

Some Medical and Economic Aspects of the prevalence of Malnutrition in Sri Lanka

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THE problem of malnutrition has been a chronic situation and much discussed in medical circles for over three decades. The fuel crisis of 1973 was an emergency situation. When this was superimposed on the chronic food lack in many developing countries, the incidence of malnutrition was heightened. The problem is now perceived widely and is of grave concern beyond hospitals.

The first need is to define the problem in a way that priorities are identified so that relevant measures would be adopted to tackle the problem. Not only must we have the numbers affected but also a subclassification to show the ecology, family and community environment in which they live.

This definition could be achieved by the following studies :

- nutritional surveillance of the community.
- analysis of hospital data to further identify risk groups within the community.

The survey done by CARE, U. S. Health, Education Welfare and the Ministry of Health from September 1975 to March 1976 was to provide a statistically valid assessment of the nutritional status of the preschool population in Sri Lanka. Anthropometric measures such as weight for height and height for age were combined as suggested by Waterlow to classify nutritional status. Tables I and II show the distribution of acute and chronic under-nutrition by SHS areas and age.

TABLE I

% Acutely Undernourished		% Chronically Undernourished		Inf. Mortality Rate 1974	
R'pura	8.8	Kandy	49.6	N'eliya	78
Kandy	8.3	Badulla	49.4	Badulla	73
B'caloa	8.4	Kegalle	39.6	Kandy	71
Galle	8.2	Matale	38.9	R'pura	66
Matale	7.2	R'pura	37.3	Matale	65
Kegalle	7.1	B'caloa	36.5	Kegalle	60
A'pura	6.9	Galle	33.3	K'tara	52
K'tara	6.2	A'pura	30.7	Galle	50
Matara	6.0	K'gala	30.4	B'caloa	45
Vavuniya	3.8	Matara	29.7	Colombo	42
Badulla	3.8	Vavuniya	29.6	Matara	40
K'gala	3.7	Jaffna	28.4	Amparai	39
Puttalam	3.1	Kalutara	26.8	K'gala	38
Colombo	4.9	Puttalam	24.4	Hambantota	35
Jaffna	3.7	Colombo	20.7	Mannar	34
Average	6.6	Average	34.7	A'pura	36
				Trincomalee	32
				Moneragala	30
				Puttalam	28
				Polonnaruwa	23
				Vavuniya	22
				Jaffna	21

TABLE II

Age (Months)	% Acutely Undernourished (weight per cent).	Chronically Undernourished (weight per cent).
6-11	5.0	11.8
12-23	10.8	24.8
24-35	6.9	33.1
36-47	4.8	40.8
48-59	5.0	41.9
60-71	6.2	46.2
Average-Sri Lanka	6.6	34.7

This baseline survey will be useful not only for ongoing surveillance but also to assess change resulting from remedial programmes. Acute undernutrition suggests a recent deficiency either due to an acute unavailability of food or to acute disease. Short term measures such as nutrition therapy and treatment of infections would help relieve acute deficiency. But long term measures are certainly necessary to eradicate chronic undernutrition which is due to chronic hunger. It is obvious that districts like Ratnapura, Kandy, Batticaloa and Galle are the worst off. The survey also indicates that children of the age group 12 to 23 months are the high risk group for remedial measures.

Table III would finally illustrate the magnitude of the problem—that approximately 40% of Sri Lankan children are so malnourished that they need some nutrition intervention programme.

TABLE III

% Gomez Second and Third degree combined			
Kandy	..	..	54.6
Badulla	..	..	50.6
Ratnapura	..	..	49.7
Matale	..	..	45.9
Kegalle	..	..	43.4
Galle	..	..	44.6
Batticaloa	..	..	42.3
Kurunegala	..	..	39.6
Anuradhapura	..	..	38.4
Matara	..	..	37.2
Vavuniya	..	..	36.4
Kalutara	..	..	35.7
Puttalam	..	..	34.6
Jaffna	..	..	32.5
Colombo	..	..	29.1
Average	..	..	42

An analysis of the differential infant mortality rate in different districts in Sri Lanka shows the strong correlation between nutritional status and high child mortality (Table I). There is then an urgent need for nutrition intervention in these same areas. At the same time it must be stated that it is now possible to reverse severe

malnutrition fast enough to reduce its old high fatality risks. This is because nutrition therapy is mostly based on the use of Triposha (WSB). If this programme can be popularised in more provincial paediatric units, the mortality rates in those areas could be reduced.

Analysis of hospital data has been done both retrospectively and prospectively in the University Paediatric Unit, Colombo, to identify factors that would place a child "at risk of malnutrition".

TABLE IV
Severe PCM and Breast Feeding

	Marasmus	Kwashiorkor
Total number of cases	100	16
Not recorded	1	1
Not established	13	0
Breast fed less than one month	14	1
Do. 1-3 months	28	3
Do. 3-6 months	15	3
Do. 6-12 months	10	1
Do. more than one year	19	7

Firstly, Table IV reveals the clinical presentation. The majority had marasmus which would reveal a chronic state of hunger or calorie inadequacy prevalent in Sri Lanka rather than an acute famine situation (which would have revealed a high incidence of Kwashiorkor).

This high incidence of marasmus is related to poor breastfeeding (Table IV). It is obvious that artificial feeding is a failure among these families. With the population explosion and the world shortage of milk, the prices of infant milk foods are ever soaring. Therefore it is necessary to promote breastfeeding at all levels and to remove any prestige value on tinned milk foods.

TABLE V
Severe PCM — Age

	Marasmus	Kwashiorkor
Total number of cases	100	16
Not recorded	3	0
0-1 year	39	1
1-2 years	25	10
2-3 years	19	2
3-4 years	11	1
4-5 years	0	0
Over 5 years	3	2

Age distribution is displayed in Table V. Marasmus occurs in infancy and Kwashiorkor in the older child. Boys and girls are equally affected and there is no special risk of malnutrition for a girl baby in Sri Lanka.

It has been shown for many years that those families who are affected by malnutrition come from groups who earn less than Rs. 300/- a month (Table VI.) The pattern is similar to the rest of the developing countries and indeed that is why malnutrition remains a problem of these countries.

TABLE VI
Severe PCM — Family Income
Total No. of Cases — 116

Series	Urban Average	National Average
Not recorded	36(31%)	—
Less than Rs. 100/-	43(37.1%)	3.5% .. 8.3%
Rs. 101/- — 200/-	31(26.7%)	17.7% .. 35.3%
Rs. 201/- — 400/-	6(5.2%)	39.6% .. 37.2%
Rs. 401/- & above	Nil	39.2% .. 19.2%

Further analysis of this socioeconomic background is displayed according to father's education and thus his employment. (Table VII).

TABLE VII
Severe PCM — Father's Education
Total Number of cases — 116

Series	Urban Average	National Average
Not recorded	19(16.4%)	—
Not schooling	19(16.4%)	7.2% .. 11.6%
Primary	34(29.3%)	39.1% .. 47.9%
Secondary	38(32.8%)	38.4% .. 32.4%
G.C.E. (O/L)	6(5.2%)	12.9% .. 7.1%
G.C.E. (A/L)	0	2.4% .. 1%

Mother was working only in families where the father was dead or separated. There were no families with malnourished children where both parents were working.

There are many social problems and acute crises such as loss of a parent by death or separation or loss of employment, shifting of residence (rural to urban) unhappy marriages—all contribute to precipitation of severe malnutrition in children. Table VIII shows an analysis of 50 consecutive admissions of malnourished children in 1975 supporting this observation.

TABLE VIII
Factors Immediately Preceding Onset of Malnutrition
50 Malnourished Children in 1975

Post Measles	20
Following Gastroenteritis	25
Unmarried parents	4
Unsatisfactory parental relationship	7
Parental separation	5
Death of parent	4
Loss of employment	13
Other sudden hardships	7

It is necessary to stress that the chief role of medical personnel in minimising the effects of malnutrition is to prevent and effectively and rapidly cure those infections that push children on minimal nutritive intake into severe malnutrition. Fifty malnourished children in hospital were compared with fifty others in hospital, but not malnourished, in respect of incidents of infections (Table IX). Gastroenteritis particularly a history of recent gastroenteritis and poor dietetic therapy often lead to

severe malnutrition. Not only mothers but even doctors need better knowledge of nutritional support during acute and chronic illness. It has been known for many years that milk should not be routinely withheld with the onset of diarrhoea.

TABLE IX
Associated Infections

	<i>Kwashiorkor</i>	<i>Marasmus</i>	<i>Not Malnourished</i>
Total No. of cases	57	154	46
No. with Helminthiasis	33(57.7%)	73(47.4%)	12(26%)
Whipworm	30(52.6%)	56(36.4%)	7(15.2%)
Round-worm	20(35.1%)	50(32.5%)	9(19.6%)
Hook worm	14(24.6%)	31(20.1%)	1(2%)
Gastroenteritis (NS)	22(38.6%)	42(27.3%)	—
Respiratory Infections	19(33.3%)	21(13.7%)	—
Skin infections	7(12.7%)	8(5.2%)	—
Measles	5(8.8%)	2(1.3%)	—
T. B.	2(3.5%)	1(0.7%)	—
Amebiasis	3(5.2%)	8(5.2%)	2(4.3%)
Giardiasis	0	4(2.6%)	1(2%)
Strongyloides	0	0	1(2%)
Salmonellosis	1(1.3%)	2(1.3%)	—
Shigellosis	1(1.3%)	4(2.6%)	—

The interaction between measles and malnutrition has been documented in many countries. Table VIII illustrates this. The problem of measles has been accentuated recently since both morbidity and mortality have increased and must necessarily be related to poor nutritional status among children. Measles immunisation must be considered urgently for those at risk of malnutrition.

Certain cultural beliefs in respect of measles leading to low protein diet and withholding therapy must also be rectified to reduce this association between measles and malnutrition.

It is necessary to highlight the link between large family size and malnutrition. 59.5% of the series in the University unit in Colombo had more than four children in the family.

TABLE X
Severe PCM and immunisation
(Indicates utilisation of NCH service)

Total Number of Cases	116
Not recorded	5
Immunisation complete	Nil
Immunisation incomplete	30(26.7%)
Immunisation Nil	81(69.9%)



The child is particularly susceptible to protein-calorie malnutrition (PCM) between the ages of 1 and 5 or 6 years. If PCM remains untreated, it can be fatal.

Finally Table X demonstrates that malnutrition is seen among those who do not avail themselves of free health facilities provided by the state. A question which could be raised here is whether any preventive programme should be solely MCH clinic based. There is a need for a catalytic force of lay health workers who are non-professional and preferably volunteers to motivate mothers to utilise free health facilities already available. The basis for preventive programmes should be around regular assessment of growth, active promotion of breastfeeding, education on food values and home made weaning foods, knowledge of food and personal hygiene, immunisation, family planning and simple curative therapy for minor infections. In the wake of fluctuating food prices with changes in food availability, there must be a system of information where mothers would know the cost per nutritive value of foods (and not cost per pound) so as to equip them with the knowledge of how best to spend their money and prevent malnutrition of their children.

The importance of nutritional surveillance by regular collection and evaluation of data is to confirm the need for planning strategy for national programmes. The need to implement any definite action is thus soundly based. International agencies cannot then be accused of foisting carbon copies of other country programmes incurring unnecessary expenditure when such are not really justified.

Looking beyond the hospital where children are treated for severe malnutrition, it is necessary to evolve both short term and long term policies concerning the community at large. Until then the prevalence of malnutrition will hinder the progress of generations to come.

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Men, Women, Children and Proteins

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MEN, women and children cannot live without proteins. They can, if need be, live almost without carbohydrates. The Arctic explorer, Stefansson, and a colleague lived in good health for a whole year on a diet composed solely of meat and therefore almost devoid of carbohydrate.

Men, women and children also can, if they so desire, do without almost any fat. Thus, the Hos, an aboriginal tribe living in the Bihar Province of India, do not use any kind of fat or oil in their cooking. Nor do they consume any meat or milk. Their intake of fats and oils therefore must be precious small. Nevertheless, they do not show any disorder which could be attributed to fat deficiency.

As to alcohol, the only other source of energy in human nutrition, most women and all children seem to be able to stay well and happy without it. From a strictly nutritional point of view, alcohol is certainly entirely dispensable. Many men, however, would argue that life without alcohol is not worth living but that is another story.

Why, it may be asked, cannot we live without proteins? As it happens, every single cell in the body is composed partly of protein. Without protein young cells cannot grow and mature cells cannot maintain their structure. Whereas fat in the body can be derived from carbohydrates and carbohydrates can be derived from proteins, proteins cannot be derived from either. It follows that proteins have necessarily to be taken in the diet.

Proteins are large molecules made up of nitrogen-containing amino acids. For many years it was believed that all proteins were similar in composition. At the turn of this century, however, Emil Fisher showed that proteins are composed of amino acids which are differently arranged in different proteins. There are some 22 amino acids which are known to enter into the composition of body proteins. The body can make some of these if a supply of nitrogen is made available. The amino acids which the body makes under proper conditions are called non-essential amino acids. Those that cannot be synthesized by the body must be supplied in the diet. These are the so-called essential amino acids of which there are eight.

What functions do proteins perform in the body? They are essential to growth for they provide the essential amino acids which are the building blocks for tissue synthesis. Also, proteins supply the raw material necessary for the synthesis of digestive juices, plasma proteins, haemoglobin, enzymes, and certain hormones and vitamins. Proteins can also be used to obtain energy, although it is a waste to use it for that purpose.

Protein deficiency in childhood results in a disease called Kwashiorkor characterized by failure to thrive, muscular wasting, mental apathy, swelling of the body and a liability to liver damage. Kwashiorkor is the name given to this disease by the Ga tribe living in Ghana. In the Ga language, Kwashiorkor means "the sickness the older child gets when the next baby is born". The older child who has been taken off the mother's breast to make room for the newborn baby, develops Kwashiorkor because its principal source of good quality protein, namely its mother's milk, has now been diverted to the newcomer. Kwashiorkor or protein malnutrition can occur at any age but it is most common in toddlers who have been weaned from the breast on to diets deficient in protein. In the adult, protein malnutrition leads to loss of strength, impairment of working capacity and a greater susceptibility to various diseases. It is no exaggeration to say that sooner or later protein deficiency kills men, women and children.

The stark truth is that in many countries today, including Sri Lanka, people are facing a "protein crisis". This means that in these countries either because demand exceeds supply or because of unfair distribution or both, many men, women and children are not receiving enough protein to keep them healthy. In Sri Lanka it has been variously estimated that over a million children may be suffering from protein — calorie malnutrition today. Many of them will probably perish from complications of this condition.

Since proteins are essential for human health and they are in short supply in this country, it becomes important to distribute the available proteins equitably. To say this is immediately to raise a question: how much protein does a man need daily to remain healthy? Since men have stopped growing, they need protein only for maintenance purposes. The Joint FAO/WHO Expert group which met in 1971 arrived at the figure of 0.57g per day for each kilogram of body weight as the "safe level" of protein intake in terms of cow's milk or egg protein for an adult man. For an adult woman the figure is 0.52g per kilogram. This means that the average Ceylonese man who weighs about 55kg (120 lb.) needs about 30g protein per day and the average Ceylonese woman who weighs about 45kg (100 lb.) requires about 23g protein per day — provided the protein is taken in the form of milk or egg protein. But few people in this country can afford milk and eggs. Most of our people take a mixture of vegetable and animal proteins, the nutritive value of which is lower than that of milk or egg protein. Therefore more such protein is required to satisfy needs. In general, therefore, it is a safe estimate to say that the average Ceylonese man needs about 1½ oz. of protein a day. The average Ceylonese woman, because she weighs less, needs

about 1 oz. per day. If she is pregnant or lactating she needs more. The nutrition of the pregnant woman has an important influence on the course of the pregnancy and the health of the infant. Human milk contains about 1.2g of protein per 100 ml and since a lactating woman may produce as much as 850 ml of milk per day the protein content of the daily secretion is about 10g. At least this amount should be added to her diet, over and above her normal requirements. The amount of protein required to support growth is much greater than that required to maintain the structure of tissues. The weight of an infant doubles during the first six months of life and trebles during the first twelve months. After the first year the growth rate declines until adolescence at which time there is another spurt of growth.

Accordingly, growing children require much more protein per unit of body weight than adults. Roughly speaking, a newborn baby requires about 5 grams of protein per kilogram of body weight; a toddler requires about $3\frac{1}{2}$ grams per kilogram and an adolescent about $1\frac{1}{2}$ grams per kilogram. Thus an adolescent son (or daughter for that matter) requires more protein than his father, and should get it. A pregnant or lactating wife needs — and deserves to receive — more protein than her husband, no matter how hard-working he may be. In many families, however, the men demand — and get — the major share of the available supply of meat and eggs even at the expense of the young children. This is based on the belief that people who do hard physical work require plenty of meat and fish and eggs in their diet. The great German chemist Liebig was the originator of the idea that the energy for muscular work is derived exclusively from protein breakdown. We now know that this is nothing but a misconception. There is no evidence at all that muscular activity increases protein breakdown. In 1889 two physiologists, Fick and Wislicenus, climbed a Swiss mountain 6,000 ft. high and showed that the amount of protein broken down during the climb was no greater than that broken down during an ordinary working day. There is thus no physiological justification for men to arrogate for themselves the lion's share of protein from the family ration. If protein were distributed according to physiological need, men would receive much less than they traditionally get and women and children much more.

On the basis of their capacity to support growth and maintain the structure of tissues, proteins have been classified as biologically complete or as biologically incomplete. A biologically complete protein contains all the essential amino acids in adequate amounts to meet human requirements. A biologically incomplete protein is deficient in one or more of the essential amino acids. Animal proteins (meat, fish, eggs and milk) are biologically complete. Not all vegetable proteins though, are biologically incomplete. Rice protein, for example is nearly biologically complete in quality. Moreover, suitable mixtures of vegetable protein could be as good as the best animal proteins. In order that the deficiencies of one might be compensated for by another it is always desirable to eat proteins in combinations such as the traditional ones like "rice and dhal", "bread and cheese" and so on. It is recommended that for adequate nutrition, at least $\frac{1}{4}$ of a person's daily protein requirements should come from animal sources.

Finally, what are the common foods which are good sources of protein? Meat, fish, eggs, milk, beans and peas are good sources. Rice, bread, potatoes and maize are fair sources. Something like 8% of rice is protein and rice is one of the principal sources of protein for poor men, women and children in our country.

Some 20% of meat is protein. All meats have about the same nutritive value although they differ so much in flavour. People are very choosy indeed in their taste for meats. Most of us would not dream of eating frogs and snails which the French love to eat. Muslims would starve to death than eat pork; South Americans relish guinea-pigs. In times of famine people have eaten horses, dogs, cats and even rats. Men are still living who regularly eat the flesh of locusts, lizards, snakes and monkeys; nor are they yet dead who find human flesh delicious. Beef is a widely consumed meat but Hindus will not touch it. If Robert Knox is to be believed, Kandyans of old regarded beef-eating as disgusting a habit as not washing after having been at stool—"which thing" Knox wrote in 1681, "are reckoned with this people an abomination."



Malnutrition increases the vulnerability of a child to infectious diseases. Of all the deaths recorded of infants and young children, 50 to 75 per cent are attributed to a combination of malnutrition and infection.

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The Importance of Coconut as a food

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WHEN one housewife meets another these days, one of the topics of conversation is invariably the high price of coconuts. For practically 89% of the population of Sri Lanka, coconut oil is the only cooking fat available and according to the nutritionists the only source of fat for the majority of the population who depend on it for a large proportion of their calories. Coconut is therefore an essential item in our diet.

Coconut Production and Consumption

There are about 7.3 million hectares of coconut in the world yielding approximately 30,000 million nuts per year of which about 25,000 million are from Asia. Most of the countries of Asia consume about 50% of their production with the noted exception of the Philippines, the world's largest producer of coconuts, which consumes only 3% of its crop. In Sri Lanka we consume 60% of our crop. Thailand and India are said to consume 90% and 85%. But as far as per capita consumption can be assessed Sri Lanka which produces 2,600 million nuts and consumes 60% leads the way.

The figures relating to production and consumption are very approximate and depend the one on the other. For example, according to the Department of Statistics Survey² the average consumption per head is estimated annually at 125. (90 as fresh nuts and 35 in the form of oil). This figure coupled with export statistics is used to calculate the production. However, the consumption pattern is bound to vary with the steep rise in prices.

Food values of the Coconut Kernel

The coconut kernel has been described as the complete food as it contains fats (36%), protein (4.5%), carbohydrates (13%). It is somewhat deficient in minerals and vitamins. For Sri Lankans at whatever level of income, the coconut is an integral part of the diet, be it breakfast (pol sambol, pittu, etc. or margarine) or lunch and dinner (milk for curries, oil for frying.) There is no substitute for coconut in our food at present.

Coconut oil is said to be one of the most digestible of fats, not excluding butter. It contains glycerols of saturated and unsaturated fatty acids, such as caprylic, lauric, myristic, palmitic, stearic, oleic and linoleic³. It is the presence of the saturated fatty acids, similar to that respect to animal fats, that lead to the charge that coconut oil is injurious to the health due to formation of cholesterol in the body. Whether this would be as injurious for people who take it in limited quantities and have no other source of fat is open to question.

The Importance of Coconut as a Food

Carbohydrates are present as sugars, mainly sucrose (6-7%) and the balance mainly as cellulose (crude fibre).

Coconut protein has received a great deal of attention from biochemists the world over as coconut is found in areas where protein deficiencies are common. The protein content of the kernel is small (4.5%) as compared to its oil content, but contains all the amino acids essential to human growth. The following amino acids are present in coconut proteins—lysine, tryosine, phenylalanine, tryptophane, cysteine, methionine, leucine, valine, isoleucine, threonine, histidine, and arginine. According to Hagenmeir *et al*⁴ 200,000 tons of protein could be extracted annually from the world production of coconut.

When oil is manufactured from copra, the protein is left behind in the copra cake or poonac which in Sri Lanka goes to feed the livestock industry. In the Philippines, most of the cake is exported and as they consume very little fresh coconut, protein from the kernel is not available to the human population. Therefore in the Philippines there is a great deal of interest in extracting protein from the kernel and feeding it to the population in some other form. But this is not necessary in Sri Lanka as we eat so much fresh coconut.

Protein extract foods include coconut flour obtained from the residue left after processing the fresh coconut kernel to obtain oil (as distinct from the copra process). An instant skim milk powder (containing 30% protein) and Coco syrup (19% protein) have been developed at the Coconut Foods Pilot Plant in the Philippines. However, none of these processes have proved economically viable as yet, and remain in the experimental stage.

Wastage

Although Sri Lankans consume so much coconut they also waste a great deal. The wasteful methods practised by the Sri Lankan housewife have been commented upon over and over again. Grated (scraped) coconut is extracted with water by squeezing manually. The percentage of oil extracted in this way will vary with each person's ability or industry, but is only 50-60% and the same for the protein. Therefore nearly half the oil and protein is thrown out with the residue. The culinary habits with regard to coconuts have changed with the increase of coconut production over the century. The cultivation of coconuts on a large scale in plantations started around 1890, but at the turn of the century coconut was still a fairly scarce commodity and a luxury. This was particularly so for the hill country and some people still remember the way their grandmothers would grind the coconut and put into the curry as they still

do in India. With the increase in coconut cultivation and the availability of plentiful supplies at low prices, the practice altered and only the milk is now used in curries. Upto recent times few people would consider grinding coconut even for the purpose of extracting more milk. With today's exorbitant prices a number of people are going back to these old methods and this should be encouraged.

Why the High Price?

Very simply, the scarcity of nuts is the cause of high prices. Scarcity is due to decreasing yields, increasing population and competition with industry.

Industry

Although coconut is so important as a food item there is also a vigorous industry based on coconut kernel alone which supplies approximately Rs. 400 million in foreign exchange to the country. About 38% of the coconut crop of Sri Lanka (this figure will vary from year to year) is processed into copra, which in turn is processed into oil and poonac and approximately 14% into desiccated coconut. Practically all of the desiccated coconut manufactured is exported, while the export of oil varies with external and internal demand and production. In times of scarcities there is a strong competition for nuts between the fresh nut consumers' market and the industry.

Factors influencing Yield

There are many factors influencing yield. According to Child⁵ "of all factors which influence coconut yield, rainfall is the most important." The world wide drought which resulted in the failure of several monsoons has had its effect on the production of coconut, not only in Sri Lanka, but throughout the world. Studies conducted by the Coconut Research Institute on their estate at Lunuwila and by others elsewhere in the world show that drought affects the crop of about 12 months later. The effects of the severe drought such as was experienced last year will be felt in this year's crop, both in terms of number and weight of the kernel. The Coconut Research Board's estimate is that there will be a reduction of 23.5% in the crop in 1977 as against 1976.⁶

The rainfall patterns over the past five years, i.e. from 1972, show severe drought periods in the first three months of the year. This has resulted in even more meagre crops than usual in the months January to March, which is the lean season anyway. Generally there is a recovery in May to give bumper crops which continue into September and even November, but the failure of the South-West Monsoon last year is likely to result in poorer crops in May this year and the succeeding months. It is likely that coconuts at -/20 cents have become a thing of the past.

The other important factors affecting yield are soil and its nutrients. Coconut will grow on most soils provided they are well drained. Too often it has been said that coconut is the lazy man's plantation and all one

has to do is to sit aside and wait for the nuts to fall. In Sri Lanka the attention paid to cultivation of coconut lands by the average person is minimal, unlike for example in Kerala (in India) where the plant is tended with care. Irrigation of coconut lands is unknown in Sri Lanka, but may have to be practised before long.

It has been proved that the application of fertilizer results in increased yield and that other cultivation practices are essential for good harvests. The Coconut Research Institute has conducted much research into fertilizer and its application and has advised the public on the quantum and type of fertilizer to be used on coconut estates for different types of soils. Since 1956, the Government has had a system of fertilizer subsidies to encourage its use, but during the last few years the practice of fertilizer application has received a setback partly due to increase in prices, since the 1974 energy crisis. The advent of Land Reform also brought some upsets, in that many estate owners were reluctant to spend money on fertilizer which they feared they would not be able to recover with the take-over of their land. In 1973 permits were issued for only 26,518 tons of fertilizer as against 44,836 tons in 1972, and 59,148 tons in 1971.²

Many good estates have deteriorated not only as a result of the lack of fertilizer but of other cultivation practices, such as cutting of drains, burying of husks, etc. Subsidies are now available for these, but their effects will not be felt for many years.

High Yielding Varieties

Replanting with hybrid varieties (Tall X Dwarf palms) which give a higher yield and come into bearing sooner had also been encouraged. But the number of seedlings available was inadequate. Also the hybrids are not as hardy as the tall palm and can only be grown in the wet zone and need more care and attention.

Better Utilisation of Existing Supplies

Another way of achieving the same result as an increased yield is to devise methods of reducing the consumption by eliminating the present waste in the domestic use of coconut. The Coconut Processing Board has tried to encourage and develop some more efficient method of coconut utilization and also of its by-products like shell and parings which are thrown away now.

1. By promoting the bottled coconut milk developed by the C. I. S. I. R. This product has been found to be acceptable to the public and has a shelf life of nearly six months. Even if 10% of the population were to use it there would be a considerable saving in nut consumption. There are a number of problems associated with this product, such as (a) the need for a returnable container. Containers are at a premium and one cannot be sure of their return. (b) An efficient method of extraction of milk so that all the oil and protein is extracted.

This is essential if the project is to be justified. The CISIR is working on improvements to this process.

2. Some senior coconut experts have long advocated the use of desiccated coconut for domestic use. The production of extra fine desiccated coconut which could be added straight into the curry would result in the whole coconut being consumed and not wasted. It may perhaps be more acceptable now than before since people are getting reconciled to grinding their coconut residue and using it in curries. The advantage of using desiccated coconut is that it could be manufactured in the season of plenty and kept for six months or more under controlled humidity conditions. This is true for bottled coconut milk too. In this way perhaps some solution could be found to the seasonal variation of the availability of nuts.
3. Recently a competition was conducted for an improved coconut grater and prizes were offered. The winner of the first prize devised a grating head which gave a very fine product giving 82% extraction of oil. This too requires some further refinements and improvement. More efficient extraction

at home would go a long way to reducing the number of nuts used.

If the present coconut crisis has drawn our attention to the need for good cultivation practices and to the need to reduce the criminal waste of coconut fats and proteins that goes on in this country, and if we are able to reduce it even partially, then we could look on the crisis as one of those disguised blessings which we meet with once in a way.

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Pulses—A Complementary Crop for Rice

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In an integrated food and nutrition strategy there is an urgent need for the cultivation of rice and pulses as complementary rather than competitive crops. Pulses provide an inexpensive source of protein, and in combination with rice counteract deficiencies of lysine and methionine in the local diet.

Unfortunately agricultural policy has concentrated only on increasing the output of rice, while neglecting the pulses which were imported cheaply mainly from India and other countries. A recent government ban, however, on the import of green gram, black gram, groundnut and cowpeas, and a gradual restriction in the import quotas of lentils and pigeon peas have given the farmer the necessary incentive to produce these pulses locally.

Grow improved varieties

The first consideration in any pulse development programme would be the use of improved varieties, which have been bred for a higher harvest index in a shorter space of time. Such varieties are now available from the Department of Agriculture. The best known are MI-I, MI-4 and Type 59 green gram, MI-I and Type 9 black gram, MI-35 cowpea, PB-I Improved Pelican and Bragg soyabean and MI-I and SAA6 groundnut.

Three of these in particular, namely, MI-35 cowpea which is a popular substitute for the imported Masoor dhal, and MI-4 and Type 59 green gram may be harvested in 60–70 days, and yet their yields are superior to the indigenous varieties.

Apply phosphate Fertilizers

The benefit of the high genetic potential of these improved varieties, however, cannot be fully realised unless, the farmer is prepared to give them a higher standard of management than he has been accustomed to in the past.

The fact that pulse crops have been grown in marginal land does not necessarily mean that these crops are unresponsive to fertilizers. On the contrary, the improved varieties show a marked response to fertilizers, specially in soils of poor fertility where a starter dose of at least $\frac{1}{2}$ cwt. of concentrated superphosphate and $\frac{1}{2}$ cwt. of urea (per acre) are essential.

Unlike most crops, pulses do not require too much nitrogenous fertilizer because it discourages rhizobia formation—that is, the development of nitrogen-fixing bacteria in the root nodules—and this in turn results in poor growth. Phosphate however is very essential to promote rhizobia development.

Rotate pulses with rice

With the availability of improved varieties and a government scheme of subsidized fertilizers, the time is ripe for pulses to be included in an intensive cropping pattern with rice. The short-duration varieties in particular may be cultivated successfully in paddy fields as relay crops at the tail end of a rice crop, or as sandwich crops in between two seasonal crops of rice. The short age and small water requirement of these varieties makes this a feasible proposition.

In fact, this characteristic of low water requirement may be further exploited by using these pulses to replace rice in places where this staple cannot be cultivated owing to a shortage of water. In the dry zone, there are several thousands of acres of paddy fields which are allowed to lie fallow during the *yala* season for this reason. There are about 200,000 acres in the Anuradhapura and Kurunegala Districts alone. This is a disproportionately large extent of land which is allowed to lie idle when a considerable portion of it could be profitably cropped with pulses utilizing small amounts of "tank" or well water.

Crop diversification of this nature is very essential if we are to make maximum use of our limited land resources and also the best use of expensive fertilizers. The pulses derive the cumulative benefit of the phosphorous and potassium fertilizers given to the previous rice crop. Being legumes they also manufacture a certain amount of nitrogen with the assistance of nitrogen-fixing bacteria. Any excess is available to the following rice crop when the stubble of the pulse is ploughed in at the end of the season.

There are fringe benefits too. The rice crop benefits from the intensive weeding that is given the preceding

pulse crop, in the sense that it has less weeds to bother it than had the fields been left fallow.

A word of warning though! The rice farmer who takes to cultivating pulses in his paddy fields is prone by force of habit to flood the fields. The water is let in and allowed to stand for long periods in the *liyaddas*. While this is alright for rice, it is detrimental to pulse production. Pulses, which are extremely sensitive to even temporary water-logging, receive a serious setback in growth. Or, in the case of MI-35 cowpea the plants often run to leaf at the expense of pod production. The ideal pattern of irrigation therefore would be several light irrigations every 10-14 days instead of flooding.

The rice farmer who takes to pulse production is also liable to be caught napping in the matter of weeding. Accustomed as he is to controlling weeds by flooding his fields, he tends to forget that when several light irrigations are given, weeds spring up much faster than usual. If these weeds are not eliminated during the first month the ultimate yields will be low.

Reap rich rewards

But is it worth it? Will the return from pulse production be profitable enough to induce the farmer to change his previous cropping pattern? All indications so far are positive. Take green gram for instance. Under irrigation we can expect an output of 800-1000 lb. of seed per acre. At a selling price of 3 rupees a pound this should bring in an income of Rs. 2,400 to Rs. 3,000 rupees.

The cost of production of such a crop, taking into account all extra inputs such as fertilizers, weedicides and insecticides, should not exceed Rs. 1,000. This leaves a clear profit of Rs. 1,400 to Rs. 2,000, which is just as good or better than the profit margin from rice.

On the Possibility of Expanding the lesser Marine Resources of Sri Lanka

Rodney. S. L. Jonklaas

With the steadily increasing emphasis on exploitation of traditional Fishery Resources such as fishing crustacea for food, it would seem that over-fishing is imminent if not already evident particularly in accessible coastal waters.

It is true that marine food products are not only in increasing demand for local consumption, but are also being exported and form a necessary part of the diet of an increasing tourist influx.

As everyone must know, the coastal seas are not inexhaustible. There is hardly any conservation in evidence and even former legislation appears to be

ineffective, if not impossible to enforce, in the face of the increasing intensity of fishing.

However, with suitable introductory propaganda, demonstration and advertisement, other edible marine forms can be exploited profitably, thereby reducing the pressure on those which are over-fished.

Colonial influence still prevails in our choice of sea-foods. Such nourishing material as eggs of sea-urchins (*Echinus*), mussels (*Mytilus*), oysters (*Ostraea*) are virtually unknown in marketing circles, although seafood conscious visitors from Europe are constantly demanding them from star-class hotels along the coast.

Sea-urchin eggs are almost unknown as food, yet there is a plague proportion population of them along the West coast from Moratuwa to Negombo. Collecting them by wading or shallow diving is easily done during the North-East Monsoon, at which time the tourist influx is at its peak and this would not only result in additional exotic seafood availability but also a reduction in numbers of a creature which is a real discomfort to swimmers and waders near reefs.

There are several molluscs that are already finding good markets for food both here and abroad. Of them perhaps the squid is the best known and most exploited, but nowhere near the volume available during the season. Squid fishing is still more or less a primitively handled operation. The huge schools of these creatures which come close to the surface by night on the West and East coast are barely harvested by the small craft and number of fishermen in them.

The octopus is virtually unknown as food except by the fishermen themselves. Capturing them is still done in the most primitive manner imaginable yet thousands are found all over the coral and rock reefs and can be caught in the effective manner adopted in the Mediterranean; that of luring them into ceramic or earthenware flasks. From personal observation, octopuses are very much in the increase in the Negombo area, because of the abundance of their natural food viz. crayfish. Owing to intensive and, if it may be said, destructive cray-fishing methods, the use of random-laid nets, many of the crustaceans are exposed to octopus attack during the night and it is estimated that less than 50% of those netted are eventually collected. A fishery for octopuses will therefore cut down on the predation of the more valuable and exportable crayfish.

Mussels are gathered and eaten mainly by the less affluent fishing communities along stretches of coast where they grow on reefs and rocky outcrops. Elsewhere in the world they form an useful food and in fact are now coming into the high priced gourmet range in Europe. It is significant that hardly one hotel features mussels on its menu, yet literally tons of them are present a few furlongs from many hotels on the West coast.

The edible oyster used to be collected and marketed in colonial times; Bentota was famed for its oysters. For some unknown reason, possibly regional over-exploitation resulting in a diminution in catch, the fashion subsided and now one hardly even hears of oysters served as food in hotels or resthouses.

From personal observations, the oyster population in Bentota is now abundant, but may have to be collected by divers operating at high tide, possibly using basic skin-diving gear (viz. mask, flippers, possibly self-contained underwater breathing apparatus). Yet the results are certainly worth the effort. The tourist population in this area can absorb almost the entire catch and can pay well for it.

Oysters abound in the Negombo lagoon. Here, there may be a problem of pollution from organic matter, but adequate rinsing of live oysters in fresh unpolluted seawater can quite effectively serve to flush them out and render them fit for consumption.

There is an increasing interest taken in the utilisation of a former by-product of the chank fishery; the flesh of the chank itself. If an effective method can be devised to extract the animal within the shell while it is still fresh, yet not damage the shell which is an exportable commodity, a nourishing source of protein is available. Already several hundred fishermen who dive for chanks have eaten the meat with excellent results. Since up to 50,000 chanks are collected per month by some small groups of divers, the flesh of these, if extracted for food, could reach a respectable tonnage.

Another sea-food, little known anywhere in the world, is a species of sea anemone, found in abundance in the Jaffna area. This is now collected by divers spearing them in the shallow water and the flesh is processed in such a way as to make it reasonably palatable when curried. Only a relatively small population feeds on this, especially around the Nagadipa area, but it would appear that this food is safe and nutritious and therefore expansion of this fishery is feasible.

If the coastal marine resources of Sri Lanka are to be safeguarded and sensibly exploited for future generations, there must be a **programme** whereby those species over-exploited be conserved if not protected until they are once again available at suitable prices and in safe concentrations. To offset this, and also provide employment and the necessary volume of protein, the relatively unexploited material must be harvested.

The **most endangered marine form** now is the Spiny Lobster or Crayfish (*Palinurus* Sp.) which, in spite of recent conservation laws, continues to be over-fished and drastically reduced in numbers. The next could be *Penaeus indicus*, the popular prawn from coastal and brackish waters, now being trawled in ever increasing quantities along the North-West coast.



'The intake of appropriate and adequate foods and their effective utilization by the human body is the cornerstone of human growth and development to provide the basis for the maximum fulfilment of each individual's potential....'

White House Conference on Food, Nutrition & Health 1969

Food Adulteration – A National Problem

The magnitude of the adulteration of various items of food in Sri Lanka was revealed at a recent conference by Mr. P. J. Aiyar, WHO Consultant in Food Hygiene. The conference was held on the 15th of February at the Kandy Secretariat to discuss the implementation of the Food and Drugs Ordinance in Sri Lanka. Mr. Aiyar's current assignment in Sri Lanka relates to assisting the government to revise the existing food legislation, strengthening food analytical laboratories, conducting training programmes and workshops for Food Inspectors and laboratory personnel involved in food analysis, etc.

Mr. Aiyar said that 1,600 items of bottled and packeted food sold in Colombo during the years 1974, 1975 and 1976 had been tested and analysed. Nearly 60% of the food items like milk, vinegar, jams, chillie powder, turmeric powder, gingelly oil, coffee powder, etc. sold in the open market were adulterated with substitutes which were in many cases poisonous or otherwise injurious to health and thus were unfit for human consumption. Milk is often adulterated with water or some kind of powdered milk. Coffee powder contains a major percentage of roasted and powdered peanut shells. Vinegar was found to be adulterated with formic acid which is poisonous. Jam, supposed to be made of fruit and sugar, contained neither. It was a spurious material made out of agar (China grass) jelly, coloured with a toxic coal-tar dye, flavoured with artificial flavours and sweetened with an artificial sweetener, saccharin. Curry powder and turmeric powder contained sawdust and wheat flour respectively, and were also dyed with poisonous textile dyes.

During an interview with a representative of the National Science Council to discuss measures to combat the problem of food adulteration, Mr. Aiyar hastened to add that all types of adulteration are not poisonous. The various food additives like synthetic colours, flavours, emulsifiers, stabilizers, bleaching agents, anti-oxidants etc., which are now being increasingly used in processed food for improving their colour, flavour or texture, taste or keeping quality, pose still another grave problem. Extensive and increased use of such extraneous materials in food has caused great concern to the WHO and the FAO who have appointed Joint Expert Committees to investigate these matters and make suggestions regarding the safety or danger potentials connected with the use of such materials. Amongst the various food additives used, the hazards to health associated with the consumption

of coal-tar dyes have been widely recognised. Several of these coal-tar dyes, after prolonged consumption have been proved to be carcinogenic or to exhibit toxic symptoms. **Metanil Yellow** and **Rhodamine B**, which are two colouring materials extensively used in Sri Lanka, come under this dangerous category. Suitable legislation for controlling the use of such dangerous coal-tar dyes in food is an immediate must in Sri Lanka, and he added that the Ministry of Health is taking urgent action in the matter, on the advice of the WHO.

Ignorance, indifference and gullibility on the part of the consumer and greed on the part of unscrupulous manufacturers and traders of food contribute to the widespread prevalence of adulteration. Remedial measures suggested were :

- 1) educating the consumer, the trader and the manufacturer on the hazards to health consequent on consumption of adulterated food. This can be done through the usual mass media of the Press and the Radio.
- 2) revising the existing legislative measures (Act and Regulations) to suit the present day needs ; and
- 3) proper enforcement of the law by the Government and the local authorities, in the interest of the welfare of the public.

The Food and Drugs Act of 1949, currently enforced, empowers four separate authorities—the local bodies, the Director of Health Services, the Commissioner of Excise and the Principal Collector of Customs. This has however been ineffective because it makes no provision to confiscate stocks of adulterated items or to punish the manufacturers. The government, with the assistance of the WHO, is now actively engaged in revising and updating the food legislation. The local authorities should also play their part effectively by arranging frequent inspections, sampling, seizure of suspected stock and proceedings against offenders. The infra-structure for the enforcement machinery will have to be suitably geared to meet this grave danger which undermines the health of the nation. Concluding, Mr. Aiyar said that "The problem of food adulteration is one of national dimension. There should be greater awareness of the dangers of adulteration and a greater will on the part of the public to put a stop to this practise."



"I believe that the greatest possibilities for chemistry in relation to the well-being of man during the coming 100 years may lie in the study of systems involving proteins, nucleic acids and other macromolecules."

Linus Pauling

UNESCO Science Prize for 1976

The 1976 Unesco Science Prize has been awarded to Mr. Alfred Champagnat (France) whose candidature was presented by the World Federation of Engineering Organizations. His important findings on the *low-cost mass production of new proteins* will have a direct impact on human nutrition. The following excerpt is from the address given by Mr. Amadou-Mahtar M'Bos, Director-General, Unesco on the occasion of the presentation of the 1976 Unesco Science Prize in Paris on the 9th December, 1976.

The Unesco Science Prize is awarded every two years in recognition of an exceptional contribution made by an individual or group to the progress of developing countries or regions through the application of science and technology.

It was the intention of the General Conference, by instituting this Prize, to encourage the scientific community to be more systematic in its efforts to find ways of placing science and technology at the service of the underprivileged.

This year, on the recommendation of the international jury which has the difficult task of choosing the winner from among the various candidates, the Prize is being awarded to Mr. Alfred Champagnat who has spent most of the past twenty years in making possible the production of proteins from certain hydrocarbons.

As you know, one-fifth of the human organism is composed of protein. Proteins are the body's biochemical building blocks and the principal maintenance material of the system. The moderately active adult woman or man needs a daily intake of between 30 and 35 grams of protein, failing which the metabolic machine that is the human body is obliged to consume its own structural protein. The United Nations Protein Advisory Group even recommends that this figure should in practice be increased by 30% to allow for actual needs which may vary from person to person. Children, especially, require more protein for their growth. In many parts of the world, however, there is insufficient protein to meet these basic needs.

Proteins are combinations of various amino acids, the twenty or so chemical compounds that distinguish living organisms from the inert structures of the mineral world. What distinguishes proteins from other nutrients such as carbohydrates and fats is the fact that they contain nitrogen as well as carbon, hydrogen and oxygen. While some amino acids can be synthesized by the body if the necessary supply of nitrogen is available, other essential amino acids must be found in the diet. This is true of all animals and also applies, in part, to the vegetable kingdom.

The world's present food supplies, however, are not only quantitatively inadequate — I need only refer to the

recent famine in the Sahel, which was one of many — but are also lacking in quality. Hundreds of millions of human beings are subject to endemic malnutrition because their diet does not contain the requisite amount of vital protein.

Scientists have been trying for a long time to biosynthesize proteins from natural substances which are in abundant supply, such as hydrocarbons. Unfortunately, their efforts have not been as successful as had been hoped and experts have tended to be gloomy in their predictions.

Thus in 1957, when Champagnat and his colleagues began their work, a group of researchers had already published their conclusion that it was not possible to biosynthesize proteins on the basis of hydrocarbon compounds derived from various industrial products.

It was fortunate that Champagnat and his colleagues were not aware of these gloomy predictions, or they might have had second thoughts about persevering in the work which has brought them such success.

Champagnat had the idea of utilizing some of the viscous or waxy **by-products of petroleum** as the immediate substrate for the culture of selected micro-organisms. These would be micro-organisms containing amino acids and proteins, which are amino acid compounds. They grow at approximately the same rate as the usual products of biosynthesis carried out on sugary substrates.

Micro-organisms such as yeasts grow on certain fractions of petroleum and nature has so arranged things that they "eat" only the paraffin fractions of the petroleum which possess 10 to 25 atoms of carbon. The aim was thus clear. What had to be discovered was a chemical process which would optimize both these factors. This is what Champagnat and his team succeeded in doing in a series of very difficult experiments carried out in the French laboratories of the British Petroleum Company. They were able to develop processes for the microbiological de-paraffination of certain petroleum fractions, an operation which had formerly been carried out by purely physical means. And instead of paraffin, they obtained comparable quantities of micro-organisms extremely rich in proteins.

At present, the "food" obtained by this industrial fermentation process is of only indirect use to man. It is used to feed the animals on which our diet depends in varying degrees according to the civilization or culture to which we belong.

At the current stage of research, the main advantage of the new synthetic products is that they make it possible to increase the production of animal protein. Such protein is now being used mainly in the developed countries, but the operation makes it possible to save cereals which people in some areas desperately need.