

IDRC - Lib
74361

Nutrition, Technology and Supplementary Foods in Asia

by Richard H. Young

Paper Prepared for Proceedings of the
Canadian Institute of Food Science and Technology
29th Annual Conference in Calgary, Canada
on "Opportunities in Developing Countries"
Wednesday, July 2, 1986



Program Officer, Postproduction Systems
Agriculture, Food and Nutrition Sciences
International Development Research Centre
South Asia Regional Office, 11 Jor Bagh
New Delhi 110003, India

11/11/87
YOUNG
no. 4

NUTRITION, TECHNOLOGY AND SUPPLEMENTARY FOODS IN ASIA

by

Richard H. Young
International Development Research Centre (Canada),
South Asia Regional Office,
New Delhi, India.

Prepared for the Proceedings of the Meeting of the Canadian
Institute of Food Science and Technology, Calgary, June 1986.

ABSTRACT

Despite considerable investments in agricultural and technological research, malnutrition continues to pervade the poor masses of Asia. While long-term improvements will depend on sound policies to generate employment and income, particularly for the rural landless, there is a clear need for viable interventions to meet the pressing demands for adequate nutrition among the more vulnerable groups. This article examines the role of food technologies in the development and delivery of supplementary foods to malnourished people in Asia. To improve the effectiveness of these foods in relieving malnutrition, better integration of activities in the market, socioeconomic and product development sectors is advocated.

INTRODUCTION

At the summit meeting of the South Asian Association for Regional Cooperation (SAARC) in December, 1985, child development and malnutrition were recommended as priority areas for collaboration. There are 400 million children in the seven South Asian countries alone, representing a quarter of the world's infant population. While progress has been made in specific areas towards improving the well-being of Asia's children, and other groups vulnerable to malnutrition, the resolutions of the World Food Conference in 1974 to eradicate hunger have not been accomplished. A change in focus to Africa in addressing the world food problem has perhaps diverted attention from Asia, which also contains vast numbers of poor people. It is therefore appropriate that SAARC has chosen to seek regional solutions to the continuing problems of malnutrition.

Solutions will not come easily. The nutrition community has recently undergone a period of self-analysis with a view to redirecting future policies (Berg and Austin, 1984; Harriss and Payne, 1984; Pacey and Payne, 1985; Chen 1985). Over the last twenty years, there has been a gradual shift in emphasis from increased agricultural productivity and technological solutions, such as single cell protein and fish protein concentrate, to integrated nutrition planning and food policy analysis. While nutritionists have been experimenting with approaches to nutrition intervention, the numbers of malnourished in low-income countries have probably increased by approximately twenty per cent since the World Food Conference (Berg and Austin, 1984). Perhaps because of this, coupled with economic decline in recent years, national governments and international agencies, with some exceptions, have shown lessened interest in nutrition issues.

Despite this background, opportunities for confronting the nutrition challenges still remain. A discussion of the wider issues involved is not the objective of this paper. It should be noted, however, that general consensus currently recommends a move away from centralised planning of nutrition programs to a mobilization of community resources for combatting malnutrition at local level.

Given the above scenario, it may be difficult to perceive a current role for conventional food processing technology in the malnutrition arena. The considerable resources earlier directed to research on such topics as oilseed protein isolates, single-cell protein, synthetic amino acid fortification and fish protein concentrate have made little impact on malnutrition (Pariser et al, 1978). There are still, however, urgent needs for appropriate supplementary foods in Asia and opportunities for technological contributions in developing them. Problems of providing adequate nutrition during the crucial weaning period beginning at six months of age still persist. Malnourishment in pregnant mothers means low birth weights and high risks of early mortality. The following discussion attempts to define a major role for food technology in addressing supplementary feeding as well as other development issues, such as employment and income generation. It is argued that, for any success to be achieved, research must be shared between the laboratory and the field and be applied in a systems context with end-user participation.

DEVELOPMENTAL BACKDROP

There is an appreciable divergence in the levels of development of Asian countries. In general, the countries of Southeast Asia are exhibiting rapid development and economic vigour and possess good human and institutional resources and strong transport and physical infrastructures. Nevertheless, rapid urbanization is occurring in the developing countries of this region with consequent commercialization of the food economy. It is estimated that the urban population of Asia will increase to 40 percent of the total in the year 2000 from its level of 20 percent in 1960 (Austin, 1980). This process is drawing more unskilled women into the workforce, with its attendant implications for family nutrition. The channelling of resources away from the rural areas has exacerbated the problems of the rural population, large proportions of which remain undernourished.

In South Asia, the burden of mass absolute poverty is much more acute and has been aggravated by rapid increases in population. These countries have predominantly agrarian economies, with widespread impoverishment and landlessness. The green revolution has generated overall self-sufficiency in food production but productivity is focussed in resource-rich regions and distribution of foods to needy consumers is inadequate. The poor masses have insufficient purchasing power to realise adequate diets. In the semi-arid areas of the region, drought-resistant sorghum and millets are widely consumed in preference to the more expensive wheat and rice which are distributed from other areas. Although agricultural policies have produced trends toward self-sufficiency in cereals, other food crops have stagnated or even declined

in production. Poor consumers in South Asia obtain their protein supplies mainly from pulses. Production figures for pulses, however, have shown downward trends in recent years.

Environmental factors further stress the food system. The inhabitants of Bangladesh have a poor, rice-based diet, the availability of which is frequently threatened by extensive flooding. In 1984, production losses for the first three rice crops were at least one million tonnes (Clay, 1985). This loss in production can also result in a drastic reduction in employment for the rural landless. Under such circumstances, malnutrition may approach famine.

NUTRITION PROBLEMS AND POLICIES

Common nutritional disorders in developing Asia are protein-calorie malnutrition, iron-deficiency anaemia, vitamin A deficiency and goitre. These deficiencies manifest themselves most profoundly in infants and pregnant and lactating women. Infant mortality rates are high and the development and learning process in surviving children may be severely debilitated. Thus, early malnutrition in Asia is a key factor affecting the vigour of human resources and, ultimately, development itself. The problem is extensive and often widely scattered in inaccessible areas. In India alone, 210 million women and children may suffer varying degrees of malnutrition. Trends toward urbanization are compounding the problem. The incidence of malnutrition is accelerating more rapidly in urban centres than in rural areas (although in the latter it is still more extensive) and the

degree of malnutrition of poor urban dwellers is frequently more severe than that of their rural counterparts (Jaya Rao, 1986).

There is general concurrence that malnutrition in Asia is a syndrome which would be ameliorated by the eradication of poverty and the provision of adequate food supplies. The governments of Asian countries in the process of development have therefore adopted long-term plans to increase income and agricultural productivity. These actions are fundamental to long-term solutions. Nevertheless, as Berg (1981) notes, the changes resulting from these policies will occur too slowly to avert malnutrition in the foreseeable future. Moreover, although the relationship between gross national product and nutritional status between countries shows a high correlation, rising incomes may not necessarily lead to increased food consumption and improved nutrition. Comparison between Asian countries demonstrates that economic factors affecting food prices may erode increased buying power and undermine nutrition interventions (Geissler and Miller, 1982).

Most Asian countries have initiated nutrition programs usually aimed specifically at vulnerable groups such as young infants and pregnant and lactating women (Gopalan, 1986; Tontisirin, 1985). In general, these programs hinge on the delivery of a basic package of services for primary health care. The essential nutrition components of this package are breastfeeding, growth monitoring, oral rehydration, immunization, nutrition education, food micronutrient supplementation, and treatment and rehabilitation of the severely malnourished. This is the basis of a program in India, known as Integrated Child Development Services (ICDS),

which covers approximately 20 million children (0-6 years) and 10 million pregnant and lactating women. Other programs exist in the country dealing with the provision of school lunches and specific nutrients such as vitamin A, iron and iodine. The Ministry of Health of Thailand has a similarly ambitious program focussed mainly on the rural problem. This is a component of the Thai government's rural development scheme which aims to satisfy the basic needs of poor communities.

The performance of nutrition programs in Asia in alleviating the deficiencies has been variable. Gopalan (1986) uses infant and child mortality rates as indicators to show that improvements have occurred between 1960 and 1981 in Sri Lanka, Thailand and India (Table 1). Particularly in India, however, the figures are still depressing and indicate the need to further address the nutrition issue. The reasons for these inadequacies in the delivery of nutrition interventions are many and complex, involving socio-economic, cultural and administrative drawbacks. The complex array of factors which may affect the nutritional status of small children have been illustrated with clarity by Pacey and Payne (1985: Fig. 1). Interventions often attack only a small sample of these factors and may therefore be destined to failure. For India, Gopalan (1983) emphasises the importance of well-executed nutrition education programs and committed field officers for the adoption of improved child feeding practices. Encouragement may be derived from the cases of Kerala state (India) and Sri Lanka, where incomes are amongst the lowest in the developing world. Despite such poverty, infant mortality is lower, life expectancy is greater and general nutritional status is better in Kerala and Sri Lanka than in neighbouring Asian regions. Such achievements have been accomplished by the relatively efficient investment of limited government

funds in health, education, nutrition and food distribution schemes (Gwatkin, 1979).

It is within this framework that the role of food technology in improving the nutritional status of Asians must be examined. Clearly, however, improved nutrition in the region will depend primarily on the increased consumption of nutritious foods, especially by vulnerable groups, coupled with supportive health, education and income-generating schemes. With respect to the latter, interest is expanding in the development of activities which specifically provide women with opportunities for employment (Anon, 1984; Clay, 1985; Mahmud and Mahmud, 1985). This will provide direct benefits for the nutritional welfare of women and children, in addition to the normal income effect. Since women are heavily involved in traditional Asian food processing, this sector is of special significance for targetted income generation. Of course, as Geervani (1983) points out, women's employment may also lead to child nutrition problems, if not linked to community child care.

CONFRONTING THE PROBLEM: THE ROLE OF FOOD TECHNOLOGY

Agroindustrial Development

Accepting that income and employment generation, particularly for the rural landless, are essential long-term measures to offset future malnutrition, a major role for food technology in the development of small agroindustries is evident. The developing countries of Asia are predominantly agricultural countries. The application of food technology can exploit this agricultural base to generate more value added to products. Gaikwad (1986) noted the need to more fully exploit food processing operations to create income and assets in rural development programs.

Clearly, for malnourished people to share in the benefits, attention must be directed away from the capital-intensive food processing sector in favour of rural, community-based industries. There is now a wealth of experience and literature on the development and implementation of so-called appropriate food technologies (e.g. dehydration, fermentation, expelling, pickling, milling) and treatment of the topic is beyond the scope of this paper. Suffice to note that the income generating function of food processing is increasingly recognised by Asian governments. For example, the seventh five-year plan (1985-1990) of the Government of India emphasises the need to stimulate the contribution of food technology to the development process. Of course, food technologies can only form a framework for viable rural industries if supported by suitable managerial, financial and organizational systems.

Foods for Vulnerable Groups

Food technology may also make an important contribution to nutrition intervention programs in Asia, in the design and delivery of supplementary foods. As Austin (1980) notes, the effectiveness of feeding programs depends on the product they deliver. Food technology has a crucial role to play in developing nutrient-dense foods suitable for weaning, which are often unavailable to target groups. In order to make a realistic contribution to nutrition, however, food technology must be placed in the context of the overall food system, and recognise the scenario of Fig. 1. Too often in the past, initiatives have arisen from food technology laboratories and pilot plants, in the absence of sound knowledge of the habits of, and socioeconomic conditions surrounding, the intended

beneficiaries. The design of supplementary foods should be essentially based on market analysis and consider raw material procurement and marketing strategies. The application of social market research in the design of food and nutrition projects in the developing world has recently been reviewed (Young and MacCormac, 1987).

Since nutrition in Asia has, as elsewhere, been considered the traditional domain of the medical profession, market specialists and food technologists are not normally involved in the formulation of nutrition policy. Supplementary food development has often taken place in isolation from the core program. Food technology needs to be incorporated as one component of a multisectoral approach to nutritional problems in Asia, other components being marketing, socioeconomics, agriculture, health and education. Although the latter may be fundamental for the acceptance of supplementary foods by the mother, conventional didactic methods of education have limitations in poor societies. Understanding entrenched attitudes and practices and placing improvements in the traditional setting should provide more sustainable results. This requires tact and patience and dedicated field workers, requirements which experience has shown to be difficult to achieve. In addition, the use of appropriate advertising geared to promoting better nutrition practices deserves much greater attention than it has received in the past (Pacey and Payne 1985; P. Pushpamma, personal communication).

Current evidence indicates that the value of weaning foods is often not recognised giving rise to undesirable child feeding practices by poor Asian mothers (Rao, 1986). According to Geervani (1983), the type of feeding practice that the mother employs depends upon variables which include customs, superstitions and beliefs, religion, cultural pattern, place

of residence, socio-economic status of the family and literacy status of the mother. Geervani suggests that weaning foods may be most appropriately prepared from the constituents of the normal adult diet. In reviewing a nutrition program in India, GopalDas (1983) points to the need to develop special "mother foods", which are both culturally and psychologically acceptable. For example, on the basis of anthropological evidence, Mital and GopalDas (1985) developed a supplementary food specifically targetted to pregnant and lactating women. Just as those in the higher income brackets, poor people may associate certain foods with prestige and status (Shah, 1986). These attitudes could be more fully exploited in designing supplementary foods for particular localities.

If such social influences are not appreciated by food technologists, supplementary food development may be a futile exercise. The results of anthropological studies can act as useful guides to food tastes and habits and need to be more widely exploited by food technologists. As Chen (1985) points out, solutions to malnutrition must be flexible and locally adapted.

APPROACHES TO SUPPLEMENTARY FEEDING IN ASIA

Two general approaches to producing nutrient-dense foods may be compared in the Asian context. In one, nutrient mix and density are obtained, as conventionally, through capital and energy intensive transformations, such as extrusion processing and dehydration. In the other, more labour-intensive processes are encouraged, using simpler technologies (e.g. cutting, abrasion, mixing, malting) and applicable in rural areas.

Centralised Processing

Narasinga Rao (1984) has reviewed the development of supplementary foods in India. Several types have been used in nutrition programs, including Indian multipurpose food (MPF), Bal-Ahar, Corn-Soya-Milk (CSM), energy food and extruded foods. MPF is a mixture of roasted groundnut and chickpea flours, fortified with vitamins and minerals. Bal-Ahar is a blend of unroasted ingredients, selected from wheat, groundnut, soybean and chickpea flours, with skim milk powder. Along with CSM, these products are more appropriately produced in centralized factories (Rao, 1983). As Beaton and Ghassemi (1982) have noted, improvements in child nutrition and reduction in infant mortality rates have been recorded in Indian programs which have employed CSM-type mixtures as supplementary foods. Nevertheless, such programs have received large subsidies from government and international sources and may not necessarily be targetted to the most vulnerable groups (Pacey and Payne, 1985). In general, logistical obstacles prevent feeding programs from serving remote rural areas where food supplementation is most needed (Krantz et al, 1984).

Community and Village Processing

Another approach is to develop processes and products which can be decentralised to district or community operation. In addition to increasing the availability of supplementary foods at local level, such schemes may also serve to generate community participation, employment and income. Naturally, these processing operations must be characterised by their use of available raw materials, low-cost, simplicity and minimal risk of contamination. Several Asian governments have

utilized this approach in nutrition intervention programs. During the Fifth Development Plan (1982-86) of Thailand, community participation in supplementary food production was emphasized with the concept of village food processing centres (Pathanathabutr, 1984). Simple roasting and blending procedures were used, employing rice, groundnut, sesame and mung bean in nutritionally balanced mixtures. In rural Nepal, a nutritious porridge for infants has been developed by adapting traditional processing techniques for corn, wheat and soybeans (Krantz et al, 1984).

These supplementary foods have achieved a degree of success in nutrition programs. There have, however, been limitations in the adoption of village-level processing and distribution of supplementary foods for reasons which can be explained by the interactions given in Fig. 1. In connection with the Thai government's rural nutrition program, Mongkolsmai (1986) examined the effectiveness of the village food processing centre as the processing and marketing agent for infant food. Mongkolsmai noted weaknesses in the implementation of the program because of inadequate appreciation of the sociodemographic and economic characteristics of the target households, compounded by deficiencies in the convenience and sensory acceptability of the product. Overall, the need for a better flow of information with respect to the beneficiaries is the clear message emanating from Mongkolsmai's study.

The benefits of applying a sound market approach to the design of technological and nutritional interventions at community level are exemplified by studies completed in the poor, arid zones of Andhra Pradesh, India. Market surveys were undertaken in three agroclimatically different regions of the state to assess production, storage, processing and consumption practices for sorghum, millets and legumes (Pushpamma and Chittemma Rao, 1981 a; Pushpamma and Chittemma

Rao, 1981 b). These comprehensive surveys indicated that the commodities are home processed by women using laborious and time-consuming procedures, that physical and nutrient losses occur during processing, that the nutritional status of women is affected because of calorific expenditure during food processing and that an appropriate weaning food is required. Further work has involved the design of small mechanical dehulling operations which remove the drudgery of food processing and permit the formulation of a wider range of food products, including weaning foods, from sorghum, millets and legumes. These operations serve as a basis for the development of rural enterprises to upgrade the use of staple crops and improve the existing diet. As previously mentioned, when managed by women, such enterprises are also a means of directing additional income to vulnerable groups since women are more likely to use this extra income for food and child care.

Surveys of poor rural consumers in Asia also indicate that ready-to-eat (RTE) foods are preferred because of the time constraints experienced by mothers. Although more costly to prepare than formulations which are not precooked, RTE foods, such as baked goods, have received greater acceptability, are more hygienic and stable and are easier to distribute. They are also regarded as "prestige foods" in many poor societies. Rural bakeries may achieve the dual purposes of manufacturing nutritious foods, in areas where they are most needed, and of generating rural income. In addition, RTE's may be important foods for farming communities during harvesting and planting seasons when minimum attention is given to child care and malnourishment is exacerbated. In India, progress is being made in popularizing baked products prepared from dehulled sorghum (P. Pushpamma, unpublished data). The advantages of providing supplementary foods in biscuit form for disaster

relief programs have recently been outlined by Young, Fellows and Mitchell (1985).

In certain Southeast Asian countries, such as Thailand, Philippines and Indonesia, the acceptance of fermented foods prepared in rural areas from fish or legumes could be more adequately exploited. A considerable variety of foods based on fermented fish/rice mixtures is traditionally consumed in the region (Adams, Cooke and Rattagool, 1985; Owen and Mendoza, 1985). In Thailand, rice gruels for infants are, whenever possible, supplemented with small amounts of fish. These simple biotechnologies deserve wider attention since they could form the basis of small food processing enterprises manufacturing nutritious, low-cost foods for feeding programs or general consumption. Currently, these foods are prepared in unhygienic, uncontrolled conditions and often harbour pathogenic microorganisms.

Bulk Reduction

In all Asian countries, rice is widely used in gruel or cooked form as an early food for infants. The high water binding capacity of rice starch, however, causes much swelling during cooking and a "bulky" gruel with low caloric density. Infants are unable to ingest sufficient quantities of rice gruel to satisfy their daily energy requirements (Hellstrom et al, 1981). It has been demonstrated that, because of its high amylase content, the addition of 5% malted barley will substantially reduce the viscosity of 15% hot-paste slurries of Indian weaning foods (Malleshi and Desikachar, 1982: Table 2). Recently, staples of poor consumers, possessing good amylase activity after germination, have been identified and found to effectively reduce viscosity and increase caloric

density in infant gruels (Desikachar, 1985; Gopaldas et al, 1985). These include sorghum (Sorghum vulgare), finger millet (Eleusine coracana), pearl millet (Pennisetum typhoideum) and maize (Zea mays). These amylase-rich foods are easy to prepare and store at household level, inexpensive and able to significantly increase the calorie intake of infants and children. A word of caution was sounded by Panasiuk and Bills (1984) who detected hydrocyanic acid in the sprouts of germinated sorghum cultivars. Nevertheless, nutrition research institutes and international development agencies are becoming increasingly interested in the application of malting for the preparation of Asian supplementary foods.

FUTURE DIRECTIONS

Despite technological developments, clear needs for proper supplementary feeding practices continue to exist amongst the poor sectors of Asia's vast population. In common with other disciplines, the thoughtful application of food technology will contribute to upgrading the nutritional well-being of low-income groups in Asia. Future research efforts, however, should actively attempt to place developments in food technology in the context of the existing food system. As in industrial societies, social, marketing and economic factors are key determinants of the acceptance of nutritious, processed foods by poor Asian consumers. These areas have frequently been neglected in nutrition intervention programs. Because of the obvious nutritional deficiencies among the targetted groups, there has perhaps been a tendency to assume that nutritious supplements would be readily absorbed by a demanding market. Experience suggests that this is not

necessarily the case and that a clearer understanding of the beneficiaries and their environments is required for guiding the development and delivery of supplementary foods. Asian institutions responsible for food technology and nutrition sectors should be encouraged to integrate their activities more closely with socioeconomic research and food systems analysis. If such integration can be achieved, research and development investments in the field will be more soundly utilized to promote better nutrition for the poor masses.

ns

March 11, 1987

The views expressed in this paper are those of the author and do not necessarily reflect the opinions of the International Development Research Centre (IDRC).

REFERENCES

- ADAMS, M.R.; COOKE, R.D. & RATTAGOOL, P. (1985).
Fermented fish products of South East Asia. *Trop.Sci.*
25, 61-73.
- ANON (1984). Development of Women and Children in Rural
Areas. New Delhi: Government of India/UNICEF, 34 p.
- AUSTIN, J.E.(1980). Confronting Urban Malnutrition: The
Design of Nutrition Programs. World Bank Staff
Occasional Papers, no.28. Baltimore: John Hopkins
University Press, 119 p.
- BEATON, G.H. & GHASSEMI, H.(1982). Supplementary feeding
programs for young children in developing countries.
Am. J. Nutr. 35, 864-916.
- BERG, A.(1981). Malnourished People: A Policy View
Washington D.C.: World Bank, 108p.
- BERG, A. & AUSTIN, J. (1984). Nutrition programs and
policies: A decade of redirection. *Food Policy* 9
(4), 304-312.
- CHEN, L.C. (1985). Nutrition in developing countries and the
role of international agencies: In search of a
vision. Paper presented at Symposium on Nutrition
Issues in Developing Countries for the 1980's & 1990's.
Washington D.C.: National Academy of Sciences, 22p.
- CLAY, E. (1985). The 1974 and 1984 floods in Bangladesh -
from famine to food crisis management. *Food Policy*
10 (3), 202-206.
- DESIKACHAR, H.S.R. (1983). Production of weaning foods
suitable for mass production and consumption in
developing countries. (P. Pushpamma, ed.) Report
of a Workshop on Weaning Foods: New Delhi, UNICEF
pp.117-125.
- GAIKWAD, V.R. (1986). Rural development strategies:
evaluation of some early experiments in India.
(M.L. Dantwala, R. Gupta & K.C. D'Souza, eds.)
Asian Seminar on Rural Development - The Indian
Experience: New Delhi, Oxford and IBH Publishing
Co. p. 80.
- GOPALAN, C. (1983). Promoting child health and nutrition
in India. *Food Policy* 8(1), 23-30.
- GOPALAN, C. (1986). Nutritional status of India's children
- has it improved in recent years ? *Bulletin of
the Nutrition Foundation of India.* 7 (1), 5p.

- GOPALDAS, T (1983). Project Poshak by CARE in Madhya Pradesh, India. (D.S. McLaren, ed) Nutrition in the Community: Chichester, John Wiley and Sons. pp. 373-395.
- GOPALDAS, T; MEHTA P.; PATIL, A. & GANDHI, H. (1985). Studies on reduction in viscosity of thick rice gruels with small quantities of an amylase-rich cereal malt. Paper presented at 13th International Congress of Nutrition, Brighton, UK, 13 p.
- GWATKIN. D.R.(1979). Food policy, nutrition planning and survival: The cases of Kerala and Sri Lanka. Food Policy 4(4), 245-258.
- HARRIS, B. & PAYNE, P. (1984). Rejoinder: Magic bullets and the nutrition agenda. Food Policy 9 (4), 313-316.
- HELLSTROM, A; HERMANSSON, A; KARLSON, A.; LJUNGQVIST, B.; MELLANDER, O. & SWANBERG, U. (1981). Dietary bulk as a limiting factor for nutrient intake with reference to the feeding of pre-school children. II. Consistency as related to dietary bulk - a model study. J. Trop. Pediatr. 27, 127-135.
- JAYA RAO, K.S. (1986). Urban nutrition in India - II. Bulletin of the Nutrition Foundation of India. 7 (1), 3p.
- KRANTZ, M.E; PAHARI, S. & COLGATE S.(1984). Sarbottam Pitho: A Home Processed Weaning Food for Nepal: Washington, D.C., Hoviprep Monograph Series No 1, 38p.
- MAHMUD, W. & MAHMUD, S. (1985). Age-Sex Aspects of the Food and Nutrition Problem in Rural Bangladesh: Geneva, International Labour Office, 45p.
- MALLESHI, N.G. & DESIKACHAR, H.S.R. (1982). Formulation of a weaning food with low hot paste viscosity based on malted ragi (*Eleusine coracana*) and green gram (*Phaseolus radiatus*). J. Food Sci. Tech. (India) 19 193-197.
- MITAL, N. & GOPALDAS, T. (1985). Habit survey of a culturally acceptable mother food in Gujarat, India. Ecology of Food and Nutrition 16, 243-252.
- MONGKOLSMAI, D. (1987). Supplementary foods in rural Thailand. (R.H. Young & C. MacCormac, eds.). Market Research for Food Products and Processes in Developing Countries: Ottawa, IDRC (In press).
- NARASINGA RAO, M.S. (1984). Current situation on formulation and product development. (M. Graham, A. Stuckey, S. Wichaidit & A. Valyasevi, eds.) Proceedings of Workshop on Home and Village Prepared Supplementary Foods in Asia: Bangkok, Prayurawong Co. Ltd. pp.19-22.

- OWENS, J.D. & MENDOZA, L.S. (1985). Enzymically hydrolysed and bacterially fermented fishery products. *J. Fd. Technol.* 20, 273-293.
- PACEY, A. & PAYNE, P. (1985). *Agricultural Development and Nutrition*. London: Hutchinson, 255p.
- PANASIUK, O. & BILLS, D.D. (1984). Cyanide content of sorghum sprouts. *J.Fd. Sci.* 49, 791-793.
- PARISER, E.R.; WALLERSTEIN, M.B.; CORKERY, C.J. & BROWN, N.L. (1978) *Fish Protein Concentrate: Panacea for Protein Nutrition?* Cambridge: MIT Press.
- PATHANATHABUTR, P. (1984). Opening address. (M. Graham, A. Stuckey, S. Wichaidit & A. Valyasevi, eds.) *Proceedings of Workshop on Home and Village Prepared Supplementary Foods in Asia*: Bangkok, Prayurawong Co. Ltd., pp.9-10.
- PUSHPAMMA, P. & CHITTEMMA RAO, K. (1981a). *Varietal Preference, Marketing, Storage, Processing and Utilization of Sorghum and Millets in Andhra Pradesh*. Hyderabad: Andhra Pradesh Agricultural University Press, 81p.
- PUSHPAMMA, P. & CHITTEMMA RAO, K. (1981 b). *Critical Analysis - Post-Production Systems of Legumes in Andhra Pradesh*, Hyderabad: Andhra Pradesh Agricultural University Press, 84p.
- RAO, M. (1983) The role of ready-to eat processed food factory, Hyderabad, in the implementation of government nutrition programmes in Andhra Pradesh. (P. Pushpamma, ed.) *Report of a Workshop on Weaning Foods*: New Delhi, UNICEF. pp. 126-135.
- RAO, M. (1986). Knowledge, attitude and practice regarding nutrition among pregnant women in rural Dharwad, Karnataka, India. *Ecology of Food and Nutrition* 18, 197-208.
- SHAH, C.H. (1986). The demand for higher-status food and nutrition in rural India: The experience of Matar Taluka.1. Basic data and interrelationship of variables. *Food and Nutrition Bulletin* 8(2), 4-23.
- TONTISIRIN, K. (1985). The nutrition situation and nutrition action programs in four ASEAN countries. *ASEAN Food Journal*. 1 (4), 162-168.
- YOUNG, H.; FELLOWS, P. & MITCHELL, J. (1985). Development of a high energy biscuit for use as a food supplement in disaster relief. *J. Fd. Technol.* 20, 689-695.
- YOUNG, R.H. & MACCORMAC, C.W., EDS. (1987). *Market Research for Food Products and Processes in Developing Countries*: Ottawa, IDRC (In press).

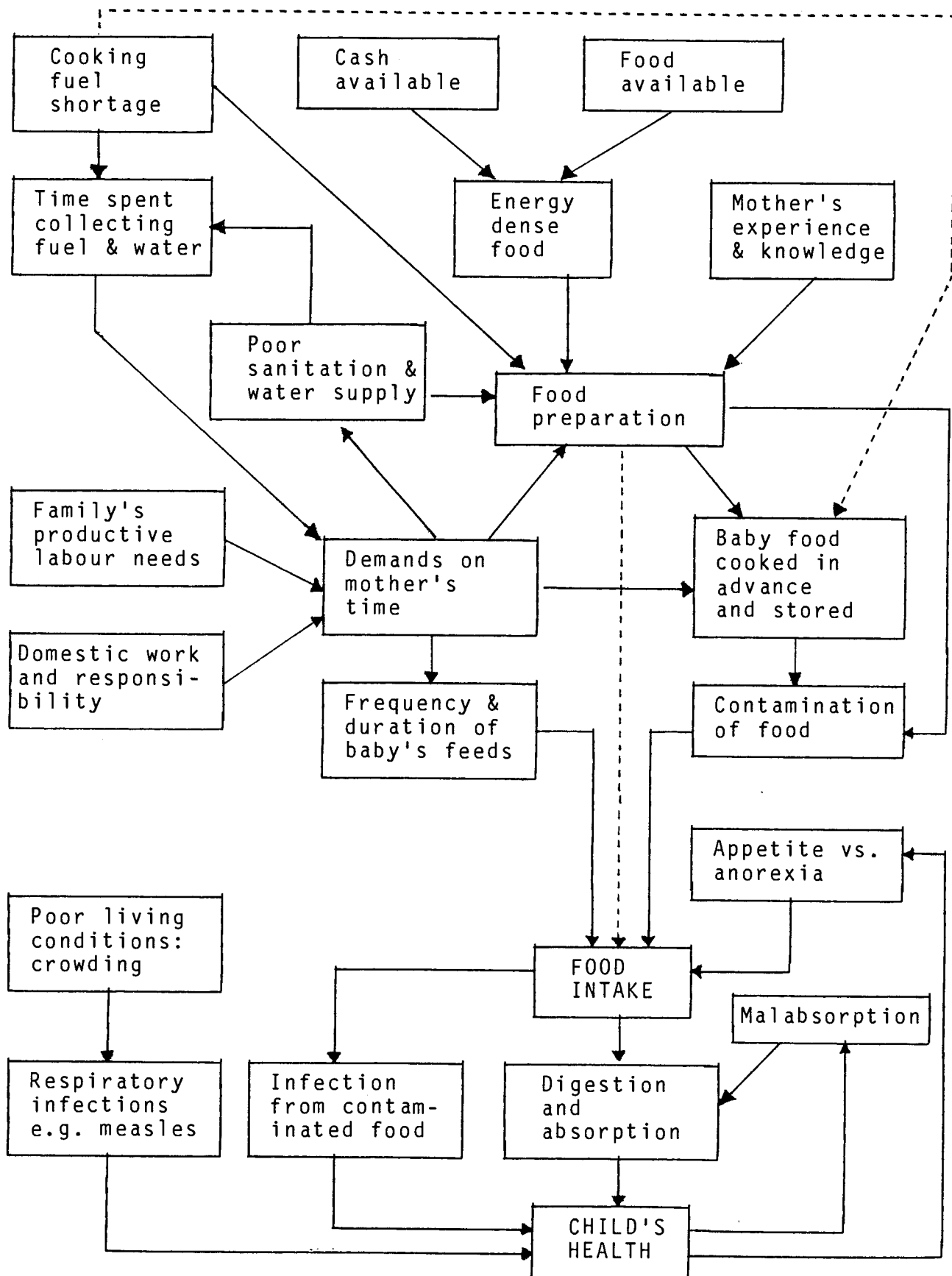


fig.1. Summary of factors affecting the nutrition of small children.
 ource: Pacey & Payne (1985)

TABLE 1

Infant and Child Mortality Rates

Indicators	India	Sri Lanka	Thailand
IMR			
1960	146	70	100
1981	120	43	50
Child Mortality			
1960	26	7	13
1981	17	3	4

Source: Gopalan (1986)

TABLE 2

Viscosity and Protein Value of Weaning Foods

Weaning Food	Protein content %	PER	Hot-paste Viscosity of 15% Slurry (cP*)	
			Plain	With added malt (5% barley)
Malted Weaning Foods**				
Ragi	12.1	2.43	60	-
Sorghum	14.6	-	900	-
Maize	15.1	-	450	-
Pearl Millet	15.5	-	60	-
Wheat	15.6	-	60	-
Chapaties***				
Wheat	15.4	2.69	6,000	96
Sorghum	13.2	2.60	3,800	108
Maize	12.5	2.71	2,000	42
Flakes				
Rice (70) + Soya (30)	17.5	2.81	1,700	42
Rice+ Green Gram + Puffed Bengal Gram***	16.9	2.72	1,800	56
Vermicelli				
Sorghum + Green Gram + Puffed Bengal Gram	13.0	2.64	4,200	100

* cP = centipoise, cgs unit of viscosity.

** Malted cereal and green gram in a ratio of 70:30

*** Cereal, green gram, and puffed Bengal gram in a proportion of 70:20:10

Source: Desikachar (1983)