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# *Incorporating Nutrition Goals in Diversification Programmes*

## INTRODUCTION

Of the several development goals, those relating to nutrition are perhaps the least understood and the most under-estimated in terms of development impact. Satisfactory nutrition and dietary well-being are desirable goals in any welfare function. Those goals could not be achieved without an adequate food supply; nor can good health be attained and maintained when satisfactory nutrition falters. Poor nutrition and health status, whether as a result of insufficient food intake, over-consumption or nutrition imbalances, lowers productivity, threatens longevity and increases health care costs. In this context, good health is defined as a state of complete physical, mental and social well-being and not merely an absence of disease or infirmity.

The blue-print for productivity losses is established during foetal development when poor maternal nutrition frustrates full brain development resulting in failure to exploit full genetic learning potential. The losses are manifested in a reduction in work output as a result of lower skills, absenteeism or death during what should have been the most productive years of the life cycle. The cost of health care increases as facilities – hospital space, health support equipment, drugs and health manpower – expand to cope with increased need for patient care. The social disruptions from sickness and death and the agony of loved ones and orphans are consequences whose costs have not been rigorously assessed.

Satisfactory nutrition depends on the consumption of foods containing a wide array of nutrients. Diversity in the choice of foods is fundamental to good nutrition since no one food or group of foods contains all the essential nutrients in the appropriate proportions. Any food policy which fails to address this need for diversity will result in a less than satisfactory nutrition and health status and would have adverse developmental consequences.

The colonial policy of overseas monoculture afforded the colonial power diversity in food supply, while it created the basis for food import dependence and fragile food economies in the colonies. These are the crucial issues that are being addressed in diversification programmes to stem the legacies of the colonial era. As the policies and programmes for diversification unfold, nutrition considerations have a crucial role in both the establishment and attainment of development goals.

This paper attempts to set out the food and nutrition related problems common to the Region, and to demonstrate how a combination of the simple concept of nutrient-cost and the multimix principle could form a powerful tool in structuring diversification programmes.

## FOOD AND NUTRITION RELATED PROBLEMS

Repeated assessment of food availability in countries in the Region point to a sufficiency in the supply of energy, protein and fat on a per caput per day basis. In 1975, Gurney estimated per caput energy and protein requirements on a daily basis for the Caribbean population at 2250 kilocalories and 43 g protein. Examples of food availability in the Region are 2552 kilocalories and 67 g protein for Guyana (1984), 2443 kilocalories and 68 g for Grenada (1986) and 2667 kilocalories and 75 g protein for Trinidad and Tobago (1985).

The two disturbing features of the supply are the large import content (Guyana excepted) and the inequity in its distribution. The domestic contribution to energy, protein and fat intake in several countries is well below 30 percent. This occurs during a decade when the Regional Food and Nutrition Strategy calls for the realization of a goal of 80 percent domestic contribution to energy and 60 percent to protein with only 2 years to the target date. In monetary terms this import dependence translates into a food

import bill valued at EC$2.2 billion, while food exports are valued at around EC$1.1 billion in 1984, resulting in a food import/ export value ratio of 2:1. The balance of trade implication of this level of performance is obvious. Countries with limited resource endowments beyond land, water and people can ill-afford to maintain such high levels of food imports and consider themselves developing.

The question of inequity in the distribution of the food supply is related to the inequity in the distribution of the means of production, particularly land and capital. The colonial patterns of agricultural production and food distribution had a pivotal role in this skewed pattern of distribution. The problem has been recognised and the countries are no longer under colonial management. The task is one of demonstrating the developmental benefits of adopting and implementing alternative strategies such as diversification programmes.

Given the skewed distribution of resources and food supply, it is not surprising to find nutrition-related problems of overconsumption and under-consumption existing side by side. Perhaps the most distressing aspect of this scenario is that the most vulnerable groups are the women and children. Under-consumption leads to malnutrition. Malnutrition among reproductive females is manifested in low birthweight babies - less than 2500 g. This undesirable outcome predisposes children to further malnutrition and infection which exacerbates malnutrition even further, often to the point of death. The prevalence of low birthweight appears higher among teenage mothers, while malnutrition is more prevalent among low birthweight children. On the other hand, overweight babies ($>$ 3500 g) may be at risk of being obese in later life, with the attendant nutrition-related problems of diabetes, hypertension and cardiovascular diseases.

Prevalance of protein-energy malnutrition (PEM) has declined in the Region over the last 30 years. Current data suggest relatively low levels in general. However, certain areas show high prevalence or pockets of malnutrition (Table 1). Problems of PEM and obesity in children are often associated with a decline in the prevalence of breastfeeding.

Iron deficiency anaemia is a major public health concern. Pregnant and lactating women and children are most at risk. Productivity increases have been recorded among workers at risk of anaemia whose diets have been supplemented with iron (Viteri). The consequences on productivity associated with poor iron status have not been addressed in the Region.

The most serious of the nutrition-related problems is that of obesity. A large proportion of adults, particularly women (24-60 percent) are obese and suffer from related diseases like diabetes, hypertension and coronary infraction (Sinha, 1984; Beckles, et al., 1985). The dietary factors implicated in the aetiology of these diseases are excessive intakes of highly-refined carbohydrates, fat, salt and alcohol.

Cancers rank high among the causes of death in the Region with stomach cancer being the leading type. Substantial evidence associates the ingestion of foods such as salted and smoked meats, salted and pickled vegetables, fried foods, alcoholic beverages and coffee with a high risk of stomach cancer Diets low in fibre and smoking are also implicated as causal factors in cancers. Many of the current foods imported into the Region are characterised as being highly-refined, fatty, salted, pickled or smoked, often in combination. (Magnus).

Alcoholism is a major cause of hospital admissions and is responsible for vehicular accidents, disruption in family life, and reduced financial security and productivity. Prolonged use of alcohol is associated with liver disease, hypertension, malnutrition, nervous disorders, pancreatitis, impaired immune system and anaemia.

Addressing the food and nutrition-related problems in the Region calls for adopting sound dietary practices and having the food production/distribution system respond to ensure the availability of safe, wholesome and nutritious foods for every individual in accordance with his/her nutritional needs and physical activity and at an affordable cost. The basic guidelines for sound dietary practices should include: (a) breastfeeding in infancy, particularly during the first 4 months of life, (b) consumption of nutritionally well-balanced meals, high in complex carbohydrates and fibre, and low in salt, sugar, fat and cholesterol, and (c) reduced intake of alcohol.

The food production and distribution system must respond to the nutritional needs of the population. The current production patterns and the concomitant food import dependence and content must change. Appropriate diversification programmes must be devised and implemented. The foregoing

TABLE 1: *Prevalence of Protein-Energy Malnutrition (< 80% Standard Weight of Age, Trinidad and Tobago 1987)*

| AREA | Age (yrs.) | Malnourished <80% | | Normal 80 – 120 | | Obese >120 | |
|---|---|---|---|---|---|---|---|
| | | No. | % | No. | % | No. | % |
| TOBAGO | <1 | 48 | 4 | 971 | 80 | 189 | 16 |
| | 1-4 | 115 | 4 | 2422 | 93 | 69 | 3 |
| ST. ANDREW/ ST. DAVID | <1 | 74 | 5 | 1238 | 80 | 235 | 15 |
| | 1-4 | 192 | 5 | 3364 | 93 | 53 | 2 |
| CARONI | <1 | 64 | 2 | 3120 | 97.6 | 11 | 0.4 |
| | 1-4 | 98 | 3 | 2826 | 96 | 5 | 1.0 |
| ST. GEORGE CENTRAL | <1 | 440 | 11 | 2941 | 74 | 596 | 15 |
| | 1-4 | 448 | 6 | 6681 | 92 | 165 | 2 |
| ST. GEORGE EAST | <1 | 233 | 5.5 | 3705 | 87.7 | 289 | 6.8 |
| | 1-4 | 133 | 1.68 | 7719 | 97.5 | 65 | 0.8 |
| NARIVA/MAYARO | <1 | 213 | 23.9 | 645 | 72.3 | 34 | 3.8 |
| | 1-4 | 687 | 36.4 | 1193 | 63.3 | 5 | 0.3 |
| ST. PATRICK | <1 | 244 | 8.5 | 2458 | 85.9 | 159 | 5.6 |
| | 1-4 | 395 | 5.5 | 6737 | 93.8 | 47 | 0.7 |
| VICTORIA | <1 | 296 | 5.7 | 4906 | 94.3 | 225 | 5.0 |
| | 1-4 | 278 | 2.8 | 9536 | 96.7 | 52 | 0.5 |

*Source:* Ministry of Health, Trinidad and Tobago

description of the food and nutrition-related problems and the dietary guidelines set out above provide a basis for targetting diversification programmes. The approach to meal planning using the multimix principle and the nutrient-cost concept could be applied to elaborating the design of diversification programmes.

## FOOD AND NUTRITION CONCEPTS AND THE MULTIMIX PRINCIPLE

Foods are usually substances of plant or animal origin, which when eaten are digested to provide the nutrients needed for energy, growth and repair of tissues and protection from diseases. Nutrients provide energy for normal body functions such as the pumping of blood by the heart or leg muscles for walking. Nutrients are used by the body to fabricate cells for the formation of bones, teeth, hair, skin and so on.

Nutritional status is the sum total or net effects of food consumption, digestion, absorption and assimilation in relation to physical activity, health status and growth and development potential. Determinants of aggregate food consumption include population, age and sex distribution of the population, household size, household income and income distribution among households, product availability and prices, tastes and preferences to name a few. Digestion, absorption and assimilation are influenced by genetic factors, past and present diet, the flora and fauna in the digestive system and health status.

The human body is unique and requires certain essential nutrients in specific combinations for growth and development and the conduct of normal functions. Nutrition and health problems arise when imbalances beyond tolerable ranges occur. Growth and development, however, do not rest solely on food intake since hereditary factors play a

decisive role in the body's adaptation to changing nutrient intake levels. Under-nutrition results when the body does not get sufficient nutrients to meet its needs. Growth ceases, weight loss follows and the person may become anaemic, lacks energy and is predisposed to a wide range of infections. Obesity results from over-consumption in association with reduced energy expenditure.

Since foods vary in their content of the essential nutrients, current guidance to meal planning in the Caribbean advocates a judicious selection of a variety of foods daily from six carefully devised food groups. These food groups, with examples of foods in each group, are as follows:

1. *Staples*
   (a) Cereals – rice, cornmeal, flour
   (b) Starchy fruits, roots and tubers – green bananas, potatoes, yams.
2. *Dried Legumes* – pigeon peas, kidney beans, peanuts.
3. *Dark, Green Leafy and Yellow Vegetables* – amaranth, dasheen leaves, pumpkin, carrots.
4. *Foods from Animals* – meat, milk, eggs, fish, poultry, cheese.
5. *Fruits* – mangoes, pawpaw, citrus.
6. *Fats* – cooking oil, butter, margarine.

The combination of foods involving the six groups with one or more staples as the hub provides a simple basis for computing well-balanced diets and is referred to as the multimix principle. Combinations of cereals and legumes are of particular importance in meal planning, especially where foods from animals are quite expensive. It has been generally accepted that legumes are poor sources of the sulphur – containing amino acids – methionine and cystine – and are relatively low in tryptophan and isoleucine. However, they are high in lysine. The low lysine content of cereals is thus compensated by the high lysine content of grain legumes, while the sulphur amino acids of cereals supplement those of legumes. It is for this reason that the biological value of cereal-legume diets is superior to either cereal or legume diets. This situation applies also to mixtures of legumes and starchy fruits, roots and tubers (Bressani).

## THE NUTRIENT-COST CONCEPT

Foods vary in the amount of energy and nutrients they contain. The market prices of foods also vary from place to place and from one time period to another. The cost of the energy and nutrients contained in foods would vary according to variations in their prices. The Nutrient-Cost Concept serves to convert prices on a quantity basis to the cost of the energy and nutrients contained in the food item. On this basis a table could be constructed setting out the relative amounts of energy and nutrients that are obtainable for a given expenditure on selected foods, given their prices; or alternatively, the relative costs of given quantitites of nutrients available from various food sources. Comparisons could then be made among food items to ascertain which foods should be given priority from a nutrient-cost point of view.

Reference to this concept dates back to when Graham Lusk, in a lecture to the New York Academy of Medicine, drew attention to "Criteria of the Monetary Values of Foods." The market price in cents of 1000 calories in various staple foods he referred to as "the cost of nutritive values." Lusk noted that where income was sufficient so as not to constrain the expenditure on food, the concept was of no practical significance, but the concept was of the greatest economic significance among the poor, the class who receives scientific knowledge last (Nutrition Reviews). Information generated through the application of the nutrient-cost concept could be used by meal planners in the home and food service institutions, dietary counsellors, food supply planners, farmers, and food surveillance personnel. By combining the application of this concept with the multimix principle, economical and nutritionally well-balanced diets have been computed.

For each of the above food groups, a listing of foods in ascending order of cost of energy, protein or other nutrients could be computed given their prices and composition. Further, given a specific objective function and appropriate constraints, economical food sources for menu planning could be identified without losing the basic desire of variety in the diet. The current model adopted is one in which the objective is to attain a level of 2400 kilocalories of energy with the following constraints as indicated in Table 2.

TABLE 2: *Contribution of Various Foods to Energy and Number of Items Selected.*

| Food Group | Percentage Contribution to Energy | No. of Food Items to be Selected |
|---|---|---|
| Staples | | |
| (a) Cereals | 30 | 3 |
| (b) Starchy fruit, roots and tubers | 14 | 3 |
| (c) Sweetener | 10 | 1 |
| Legumes | 12 | 2 |
| Vegetables | 2 | 4 |
| Foods from Animals | 14 | 8 |
| Fruits | 4 | 4 |
| Fats & Oils | 14 | 2 |

A computer programme generates the following outputs:

(a) A listing of food items in each food group in a table showing the price per pound, price per kilogram, kilocalories of energy per dollar, and grams protein per dollar and the rank order based on energy and protein cost.

(b) The selected food items around which economical diets should be constructed based on energy rank, with foods from animals ranked on the available protein per dollar expenditure.

(c) The composition of the selected ingredients in terms of water content, energy, protein, fat, carbohydrate, fibre, calcium, iron, vitamin A, thiamine, riboflavin, niacin and the cost of the ingredients.

Samples of the outputs of (b) and (c) are shown in Table 3 and 4. The information in Table 3 can then be disseminated to the public through the print and electronic media.

TABLE 3: *Ingredients for Economically Well-Balanced Diets — Trinidad — Data for Week Ending 11 June, 1988*

| | |
|---|---|
| STAPLES | Flour, rice, bread, green bananas, potatoes, cassava. |
| LEGUMES | Split peas, chickpea (channa). |
| VEGETABLES | Avocado pear, dasheen leaves, cucumber. |
| FRUITS | Mango, banana, oranges, grapefruit juice. |
| FOOD FROM ANIMALS | Beef liver, chicken gizzard, kingfish, milk powder, cheese, chicken, beef sausage (salami), cavalli. |
| FATS AND OILS | Oil, shortening. |

TABLE 4: *Approximate Diet Composition Based on Selected Foods*

| | | | | | |
|---|---|---|---|---|---|
| Water (g) | = | 145.1 | Energy (Kcal) | = | 2400.0 |
| Protein (g) | = | 75.3 | Fat (g) | = | 66.9 |
| Carbohydrate (g) | = | 383.6 | Fibre (g) | = | 6.3 |
| Calcium (mg) | = | 727.6 | Iron (mg) | = | 18.7 |
| Vitamin A (R.E.) mg | = | 2672.9 | Thiamin (mg) | = | 1.4 |
| Riboflavin (mg) | = | 1.69 | Nicain (mg) | = | 14.3 |
| Vitamin C (mg) | = | 160.1 | | | |
| | TOTAL COST ($) | = 3.50 | | | |
| | TOTAL AMOUNT (KG) | = 1.25 | | | |

## APPLYING THE CONCEPTS TO DIVERSIFICATION PROGRAMMES

The concepts can contribute to decision-making in respect of crops/livestock/fish combinations that should be emphasized in diversification programmes at the national and farm levels. The circumstances at these levels are different but the concepts are equal to the task. The multimix principle focuses on the need for substantial production of foods from each of the six food groups given the high level of import dependence. The question of choice of products within the groups boils down to selecting those products which give the highest nutritive values per unit of the combined production and distribution cost. Where food is imported or import restrictions are being contemplated, those giving the highest nutritive values per dollar of foreign exchange expenditure should be given import preference.

Governments have an obligation to protect local food production. At the same time they must ensure that the nutritional status of the poor are not adversely affected. Healthy lifestyles must be promoted as a priority and the appropriate goods and services necessary to adopt and maintain healthy lifestyles must be provided. As a consumer service, price labelling on a nutrient-cost basis could be promoted. The following are examples of some practical applications of the concepts.

A comparison between breast feeding and bottle feeding shows that infant formula is in no way a substitute for breastmilk in terms of its composition, and is also more expensive nutrient-cost-wise. The cost of the additional food needs of the mother to maintain breastfeeding (550 Kcal and 17 g of protein per day) is estimated at $0.80 compared with $2.67 for infant formula (140 g) at current prices in Trinidad and Tobago. Breastfeeding for the first 4 months could generate savings in food cost of TT$200.00 (US$1.00 = TT$4.25) per child and this includes a high foreign exchange component.

Generally the starchy fruits, roots and tubers are not competitive with rice and wheat flour on a nutrient-cost basis, but they have greater production possibilities in the Region. Since they are often competitive with imported tubers, they should be given appropriate protection through tariffs. Such protection would in time enhance their competitiveness against imported wheat.

While the sugar cane plant may be an efficient converter of solar energy, the end products are inimical to good health. Both sugar and alcohol provide "empty" calories and increase the energy content of diets without proportional increases in essential nutrients. Dietary imbalances are thus more likely to occur resulting in ill-health. As foreign exchange earners, those products could not be faulted since earnings from the sale of products of doubtful nutritional value could be used to purchase more nutritious products. However, the markets for such products would remain precarious as changes in lifestyles lower the demand for these products. Devoting large acreages to sugar and subsidising its production should give way to promoting other staples with high nutrient-cost ratios. The multimix approach to meal planning specifies the type of foods to be promoted, while basic concepts of nutrition serve to determine the relative balance among the food groups. The kinds

and quantities of foods to be promoted in diversification programmes could then be determined by the application of the nutrient-cost concept.

At the level of the farm household, decision-making is very complex. Several factors must be considered in determining the specific crop/livestock combination. The choice of producing a crop, livestock or combination of crops and/or livestock must satisfy the following conditions:

1. The product must be for household consumption or there must be a ready market for it.

2. The soil and climatic conditions must be conducive to good yields or could be modified to be made so.

3. The farmer must be knowledgeable about producing the product or could afford the technology.

4. The farmer must have the capital or access to credit to obtain the necessary inputs (seed, fertilizer, insecticide, herbicides, labour, veterinary supplies).

5. Family or purchased labour must be available.

6. Land tenure and life expectancy must be conducive for investment in projects with long gestation periods (Gladwin).

It is with the first condition that the concepts could be applied. The farm household must either sell or consume food. The problem is one of striking the right balance between the household nutritional needs and its needs for cash through sale of products. Since normally the farmer will not be able to produce all the food needs of the household, some cash from the sale of farm products will be used to purchase some food. The nutrient cost concept could be applied in the determination of that delicate balance between cash needs and household nutritional needs.

Cash and nutritional needs are enhanced when the farmer exchanges products with low nutrient cost ratios for products with high nutrient cost ratios. For example, at $1.00 per pound for ripe bananas and watermelon, a dollar expenditure on watermelon provides 49 Kcal and 1.1. g of protein compared with 282 Kcal and 3.5 g of protein from ripe bananas. There was a time when fishermen gained by selling fresh fish and buying salt fish, but now fresh fish is competitive on a nutrient-cost basis (Trinidad Prices).

In allocating scarce land and other resources to production for home consumption, those products with high nutrient cost ratios will be preferred. Where the sale of products is contemplated, high physical output rather than high nutrient-cost ratio becomes more relevant. Where both sale and consumption are considered there will be indifference to products with similar nutrient-cost ratios. Ensuring that farmers pursue diversification programmes which enhance the nutrient yield per unit of resource use would require a pricing system which tends to equalize nutrient-cost ratios. Guaranteed price schemes should take not only cost of production into account, but also the nutrient yield in relation to production cost.

At the Regional level use of the nutrient-cost approach could facilitate determination of comparative advantage and decision-making on areas of specialization taking into account the seasonality in production (dry season production of watermelons in Trinidad and Tobago versus wet season production in Grenada). Finally, the evaluation of diversification programmes could be based on the extent to which the target product moves to the top of the nutrient-cost table.

## CONCLUSION

The need for a variety of foods in the diet at a cost that is affordable by the population has been established. The food and nutrition related problems facing the Region have been described. The basic approach to solving these problems is one of changing food consumption patterns – increased consumption by the under-nourished, decreased consumption by the obese and better nutrient balance by both. Breastfeeding should be a major component of the food availability programme. The consumption of diets that are high in complex carbohydrates and fibre and low in fat and sodium should be encouraged.

The production/distribution system should be reorganized to ensure the availability of these products. This reorganization would undoubtedly involve diversification at the national level and possibly at the farm

level. Given that these nutritional considerations are acceptable, the combination of the nutrient-cost concept and the multimix principle provides an appropriate basis for selecting crop/livestock/fish combinations both at the regional, national and farm level. These concepts, however, may not find much favour among development planners because though simple, they call for fundamental changes in production and distribution structures.

## REFERENCES


[1]Beckles, G. et. al (1985). "Obesity in Women in an Urban Trinidadian Community. Prevalence and Associated Risk Factors." *International Journal of Obesity* Vol. 9, No. 127-135.

[2]Bressani, R. (1973). "Legumes in Human Diets and How They Might be Improved" in Max Milner (Ed.) *Improvement of Food Legumes by Breeding.* Protein Advisory Group of the United Nations System, New York.

[3]CARICOM Secretariat, (1981). *Regional Food and Nutrition Strategy*, Vols. 1, 2, and 4.

[4]Gladwin, C. (1980). "A Theory of Real-Life Choice: Applications to Agricultural Decisions in P. Bartlett (Ed.) *Agricultural Decision-Making.*

[5]Gurney, J.M. (1975). "Available Data on the State of Food and Nutrition of the Peoples of the Commonwealth Caribbean," *CAJANUS*, Vol. 8, No. 3.

[6]Lusk, G. (1973). "Criteria of the Monetary Values of Foods." NUTRITION REVIEWS. Vol.31. No. 7, pp. 211 – 215.

[7]Sinha, D. (1984). "Obesity and Related Diseases in the Caribbean." *CAJANUS*, Vol. 17, No. 2.

[8]Viteri, I. Personal Communication.

[9]Nutrition Reviews, (1973). Vol. 31. No. 7 pp. 211-215.