

THE UNITED NATIONS UNIVERSITY  
FOOD AND NUTRITION BULLETIN SUPPLEMENT 9

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# **Interfaces between Agriculture, Nutrition, and Food Science**

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Edited by K.T. Achaya

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THE UNITED NATIONS UNIVERSITY

# **INTERFACES BETWEEN AGRICULTURE, NUTRITION, AND FOOD SCIENCE**

Proceedings of a workshop held at Hyderabad, India, 10–12 November 1981, co-sponsored by the United Nations University (UNU), the International Crops Research Institute for the Semi-arid Tropics (ICRISAT), the National Institute of Nutrition (NIN), and the Central Food Technological Research Institute (CFTRI)

**Edited by K.T. Achaya**

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## From the CHARTER OF THE UNITED NATIONS UNIVERSITY

### ARTICLE I

#### Purposes and structure

1. The United Nations University shall be an international community of scholars, engaged in research, post-graduate training and dissemination of knowledge in furtherance of the purposes and principles of the Charter of the United Nations. In achieving its stated objectives, it shall function under the joint sponsorship of the United Nations and the United Nations Educational, Scientific and Cultural Organization (hereinafter referred to as UNESCO), through a central programming and co-ordinating body and a network of research and post-graduate training centres and programmes located in the developed and developing countries.

2. The University shall devote its work to research into the pressing global problems of human survival, development and welfare that are the concern of the United Nations and its agencies, with due attention to the social sciences and the humanities as well as natural sciences, pure and applied.

3. The research programmes of the institutions of the University shall include, among other subjects, coexistence between peoples having different cultures, languages and social systems; peaceful relations between States and the maintenance of peace and security; human rights; economic and social change and development; the environment and the proper use of resources; basic scientific research and the application of the results of science and technology in the interests of development; and universal human values related to the improvement of the quality of life.

4. The University shall disseminate the knowledge gained in its activities to the United Nations and its agencies, to scholars and to the public, in order to increase dynamic interaction in the world-wide community of learning and research.

5. The University and all those who work in it shall

act in accordance with the spirit of the provisions of the Charter of the United Nations and the Constitution of UNESCO and with the fundamental principles of contemporary international law.

6. The University shall have as a central objective of its research and training centres and programmes the continuing growth of vigorous academic and scientific communities everywhere and particularly in the developing countries, devoted to their vital needs in the fields of learning and research within the framework of the aims assigned to those centres and programmes in the present Charter. It shall endeavour to alleviate the intellectual isolation of persons in such communities in the developing countries which might otherwise become a reason for their moving to developed countries.

7. In its post-graduate training the University shall assist scholars, especially young scholars, to participate in research in order to increase their capability to contribute to the extension, application and diffusion of knowledge. The University may also undertake the training of persons who will serve in international or national technical assistance programmes, particularly in regard to an interdisciplinary approach to the problems with which they will be called upon to deal.

### ARTICLE II

#### Academic freedom and autonomy

1. The University shall enjoy autonomy within the framework of the United Nations. It shall also enjoy the academic freedom required for the achievement of its objectives, with particular reference to the choice of subjects and methods of research and training, the selection of persons and institutions to share in its tasks, and freedom of expression. The University shall decide freely on the use of the financial resources allocated for the execution of its functions . . . .

## PREFACE

In 1975 the Advisory Committee to the World Hunger Programme of the United Nations University recommended holding a series of workshops to explore and emphasize the multiple interactions between agriculture, food science, and nutrition. It was suggested that these workshops should be held at various international agricultural research institutions, and should involve persons concerned with research, training, and policy-making in the three disciplines in the countries of each region in which the workshops were held, with the participation also of some experts from other regions. In accordance with this suggestion, workshops were held at the International Institute for Tropical Agriculture (IITA) in Ibadan, Nigeria, in December 1976; at the International Rice Research Institute (IRRI) at Los Baños, Philippines, in March 1977; and at the Institute of Nutrition of Central America and Panama (INCAP) in Guatemala City, Guatemala, in November 1978 in co-operation with the International Centre for Tropical Agriculture Research (CIAT) in Cali, Colombia, the International Centre for Maize and Wheat Improvement (CIMMYT) in Mexico City, Mexico, and the Tropical Agricultural Research and Training Centre (CATIE) in Turrialba, Costa Rica. The workshop that formed the basis for this volume was organized by the International Crops Research Institute for the Semi-arid Tropics (ICRISAT) in Patancheru (Hyderabad), India, in November 1981. Another was subsequently held at the International Centre for Agricultural Research in Dry Areas (ICARDA) in Aleppo, Syrian Arab Republic, in February 1982. Two papers from the workshop in Ibadan were published in the first issue of the *Food and Nutrition Bulletin*. The report of the Los Baños workshop was produced by IRRI as a joint publication with the UN University, and the report of the one in Guatemala is being published in Spanish by INCAP. It is expected that the report of the Aleppo workshop will be published by the UN University in a format similar to this one.

It should be recognized that, from its beginning in 1975, the United Nations University has been concerned with the role of agriculture in assuring adequate food and making possible proper nutrition for the world's population. The UN University was strongly advised, however, to concentrate on issues of post-harvest conservation and food distribution and consumption as areas not receiving attention from the research

institutions co-operating with the Consultative Group on International Agricultural Research (CGIAR) and to only a limited degree from other agencies in the United Nations system. Since then, the International Food Policy Research Institute, with headquarters in Washington, D.C., has been established as an integral part of the CGIAR system, and food-distribution issues have been receiving more attention within the UN system. The series of workshops on the interfaces between agriculture, food science, and nutrition have contributed to this trend. While no further workshops in the series are currently planned, the UN University maintains its interest in these issues through sponsorship with the United Nations Development Programme of a series of multidisciplinary research projects on the influence of agricultural policy on nutrition, status and on income generation and poverty reduction. It is planned that sometime during 1984 the reports of these projects will be brought together in a workshop and ultimately be published in book form.

The papers and discussions in the present volume give broad coverage to interface problems, focusing not only on interactions at the stage of primary production, which are normally the concern of the international agricultural research institutions, but also on those at the stage of post-harvest food conservation, distribution, and consumption. There is also a section on the handling of foods to achieve better nutrition. It is hoped that this volume will be useful to persons working in the fields of agriculture, human nutrition, and food science throughout the world.

## FOREWORD

Various international organizations and national governments are finding ways and means to increase and stabilize the production of food grains to meet the food and nutritional needs of the galloping population adequately. It is increasingly being recognized that besides increasing food production, its storage processing, utilization, and nutritional evaluation are equally important and deserve immediate attention. No doubt, scientists trained in different disciplines pursue their objectives with great zeal and vigour to fulfil their mission-oriented research, but the food problem cannot be solved unless all aspects of food receive deserved attention. All the efforts should be directed to one goal—to make available within easy access low cost nutritious food to the population. For this purpose a multidisciplinary approach in research is needed that calls for a careful planning and concerted action by scientists, nutritionists, policy-makers, economists, and technologists.

It is with this background that a workshop on interfaces between agriculture, nutrition, and food science was jointly organized by the International Crops Research Institute for the Semi-arid Tropics (ICRISAT), the National Institute of Nutrition (NIN), and the Central Food Technological Research Institute (CFTRI), and was sponsored by the United Nations University (UNU). The workshop was held on 10–12 November 1981 at Hyderabad, India, with some sessions at ICRISAT and others at NIN. In addition to scientists from the above-mentioned institutions, various specialists from other parts of India, Bangladesh, Nepal, and Sri Lanka also participated in the workshop. These specialists presented state-of-the-art reports for their respective countries.

The objectives of the workshop were:

- a. to review the existing knowledge in the areas of interaction between agriculture, nutrition, and food science, and evolve newer strategies for co-ordinated action;
- b. to maximize utilization of existing resources through interaction between agricultural production and post-harvest technology and its application to human nutrition;
- c. to promote the nutritional status of the population through better quality of food supplies.

It is noteworthy that the three prominent institutes of excellence covering the three different aspects of food chain—production, storage processing, and nutritional evaluation—participated. The workshop also provided an excellent forum for interaction and exchange of information between the neighbouring countries that are faced with similar problems. The twilight zones or interfaces, which are often neglected by the specialized research organizations, were discussed and avenues of future co-operation and collaboration identified. Recommendations were made for strengthening the existing linkage and the collaborative research needs for achieving the common goal.

We gratefully acknowledge the financial assistance provided by the United Nations University for conducting this workshop and thank all the participants and other staff members of the various institutions for contributing to its success.

J.S. Kanwar

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# INAUGURAL SESSION

*Chairman J.S. Kanwar*



# INTRODUCTORY REMARKS

**J.S. Kanwar**

International Crops Research Institute for the Semi-arid Tropics, Patancheru, India

I have great pleasure in extending a warm welcome to the distinguished group of scientists who have responded to our invitation to participate in this workshop, which we consider a new milestone in our international co-operation.

It is praiseworthy that four leading research organizations, two of them international—the International Crops Research Institute for the Semi-arid Tropics (ICRISAT) and the United Nations University (UNU)—and two national—the National Institute of Nutrition (NIN) and the Central Food Technological Research Institute (CFTRI)—have arranged this joint workshop to focus attention on the interfaces between agriculture, nutrition, and food sciences. ICRISAT has a mandate for crop research that aims at high and stable yields consistent with better quality in sorghum, pearl millet, pigeon-pea, chick-pea, and groundnut. NIN focuses its attention on human nutrition, CFTRI on food science, and the UN University on research and education in related fields. I am happy that this group of experts is assembling today to look at the interfaces between agriculture, nutrition, and food science, to help alleviate hunger in the world.

This is not the first workshop of its kind that has been sponsored by the UN University. Others have been held in Nigeria, the Philippines, and Guatemala. However, none of these covered the crops of concern to ICRISAT, nor did they touch on the problems of the semi-arid tropics and of the countries represented in today's workshop. This workshop will focus attention on food grains that form the staple diet of about 800 million people in the semi-arid tropics, but restrict its comments to the Indian subcontinent and its neighbouring countries. The workshop will review existing knowledge on the interaction between agriculture, nutrition, and food science, and evolve strategies for co-ordinated action. It will also aim at maximizing the utilization of existing resources through interaction between agricultural production, post-harvest technology, and its application to human nutrition.

Three other workshops held at ICRISAT in the last two weeks have set the stage for this one: the International Workshop on Sorghum Grain Quality, the International

Workshop on the Sorghum Millet Information Centre (SMIC), and the International Workshop on Sorghum in the Eighties.

All three are relevant to this one since they have looked at the problems of grain quality and nutrition in sorghum. One interface that is often overlooked relates to the dissemination of information to users; it is heartening that the Workshop on the SMIC has looked at this aspect critically. The problems and strategies for research and development in sorghum in the world have been examined by the other two workshops. Thus they provide an ideal setting for today's workshop.

Hunger and starvation caused by national disasters or political crises are not major problems in the world today. The true hunger problem of our time is chronic undernutrition—the problem of millions of men, women, and children who do not get enough to eat. This is a problem that does not make headlines, perhaps because the hungry have little or no political power and are not able to exert pressure on their own behalf. But the toll of malnutrition is immense. The US Presidential Commission on World Hunger in 1980 concluded that hunger is at least as much a political, economic, and social challenge as it is a scientific or technological one. In the Commission's estimate, as many as 800 million people do not get enough to eat each day and many more suffer from specific varieties of malnutrition.

It goes on to state that malnutrition—which results when people consume fewer calories and less proteins than their bodies need in order to live active healthy lives—diminishes physical and mental capabilities and makes people less energetic, less productive, and less able to learn. Malnutrition also increases susceptibility to diseases. At least one out of four children in the developing world dies before the age of five, mostly through nutrition-related causes, and 100,000 children go blind every year due to malnutrition, more particularly, deficiency of vitamin A. Those affected most by hunger are children and women, and the rural and urban poor. Sometimes benign governments do provide cheap food to urban poor, or fix lower prices for farm produce, which acts as a disincentive for increased food production and starts a chain reaction of more food shortage, malnutrition, poverty, and international indebtedness.

Most of the world's hungry live in the Indian subcontinent, South-East Asia, and sub-Saharan Africa. Many also live in the Middle East and parts of Latin America.

Despite the severity of the hunger problem its true dimensions are not understood for a variety of reasons.

1. Malnutrition is a silent killer; it increases vulnerability to diseases that cause death but is seldom identified as the cause of death.
2. The sheer number of people affected makes it difficult to grasp the problem. It is much easier to understand through television and newspapers who the victims of a

flood, earthquake or war are, than to picture a quarter of the world's population going hungry.

3. Although hunger contributes to political instability, hungry people, chiefly women and children, are not much of a political threat.

Hunger offers the single most powerful point of intervention in the world of underdevelopment, poverty, unemployment, disease, and high rates of population growth.

The World Bank report lists the Indian subcontinent, including Nepal, Bangladesh, Sri Lanka, and Burma, amongst the poorest countries of the world, with an average gross national product below US\$250 per capita per annum. This is the region where the population explosion is among the highest and the calorie intake lowest. Not only is total food availability lowest, but even the quality of food is very poor and nutritionally imbalanced. Take India: the availability of pulses, which are the main source of protein for a majority of the population, has decreased from 60 g daily per capita in 1950 to about 30 g in 1980.

Future projections by Wortman and Cummings (1978) show that the food deficits in 1990 in India will be of the order of 18 to 21 million tonnes; in Bangladesh, 6.4 to 8.7; in Burma, 2.1 to 2.3, protein availability will fall still further. Unless these countries increase the productivity of the land twice as much as in the past, these shortages will not be reduced. No doubt India turned the corner by more than doubling its food production in the last 30 years, but, unfortunately, the population also has more than doubled in the same period and we are once again importing food. The production of pulses and groundnut has remained virtually stagnant, thus causing serious reduction in the availability of proteins per capita.

The rapid urbanization and accelerated demand for milk, vegetables, and meat in urban areas is also seriously affecting the quality of food available to rural dwellers. Even the dairy development projects are accentuating this phenomenon.

A few of the grey areas that should receive the attention of research scientists but do not, are:

1. While agricultural research is focusing attention on increasing production, it has inadvertently led to a decrease in production of such commodities as pulses and oilseeds, which have not yet benefited from new technologies to the same extent as have the cereals. In an atmosphere of economic competition, the less remunerative crop is replaced by the more remunerative one, resulting in imbalances in food quality. Thus all the agricultural research organizations—international, national, and regional—need to redouble their efforts to affect a breakthrough in production of scarce commodities.

2. We are no doubt concerned with increasing the yield of cereals, but there is not much research on the storability and keeping quality of the grain. The farmer also does not get adequate compensation for producing better quality grain with superior nutritional value and storability.

3. Not enough research is being done on the cooking quality of food and the keeping quality of the cooked products of cereals, particularly *roti* (unleavened bread). In this time of energy crisis, I am not sure if adequate attention is being paid to the energy required for cooking grain of new genotypes.

4. Complaints are often heard about lower palatability of some of the new products, but whether this is based on prejudice or reality is not known.

5. Social scientists have often been critical of the Green Revolution, emphasizing that it has affected the nutritional status and created more imbalances. Although I do not subscribe to this view, I would urge our scientists to study this aspect critically and indicate policy implications.

6. Breeders are making serious efforts to upgrade the lysine and protein quality in sorghum, millets, and maize through genetic engineering. There are promising indications that in pearl millet both lysine and protein could be increased without adversely affecting yields. Notable progress has also been made in sorghum and maize, but we still have a long way to go to achieve practical results. The problem is that what is more nutritious and palatable to human beings also becomes more vulnerable to pests in the field and in the warehouses.

7. The debate on upgrading vitamins and micro-elements in the grain is unresolved. We must distinguish between the practicable and the ideal.

8. I also wish to draw your attention to a few interfaces between research and education that need attention in this region.

- a. *Non-conventional types of grain.* Red sorghums are reported to be less vulnerable to pests, diseases, and birds because of a high tannin level; probably they also have a high yield potential. The Indian subcontinent is biased towards white or yellow sorghum. The technologists should be able to offer inexpensive technology for making red sorghum also acceptable. We can take a cue from the Sudan and Senegal.
- b. *Biological evaluation.* ICRISAT has no facilities for biological evaluation of food. It would be excellent if NIN could join hands with ICRISAT in evaluating the breeding material on a routine basis to provide a sound basis for genetic engineering.
- c. *Consumer acceptance.* Dr. Murthy has initiated an international panel testing programme to ascertain the opinion of the consumers in different countries. It would be excellent if our neighbours were also willing to join in this testing programme so that acceptable material could then be considered by the countries concerned for production and distribution.