100	7.72
Manshaat El Gamal	0.48	1.3	36.9	98.7	37.4	100	0.11	3.6	2.95	96.4	3.06	100	8.18
Shenou	0.76	1.5	48.6	98.5	49.4	100	0.17	4.2	3.89	95.8	4.06	100	8.22
Mean	0.61	1.33	45.1	98.68	46.48	100	0.14	3.75	3.61	96.25	3.75	100	8.07

