ABOUT THE PROBLEMS IN THE FIELD OF NUTRITION (REMARKS FOR RESEARCH ACTIVITIES)

J. Hruby

December 1978 WP-78-66

2361
Laxenburg
Austria

International Institute for Applied Systems Analysis

PREFACE

This working-paper was written during the author's stay at IIASA in September and October, 1977 and in May, 1978. It is the first contribution to the Nutritional Task (Task 2) of the Food and Agriculture Program. Therefore, the main aim of this paper is to introduce this new task to the colleagues working on other tasks in the Food and Agriculture Program. This paper is also written to define the possible aims of the task and to describe the possible contribution to the Food and Agriculture Program by the Nutrition Task.

SUMMARY

This paper is a trial to indicate a way in which it could be possible to contribute to the solution of the nutritional problem within the FAP of IIASA. It could bring some new views on the food and nutritional situation of the world as well as for the countries' groupings and of individual countries.

The present paper consists of two parts as follows:

A) Nutritional needs (by J Hruby);

B) Food Allowances: transfer of nutritional requirements into food (by J Hruby and J Vigner).

LIST OF CONTENTS

About The Problems In The Field Of Nutrition
(Remarks For Research Activities)

PART A

Nutritional Needs

J Hruby

This is to be the first attempt to touch nutritional problems in the Food and Agriculture Program at IIASA. It is needed to extend this problem fully and not to reduce it to the question of undernourishment or of hunger only. Nutrition is not only a very broad problem containing the biologic and economic aspects but also the psychological aspects as well. Its consequences are of a tremendous importance. To deal with nutritional problems in this way is, in my opinion, a task of eco-nutritionists.

1 General Considerations

1.1 Importance of Nutrition

Nutrition can influence the health status of a population in the positive and negative direction. Therefore, the nutritional status is related to the quality of life [1-6]. Behar [7] characterized the present status of "nutrition in transition" in the following manner " ... nutrition is becoming more and more fundamental, in both the prevention and the care, of the most common health problems ...".

Besides these above mentioned opinions all expressed by biologists, economists also emphasize the important role of the human nutrition [8-17].

It is necessary to emphasize that the science of nutrition is relatively a very young discipline which brings of course a dynamic development of the knowledge. This fact gives rise to necessary controversies. A series of examples follow. There is a very instructive discussion of dietary standards (e.g. Hegsted [18]). In the efforts for international unification of nutritional recommendations we find some controversial points of view. One of these topics is the sharp change in the approach to the protein intake

[19,20]. Another recent example is the controversy of Kaunitz [21] amd Zoelner [22] about the relationship of fats and atherosclerosis. Another dispute was started by Simantov [23] while discussing the relationship between developed and developing countries in a quantitive point of view. He draws attention to the fact that the reduction of one hundred calories per capita of animal origin in developed countries would permit an increase in the per capita consumption in developing countries by 385 calories. But this proposal is considered by other authors [24] as destructive for the world market.

In my opinion, this permanent discussion (a proof about the real permanency can be found by Clark [25]) is a positive phenomenon because it reflects the great interest shown in the problems of nutrition which is now the object of a more intensified study. However, the reality is not hampered when the present nutritional knowledge is applied to describe it. In this connection, a remark by Waterlow and Payne [26] can be cited when they critically discuss the controversies about protein requirements: "... it is certainly true that there is much that can be done with existing knowledge and that action cannot wait on the perfectionism of the research". Also in other branches there are great controversies, e.g. in demographic predictions (Rabar [27]).

1.2 General Food and Nutritional Situation in the World

The world food and nutritional situation has been a topic during recent years since the "food crisis" broke in 1972, when the world production decreased and grain supplies were substantially reduced. That was also the reason for the world food conference called by UNO in Rome 1974. For this conference, vast materials [28] were elaborated in respect of dimension and causes of hunger and malnutrition. An estimate of undernourished persons was performed. By undernourished persons are understood humans with an insufficient intake of energy and proteins [29]. This FAO estimation indicates an increase of undernourished people in the world by 15% from the period of 1969-71 to the period 1972-74; the World Bank determined the expansion of the number of hungry people to be 25% between 1965 and 1975. It is out of our range to judge these estimates which differ very substantially; it is not our task at all, but the basic problem is tremendous, namely the steady impairment of the situation.

The recently publisned data by FAO about the world food consumption [32] together with previous publications [31] enabled some long run observations. Now it is possible to

look at the nutritional situation from the time before World war II up to the present time (Table 1), even when, of course, these regional aggregations have been met with certain objections. Over this long time period, the data show an increasing average consumption both of energy (a mild increase) and of animal proteins (a more distinct increase). The latter increase is very important for the nutritional situation. The upgrading of the animal protein consumption is illustrated also by the higher share of these proteins on the total protein. Only one exception exists concerning this fact - the intake of animal protein in Latin America. There are enormous differences in the animal protein consumption among regions in absolute values as well as in relative figures. I would like to demonstrate these discrepancies by comparing 20 countries with the highest consumption of animal proteins at present, with 20 countries that have the lowest consumption [30] (Table 2). It is possible from this analysis to characterize the world food consumption in developed regions as an excessive, luxurious and, to a certain extent, risky one, and in developing regions as a deficient one with a negative influence on physical and mental fitness. However, it is necessary to mention that this analysis, which has been restricted to only two nutritive indicators, is rather incomplete.

The efforts of FAO must be emphasized in regard to the future outlook of the world food and nutritional situation. This organization has carried out, during its whole existence, an attempt to influence it. Boerma [32] called these efforts "thirty years's war against the world hunger". The world food conference 1974 was an important milestone in respect to this undertaking. The material of the conference brings a broad analysis of the possible future development. The demand projections [33] (Table 3), discussed there for energy and protein, show that the need for food, increases faster in developing than in developed countries. But this increasing demand of developing countries is not secured by the increase of the food production in these countries. A favourable relationship between demand and food production exists according to FAO calculations at the world level only. The same can be said for the relationship between food production and the population. But in reality, the development has not been favourable since the world food conference in 1974. Therefore, the FAO Conference in 1977 stated that "a very small progress or no progress has been reached since 1974" [34]. As a consequence, the World Food Council approved in its Manila Communiqué a program to eradicate hunger and malnutrition [35]. The Second Session of FAO Ad Hoc Committee on Food and Nutritional Policies in 1978 [35] confessed, that "efforts have been made to respond (to resolutions) but it cannot be denied that FAO as well as other parts of UN system has been slow". It is necessary to

draw attention to the world models by Meadows [36] and Mesarovic - Pestel [37] that indicate a great restriction in food consumption after the year 2000.

1.3 Food and Nutritional Policies

The unfavourable development of the food and nutritional situation leads to the necessity of complex governmental and other organizational measures for food and nutritional policies. FAO has been engaged in this field since its foundation's conference [38], where it was said "... a sound food and nutritional policy must be adopted by each government ...". It accepted the document about the formulation of food and nutritional policies [39].

FAO went on systematically in this direction organizing regional seminars. The idea of food and nutritional policies was then also strongly urged at the first world food conference. The World Food Council, established on the basis of this conference, is, properly speaking, an expression of this policy. Further, the afore-mentioned ad hoc committees on food and nutritional policy were established by FAO. The FAO/WHO experts group devoted also a session to this question [40]. In the meantime, some countries have started already to develop their own national food and nutritional policies. It would be possible for illustration to quote many countries of various social and economic status.

The present existence of nutritional disorders, undernourishment, malnutrition, and overnutrition, is a clear proof of the social necessity to identify and solve the nutritional problem at all levels, on a household, national, and international scale.

2 General Methodology

The food consumption can be defined as the satisfaction of nutritional needs by consuming consumptional goods - food-stuffs which are losing at the moment of the consumption their substance. This definition [11] contains the previously mentioned, two basic aspects of the nutrition - biologic and economic ones. The food consumption in the economic language is a synonym for nutrition. This concept of the food consumption indicates that both a pure economic or a pure biologic approach to the food consumption data can bring only a restricted understanding. Therefore, it seems necessary to combine both approaches. Because of the biological basis of the food consumption it also has to be emphasized that the satisfaction of nutritional needs is the main indicator not only for food consumption, but also for food production, food trade and so on. The fulfilment of these needs is therefore correlated to the whole nutritional system and an important indicator of the food and agriculture system. This approach we call eco-nutritional.

There are 6 stages of the eco-nutritional analysis.

First Stage

- gathering of food consumption data. There are generally three basic sources of the food consumption data;

  a) global data, which has been derived from production and trade statistics representing the food quantities which are at disposal at the given time period; e.g. the food balance sheets of FAO. This method must be considered as the basic one [41].

  b) data from household budgets which represent actual (not only disponible) food quantities;

  c) data from investigations on individuals.

  All three sources have their bias. It is important to notice that these data are stated at different time levels - either at the retail level or at the "food as consumed" level. This fact must grow in importance for the comparison with dietary recommendations which are always stated for food as consumed.

Second Stage

- analysis of food consumption data from different points of view;

- development in time series, differentiation according to income groups, international comparisons, origin of food;

- production in the country, import subsistence economy.

Some of these data reflect the food habits from a psychological aspect.

Third Stage

- analysis of food prices, of food expenditures and of the position of food expenditures in total expenditures.

Fourth Stage

- translation of food consumption data into biological indicators on the basis of food composition tables containing coefficients for separate nutritive factors stated through chemical analysis.

Fifth Stage

- comparison of resulting biological indicators of the food consumption with the nutritional recommendations mentioned above as dietary allowances. The recommended intake of nutritive factors is stated by biologists for different population groups according to their age, sex and physical activity. These detailed recommendations are given in per capita terms to compare with the available food consumption data. This procedure is called sometimes a nutritional balance.

Sixth Stage

- with the help of this procedure, another instrument for the evaluation of the food consumption was developed - food allowances.

3 Objectives, Directions and Open Questions of the Possible Research "Nutritional Needs"

3.1 Objectives

The place of nutrition within the FAP framework could be determined by the two following quotations:

a) it was said [27] that the aim of the project is to help to "reduce or eliminate hunger in the short run and reach an adequate level and structure of sustainable production in the long run".

b) it was written in the IIASA research plan 1977 [42], that "the objectives of the task nutritional requirements are

- to investigate adequate nutritional requirements specifically
- gatner data on this controversial issue
- to provide a scientific formulation for the food requirement to be used in models developed."

These two points could be, in my opinion, the general objectives. The incorporation of the nutritional problem into the Food and Agricultural Program creates a possibility to contribute to several attempts of theoretical global approaches removing present economic injustice in the world (which is particularly manifested in nutrition). This idea is proved to be successful by Tinbergen [43], in a less abstract way by the new international economic order [44] and by the establishment of the World Food Council. For such purposes the state of the art and the indication of the solution of the nutritional problem can be very useful.

In concrete terms, the attempt could be the following [45]:

- the determination of the nutritional requirements both in the quantitative and qualitative sense of particular population structures;
- the expression of these requirements in terms of specific food bundles,

- the preparation of inputs for national agriculture models,

- the consideration of policy measures that respond to the nutritional needs.

Some general views have been discussed already, and here I would like to elaborate some concrete points on these objectives.

a) "to reduce or eliminate hunger"

There is a broad discussion of this issue. Two remarks should be allowed. Firstly, the term "hunger" should be understood in the sense used by Castro, that is not only as undernourisnment but also as malnutrition in both directions - deficiency and excess. Secondly, the problem is, that "prevention is both amazingly simple and impossibly difficult" [46].

A very clear description of the problem is given by FAO with the following statement [29]: "A primary cause (of undernourishment and malnutrition) is seen in inadequate individual food consumption. The national food production may be one determinant, but other factors such as ecology, access to land or employment, income and food prices, prevalence of infection and infestation can be more important at the individual level". Therefore, note two principle elements of the food and nutritional strategy which have been elaborated by FAO:

- "efforts towards the rural and urban poor",

- "to assure availability of adequate supplies to improve the quality of the diet"

b) "to investigate adequate nutritional requirements, to provide a scientific formulation for the food requirement" (these are also the two first points of the nutrition task in the IIASA research plan 1978/79 [45]).

Even when there are some controversial issues about nutritional requirements - some of them have been already mentioned above - it can be generalized that the expression of these requirements in the form of dietary allowances

is recognized. Also the international recommendations have been elaborated in this direction and, therefore, should be the basis for the calculations.

For the second task - formulation of food requirements - it is possible to use the method of food allowances as described in PART B. This method applies fully to the dietary allowances besides taking into account some economic points of view - the situation and the development of the food consumption and food prices.

These two forms of allowances (dietary and food) represent the nutritional needs.

c) "preparation of input data"

The described indicators would be prepared at the national level as per capita values for models on the basis of specific national population structures. The dietary allowances would serve once for the judgment of the present and future situation and once for the construction of the food allowances. The food allowances would be used for the prediction of future development as an alternative to demand projections.

d) "consideration of policy measures"

The specific position of nutrition requires also a specific approach and specific measures. An extraordinary role belongs here to the education of population and to the training of experts, i.e. the policy measures are not of economic character only. The whole package of possible policy measures should be considered. There are numerous studies devoted to this problem. Aside from FAO publications, see [47-50] for developing countries and [51-55] for developed countries.

3.2 Directions

Of course the identification of the right place of nutrition in Food and Agriculture models would be also an extensive research task. It must be taken into account that there has been already a necessity to define the nutrition system and to construct its models - [see 17,56,57]. According to the knowledge in nutrition, it is my opinion that the present economic approach should be omitted which sustains the need of food and the satisfaction of the hunger feeling. The nutritional science brings many proofs that this approach simply considering the energy intake has been overcome and that the nutrition means the intake of many other components aside of the intake of energy. Therefore the expression "nutritional needs", corresponds better to the present knowledge. The nutritional needs should be a directive element of the nutritional system. The existence of such systems and models is not an obstacle in relation to food and agriculture models, because various systems on the same object are permitted to be introduced. It should be more a support for a meaningful position of nutrition in these models. Nutritional needs have to be either a directive element or at least be accorded to have an equal level of importance with other elements.

Generally speaking it would be necessary to identify the following questions:

- what are nutritional needs?
- how is it possible to use the nutritional needs for input data for food and agriculture modelling?
- what are the possible policy measures going out from nutritional needs.

Very probably this exercise would be divided into three main directions:

a) questions which will come from a "universal core", the results will be valid in general;

b) questions which will concern groups of countries;

c) questions which will solve problems at separate countries.

To the first direction problems of nutritional requirements will belong. To solve these questions the literature has to be studied critically. The final decision about principles has to be applied. Similarly, problems of the nutritive value of food commodities are to be approached. In addition, basic considerations about appliance of nutritional needs in models and about policy measures have a universal character.

In the second direction, the countries could be divided into groups with common features according to the analysis of the food and nutrition situation in separate country studies. There will be mainly two basic groups of countries. The first group of countries does not have its nutritional needs satisfied sufficiently (in practice developing countries). The second group has nutritional needs which are satisfied excessively in certain nutritive factors (in practice developed countries). In other words, there will be countries with undernourishment and malnutrition, and countries with overnutrition and possibly some malnutrition. In this respect a different approach will probably be necessary to apply nutritional needs in modelling, and certainly in formulating policy measures. At this point perhaps a further division of the group of countries according to their political and economic status, i.e. economic management, will be reasonable (market economies, centrally planned economies).

In the third direction, a prevailing number of research questions arises. They should be investigated and solved separately for every and each country. The primary question of food allowances is to consider the nutritional needs in terms of food. The specificity of this approach lies in the fact that it is constructed on the basis of the national consumption. While nutritional needs terms can be stated in general biological terms, the food allowances cannot be generalized because they consider as much as possible the local or national situation. It is not only a question of the staple foods, but also of the structure of food commodity groups, of the level of food prices etc. Further, there are questions of population structures, food expenditures, and their shares on total expenditures, production possibilities, foreign trade, and subsistence economy.

The nutritional problem is manifested in order to illustrate its complexity. The nutritional needs differ with the age, sex, physical activity, health status, and body weight of an individual. The satisfaction differs by income, food habits, and commodity availability, all of which are interdependent on the production pattern. The degree of satisfaction of nutritional needs and the effects

of nutrition on health, quality of life etc. are manifold, e.g. temporary, and cause reversible or irreversible damage. Since the research task would have to recognize this complexity and since all these aspects cannot be included within a national model, a parallel analysis will be necessary.

To adjust the nutritional analysis to the FAP approach, it would mean:

a) methodological problems - commodity aggregation, quote systems, simulation modelling;

b) logistic of imbedding a relative independent research task within the FAP frame.

Since the national models of FAP are addressed to the economic policy of governments, the food and nutritional policy exercise will be relatively independent because of the necessity to emphasize not only economic, but also educational, organizational, legislative and other measures.

The research work should proceed in the following stages:

a) study of nutritional requirements;

b) study of population structures and their future changes in some of the countries under case studies;

c) calculations of nutritional requirements in these countries;

d) study of the nutritive value of food;

e) analysis of the present food and nutrition situation in chosen countries that means

- transfer of food consumption into indicators of the nutritive value;

- comparison of nutritional requirements and indicators of the nutritive value of the food consumption;

- evaluation of economic factors;

f) study of the considered future changes in concrete countries;

- demand projections;

- production;

g) determination of food allowances in chosen countries;

h) comparison of food allowances with present and future situation in chosen countries;

i) deliberations about adoption of nutritional needs in the frame of food and agriculture modelling;

j) deliberations about policy measures.

3.3 Open questions

Finally I want to draw the attention to a few open questions, which should be especially under discussion

a) international recommendations

I suppose that the use of international recommendations [20,58-60] on nutritional requirements will be prefered to national recommendations.

b) protein requirement

The position of protein requirements is particular. The requirement of this nutrient, without doubt a key-factor in the composition of the diet went through a complicated development. It was subject to three meetings of international experts - 1957 [61],, 1965 [19] and 1971 [20]. While adopting the "safe level of protein intake", a quite basic turn in the approach, if not a somersault was undertaken at the last of the three meetings. Consequently, the use of this level leads to a very low share of proteins on energy intake (about 8% as Passmore mentioned in the Report [20], which does not correspond to the actual food consumption also in developing countries with a bad nutritional level, where this share is about 10%). Passmore is suggesting this level (10%) as a minimum for national planning. The new international protein recommendations formulated by the FAO meetings in 1971 were applied in FAO projections [62]. The result of this analysis

was that after a "protein gap" in the world [63], the protein consumption has now become excessive. This question is continually under investigation and, as can be seen in an FAO publication [41], the relationship between protein and energy is investigated in four developing countries. The 10% level should be taken as a basis for further calculations.

c) Food Consumption Tables

Here I propose to rely upon the international tables, which were also applied by FAO in the Food Balance Sheets. FAO is systemically extending these tables in narrow cooperation with the Data Bank of the US Department of Agriculture [64]. The comparison of Czechoslovak consumption data based on national tables and FAO tables, indicates that there are not substantial discrepancies (Table 4).

d) Food Balance Sheets

For the purpose of the global modelling, the basic source of consumption data has to be the Food Balance Sheets at a nationally aggregated level, even when they "mask the differences in food consumption" and even when quite negative opinions exist about them. Now a new set of Sheets [30] has been prepared by FAO for all countries of the world.

e) Losses

Witnout doubt, there are losses between "retail level", to which the food balance sheets are related, and "food as consumed" for which the nutritional requirements are elaborated. It is clear that the percentage of these losses differs from country to country, but no data are available for this opinion. The FAO studies [61,65] consider the losses of energy and proteins by 10%.

f) Policies

The question about possibilities of food and nutritional policies should be discussed because "almost all of the issues, that decision-makers face, involve multiple objectives that conflict in some measure with each other" [66]. Another point is the relationship of these policies to

agricultural policies, as it was indicated in one meeting at FAO [67]. FAO [38] varies in its definition of educational, economic, organizational, and legislative measures and the discussion should be developed accordingly.

4 References

[1] McCarrison R, Sinclair H M: Nutrition and Health. London 1961 (3rd edition)

[2] Castro J de: Hunger and Food-Science and Mankind. No. 1, 1958

[3] Masek J: Nutrition and today's culture (in Czech) - Proceedings of XVIIth Congress of Czech Society for Rational Nutrition 1967, p.12

[4] La Nutrition et le Travail - FAO, Rome 1962

[5] Fisher E,: Malnutrition and Mental Development: A Critical Review - The Ind.J. Nutrition Diet 1971,8,149

[6] Pollitte E and Thompson C: Protein-calorie Malnutrition and Behaviour: A view from Psychology - Department of Nutrition and Food Science Massachusetts Institute of Technology 1975

[7] Nutrition in transition (M Behar), Food Policy, 2,1977,4 338-339

[8] Marx K: To the Critics of the Political Economy (in Czech) Prana 1953.p.161

[9] Cépéde M: La Science contre la faim - Paris 1970

[10] Berkovic E: Ekonomski problemi ishrane u SFR Jugoslaviji - Beograd 1964

[11] Solnarova B, Hruby J: Nutrition as an economic problem (in Czech), Prana 1967

[12] Boerma A: Keynote to the First Asian Congress on Nutrition. Nutr.Newsletter 9, 1971, 1, 1

[13] Berg A: The Nutrition Factor - Washington 1973

[14] Ganzin M: Food for all - Food and Nutrition (FAO) 1,1975,1,3

[15] Simantov A: Relations between developed and developing countries in the field of agriculture and food or the need to promote a "Human Economy", Eur.R.agr.Eco. 2,1974/1975,2p.135

[16] Rogers A: Migration, Urbanization, Resources and Development, IIASA RR 1977

[17] Taylor L: Research Topics in Income Distribution and the Economics of Food - Int.Food Policy Res.Inst., 1976

[18] Hegsted D M: Dietary Standards - J. of Am Diet Ass. 66,1975,1,13

[19] Protein Requirements - FAO 1967

[20] Energy and Protein Requirements - FAO 1972

[21] Kaunitz H: Kann die Lipidtheorie der Atheriosklerose aufgegeben werden? - Aktuelle Tendenzen auf dem Gebiet der Ernährungsforschung - Wien 1976, S.1 and 15

[22] ZOELNER N: Diskussionbeitrag zum Referat H. Kaunitz - Aktuelle Tendenzen auf dem Gebiet der Ernährungsforschung, Wien 1977, S.11

[23] SIMANTOV A: World Food Consumption. Can we achieve a balance? - Food Policy 1,1976,3,232

[24] de HOOGH S, and others: Food for a growing world population. Some of the main findings of a study on the long-term prospect of the world food situation. - Eur.R.agr.Eco. 3(4), pp.459-499

[25] CLARK C: Hungert die dritte Welt wirklich? Die Welt 10.9.1977

[26] WATERLOW J C, PAYNE P R: The Protein Gap - Nature 258,1975,11,113

[27] RABAR F: Food and Agriculture: Global aspects of Supply and Demand, IIASA Conf.76,vol.1,p. 93-109

[28] Assessment of the world food situation. Present and Future. Food and Nutrition. (FAO) 1,1975,1,7-43

[29] Current Information on the World Food and Nutrition Situation (IInd Session FAO Ad Hoc Committee on Food and Nutrition Policy 1978 SN:FNP/78/2)

[30] Provisional Food Balance Sheets 1972-74,FAO,Rome 1977

[31] Third world Food Survey, FAO Rome 1963

[32] BOERMA A: The Thirty Years' War against Hunger - Food and Nutrition (FAO)

[33] The food problem of the future - Food and Nutrition (FAO), 1,1975,1,27

[34] Resolution 8/77 on Nutrition (19th FAO Conference) (IInd Session FAO Ad Hoc Committee on Food and Nutrition Policy 1978 SN:FNP/78/9)

[35] Progress Report of the Implementation of the Recommendations Concerning Nutrition (IInd Session FAO Ad Hoc Committee on Food and Nutrition Policy 1978 SN:FNP/78/8)

[36] Meadows D et al: The Limits of Growth - New York 1972

[37] MESAROVIC M, PESTEL E: Mankind and the Turning Point New York 1974

[38] Nutrition Planning and Surveillance; (IInd Session FAO Ad Hoc Committee on Food and Nutrition Policy 1978 SN:FNP 78/3(i))

[39] Formulation of Food and Nutrition Policies - Nutrition Newsletter 10,1972,2,14

[40] Food and Nutrition Strategies in National Development - FAO/WHO Expert Committee on Nutrition - Geneva 1976

[41] Information Needed for Food and Nutrition Assessment (IInd Session FAO Ad Hoc Committee on Food and Nutrition Policy 1978 SN:FNP/78/3 (iii))

[42] IIASA Research Plan 1977

[43] TINBERGEN J: Reshaping the International Order. New York 1976

[44] TANSEY G: Equality of Opportunity between Nations' Food Policy 2,1977,2,157-8

[45] IIASA Research Plan 1978/79

[46] BEATON G H, BENGOA, J M: Nutrition in Preventive Medicine. WHO Geneva, 1976

[47] Rapport au gouvernment de la Tunisie. Une expérience de nutrition et planification alimentaire (1965-69) dans le cadre de l'elaboration du troisième plan Tunisien (G L Bideau) FAO Rome 1970

[48] Rapport au gouvernment du Maroc sur les objectifs alimentaires et nutritionnels du plan quinquennall 1973-1978 (M.Autret), FAO, Rome 1972

[49] Food and Nutrition Planning. Rep. to the Government of Pakistan (Hrubý J) FAO, Rome 1975

[50] Report to the Government of Iran on Food and Nutrition Planning (L Joy), FAO, Rome 1973

[51] BEHAR M: European Diets vs. Traditional Foods. Food Policy, 1,1976,5,432-435

[52] FABER D C, et al: Changes in Human Nutrition and US Export. Food Policy 1,1977,1,67-73

[53] BLYTHE C: Problems of Diet and Affluence. Food Policy 1,1976,2,91

[54] SEXAVER B: The US Food Stamp Programme. Food Policy 2, 1977,4,331-337

[55] O'HAGEN J P: National Self-Sufficiency in Food. Food Policy 1,1976,5,355-366

[56] Planning National Nutrition Programmes: A Suggested Approach. - USAID, Washington 1973

[57] HRUBÝ J: Systems approach to the nutrition of the population (in Czech) - Výziva lidu 33,1978,3,42-43

[58] FAO/WHO Expert Group on Calcium Requirements, 1962 FAO Nutr.Meet.Rep.Series No.30

[59] Joint FAO/WHO Expert Group on Requirements of Vitamin A, Thiamine, Riboflavin and Niacin (1967,FAO,Nutr.Meet. Rep.Series No.41)

[60] Report of a Joint FAO/WHO Expert Group, on Requirements of Ascorbic Acid, Vit.D, Vit.B 12, Folate and Iron. (1970 - FAO Nutr.Meet.Rep.Series No.47)

[61] FAO Committee on Protein Requirements (1957 - FAO Nutr.Studies No.16)

[62] Agricultural Commodity Projections 1970-80, FAO, Rome 1971, vol.I,p.47

[63] International Action to avert the Impending Protein Crisis, New York, 1968

[64] FAO/USDA Cooperation on Computerized Nutrient Data Bank. - Food and Nutrition (FAO) 3,1971,1,21

[65] Caloric Requirements (1957, FAO Nutr.Studies No.15)

[66] Conflictive objectives in decisions. ed. by D E Bell, R L Keeney and H Raiffa - Chichester J Willey and Sons Limited, 1977

[67] Nutritional implications of agriculture policies. - Food and Nutrition.FAO 3,1977,1,28

Tab. 1

Energy-consumption and consumption of animal proteins in the world and in the main geographical areas

Area	Period 1934-38			Period 1972-74			1934-38=100
	abs.	rel.		abs.	rel.		
Energy-consumption Kcal/per capita/day							
World	2380	100,0		2483	100,0		104,3
Europe	2870	120,6		3169	127,6		110,4
North America	3260	137,0		3099	124,8		95,1
Oceania	3290	138,2		3007	121,1		91,4
Far East	2090	87,8		2142	86,3		102,5
Near East	2295	96,4		2432	97,9		106,0
Latin America	2160	90,8		2475	99,7		114,6
Consumption of animal proteins (g/per capita/day)			share of animal proteins on total proteins in percent			share of animal proteins on total proteins in percent	
World	18,0	100,0	26,1	23,7	100,0	34,9	131,7
Europe	28,0	155,6	32,9	50,6	213,5	54,2	180,7
North America	51,0	283,3	59,3	56,0	236,3	61,3	109,8
Oceania	67,0	372,2	65,0	57,7	243,5	64,2	86,1
Far East	7,0	38,9	11,5	9,4	39,7	17,2	134,3
Near East	12,0	66,7	16,7	13,7	57,8	20,2	114,2
Latin America	28,0	155,6	43,7	27,5	116,0	41,8	98,2

Table 2

Countries with the highest and lowest consumption of animal proteins (1974)

Countries with the highest consumption of animal proteins	order	quantity g/per capita/ day	share of anim. proteins from total proteins in percent	Countries with the lowest consumption	order	quantity g/per capita/ day	share of anim. proteins from total proteins in percent
Iceland	1.	91,8	80,5	Bhutan	1.	1,7	3,8
New Zeeland	2.	76,1	70,7	Ruanda	2.	3,0	5,9
USA	3.	71,6	69,1	Upper Volta	3.	3,2	5,5
Argentina	4.	67,1	62,7	Guinea	4.	4,1	9,6
Ireland	5.	65,6	62,4	Burundi	5.	4,2	7,1
Canada	6.	65,2	66,1	Nigeria	6.	4,4	9,6
Norway	7.	64,7	67,0	Mozambique	7.	4,8	13,0
Australia	8.	64,1	65,9	Indonesia	8.	5,3	12,2
Finland	9.	62,3	66,2	India	9.	5,5	11,4
France	10.	61,7	63,6	Malavia	10.	5,8	8,7
Mongolia	11.	61,5	65,8	Cape Verde	11.	6,3	11,6
Uruguay	12.	61,4	62,6	Comoros	12.	6,6	16,8
Belgium - Luxemburg	13.	60,7	60,9	Sri Lanka	13.-14.	6,7	16,4
Denmark	14.	59,4	66,1	Bangladesh	13.-14.	6,7	14,8
Poland	15.	58,5	55,7	Haiti	15.	6,9	14,2
Sweden	16.	57,4	66,6	Kampuchea	16.-17.	7,0	15,9
U.K.	17.	56,2	62,4	Togo	16.-17.	7,0	13,7
CSSR	18.	56,0	58,5	Zaire	18.	7,1	23,0
Switzerland	19.	55,8	64,2	Nepal	19.	7,5	14,7
Fed.Rep.of Germany	20.	55,5	64,6	Benin	20.	8,3	16,6

Table 3

Food demand per capita in calories and proteins

Period	Calories			Proteins (g)		
	World	countries		world	countries	
		developed	developing		developed	developing
1980	2560	3190	2330	71,1	98,4	61,2
1985	2610	3220	2400	72,6	100,0	63,3
1990	2670	3260	2480	74,3	101,9	65,6
			Percent			
Increase						
1980 - 70	3,3	1,2	6,1	3,5	2,1	6,5
1985 - 70	5,3	2,3	9,3	5,3	3,8	10,2
1990 - 70	7,5	3,6	12,7	7,7	5,7	14,2
			Percent per years			
Rates of growth						
1970 - 80	0,3	0,1	0,6	0,3	0,2	0,6
1970 - 85	0,3	0,2	0,6	0,3	0,2	0,6
1970 - 90	0,4	0,2	0,6	0,4	0,3	0,7

Table 4

Comparison of nutritive factors of the CSSR food consumption according to CSSR computations and according to FAO computations

Period	CSSR values = 100%	FAO values	Differencies FAO higher abs.	FAO higher rel.	FAO lower abs.	FAO lower rel.
Calories						
1965	3060	3199	139	4,54	-	
1970	3073	3200	127	4,13	-	
1973	3082	3217	135	4,38	-	
1974	3109	3218	115	3,71	-	
Total proteins g						
1965	85,5	92,4	6,9	8,07	-	
1970	97,0	94,2	-		2,8	2,89
1973	98,3	94,5	-		3,8	3,87
1974	100,1	95,8	-		4,3	4,3
Animal proteins g						
1965	43,3	46,3	3,0	6,93		
1970	52,1	52,8	0,7	1,34		
1973	54,6	54,6	-			
1974	56,2	56,0	-		0,2	0,36
Fats g						
1965	104,1	113,4	9,3	8,93		
1970	113,2	119,5	6,3	5,56		
1973	115,4	125,2	9,8	8,49		
1974	118,7	127,1	8,4	7,08		

PART B

Food Allowances: transfer of nutritional requirements into food

Dr Jiri Druov,CSc; Ing. J Vigner

Nutritional requirements are elaborated at present in a series of factors, many of them were discussed at the international level. Their practical objective - to be an instrument for the food and nutritional planning - is generally recognized. Two quotations should illustrate this fact, one from the East - Pokrovskij [1] and one from the West - Hegsted [2] But, these biological data are rather inconvient for the broad application in the food and nutritional planning , because the planners are used to thinking in terms of food. Therefore, the idea of transfering those biological recommendations into food can be found quite often in the literature. This idea is a relatively old one in CSSR, where the first attempt was realized in the year 1954 [3]. The same was true for some other socialist countries [see 4 and 5]. Similar attempts were made by Wirths for the EC and Autret for Morocco [6-7]. It is also possible to introduce other requirements for this exercise [2,8].

In the CSSR, as mentioned above, this procedure was used in the fifties and, for the first time, as far as our knowledge reaches, the linear programming was applied for this purpose. Even when this attempt was a theoretical one and led to an oversimplified result (5 items only), it was clearly proved that this approach is viable [9]. In the Institute of Human Nutrition in Prague, we have been working on the problem of the transfer of nutritional requirements into food since the year 1964. We used the method of linear programming which we called food allowances [10]. Our definition of these allowances is the following:

> They are quantities of food derived from actual food consumption and pay regard, to a certain extent, to trends of this consumption, which fulfill the nutritional requirements (dietary allowances) at the given population structures under the condition of the optimization of costs.

Since 1970, I have continued with my co-author Vigner, who enriched the methodology and elaborated under the same basic principles the new food allowances [11].

Following, the basic principles are introduced.

a) The elaboration of the food allowances is based on the synthesis of the dietary allowances, of the nutritional guidelines (which are not expressed in allowances, e.g. requirements after the reduction of empty calories, priority of lean meats, etc.) and of the effective food consumption.

b) The method of the linear programming is applied for the solution. According to Bartak [12] the task was formulated in the following way:

to find out such quantities of food commodities, which correspond to nutritional requirements at minimal costs;

c) Later the requirement of minimal costs was extended to maximal costs which means, according to Cerný [13], the change in the equation only, (see equation 4).

d) The character of entrance data:

- Food commodities with different ranges. The effective consumption is either the lower limit (in cases when an increase in consumption is predicted from the development of the food consumption in the country and this increase is not against nutritional guidelines or the increase is desirable on the basis of these guidelines) or upper limit (in cases when a decrease is predicted from the development of the food consumption and is in accord with nutritional guidelines or the decrease is desirable on the basis of these guidelines). The extent of ranges (30-100%) is estimated accordingly and the demand functions are also taken into account. Other indicators are also applicable, e.g. possibilities of the production or of foreign trade. The number of items can differ from case to case and at present, we are using about 70 items.

- Nutritional requirements - dietary allowances. The following ranges are used: energy and main nutrients (in Czechoslovakia, dietary allowances include, apart from vegetable proteins, proteins of animal origin, fats, carbohydrates) +- 5 percent; minerals and vitamins +- 10%. The number of items can again differ, presently we

are using 14 items. Especially in developed countries the broader extent is recommended as it has been demonstrated on the problems of fats [14].

- In both cases the per caput data are used.

- Nutritive values. From the Food Composition tables the indicators for 100 g of retail weight were taken. The specific losses between the time point at retail level and time point of food as consumed were used in our solution, so that no adjustment of dietary allowances was made. Otherwise the adjustment of dietary allowances (increase for losses) is necessary.

- The average food prices are calculated.

The following equations are used:

$$(1)\quad \sum_{j=1}^{n} a_{ij} x_j \leqq b_i \qquad (i = 1, \ldots\ldots, h)$$

$$(2)\quad \sum_{j=1}^{n} a_{ij} x_j \geqq b_i \qquad (i = h+1, \ldots, k)$$

$$(3)\quad \sum_{j=1}^{n} a_{ij} x_j = b_i \qquad (i = k+1, \ldots, m)$$

$$(4)\quad \sum_{j=1}^{n} o_j x_j = Z \text{ (min)}$$

$$(5)\quad x_j \geqq 0$$

where

a_{ij} $(i = 1,\ldots,m;\ j = 1, \ldots,n)$ are nutritive values of food commodities;

x_j $(j = 1,\ldots,n)$ are food commodities

b_i $(i = 1,..,m)$ are nutritional requirements (applied as a range of ± 5 percent at energy and main nutrients and of ± 10 percent at minerals and vitamins)

o_j $(j = 1,\ldots n)$ are food prices

With the help of the Czechoslovak example, we would like to explain the procedure more in detail:

1. The determination of dietary allowances per capita (as a weighted average of dietary allowances for 33 population groups, where the weight is the demographic structure)

2. The analysis of the food and nutritional situation:

   a) The transfer of per capita food consumption data into biological terms - nutritive values of food items including the losses;

   b) the comparison of daily quantities of the biological factors in the food consumption per capita with the dietary allowances per capita.

3. The evaluation of the present food and nutrition situation in the CSSR:

   a) the following factors are in excess (again more than 10% of dietary allowances) - calories, fats, linoleic acid, iron, vitamins B_1 and PP;

   b) the following factors are deficient (again more than 10% of dietary allowances) - vitamins A and C. These are the gaps which should be filled in food allowances.

4. The determination of the food consumption development and its evaluation from the point of view of the analysis in the previous point -
   meat - increase in lean meat
   decrease in fat meat and fat meat produce
   milk - increase
   fish - increase
   eggs - no change
   fats - increase in vegetable fats
   strong decrease in animal fats
   cereals - decrease (this commodity group will be under examination from the point of view of fibre contents)
   sugars - decrease
   pulses - increase
   vegetables - increase
   fruits - increase
   potatoes - decrease

5. The nutritive value of upper and lower limits is calculated and the ranges are adjusted according to dietary allowances.

6. Optimization calculations with necessary adjustments of food ranges.

7. The resulting food allowances - (table 1)

8. The comparison of food allowances and present food consumption (1975) (table 1).

The food allowances are acknowledged in a CSSR governmental resolution [15] as an official instrument for planning.

5 References

[1] POKROWSKIJ, A A: Über die Bedarfsdeckung des Organismus mit den wichtigsten Nährstoffen. Ernährungsforschung, 9, 1964, 3, 381-394

[2] HEGSTED, D M: Dietary Standards J.Am.Diet.Ass., 66,1975,1,13

[3] Supposed per capita food consumption in 1958 (in Czech) - Society for rational nutrition 1954 (unpublished)

[4] AGANBEGJAN, A G: Determination of rational norms of consumption via linear programming in the book: Soviet economists to the use of mathematics in the economics (in Czech) - Praha 1964,pp.243-253

[5] SZCZYGIEL, A, SICKOWNA, J, NOWICKA L: Normy wyzyvienia dla osiemnastu grup lodnosci. - Warszawa 1965

[6] WIRTHS W: Der Nahrungsbedarf der Bevölkerung in der EWG unter ernährungsphysiologisch optimalen Bedingungen, in: Agrarpolitik in der EWG, s.77-89, München 1968

[7] AUTRET M: Rapport au Government du Maroc, sur les objectifs alimentaires et nutritionnels du plan quinquennal 1973-1978. - FAO, Rome 1972

[8] BLYTHE C: Problems of diet and influence. - Food policy, 1,1976,2,91

[9] VELIMSKÝ V: Contribution to the computation of the cheapest food - assortment at the maintaining of dietary allowances (in Czech) - Res. Report VÚMEPP, Prana 1954

[10] HRUBÝ J: Contribution to the concept of the development of nutrition in Czechoslovakia (in Czech - English Summary) - Praha 1971

[11] VIGNER J: New models of the food allowances valid since 1976 - (in Czech) Vyziva lidu, Pril. Vyziva a spotreba pozivatin v cislech, 10,1975,2 a 3.

[12] BARTÁK R: To the use of the method of the linear programming at the solution of the nutrition problem - (in Czech) Res. Rep. ÚVÚPP 1968

[13] CERNÝ F: Construction of the model of food allowances (in Slovak), - Res.Rep.IKEM, Praha 1975

[14] HRUBÝ J: Consumption of fat as an important part of the food and nutrition policy in developed countries. - Bibliotheca Nutritio et Dieta 25, 1977, 102-107

[15] Governmental resolution Nr.102/1976

Table 1

Food allowances and their comparison with the present food consumption (kg/per capita/per year)

	Food allowances	Food consumption	Food allowances = 100
Meat (carcass weight)	90,0	81,1	90,1
Fish	7,0	5,8	82,9
Milk (in milk value, without butter)	250,0	210,4	84,2
Eggs (in pieces)	306	297	97,1
Fats (in weight)	20,0	22,8	114,0
Sugar	28,0	36,1	128,9
Cereals (in flour value)	89,0	108,1	121,5
Potatoes	96,0	95,8	99,8
Pulses	3,5	1,3	37,1
Vegetables (in fresh value)	103,0	73,7	71,6
Fruits (in fresh value)	69,0	47,7	69,1