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PLANNING NATIONAL NUTRITION PROGRAMS: A SUGGESTED APPROACH

VOLUME II—CASE STUDY

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INTRODUCTION

Volume II illustrates the methodology outlined in the first volume, describing the Ecuadorian nutrition system, identifying some points of intervention or courses of action, and selecting among several alternative choices, analyses of six possible interventions. This volume illustrates in addition some of the problems of the first attempt at description of a national nutrition system with available data and some of the difficulties that nutrition planners will encounter as they select and study interventions for improving nutritional status.

The appendices are organized following the outline of the methodology. In Appendix I, the nutrition system of Ecuador is described, divided into three major parts: the Consumer, Production, and Marketing and Processing Subsystems. In Appendices II to VII interventions that may improve the nutritional status of the target group are analyzed. The volume concludes with a summary of methodological and presentation issues relevant to most nutrition planners and with recommendations for action and further study in Ecuador.

Selection of the intervention for analysis was more a function of illustrating the methodology than of providing answers for Ecuador. In an actual planning exercise the target group may be more narrowly defined than it is in this volume or a budget limitation may be imposed on the nutrition planner. These and other constraints would assist the planner in selecting interventions. For example, if a policy-making body decided that the highest priority should be given to infants, preschool children and pregnant and lactating women living in the rural highlands, then several of the interventions presented in this volume would not have been presented. However, we believe that by using a variety of intervention types our approach will be better demonstrated.

Donated food programs, channeling commodities through schools and maternal-child centers are common throughout the world. However, relatively

little attention has been given to calculating their costs and nutritional impact in comparison with other programs. Appendix II presents an analysis of costs, probable inefficiencies, and nutritional benefits of two types of donated food programs for infants, preschool children and pregnant and lactating women.

Many specialists in Ecuador and elsewhere believe that increased pulse production would provide low-cost high-quality protein for consumption by some of the members of the target group. Appendix III examines the cost and benefits of an investment in credit for low-income pulse producers.

Appendix IV, "Intervention in Milk and Milk Products," is an example of one of the most common opportunities for a nutrition planner to participate in national planning. Ecuador has a chronic milk shortage in relation to demand and nutritional requirements. In partial response to this, the World Bank (International Development Association) made a substantial loan for dairy herd and livestock development. The analysis shows how a planner can modify an investment so that a nutritional impact with the target group can be realized.

Protein fortification of cereals has been attempted in several countries and is under consideration in others. Appendix V presents an analysis of lysine fortification of wheat flour in Ecuador. While it does not appear that an investment in lysine fortification would be appropriate for Ecuador at this time, the appendix demonstrates the method for considering and analyzing this intervention in any setting.

Appendix VI briefly describes why we did not make an in-depth analysis of increased fish production and consumption in Ecuador. While this intervention appears fruitless in Ecuador it probably deserves attention in many other countries.

In Appendix VII two investments for increased agricultural production are analyzed for their impact on small farmer income (and their food intakes). Credit and irrigation were selected because they are common programs in most countries, offering the nutrition planner an opportunity to participate in and perhaps modify national development planning to increase nutritional impact.

Many more interventions could have been selected, such as alternative fortification agents, improved on-farm and market storage to reduce waste, price subsidies of commodities as well as interventions in some of the ancillary subsystems such as potable water, foreign exchange policies, or family planning. However, the time and resources limitations imposed on us were similar to those to be found with other efforts at national nutrition planning.

The method for comparison of alternative interventions calculates and then compares the costs of delivering an additional 1 gram of usable protein (NPU) and 100 calories to the target group through different nutrient sources. This comparison makes explicit the trade-off between lowering marginal costs and increasing the amount delivered. Most of the interventions are characterized by increasing marginal costs for nutrients delivered because economies are not in effect as more and more target group members are benefited by an intervention. For example, in the analysis of the production and consumption of pulses, costs for increasing production are relatively low when the loan program is highly selective in choosing farmers who will receive credit. However, as the program expands and farmers who are less responsive to changing cultivation practices are recruited, the returns for an equal amount of credit invested will be less, increasing marginal costs.

This method of comparing costs of alternative interventions encourages constant monitoring of program operations, since at some point during program expansion, costs of one intervention may become excessive, requiring revision in design or selection of another alternative.

Appendix I

DESCRIPTION OF THE ECUADOR NUTRITION SYSTEM

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SUMMARY

The nutrition system of Ecuador is described, including analysis of the major nutritional deficiencies and the population groups affected, the characteristics of these population groups, and the food production, processing, and distribution activities. Accompanying the description of each aspect of the nutrition system is the identification of what appear to be significant relationships or factors that contribute to nutrition problems. Available data have been used throughout the description and gaps in information that suggest further study are identified.

This description is not complete, but provides the starting point for selecting some interventions for analysis and the framework for ordering additional data gathering as time and resources permit.

The appendix concludes with a discussion of problems of using available data in describing and analyzing a national nutrition system. These remarks are also applicable to some of the data problems in intervention analysis.

An annex to the appendix suggests one way that estimates of the nutritional status of age and geographic-specific target groups can be developed without conducting a national nutrition survey. The approach uses data on family size, composition, and income, food consumption and purchasing habits, and food prices to estimate nutrient intakes of target group individuals.

MAPPING MALNUTRITION

Available data in Ecuador do not present a complete and accurate ıcture of the nutritional status of the population, but they are adequate › begin national planning. As a general description of inadequate ıtrition by regions and age groups, this information will suggest ıtrients in greatest deficiency and the population groups at greatest sk, the first steps in selecting tentative goals and target groups.

Figure 1 describes significant inadequacies in food intake in various regions of the country. These data are taken from a study conducted July-September 1959.* Even though this survey is 13 years old, and the survey design does not permit generalizations at a national level, its findings are still useful for this analysis. It appears from the study design that the findings are an accurate reflection of the nutritional status of the lower middle income groups in the regions surveyed. The sample for the dietary survey was drawn from a random selection of cities and villages.

Incomes for the coastal families averaged 50 percent higher than for the Sierra. In the Sierra, families from 24 villages and neighborhoods in large cities were surveyed; on the Coast 15 sites were used. From incomes reported by the 341 families, it appears as though most are in the middle and lower-middle income groups.

The map (Fig. 1) shows that rural areas in the Sierra have more adequate calorie intake, but considerably less animal protein.** Both urban and rural areas suffer from riboflavin deficiencies. In the coastal rural areas, however, calorie deficiencies are most striking while animal protein is not in as great deficiency as in the Sierra. In rural coastal areas, calcium, riboflavin, and niacin deficiencies are serious. Guayaquil, the largest city of the country, appears to be in better condition than other locations. The second map (Fig. 2) based on surveys in rural areas near Quito tends to confirm the first: nearly adequate calorie intake in the rural Sierra, but deficiencies in animal protein, calcium, riboflavin, and Vitamin A.

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*"Ecuador: Nutrition Survey," A Report by the Interdepartmental Committee on Nutrition for National Defense, July 1960, US Department of Defense.

**Animal protein is of higher quality than protein from vegetables because it is more fully utilizable by the body.

Fig. 1. Food Intake Deficiencies as Found by ICNND Survey, 1959—Ecuador

ICNND findings expressed as a percentage of INNE standards of adequacy. These standards represent average requirements based on age, body size, biological status of Ecuadorian population.

*FAO survey, 1953–1954.

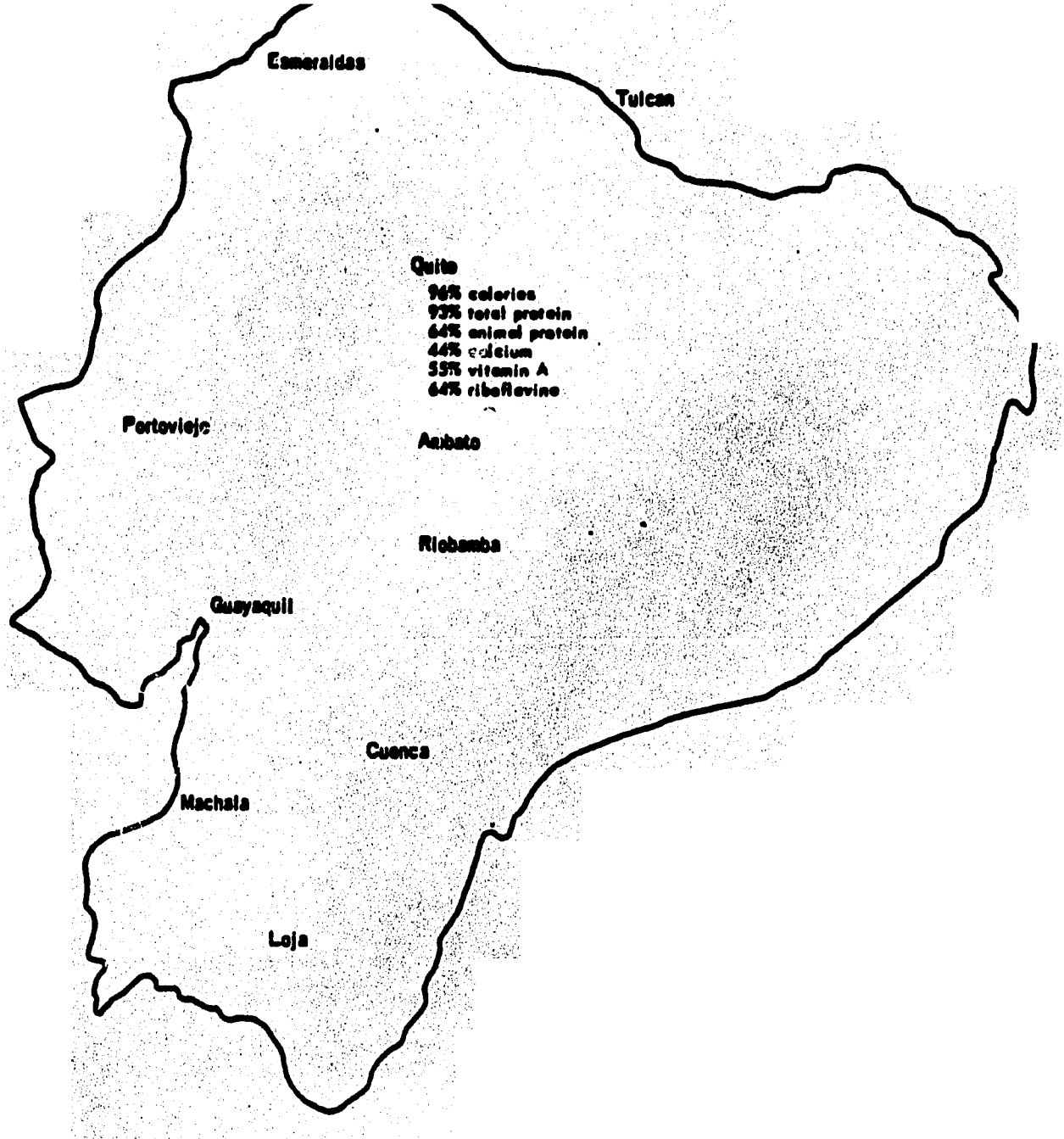

Fig. 2. Food Intake Adequacies in Sierra Villages, 1960—Ecuador

Source: Ministerio de Previsión Social, INNE, "Encuestas Alimenticias en El Ecuador," 1960. Values stated as percent adequacy of requirements averaged for Ecuadorian population.

the distinctive characteristics in food production, distribution, processing, and consumption of each area. Existing data could be disaggregated to more detailed levels such as political subdivisions, regional planning units, income groups, food production or processing centers, and individuals within families as required by later analysis.

1. Data Used in Description

The most recent national nutrition survey in Ecuador was conducted in 1959; since then surveys covering limited areas or specific age groups have been conducted. Because of these data gaps, probably typical of most countries, data from several sources have been combined to describe the probable extent and severity of inadequate nutrition:

- Reported dietary deficiencies
- Location of food production
- Timing of harvests
- Food habits
- Per capita income distribution
- Food prices
- Preschool and infant mortality rates
- Population projections by location, age, and biological status

2. Description of Malnutrition in Ecuador

Dietary deficiencies* and other indicators of nutritional status of the population can be displayed with a series of maps, tables, and charts to provide an estimate of the location, type, and magnitude of malnutrition problems.

*Adequacy is defined by comparing intakes to recommended daily allowances of the National Institute of Nutrition of Ecuador, based on age, body size, and biological status of the population.

by adequacy of food intake, but also by health problems which may have arrested physical development. On the whole, rural areas of both Coast and Sierra are associated with poorer nutritional status than the cities of Quito and Guayaquil.

Figure 4 depicts the infant and pre-school mortality rate by province. Since mortality and morbidity rates of nutritionally "at risk" populations are useful indirect indicators of inadequate food intake, they are used here to support dietary and clinical findings. Mortality data are indirect indicators of nutritional status and even more indirect indicators of dietary adequacy. Infant and child mortality can be caused by many traumas and diseases. An inadequate diet, or an adequate diet with frequent infectious diseases, will lower the resistence of children to fatal febrile or parasitic illnesses. Public sanitation problems and epidemics such as measles, malaria, and whooping cough are sometimes considered the primary causes of high mortality rates, but depleted nutritional status caused by inadequate food intake is frequently cited as a contributory cause.

The cities of Quito and Guayaquil have generally lower pre-school mortality rates than the provinces of the same region, and on the whole the Sierra region has higher death rates than the Coast. These data also confirm the basic findings of the first dietary study: the rural areas have less adequate diets than the cities and the population of the rural coastal area has a generally better diet than that of the rural Sierra.

Figure 5 presents the location of staple crop cultivation in Ecuador. Although most crops are transported between regions, the location of the staple crop and information about harvest times will assist in identifying

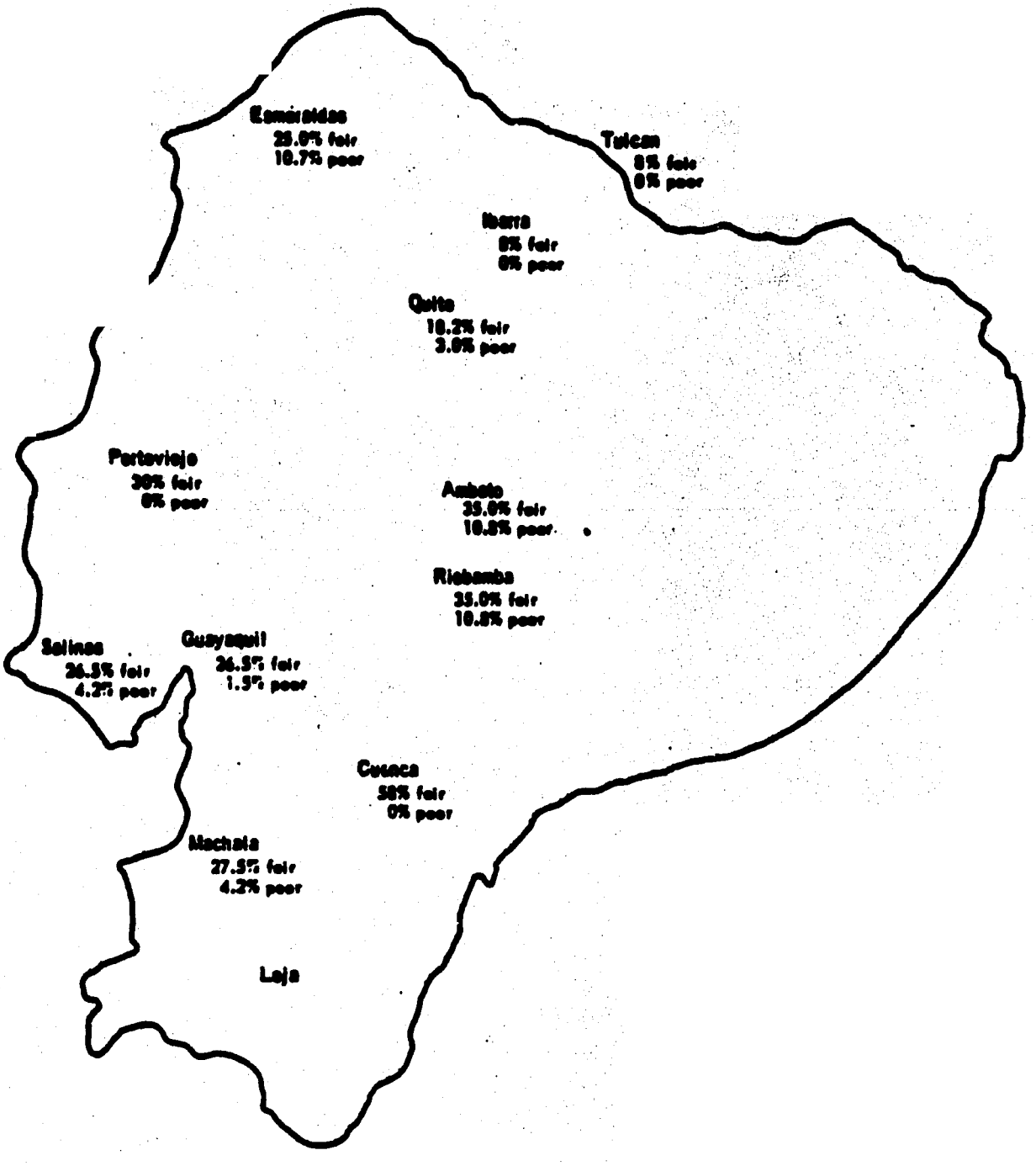

Fig. 3. Nutritional Status Judged by Clinical Findings, 1959—Ecuador

0–4 year male children.

Source: ICNND

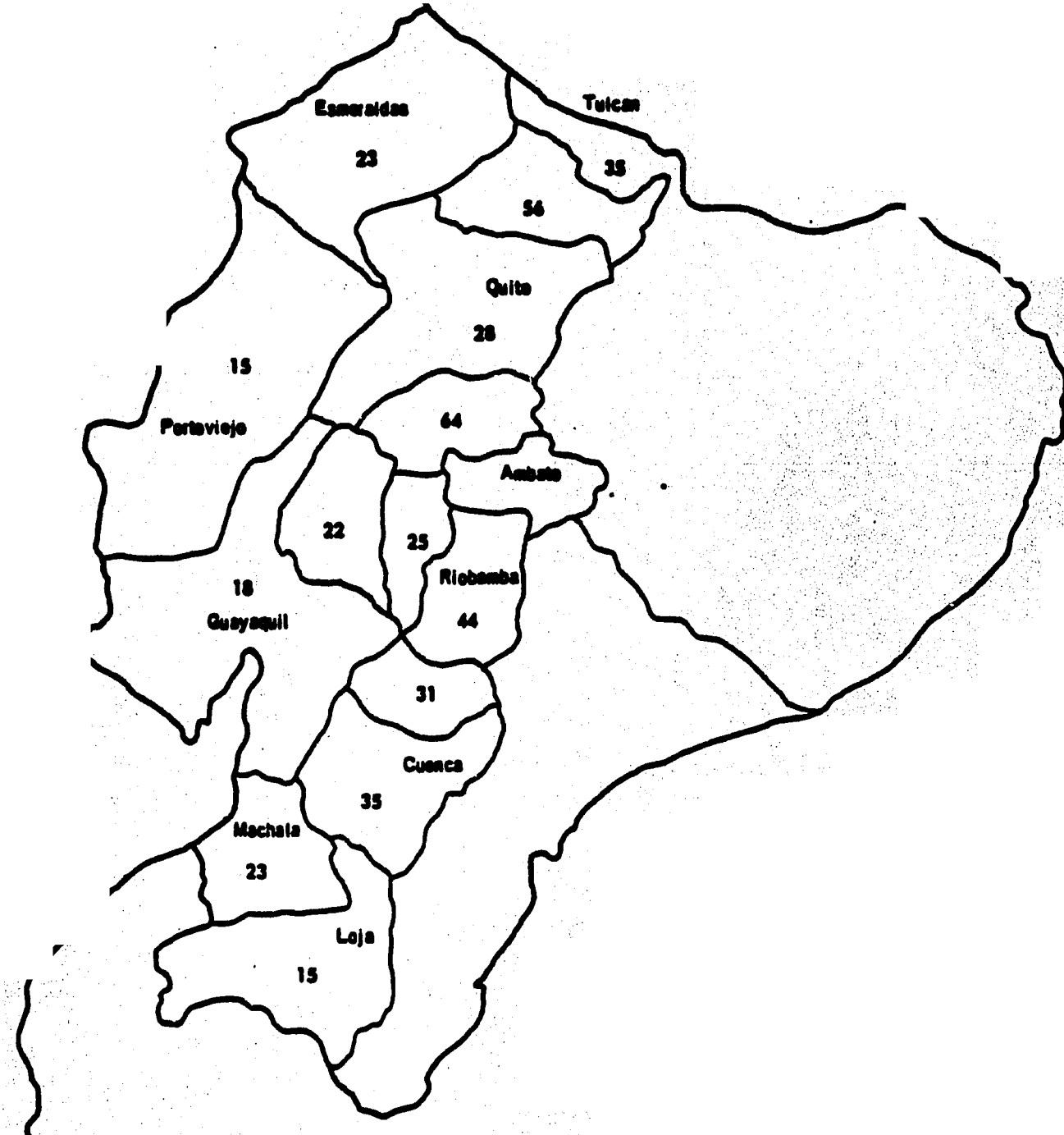

Fig. 4. Death Rates: 0–4 Years of Age per 1000 Age-Specific Population

Source: Instituto Nacional de Estadisticas Annerio de Estadisticas Vitales 1970.

Fig. 5. Location of Principal Staple Crops—Ecuador

times and zones of scarcity in rural areas. Corn, barley, and potatoes are the staples of the rural Sierra, while rice, plantain or banana, corn and yuca are staples of the rural Coast. In the cities of each region, there is a tendency for staples to be interchanged, with rice going to the Sierra and some potatoes moving to the Coast.

If this map is compared to the calendar of harvests (Fig. 6), it is clear that in the rural Sierra, March-July are months of food shortage. Staple food prices which rise during this period tend to confirm this. The ICNND study, on which much of this dietary analysis is based, was conducted from July through September, months of relative abundance. This would suggest that annual average food intakes are probably lower in the Sierra than indicated in the ICNND study. This seems to be particularly true for calories, the chief sources of which are the staples of potatoes, barley, and corn.

3. Summary: Severity and Type of Malnutrition

Protein and calorie malnutrition is more severe in rural areas than in the cities. Additional deficiencies are found in rural zones: calcium, riboflavin, and thiamine. Anemias are most frequently found on the Coast, but low iron intake has not been conclusively identified as the cause. The highlands appear to have generally more serious problems than the Coast as indicated by dietary studies and the infant and preschool child mortality rates. These problems are more severe during the summer months preceding harvest.

4. Magnitude of the Problem

a. Who is Affected

The analysis thus far has used the family as the data unit, i.e., food intake of the whole family has been compared with total family nutrient requirements. However, data on intra-family distribution from other countries suggests that adult males and older children tend to get first preference on food available. In addition, the staple foods-grains, tubers, and some legumes—have a high bulk-to-nutrient ratio. Thus infants and small children, because of their small physical capacity

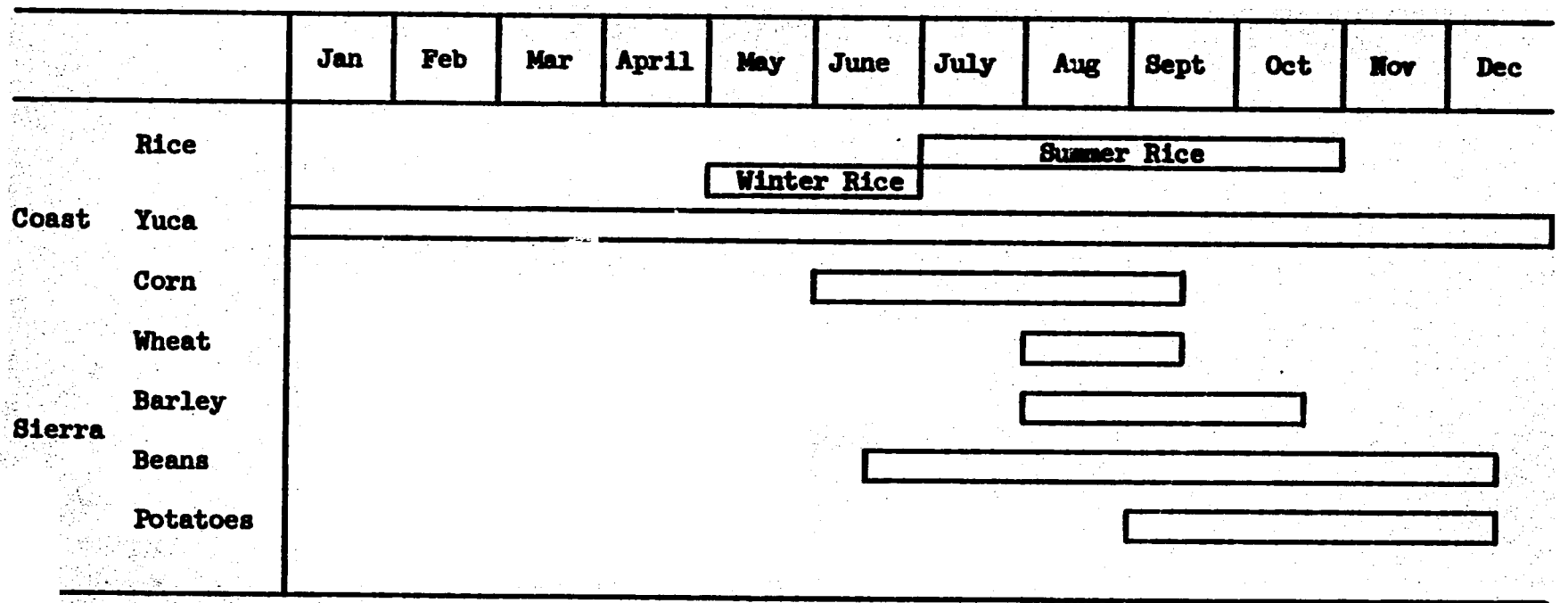

Fig. 6. HARVEST PERIODS FOR SOME STAPLE FOODS — ECUADOR

Source: Zonas Agricolas del Ecuador, Luis Alberto Lopez Cordero. Junta Nacional de Planificacion.

for food, cannot eat enough of the adult diet to satisfy their extraordinary protein and other nutrient requirements.

Pregnant and lactating women also have high nutrient requirements. There is no direct evidence in Ecuador that this group receives preference in the family food supply. On the contrary, statistics on birth weights, complications during pregnancy, maternal mortality and pre-natal mortality suggest that pregnant and lactating women share nutritional risk with infants and young children.

b. How Many are Affected

For these and other reasons the Ecuadorian government and USAID have given highest priority to infants, pre-school children and pregnant and lactating women as targets for nutrition improvement programs. How large is the population group affected? The table below presents the number of infants, pre-school children, pregnant and lactating women in the total population, broken down into major geographical sub-divisions. This group represents approximately 20 percent of total population.

Table 1

TOTAL POPULATION:
INFANTS, PRE-SCHOOL CHILDREN, PREGNANT AND LACTATING WOMEN
by Region and Location

	1972				
	Coast		Sierra		
	Urban	Rural	Urban	Rural	TOTAL
Percent by region*	44%	56%	33%	67%	
Infants (0-12 mo.)	56,069	69,630	42,297	83,032	
Pre-school (12-60 mo.)	251,191	310,949	189,619	376,483	
Pregnant & lactating women (4.6% of total population)	67,779	81,409	50,782	97,327	
Total					1,676,567

Source: Secretaria General de Planeacion Economica de la Junta Nacional de Planificacion y Coordinacion, Departamento Tecnico, Division de Estadisticas y Censos, "Proyeccion de la Poblacion del Ecuador 1960-1980." Quito (no date).

*Ecuador is a rural country, the Sierra more so than the coast. Since age breakdowns are not available by rural and urban areas, we have assumed that the specific populations will be evenly distributed in rural and urban areas.

tion is found in target group populations. National income distribution surveys are used to link information on costs of adequate diets and food habits to estimate the magnitude of the malnutrition problem. While this calculation does not yield a completely accurate picture, it does give the general dimensions of the groups affected. These estimations should be subject to constant checking either through more refined estimates of family income, diets and food prices, through national sample surveys, or records of health centers and health and nutrition status screening sites.

In Ecuador personal income is distributed in the following patterns for rural and urban sectors.

Table 2

DISTRIBUTION OF AGRICULTURAL INCOMES:** 1965

Decile	Thousands of Active Persons	Total Income (Millions of Sucres)	Average Monthly Income Per Economically Active Person*** (Sucres)	(Dollars)	Average Per Family**** (Sucres)	(Dollars)
1st	107	171.0	133	7.30	186	10.22
2nd	107	205.2	160	8.80	224	12.30
3rd	107	223.2	174	9.57	243	13.40
4th	107	257.4	200	11.00	280	15.40
5th	107	291.6	227	12.40	317	17.36
6th	107	392.4	305	16.70	427	23.00 ← A
7th	107	428.4	333	18.30	466	26.00
8th	107	565.2	440	24.00	616	34.00 ← B
9th	107	1,060.2	825	45.00	1,155	63.00
10th	107	4,959.0	3,862	212.00	5,406	296.00

Source: Ecuador, Junta Nacional de Planificacion y Coordinacion Economica.

**All farm production, including on farm consumption.
***Sucres computed at S/18.18/$1.00.
****Assuming 1.4 persons economically active person.

INCOME DISTRIBUTION URBAN AREAS

Monthly Income Per Economically Active Person (Soures)	Number of Economically Active Persons Per Family	Family Income/Month (Dollars)	(Soures)	% of Total Urban Population in Each Group	% of Total Urban Income in Each Group
-0-			-0-	2%	neg.
200	1.4	11.20	280	7.2	neg.
200-399	1.4	11.20-22.40	280-560	17.5	5.35
400-599	1.4	22.40-33.60	560-840	15.0	8.06
600-799	1.4	33.60-44.80	840-1120	12.0	8.76
800-999	1.4	44.80-56.00	1120-1400	10.1	9.60
1000-1999	1.4	56.00-112.00	1400-2800	4.0	6.3
2000-2999	1.4	112.00-208.00	2800-5200	5.5	15.15
3000-3999	1.4	208.00-224.00	5200-5600	2.9	10.43
4000-4999	1.4	224.00-280.00	5600-7000	1.1	5.15
5000-6999	1.4	280.00-392.00	7000-9800	1.1	9.80
7000-8999	1.4	392.00-504.00	9800-12600	.7	5.66
9000+	1.4	504.00	12600	1.2	14.8

The comparison of costs of typical diets for low-income families and low-cost nutritionally adequate diets to income scales is a method for estimating the number of families whose income does not permit purchase of adequate nutrients at current prices and those whose incomes are adequate but because of food habits do not make nutritionally optimum purchases. These points are indicated by "A" and "B" in the above table. By developing a reference family, responding to the average size and ages of low-income families, an estimate can be made of the number of target group individuals in the different income categories and from this an approximation of the number of individuals affected.*

*Methodology and data base for these estimates are found in Annex 1.

population does not have adequate resources to buy sufficient nutrients. This results in severe to moderate malnutrition. Approximately another 10 percent have the resources but food habits preclude adequate nutrition. In the rural area, taking into account increased rural incomes since 1965, lower food costs on the farm and different food habits, it is estimated that 60 percent of that population does not have adequate resources to buy or grow a nutritious diet. Ten percent more could, but do not consume adequate diets.

The size and location of the malnourished target group can be estimated as follows:

Table 4

MALNOURISHED TARGET GROUP:

INFANTS, PRE-SCHOOL CHILDREN, PREGNANT & LACTATING WOMEN

by Region

	Infants (0-12 mos)	Pre-School (12-60 mos)	Pregnant & Lactating	Total
Coast				
Urban Total	39,250	175,830	47,440	262,520
Low Income	33,640	150,715	40,670	
Food Habits	5,600	25,120	6,780	
Rural Total	48,740	217,665	56,990	274,665
Low Income	41,780	186,570	48,840	
Food Habits	6,960	31,090	8,140	
Sierra				
Urban Total	29,600	132,730	35,550	197,880
Low Income	25,380	113,770	30,470	
Food Habits	4,230	18,960	5,080	
Rural Total	58,120	263,940	68,130	389,790
Low Income	49,820	225,890	58,400	
Food Habits	8,300	37,650	9,730	

B. RELATIONSHIPS IN THE CONSUMER SUB-SECTOR

1. Income

Income elasticities for food among low-income families in Ecuador are high, estimated at between .6 - .8. For subsistance farmers, these

income among low-income families have a high nutrition payoff.

Nutrition planners should review programs which purport to increase income to determine their effects on food intake or target group families. In Part VII of this appendix, an analysis of two classical agricultural programs has been undertaken; income and food intake implications of each have been considered. In Ecuador, additional analysis could be done on the effects on family income through the food for work program, price supports to rice farmers and dairy farmers, land distribution through agrarian reform, and other programs.

Interventions to increase incomes do not necessarily require massive expenditures by the government, as is indicated in App VII's analysis of credit to small farmers. However, they may entail some political risk, a price that most governments may be unwilling to pay. Redistribution of national income is a revolutionary process as governments have found that have attempted sweeping agrarian reform schemes or strictly enforced progressive income taxes and welfare programs. The political costs more than the program expenditures may preclude effective incomes approaches for most governments. Moreover, it is apparent by reviewing other relationships in the consumer subsystems that income increases alone will not resolve nutrition problems. For some families the increased income required to purchase an adequate diet is so great that it is difficult to conceive the circumstances under which this gap could be filled in the near term. Nevertheless, it is useful to compare the payoff of interventions that principally raise incomes with those that affect the system in other ways. For example, using nutrient costs developed in the annex, the addition of income needed to achieve additional nutrient intakes can be calculated.

Food habits

Food habits play an important part in determining food intake. Although Ecuador has not had an extensive food habits survey since the ICNND work of 1959-1960, it is possible to combine these early data with more recent small surveys to derive a useful description of consumer food behavior in the country. The following table indicates broad categories of the food culture. Interventions which include a change in consumer behavior must deal with these patterns.

If interventions are designed to increase the total supply of family food on the assumption that the increase will be shared equally or according to nutrient need, then this factor has great importance. Intra-family distribution was discussed in the preceding section as one of the data elements in the diagnosis of malnutrition. It is also a cause or contributing factor to malnutrition. Data on this relationship do not exist in Ecuador and are described through circumstantial evidence.

The relationship between age of weaning and the frequency of infant mortality has been established in several developing countries.* Ecuador is no exception, with infant mortality increasing rapidly during 9 to 12 months post-partum, the period during which most infants are introduced to adult foods.**

Data in Ecuador are not adequate to establish trends in breastfeeding practices, but it is believed that urbanization causes length of breastfeeding to decline. On the other hand, rural indigenous groups are thought to wean children as late as two years.

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*Sergio Valient, and others, "Lactancia Como Problema de Salud Pública de Chile," Department of Nutrition, Faculty of Medicine, University of Chile, Publication Inv. 37/72.

**Infant deaths are reported by month in Ecuadorian vital statistics

TABOOS FOR TARGET GROUP ECUADOR

SIGNIFICANT IN ANY NUTRITIONAL PLANNING

Who	Where	What
Small children	All of Ecuador	Shouldn't eat cheese because makes child talk late, and/or makes child deaf and dumb, and/or have a slow mind.
Small children	All of Ecuador	Should eat strawberries and wine because makes child talk sooner.
Women, lactating	All of Ecuador	Should drink beer because makes more milk.
Women, pregnant	Rural Sierra	Shouldn't eat pork.
Women, after childbirth	Rural Sierra	Should eat chicken.
Small children	Rural Sierra	Shouldn't drink "milk" (zamore) from a cow who just had a calf.
Women, barren	Rural Coast	1. Should eat fresh-fish head soup. 2. Should eat honey, avocado, oyster
Women, after childbirth	Rural Coast	1. Shouldn't eat steer. 2. Should eat cow's snout.
Small children	Rural Coast	Should not eat brains.
Small children, with colds	Rural Coast	Should eat lemons and oranges.

Source: Wilma Freire "Datos Recolectadoes en la Provincias de la Sierra y la Costa durante 1971-1972," Caritas, 1972.

Unlike several other Latin American countries, Ecuador does not have an infant food industry, nor are imports within the price range of any except upper classes. The absence of a convenient and acceptable substitute for breastmilk has probably contributed to the later weaning period in Ecuador.

A. NUTRIENT SUPPLY AND REQUIREMENTS

Most of the food consumed in Ecuador is domestically produced, with the exceptions of wheat and edible oils. Food supply is currently insufficient to achieve recommended levels of adequacy for all the population. The summary of the food balance sheet for 1968, compared with the estimated weighted average requirements for population is shown in Table 6.

Table 6

REQUIREMENTS AND AVAILABILITIES OF NUTRIENTS
Ecuador 1968

Nutrients	Available/* capita/day	Recommended per day**	Difference No.	Difference %
Calories	1.618	2.100	-482	22.9
Total Proteins (gr.)	41.9	57.0	- 15.1	26.5
Animal Proteins (gr.)	23.3	28.0	- 4.7	16.8
Fats (gr.)	47.6	58.0	- 10.4	17.9
Carbohydrates (gr.)	282.0	341.0	- 59.0	17.3
Calcium (mgr.)	430.4	850.0	-419.6	49.4
Iron (mgr.)	12.2	12.0	+ 0.2	1.7
Vitamin A (mgr.)	37.8	1.2	+ 36.6	3.950
Thiamine (mgr.)	1.0	1.2	- 0.2	16.7
Riboflavin (mgr.)	0.8	1.4	- 0.6	42.9
Niacin (mgr.)	11.7	14.0	- 2.3	16.4
Vitamin C (mgr.)	143.2	60.0	+ 83.2	138.6

* Data from food balance sheets.
** Based on average weights and age groups.

Source: Mario Ribadeniera B., Hoja de Balance, Ecuador, 1968.

This is a useful indication of the nutrition availability increases that would be necessary to fill aggregate needs. The magnitude of the nutrient deficit may be appreciated if expressed in production terms. Assuming that no changes were made in the percentage of food production absorbed by waste, exports, seed and animal feed, the aggregate gap

pulses and milk and milk products. This calculation has assumed that population growth would be zero; if the dynamic of Ecuadorian population growth is taken into account, the task is even more immense.

However, these averaged figures disguise disparities in food distribution and consumption, evidence of which can be found in high infant mortality rates and low consumption rates of high nutrition-valued foods among poorer classes. If all groups were to receive adequate diets under assumptions about current distribution patterns, production would have to increase several fold. This, of course, would result in surpluses in normal marketing channels, declines in prices below costs of production and subsequent declines. Thus, it is evident that some manipulation of the distribution system as well as food supply is needed.

B. FOOD SUPPLY TRENDS

Human food supply is total domestic production as modified by imports, exports, seed, animal feed, other non-food uses and waste. The following table is a summary of the food balance sheet for 1968. The deficit in relation to requirements illustrated in the production of that year has been typical of the last decade. Food production has barely kept pace with population growth, and in the aggregate there has continued to be a deficit of calories, proteins, and other nutrients.

Table 7

FOOD BALANCE SHEET SUMMARY: ECUADOR 1968

Food Classes	Supply						Utilization									
	Production MT	Import MT	Donations MT	Exports MT	Stocks MT	Apparent Internal Consumption MT	Losses MT	Seed-Breeding MT	Feed MT	Industrial Consumption	Gross Available MT	Waste MT	Net Available Total MT	Net Available Per Capita/Year Kgs.	Per Capita/Day Calories Kc.	Per Capita/Day Protein Gr.
Total	6,379,159	83,388	9,884	1,389,844	38,886	5,160,047	664,463	135,671	449,797	139,882	3,846,734	440,916	3,409,836	393.7	1,648.0	41.9
Cereals and Dry Legumes	588,398	77,869	840	-	38,886	633,813	63,189	67,843	376	39,341	463,176	67,088	396,156	68.9	849.0	7.9
Tubers & Roots	476,686	-	-	-	-	476,686	16,831	69,789	33,384	849	357,781	71,139	286,648	49.3	96.8	2.3
Vegetables	118,615	-	-	-	-	118,615	9,378	-	7,797	-	101,278	22,276	79,002	13.6	17.7	0.7
Fruits	3,441,682	1,498	-	1,298,779	-	2,190,891	931,176	-	386,388	481	1,892,334	280,488	1,614,396	180.9	497.0	5.2
Meats	189,712	64	-	-	-	189,713	4,997	-	-	-	189,112	23,086	82,089	14.1	78.7	12.3
Milk & Milk Products	1,279,863	-	1,179	-	-	1,281,082	12,412	-	39,580	21,647	608,679	-	608,679	19.3	189.2	9.6
Eggs	89,788	7	-	-	-	89,788	1,289	3,588	-	-	80,492	8,894	18,238	3.1	13.6	1.0
Fish & Seafood	68,988	-	-	11,360	-	57,940	3,492	-	-	3,696	50,413	25,739	23,673	4.0	13.0	2.1
Fats & Oils	38,766	798	487	-	-	37,994	879	-	-	-	37,112	-	37,112	6.4	154.8	-.
Other	868,984	4,084	8,288	44,889	-	838,671	88,384	-	-	-	210,378	-	210,378	36.4	389.0	8.8

Source: Hugo Ribadeneira, Base de Balance de Alimentos Ecuador 1968, Ministry of Production

This situation has not been remedied with increased food imports. For the past ten years food imports have accounted each year for about 10% of the value of all imports. Although wheat imports are rising, overall food imports are not expected to increase over the coming decade. Donated foods which supply a small, but highly visible portion of the food supply have increased during the last ten years, but are expected to level off or decline in the near term.

Total food exports on the other hand have not increased either with the two exceptions of sugar and fish. Seafood and fish, examined in more detail below, present the interesting example of a source of calories and high quality protein which is being exported at the expense of domestic consumption. At first examination this appears to be a policy which might be reversed to benefit malnourished groups in Ecuador. However, closer study reveals that fish, even the least expensive varieties, are a high-cost source of protein and calories in Ecuador. At current world prices for tuna, the largest volume of exports, Ecuador can afford to export this source of nutrients and import edible oils and wheat, less expensive sources of protein and calories.

Because of suspected weakness of agricultural production data in Ecuador, additional evidence of food supply was sought. The index of food prices relative to the cost of living index provides a direct indicator of the demand for food and indirect evidence of food supply adequacy. The index of food prices in Quito has risen more sharply in the last ten years than the index of the general cost of living (see Table 8). Rising standards of living bringing increased demands for food have contributed to this relative price increase, but continual food deficits have also been a factor.

Table 8

CONSUMER FOOD PRICE INDEX

Quito Annual Average 1965=100

	Year												
	1951	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Food Price Index	75.9	83.4	85.6	92.4	97.0	100	108.5	114.5	118.7	130	134.8	143	152
General Index	76.3	86.0	88.5	93.7	96.9	100	104.5	108.1	112.7	119	126.0	136	143.0

Source: Ecuador, Instituto National de Estadisticas, Indice de Precios al Consumidor, May, 1972.

C. COSTS OF NUTRIENT PRODUCTION

Production costs of staple nutrient sources expressed on a per nutrient basis focus the attention of agriculture and nutrition planners on similar issues: What are the reasons for variations in production costs and how can these costs be reduced without reducing farmer income? When looking at the distribution and processing sub-systems, the nutrition planner can likewise review conditions within these sub-systems for ways of lowering per nutrient costs. Since most of the staple foods are produced by small farmers, efforts to increase efficiency may benefit farmers by yielding greater earnings and the consumer by reducing food prices relative to other goods. Table 9 presents representative production costs of several foods in Ecuador. They are a beginning data point in analyzing relationships in the production system, for calculating the effects of marketing and processing practices on per nutrient costs, and for comparing alternative interventions. However, these data should be expanded to include production costs according to region type of farms, and more detailed analysis of alternative modes since costs vary widely.

Table 9

PER NUTRIENT COSTS OF PRODUCTION: SELECTED PRODUCTS

	Dollars	Cost Per 100 Calories	Cost Per Gram NPU Protein
Rice[1] (subsistance)	$5.44/QQ	$.0030	$.0021
(mechanized)	$4.54/QQ	.0027	.0019
Corn[2] (soft type)	$2.50/QQ	.0016	.0015
Frejol[3] (improved method)	$3.68/QQ	.0023	.0010
Milk[2]	$ .05/liter	.008	.002
Beef[4]	$ .32/pound	.06	.0049
Potatoes[2]	$2.00/QQ	.004	.0028

[1] Excluding costs of family labor. Source: AID, Capital Assistance Paper, Ecuador: Land Sale Guaranty, 1969.

[2] Estimates based on current retail prices in Quito

[3] Ministry of Production (no date), includes all labor costs

[4] Junta Nacional de Planificacion (1968 prices)

D. DESCRIPTION OF FACTORS OF AGRICULTURAL PRODUCTION: RELATIONSHIPS IN THE PRODUCTION SUB-SYSTEM

1. General

Nearly all of the food consumed in Ecuador is produced domestically by small farmers (2-20 hectares) using rudimentary, labor intensive farming techniques, and relying on non-institutional credit for capital and operating expenditures. Production of staple foods—corn, potatoes, rice, yuca, beans, and barley - is dominated by the smallest and least productive farmers. Bananas, another staple, and industrial and export crops are more likely to be harvested from plantations, employing more advanced techniques.

2. Credit

Credit availability at reasonable terms has been identified by numerous agricultural production analysts as a crucial factor in stimulating growth. However, the volume of credit available in Ecuador is low in terms of the number of farms, number of persons actively engaged in farming, and the number of hectares under cultivation. Using any or all of these measures, credit for agriculture in Ecuador ranks among the lowest in Latin America. Although data is not available on the end use of agricultural credit, a review of major credit investments indicates that a large portion of the total has been allocated for export or import substitution crops - bananas, oil seed and rice - or high-priced nutrient sources - milk and beef. Relatively little credit has been allocated for staple food production or for production by small farmers.

A detailed description of credit policies and programs and an analysis of credit for small farmers as an intervention in the nutrition system are presented in Appendix VII.

3. Land Tenure

The pattern of land distribution is thought to be an impediment to growth of this sector. The 1968 Agricultural Census showed that 74

percent of the total agricultural units included only ten percent of the total agricultural land. At the other extreme, 1.6 percent of the units held 47 percent of the land. The problem of minifundismo or extremely small divisions of land is present throughout Ecuador, but is most serious in the Sierra. In the East, land is available for colonization while coastal rice, banana and cacao have traditionally been produced on larger parcels of land.

The type of land tenure is another factor in the production subsystem. As a result of the agrarian reform, landless tenants have nearly disappeared in Ecuador. Legal title to land secures agricultural credit if available for small farmers.

Agrarian reform has been used as a means to redistribute agricultural income, but to date it has not succeeded. Since the agrarian reform law was enacted in 1964, the Ecuadorian Institute for Agrarian Reform and Colonization has not had adequate funds to implement an effective program. Many tenant farmers whose landlords were forced to give them title to the land they had farmed are worse off now than before because the parcel of land is too small to support a family and the landlord has denied to the new owner previously held rights to water and pasture. Technical assistance and credit have not been forthcoming for the new owners. From Table 10 "Distribution of Land by Size of Landholding, 1954-1968", it is clear that agrarian reform has made limited impact on a more equitable distribution of land. The most impressive change has been to increase the number of small farmers, those who have the least access to credit, technical assistance and other programs that would increase production.

Table 10

DISTRIBUTION OF AGRICULTURAL LAND BY SIZE OF LANDHOLDING, 1954 AND 1968

Size in Hectares	Units				Area			
	1954		1968		1954		1968	
	Number	Percentage of Total	Number	Percentage of Total	Thousands of Hectares	Percentage of Total	Thousands of Hectares	Percentage of Total
TOTAL	344,234	100.0	633,218	100.0	6,000	100.0	6,937	100.0
Less than 5.0	251,686	73.1	470,347	74.3	432	7.2	709	10.2
5.0-19.9	57,630	16.7	104.755	16.5	566	9.4	952	13.7
20.0-99.9	27,742	8.1	48,301	7.6	1,139	19.0	1,995	28.8
100.0-499.9	5,787	1.7	8,467	1.4	1,156	19.3	1,648	23.7
More than 500	1,369	0.4	1,348	0.2	2,707	45.1	1,634	23.6

Source: (1) 1954-Censo Agropecuario Nacional, 1954. See also Comite Interamericano de Desarrollo Agropecuario, Tenencia de Tierra y Desarrollo Economico-Social del Sector Agricola-Ecuador (Washington, D. C., 1965), pp. 5-10, 18; Union Panamericana, Instituto Interamericano de Estadistica, America en Cifras, 1967--Situacion Economica: 1. Agriculture, Ganaderia, Silviculture, Caza y Pesca (Washington, D. C. 1969) Cuadro 111-04, p. 19.

(2) 1968-Juna Nacional de Planificacion y Coordinacion Economica, Secretaria General de Planeacion Economica, Division de Estadistica y Censos, Encuesta Agropecuaria Nacional-1968 (Quito, 1969), Cuadro I, p. 1. [As cited in U.S. Dept. of State, Agency for International Development, Capital Assistance Paper, Ecuador: Agricultural Development and Diversification (Washington, 1970).]

4. Level of Technology

The level of technology is another factor in the production subsystem. Value added, labor productivity, capital inputs and yields per hectare are indicators of the level of technology. (See Table 11) By any scale, Ecuadorian agriculture is one of the least technologically advanced in Latin America, except for export products of bananas, cacao and sugar. Corn, potatoes and rice, the foods which form the basis of the diet, are produced on small farms which often do not have even animal traction.*

*"Productivity of the Agricultural Sector in Ecuador," Economic Bulletin for Latin America VI, No. 2 (October, 1961).

Table 11

VALUE OF PRODUCTION, VALUE OF INPUTS AND VALUE ADDED IN THE MAIN BRANCHES OF THE AGRICULTURAL SECTOR, AGGREGATE AND PER HECTARE BASIS, 1955
(Millions of Sucres)

	Crop Farming			
	For Domestic Consumption	For Export	Stock Raising	Total Agriculture
Value of production	1,698	1,439	915	4,052
Minus Value of Inputs	244	62	237	543
Equals Value Added	1,454	1,377	678	3,509
Area Farmed (1,000 ha)	860	472	1,740	3,072
Value Added per ha (sucres)	1,691	2,917	390	1,142

Source: "Productivity of the Agricultural Sector in Ecuador," Economic Bulletin for Latin America, VI, No. 2 (October 1961), Table 3, p. 66.

Although the research base for this study is now more than 15 years old, interviews with specialists in Ecuador lead us to believe that little has changed. However, if the amount of agricultural credit available influences the amount and structure of inputs, then after a nearly four-fold increase in total credit between 1955 and 1968, some improvements should have been made. If the end-use of the credit has followed the national development priorities in effect during the last two decades, then improvements in efficiency probably have occurred in greatest proportion in export crops of bananas, cacao, coffee, and sugar.

Yields of crops per hectare are another measure of efficiency. Table 12 compares yields of several basic crops. Rice production has received the largest single investment of any of the grain crops, as a result of the government's effort to increase exports. Further irrigation and seed improvement projects are planned for the Guayas River Basin.

Table 12

YIELDS PER HECTARE

(Metric Tons)

	Ecuador			Chile	Colombia	United States
	(1)	(2)	(3)	(1)	(1)	(1)
	1954-57	1961-69	1969-70	1955-57	1956-58	1955-57
Wheat	0.605	0.957	0.875	1.400	1.005	1.380
Rice	1.055	2.395	2.138	2.655	1.980	3.506
Barley	0.560	0.560	0.909	1.663	1.444	1.364
Corn	0.635	0.630	0.977	1.770	1.443	2.784

Sources: (1) "Productivity of the Agricultural Sector in Ecuador," Economic Bulletin for Latin America, VI, No. 2 (October 1961).

(2) Unpublished data from Republic of Ecuador, Ministry of Production, "Empresas Agricolas Division.

(3) U.S. Agricultural Attache, Quito, "Grain and Feeds," February 8, 197

5. Other Inputs

Ecuador ranks low among Latin American countries in the use of standard agricultural inputs such as irrigation, mechanization and fertilizer, although the latter has increased three-fold in the last decade. Soil improvement is practiced most in the export crops of banana and sugar cane which account for about 50% of consumption. Non-food crops such as cacao, coffee and cotton also receive large amounts of fertilizer. According to a study in 1966, less than one tractor was used per thousand hectares of land while Colombia has about three times as many.*

Irrigation is not widely used in Ecuador, though unreliable climatic conditions make it desirable. Lands under irrigation are evenly divided between the Sierra and the Coast, although the state Guayas, a major rice producing area, has a larger share than others. A detailed description of irrigation programs in Ecuador and their effectiveness as interventions in the nutrition system are discussed in Appendix VII.

*CEPA, Estudio Económico de America Latina, 1966, Cuadro IV-10, as cited in Ecuador, Bulletin of the Central Bank, XLII, No. 498 (January, 1968).

6. Labor

The farm labor force constitutes about one-half of the economically active population in Ecuador. About 75 percent of the farm population are heads of households and their families, working their own or rented farms. Ten to fifteen percent are landless laborers and an equal number are casual laborers. Many of the farm laborers own or rent their own farms, but turn to wage-earning to supplement cash income from crops sold. The proportion of permanent farm workers to total agricultural labor force is much higher on the Coast than in the Sierra or the East, because of the plantation economy of bananas, sugar cane and cacao.*

a. Productivity

Approximately 50 percent of the agricultural labor force produces food for internal consumption. Thirty-five percent are in cattle production and about 16 percent produce for export. Comparison of the number of workers per hectare for the three different fields demonstrates the higher productivity of workers on export crops. If a further comparison is made of the value of production per worker, the differences among agricultural, cattle and export farming are even more striking (see Tables 13 and 14). A direct correlation between worker productivity and mechanization can be made.** This emphasizes further the destination of existing agricultural credit to export crops rather than domestic consumption commodities.

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*JUNTA Nacional de Planificacion y Coordinacion, Encuesta Agropecuario, 1968.

**"Productivity of Ecuadorian Agriculture," Economic Bulletin for Latin America, Vol. VI, No. 2, October, 1961.

Table 13

DISTRIBUTION OF THE AGRICULTURAL POPULATION IN THREE AREAS, 1955

		Agriculture		
	Internal Consumption	Export	Cattle	Total
Total Area (100 ha)	860.0	472.0	1,775.0	3,072.0
Active Population (1,000)	321.6	102.8	225.0	650.0
Hectares per Active Person	2.7	4.6	7.9	4.7

Source: "Productivity of Ecuadorian Agriculture," citing original research with Ministry of Development and JUNTA Nacional de Planificacion.

Table 14

PRODUCTIVITY OF THE ECONOMICALLY ACTIVE POPULATION, 1955

	Agriculture			
	Internal Consumption	Export	Cattle	Total
Active Population (1,000)	321.0	103.0	226.0	650.0
Productivity (1,000 sucres)	4.5	13.4	3.0	5.4
Productivity per Hour Worked (sucres)	2.9	5.6	0.9	2.2
Value of Production per Hour Worked	3.3	5.8	1.1	2.6
Payment per Hour Worked (sucres)	1.3	2.3	0.7	1.1

Source: "Productivity of Ecuadorian Agriculture," citing original research with Ministry of Development and JUNTA Nacional de Planification. (S/18.18/US $1.00)

b. Wages

As indicated in other sections of this analysis, income of the rural population is extremely low. The payment per hour cited in Table 14 gives an idea of farm worker wages, including meals frequently furnished by the owner. In dollars, for a ten-hour day, total earnings would be 70 cents, $1.25 and 40 cents for work in internal consumption, export, and cattle production, respectively. Although these data are from 1955 census tabulations, there is little evidence that real wages have increased for farm workers. Furthermore, much of the work is seasonal and, until recently, for the hausipungeros, a certain portion

of all work for the landowner was given in return for water, grazing rights, and other services, and did not present a cash income.

c. Education

The education of the farm population is the lowest of all sectors in Ecuador. Access to schools, even those with only three to four grades, is limited in rural areas, and dropouts for farm work or because schools have limited numbers of grades contribute to the low education levels. Nationally, Ecuador claims 57-60 percent of all school-age children enrolled in primary school. In 1962, 35 percent of the population were reported to be illiterate.*

e. Role of the Nutrition Analyst

Leaving aside nutritional considerations, Ecuador must increase the production of its agricultural sector if economic growth is to continue. The government has recognized this and has made large investments in some crops and regions. Since these investments have had as their objective the increase in value of production, other objectives such as filling nutrient needs of lower income groups or income distribution have been of secondary importance.

The nutrition planner, however, must compare alternative interventions in the production sub-sector to determine the extent to which attempts to achieve nutrition goals will cause a sacrifice in the dominant national objective: increased value of production. For example investments which favor large farmers producing for export are likely to have an impact on nutrition goals different from those for smaller farmers producing for domestic consumption. Obviously, the most convincing case for a nutrition intervention in the production sub-sector is one which does not result in significant losses in value of production.

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*Agency for International Development Bureau for Latin American, Summary Economic and Social Indicators, 18 Latin American Countries: 1960-1970 (Washington, 1971).

Few analysts have been able to undertake an accurate calculation of the trade-offs between these two objectives. Until a data base is established in Ecuador, the nutrition planner can only set forth the apparent nutritional outcomes of alternative investments in the production sub-sector and then compare them with current proposed investments for conventional objectives.

III. FOOD DISTRIBUTION AND PROCESSING

A. MARKETING

Like food production, marketing is highly decentralized and a large portion of total production remains within relatively isolated marketing regions. Government participation is not strong, although the legal basis for price and quality regulation exists, and individual food processors have limited influence over marketing practices or prices. Transportation between major producing and marketing areas has greatly improved in the last decade, but still inhibits the flow of goods and services. Intermediaries play a large role in marketing, but there is little evidence that they restrict marketing or that their margins are exorbitant. The following table shows marketing margins for wheat, barley, and corn.

Table 15

TYPICAL FOOD PRICE CHAINS

	Per Quintal	Per 100 lb
WHEAT		
Price at Farm by Dealer	S/67	$3.35
Transport to Quito	6	0.30
Dealer Margin	19	0.95
Price at Quito (to Processor)	92	4.60
Price at Farm by Dealer	70	3.50
Transport to San Jose	4	0.20
Transport to Guayaquil	6	0.30
Dealer Margin	9	0.45
Price at Guayquil (to Processor)	97	4.85
BARLEY		
Price at Farm	S/37	$1.85
Transport to Pajili	2	
Dealer Margin	4	
Transport to Quito	3	
Dealer Margin	11	
Distribution Margin	22	
Retailer Margin	13	
Cost to Consumer	92	4.60
Cost of Distribution	55	2.75
CORN		
Price at Farm	S/34	$1.70
Transport Ibaria to Otavalo	3	
Dealer Margin	6	
Transport to Quito	5	
Dealer Margin	10	
Distributor Margin	17	
Retailer Margin	15	
Cost to Consumer	90	4.50
Cost of Distribution	62%	2.80

Source: Ruas, Farmers' Union, "Survey of Grain Marketing and Storage in Ecuador," 1963.

About 50 percent of all food produced and available for human consumption is marketed beyond the primary market town. The remainder is consumed on the farm or traded in the market closest to the farmer. Only at harvest time for some perishable staples such as potatoes and green vegetables does the market seem incapable of clearing the supply. Although few studies have been done on marketing volume, it appears that Ecuadorian market structure is capable of carrying a larger volume, without major modification.

1. Storage

Storage of grains, pulses, and potatoes is a major shortcoming of the current marketing system. Because of high losses due to rodents and spoilage, adequate storage facilities would add to food available for human consumption. The tables below illustrate storage deficits for some staple foods and present estimates of waste of four staple grains. The location of greatest waste in the system is not known, although it is apparent that losses at mills, intermediate warehouses, and in transport accounts for a substantial portion of all waste.

TABLE 16

ESTIMATED OFF-FARM STORAGE DEFICITS FOR SELECTED COMMODITIES, 1970

(Thousands of Metric Tons)

Commodity	Total Production	Marketing Requirements	Present Storage Facilities	Storage Deficit
Corn	197.7	98.8	—	98.9
Wheat	94.5	94.5	70.0	24.5
Barley	71.5	35.8	18.0	17.8
Potatoes	360.0	180.0	—	180.0
Peas	35.0	17.5	—	17.5

Source: Ecuador, Junta Nacional de Planificacion y Coordinacion Economica Estudio preliminar sobre almacenamiento de granos en el Ecuador, Documento No. 06-03, 16 de Septiembre de 1968.

AVERAGE ANNUAL TOTAL PRODUCTION AND WASTE
OF WHEAT, RICE, BARLEY, AND CORN, 1962-69
(Metric Tons)

Product	Total Production	Total Waste	Waste as Percentage of Production[1]
Wheat	73,671	5,863	8.0%
Rice	247,548	37,132	15.0
Barley	88,567	6,542	7.5
Corn	190,626	20,475	12.0

[1]Another study estimated 18% waste in wheat, and 20% for corn and barley: Henry N. Ruas, Farmers' Union, "Survey of Grain Marketing and Storage in Ecuador," 1963.

Source: Unpublished tables, Ministry of Production, Division of Empresas Agricolas.

2. Weights, Measures, and Quality Standards

The development and enforcement of standards is in its infancy in Ecuador although two organizations have been authorized to act in this field. The lack of standardized weights, measures, and quality standards and their enforcement affects the income of farmers as well as the values of food purchased by the consumer. Strict enforcement of standards may, at the outset, reduce small farmer income since they produce, on average, lower quality commodities. For example, when government-owned grain storage facilities were introduced in some regions, small farmers were penalized because of the high humidity and foreign matter found in their grains. However, standards are a necessary complement to campaigns to introduce improved varieties, which eventually should benefit small farmers.

3. Market Information

Regular and accurate data on volume and quality of agricultural sales are not available in Ecuador, although recently the Ministry of

Production began a daily information service on wholesale prices of selected commodities in 11 major cities, distributing this information by radio, newspaper, and television. This service is a great improvement over the past, but will be incomplete until prices can be associated with recognized standards of quality and volumes marketed.

Most small farmers still rely on buyers to reflect accurately market influences. Many sell their production from their farm because they lack their own transportation, further isolating them from market data and increasing their vulnerability to dishonest dealers.

4. Prices

The government does not vigorously intervene in determination of prices for agricultural products. Minimum producer prices have been established for rice, oilseeds, domestically-produced vegetable oils, wheat, bananas, and milk. These prices are set by the Ministry of Production, while municipalities are empowered to set maximum consumer prices. Because there is not always a coordinated policy, the price squeeze has discouraged production of some foods. Liquid pasteurized milk is an example of this.

Seasonal price fluctuations occur at the wholesale and retail levels. The variations may be attributed in large part to the lack of storage space and scarce market information. The following table shows seasonal price changes for two staple foods. Even rice, a price controlled food, demonstrates a fluctuation of 14 percent at wholesale. Potatoes, which are not price controlled and present more difficult storage problems varied even more. Retail price fluctuation was somewhat less. However, until price changes can be linked with volume, definite conclusions about causes and effects cannot be made.

TABLE 18

PRICE FLUCTUATIONS, TWO MAJOR COMMODITIES

	Quito				Guayaquil			
	Wholesale[1]		Retail[1]		Wholesale[1]		Retail[1]	
	Potatoes	Rice	Potatoes	Rice	Potatoes	Rice	Potatoes	Rice
July 1970			0.82	S/ 2.25			0.96	1.89
Aug.			0.81	2.23			1.06	1.96
Sept.			0.88	2.29			1.02	2.02
Oct.			0.91	2.30			1.04	1.97
Nov.			0.88	2.26			1.05	2.05
Dec.			0.79	2.19			0.99	2.05
Jan. 1971	46	S/169	0.71	2.08	S/56	S/160	0.83	1.98
Feb.	36	180	0.62	2.18	40	166	0.76	1.96
Mar.	29	191	0.56	2.30	38	187	0.82	2.11
April	36	193	0.55	2.36	45	181	0.76	2.06
May	24	195	0.52	2.26	27	187	0.52	2.02
June	31	194	0.55	2.28	36	186	0.58	1.98
July	43	187	0.59	2.37	49	168		
Aug.	45	195			47	173		
Sept.	53	194			57	177		
Average	38.1	188.66	0.706	2.25	43.88	176.11	0.865	2.00
% Deviation From Average	+39%	+4%	+25%	+5%	+27%	+6%	+22%	+5%
	-37%	-10%	-26%	-7%	-17%	-9%	-39%	-5%

[1] Wholesale price is for quintals; retail price is per pound.

Source: Republica del Ecuador, Instituto Nacional de Estudistica, Indice de Precios al Consumidos, July 1971; Universidad de Guayaquil Institut de Investigaciones Economicas y Politicas, Indice de Precios al Consumidos, Guayaquil 1960-1971, June 1971; Ministerio de la Produccion, Servicio de Informacion de Mercadeo Agropecuario, "Mercados entre Mayoristas Tranacciones Mayoristas y Minoristas," January 1971-September 1971.

B. TRANSPORTATION

The transportation system is a serious barrier to overall economic development and especially to agricultural development. This problem has been recognized by the Government of Ecuador and major investments in road improvement have been made in the past decade. Extension of the road network is being made as part of petroleum exploitation in the northeast section of the country. Railroad transport for passengers and cargo is not a major factor in the total system, and during the last decade, it has declined in relative and absolute importance. Internal air cargo has doubled in the last decade, but expense in comparison to truck transport continues to limit its contribution. In the coastal provinces, river and littoral shipping play an important role.

Regionally, the Sierra has the major road network reflecting the larger number of towns and cities. The Pan American Highway links the major towns in the Sierra, running from the Colombian border at Tulcan to the Peruvian border at Macara. Other major highways run from Quito to Guayaquil and Esmeraldas on the Coast and to Puyo in the East.

On the Coast, the Guayas river basin enjoys an adequate road system, but the provinces of Esmeraldas to the north and Manabi, south of it, have few all-weather roads.

Difficulties in transporting foods have important consequences for the national and regional food supply. For example, in the regions bordering Colombia and Peru, farmers find better markets across the borders rather than transporting production to major market areas in Ecuador. Much of this trade is thought to be contraband and estimates of its volume are not available. Furthermore, arbitrages, which would tend to smooth out inter-market price variations, is not a common practice, in part, because of lengthy and costly transport. Finally, the relative isolation of many areas precludes marketing of perishables such as milk, meat, and fish. Several provinces do not have adequate internal milk supplies and are unable to attract imports from other regions because of transport problems.

C. FOOD RETAILING

Food retailing takes place in public markets located in towns and cities and through corner grocery stores in the larger centers. Supermarkets or food chains do not represent a major factor in the system. Those that exist are located in middle and upper-class neighborhoods. A government-operated fair price store, ENPROVIT, has numerous outlets in large cities, but because of its small volume of sales and restrictions on the type of food which it can sell, it has not yet made a significant impact on food retailing.

Maximum food prices and weight and measure controls are maintained by municipalities, but enforcement is frequently lax. Some foods, such as unpasteurized milk, avoid price control entirely. On the other hand, pasteurized milk is strictly price controlled, giving small margins to the retailers. For this reason, many markets are reluctant to carry this product.

Few retailers have adequate storage space, refrigerated or free from rodents. Installation of meat or dairy cases, which are not manufactured in Ecuador, would represent an unreasonable investment for most retailers.

D. FOOD PROCESSING

Processed foods contribute a significant portion of the calorie supply in Ecuador, if sugar and wheat are included. However, because processed foods are generally more expensive per nutrient than unprocessed food and are less available in rural areas, they are a small part of the food culture of the low-income families. The major exceptions to this are sugar, in the panela or cake form, grains and milk. As indicated in the diet studies cited in this report, many of the grains are processed in the home or by cottage-scale industries, and milk is frequently consumed without pasteurization or bottling.

Approximately 30 percent of all processed food calories and proteins are derived from wheat flour, with sugar accounting for another 40 percent. In total domestically processed foods contribute about 20 percent of the

total caloric requirements and about 30 percent of the total calories consumed. Similar proportions are found for protein consumption, and domestically processed fat supplies a somewhat higher percentage. Milled rice is not included in these figures.

Ecuador imports few processed foods for the commercial market. In the past decade, investments in edible oil processing, milling, and meat, fruit, and vegetable canning have reduced previous import levels. Unmilled wheat is the largest human food import.

Investment in food processing has grown strongly during the period 1961-69. However, a large portion of this growth has been in foods for export such as sugar and fish processing. For the period 1966-69, the only series for which figures are disaggregated, the exclusion of canned and frozen fish, sugar, candies, and animal feed reduces the growth rate markedly.

Food processing plants are located primarily in or near the two major cities Quito and Guayaquil, the centers of greatest demand, necessitating costly transport from production areas. Some food processing, such as slaughterhouses, grain mills, and to a lesser extent milk pasteurizing, is decentralized. Table 19 shows the distribution of major food processing plants in Ecuador. These data do not include the cottage-level processors found in some towns which are near production areas.

Within this general framework, the quality, volume and destination of individual products vary widely. Individual characteristics of the food industries have important implications for the extent to which the foods can be seriously considered as good sources of proteins and calories for the target group or which may serve as vehicles to carry fortificants or enriching nutrients. For most processed products, under the present distribution and pricing pattern, the low-income rural population is

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* Imports of powdered milk, flours, and edible oils are chiefly by food distribution agencies.

Table 19

LOCATION OF FOOD PROCESSING

1966

(number of establishments)

Type of Industry	Total	Guayas (Coast)	Pichincha (Sierra)	Manabi (Coast)	Azuay (Sierra)	Tungurahua (Sierra)	Others
Slaughterhouses	12	1	5		3	2	1
Milk products	18	8	6		1		3
Fruit & vegetable canning	7	5	1		1		
Frozen and canned fish	9	7		2			
Rice mills	32	23		6			3
Flour mills	25	6	8		1	3	7
Bakeries	72	24	23	3	4	4	14
Sugar mills	9	3					6
Candies	10	4	5			1	
Edible oils	9	7	1	1			
Instant coffee	4	1	3				
Animal feed	5	2	1		2		
Others	11	6	1	1			3

Source: Enrique Espinel R., "La Industria de Alimentos en El Ecuador," 1970.

effectively excluded from the market. Diet studies show that although processed foods are purchased even by the most isolated, because of custom and income, consumption is limited to small amounts used as condiments or on festive occasions. Noodles made in Guayaquil, for example, may be found in markets in small Sierra towns, but are purchased in small quantities for soups. And the vitamin-enriched American-style bread of Su Pan in Guayaquil is eaten like cake by the poor of that city.

Donated foods are used principally for primary school feeding, maternal and child health programs, and food-for-work in community development projects in Ecuador. The school breakfast and lunch program has received the majority of donated commodities. CARE and CARITAS have divided the market to avoid duplication of efforts. Approximately one-half of all children enrolled in primary school are reached by the program. Given the dropout rate at this level, it is assumed that approximately 25 percent of all primary school age children are reached by the program. Since those children at greatest risk also have the highest dropout rate, the coverage of this group is somewhat lower and the nutritional improvement is diminished.

The pre-school child, especially the infants, are the target, but most donated foods do not reach this group. Only an estimated 5 percent of all pre-school children are served by MCH centers. The extent to which children receive a significant contribution to their nutritional status is not known. Unlike school programs, attendance is not required, and in many MCH sites, consumption of the food by the child cannot be assured because it is taken home for preparation. More and more centers are preparing the food and requiring the mother and child to eat it there.

Food-for-work projects absorb about 20 percent of all donated foods. From a list of 1970 projects in the CARITAS annual report, school and road construction appear to be the most common. Foods are given in bulk and their impact on the pre-school and school-age child is not known. One food consumption study in the Sierra suggests that, in Indian homes, children are more likely to share equally in food distribution than in Mestizo homes.

Further investigation is necessary to determine more exactly the contribution of donated foods to the nutritional status of the pre-school

*Sylvia Forman, "A Study of Six Sierra Villages." 1971, unpublished.

child. However, it appears that much of the food for school feeding, other child programs such as camps and orphanages, and food for work, does not reach the target groups of pre-school children and pregnant and lactating women.

An additional area worthy of study is the present level of financial commitment of GOE to these programs. From 1965, when the school program began full scale, to 1969, GOE spent about $230,000 per year in administration, transport and storage costs. In 1970, the contribution declined to $171,000, and in 1971 is approximately $125,000. Ministry of Health, Misión Andina, and Ministry of Production financial data are not available.

Additional information on food distribution programs can be found in Appendix VI.

The significance of the description of the Ecuadorian nutrition system is not because it revealed opportunities for solving the nutrition problem never before considered, but because it:

- Points out limitations to preferred solutions, such as income growth, food distribution, or reliance on processed foods
- Makes clear that no one solution or program will suffice because of the diversity of the target group population
- Suggests that the system is interrelated and that a proposed intervention may yield unexpected costs or benefits throughout the system
- Sets forth areas for additional study or reevaluation of currently available data
- Brings together for the first time data from several disciplines and ministries, focused on the nutritional result.

An additional benefit for the planner of beginning the descriptive and analytical process is that it creates a body of knowledge about the nutrition system that is the basis for evaluating proposals made by agricultural, health, commerce, or finance ministries. The analysis of the first intervention (Appendix II, Milk and Milk Products) was based on the information gathered during the descriptive phase and was responsive to an on-going livestock and dairy herd loan. It is likely that nutrition planners will be asked to comment on planned investments by other ministries. While additional research may be required to assess the nutritional impact, the description of the total system is the first step, giving a perspective on the projects lacking in other ministries.

G. DATA ISSUES IN NUTRITION PLANNING

The selection and management of available data are some of the most important aspects of national nutrition planning. Nutrition planners are required to use information generated by several ministries, private agencies, international organizations and private industry and commerce—

These data may also be inconsistent so that the planner must reconcile differences or select the most reasonable figures among conflicting estimates. Furthermore, the nutrition planner will be faced with an abundance of data about the volume of agricultural production, for example, but relatively little about consumer behavior or production and distribution costs. Finally, the planner will be tempted not to act or recommend a course of action until "all data are in" even though this may require a delay of several months or additional expenditures for surveys and studies.

These difficulties will demand great ingenuity and persistence by the planner or he will find himself buried in reams of statistics, unable to begin. The questions posed in the description of the nutrition system provide the framework for searching for and organizing data from a variety of sources. A basic decision at the outset is to what level can and should data be disaggregated and on what level of political, geographical, or cultural subdivisions should generalizations be made. In the Ecuador case, four geographic subdivisions were selected; however, as Ecuadorian planners continue they may want to make generalizations at more detailed levels such as provinces, planning districts, or ecological zones.

Published production data may give only national totals by crops or size of landholding. However, if resources allow, the planner may be able to return to the data base from which the totals were developed and compile data in categories more appropriate to his needs. This was not done in this study.

For purposes of system description, we believe that high levels of aggregation are adequate; however, as specific interventions are explored and analyzed, the planner will want to study production and other data in greater detail. By refraining from detailed study in the first stages of planning, the analyst will conserve time and resources

that follow, the description and analysis of the interventions illustrate this approach.

Data about the nutrition system is imbalanced, with the largest amount available about volume of production and some of the conditions of production. Information on consumer behavior, especially in relation to prices and income is usually lacking or based on conjecture. Since the bulk of the information is about the production subsystem, the planner will be tempted to give greater consideration to this aspect, short-changin the distribution and consumption side. From the outset of the descriptive process, the analyst should give highest priority to obtaining information about income, income distribution, food prices, buying habits, general expenditure patterns, marketing margins, and practices. These data are difficult to find, they usually must be brought together from a variety of sources, and often they are not based on national sample surveys, rather on isolated studies, best guesses, and stereotypes.

The annex to Appendix I represents an attempt to compile information from several sources about the consumer subsector. It cannot and does not substitute for a national nutrition and consumer survey, but it can be a basis for planning until the investment for the survey is made. The annex and the conclusions in Appendix I based on its data are also an example of how the nutrition planner can fill data gaps with explicit assumptions, to be confirmed or changed based on later study. These assumptions can be based on informed opinion, extrapolations from other countries or regions, projections from earlier periods for which data are available, or some combination of these methods. In planning, it is important that these assumptions be clearly stated so that other planners and policy makers are aware of the foundations on which plans have been built.

In the following appendices, several possible interventions are examined. In each, available published data have been used as the basis for analysis, although in some instances data gaps forced us to rely on best guesses and assumptions.

task: beginning with an idea that increased consumption of a food would be beneficial, he examines the context of that food within the nutrition system, drawing upon the general information provided in the descriptive phase. Based on this information the best point(s) of intervention emerge: in the study of milk, distribution and consumption phases are given greater attention, while in the pulses study, production is emphasized and prospects for intervention in the processing phase are examined in the wheat flour example. Conclusions are presented in comparative terms so that further study is possible.

Annex to Appendix I

METHODOLOGY FOR DIET AND FOOD COST ANALYSIS

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A.	NUTRIENT VALUES OF TYPICAL DIETS OF LOW-INCOME FAMILIES	50
B.	ADEQUATE DIET AT LOWER COSTS THROUGH FOOD HABIT CHANGE	53
C.	FREQUENCY OF MALNUTRITION	56
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Many counties and regions within countries have not had nutrition surveys for many years, if at all. Because a nutrition survey is time-consuming and an expensive undertaking during which nutrition programs may be curtailed, an alternative method was attempted to estimate the nutritional intakes. By combining information on food habits, food costs, nutrient requirements, and approximate current consumption for those groups suspected to suffer from malnutrition, it is possible to develop estimates of target group status and size sufficiently accurate for nutrition planning. However, these estimates are based on other estimates, offering the opportunity for multiplication of error. For this reason, the nutrition planner should be alert to opportunities to verify or correct his estimates through the routine data gathering efforts of other organizations.

In the following sections the approach used in Ecuador is presented. Most of the estimates below appear to be similar to independent nutrition surveys. In general, however, our conclusions suggest that the severity of nutrient deficiency and the number of people affected are somewhat greater than previously believed.

A. NUTRIENT VALUES OF TYPICAL DIETS OF LOW-INCOME FAMILIES

Data were gathered from several sources on food habits of target group individuals in urban and rural zones of the Sierra and Coast. These data were based on already published studies, observation, and conversations with social workers in each region. This information was used to construct diets, expressed in grams for each food consumed for each individual considered. Because these are average diets they do not reflect what any individual would eat on any day, but are an estimate of the daily average intake throughout the year. Nutrient values for the foods were taken from the Table of Equivalent Values developed by the National Nutrition Institute of Ecuador.

From these data tentative conclusions were reached. Daily intakes were calculated as:

	Proteins	Calories
Urban Sierra		
preschool child	8.2 grams	983
3 years: 13.3 Kg.		
Urban Coast		
preschool child	10.9 grams	987
3 years: 13.3 Kg.		

Comparing the child's intake figures with those of the adult from the same geographical division: the adult consumes roughtly 3 times as much protein as the Sierra and Coastal child; for calories, the Sierra adult consumes 1.7 times as much, the Coastal adult consumes 1.9 times as much. The difference is larger for protein than for calories, due to the larger proportion of sweetened foods (of sugar, protein-free) in the child's diet than in the adult's.

Following similar child-to-adult proportions, the typical dietary nutrient consumption for rural Sierra and rural Coast was interpolated as follows:

Rural Sierra

Protein: $\frac{\text{Adult Intake}}{3}$ = Child Intake

$\frac{21}{3} = 7$ grams

Calories: $\frac{\text{Adult Intake}}{1.7}$ = Child Intake

$\frac{1934}{1.7} = 1138$

Rural Coast

Calories: $\frac{\text{Adult Intake}}{1.9}$ = Child Intake

$\frac{2342}{1.9} = 1233$

It was assumed that a child consumes 1/2 the amount of riboflavin and Vitamin A as an adult.

Estimated nutrient intakes were then compared with those recommended. For all nutrients except protein, the standards of the National Institute for Nutrition of Ecuador (INNE) were used. Conversions of the protein allowance to Net Utilizable Protein (NPU), based on FAO/WHO requirements, allowed more precise estimations to be made throughout the study. Based on this procedure the following percentages of requirements for the target group individuals were obtained:

Percent of Daily Requirements

Urban Sierra

	Protein	Calorie
Pregnant Woman 55 Kg.	$\frac{25.1}{38.4}$ = 65%	$\frac{1768}{2550}$ = 69%
Lactating Woman 55 Kg.	$\frac{25.1}{47.4}$ = 53%	$\frac{1768}{2950}$ = 60%
Preschool Child 3 years, 13.3 Kg.	$\frac{8.2}{11}$ = 75%	$\frac{893}{1292}$ = 76%

Rural Sierra

	Protein	Calorie	Vitamin A
Pregnant Woman 55 Kg.	$\frac{21.3}{38.4}$ = 55%	$\frac{1934}{2550}$ = 76%	$\frac{238.6}{1700}$ = 14
Lactating Woman 55 Kg.	$\frac{21.3}{47.4}$ = 45%	$\frac{1934}{2950}$ = 66%	$\frac{238.6}{2000}$ = 12
Preschool Child 3 years, 13.3 Kg.	$\frac{7}{11}$ = 64%	$\frac{1138}{1292}$ = 88%	$\frac{120}{500}$ = 24

	Protein	Calorie	Riboflavin
Urban Coast			
Pregnant Woman 55 Kg.	$\frac{31.9}{38.4}$ = 83%	$\frac{1895}{2550}$ = 74%	$\frac{.49}{1.6}$ = 31%
Lactating Woman 55 Kg.	$\frac{31.9}{47.4}$ = 67%	$\frac{1895}{2950}$ = 64%	$\frac{.49}{1.9}$ = 26%
Preschool Child 3 years, 13.3 Kg.	$\frac{10.9}{11}$ = 99%	$\frac{987}{1292}$ = 76%	$\frac{.24}{.7}$ = 34%
Rural Coast			
Pregnant Woman 55 Kg.	$\frac{30.5}{38.4}$ = 79%	$\frac{2342}{2550}$ = 92%	
Lactating Woman 55 Kg.	$\frac{30.5}{47.4}$ = 64%	$\frac{2342}{2950}$ = 79%	
Preschool Child 3 years, 13.3 Kg.	$\frac{10}{11}$ = 91%	$\frac{1233}{1292}$ = 95%	

(Source: ATAC Typical Dietary Sheets
Daily Requirements, see p. 9 Nutritional Deficiencies)

B. ADEQUATE DIET AT LOWER COSTS THROUGH FOOD HABIT CHANGE

In order to determine the extent to which nutrient intake could be improved at the same or lower cost, analysts reviewed food habits, retail costs per unit of nutrients, current expenditures for typical diets and recommended intakes. Estimates were then made about the extent to which consumption of lower cost nutrient sources could be increased.

An important data gap in these calculations limits the accuracy of the conclusions. Research on physiological limits of food consumption for different age groups could not be found. This is a particularly serious limitation for infants and young children. Another constraint on this exercise was the inability of the analyst, without computer assistance, to consider a wide range of alternative diet mixes. The analyst did not calculate additional utilizable protein gained when foods with complementary amino acids are eaten simultaneously. This step should be undertaken because of the low-cost additional protein that can be gained with consumption of some food mixes. Nevertheless,

the methodology provides some insights into how nutrition education planners can make more practical their training for food habit change. It also provides an estimate of that segment of the population that could achieve adequacy with moderate food habit change.

For each of the target group individuals, with their different nutrient requirements, the cost of filling 100 percent of nutrient requirements for utilizable protein, calories, iron, Vitamin A, and riboflavin with more than a dozen staple foods was calculated. The amounts of each food required to fill 100 percent of requirements were compared to current consumption.

This identified high cost nutrient sources among foods in the curren diet and other acceptable sources which would provide the same nutrients at lower cost. Typical diets were redesigned to substitute lower cost items, yet remain within food habit constraints. Estimates of nutrient pay-offs at equivalent total food budgets could then be made. These calculations when ranked with family income distribution allowed a rough estimate of the number of families whose incomes would permit nutritional adequacy within reasonable dietary limits.

The following table presents the costs for filling nutrient requirements with various foods. Barley is one of the lowest cost sources for most nutrients. However, among the low-income families of the Sierra, consumption is nearing apparent physiological limits. Bananas and potatoes, frequent weaning foods in the Coast and Sierra, are relatively high-cost sources while rice, an acceptable food for young children, provides nutrients at lower cost. Corn ranks among the least expensive sources for both calories and proteins, but many specialists in Ecuador believe that acceptability limits are being reached.

Milk is thought to be an ideal food and is recommended in nearly every nutrition education program in Ecuador, yet it is not one of the least cost sources of nutrients. Although calcium costs were not included in this table, beans and some other pulses would provide this nutrient at lower cost.

Price in U.S. Cents Per 100 Percent of Daily Requirements

ITEM	grams utilizable protein			calories			Iron			Vitamin A			Riboflavin		
	pregnant woman	lactating woman	preschool child, 3 yrs., 13.5 lb.	pregnant woman	lactating woman	preschool child, 3 yrs., 13.5 lb.	pregnant woman	lactating woman	preschool child, 3 yrs., 13.5 lb.	pregnant woman	lactating woman	preschool child, 3 yrs., 13.5 lb.	pregnant woman	lactating woman	preschool child 13.
milk	17	21	4.9	48.2	57.8	24.4	112	112	44.8	63	76.6	18.7	13.8	16.4	6.0
cheese, "queso"	19.2	23.7	5.5	80.3	92.9	40.7	53	53	21.2	61.2	72.0	18.0	26.9	32.0	11.8
meat	25.7	31.7	7.4	20.7	27.1	11.9	16.1	16.1	6.5	453.9	534.0	133.5	21.2	102.2	37.3
beans	22.7	28.0	6.5	20.4	23.6	10.3	29.2	29.2	11.7	-	-	-	61.6	73.2	27.0
fried beans	12.9	16.0	3.7	20.4	23.6	10.3	7.7	7.7	3.1	451.2	530.8	132.7	28.2	33.4	12.3
pork, with beans	17.5	21.6	5.0	68.9	79.7	34.8	49.8	49.8	19.9	-	-	-	53.9	63.9	23.6
fish, small, bony	24.4	30.1	7.0	257.8	342.2	149.9	154.2	154.2	61.7	-	-	-	22.6	35.2	13.0
corn, prepared as hominy	8.8	10.9	2.5	7.1	8.3	3.6	8.0	8.0	3.2	46.2	54.4	13.6	65	76	28
barley	7.9	9.7	2.3	8.9	10.3	4.5	4.4	4.4	1.8	421.1	493.4	123.9	19.7	23.4	8.6
banana, type eaten cooked, green	32.6	64.9	15.1	14.3	16.5	7.2	17.9	17.9	7.1	1.7*	2.0*	.5*	23.7	28.1	10.4
banana, type eaten fried rings	45.2	53.8	13.0	18.4	21.2	9.3	26.2	26.2	10.5	2.9	3.4	.9	36.6	43.5	16.0
banana, type eaten ripe	32.0	39.5	9.2	17.1	19.8	8.7	18.6	18.6	7.4	11.6	13.6	3.4	32.0	61.8	22.8
rice	15.6	19.2	4.5	14.8	17.1	7.5	22.3	22.3	8.9	687.7	809.0	202.3	112.8	133.9	49.3
potatoes	28.4	35.1	8.1	30.1	34.8	15.2	21.1	21.1	8.5	30.2	105.1	26.5	84.6	100.4	37.0

*Based on the ICNN table's value which is approximately 3 times the Vitamin A value found in other tables. Thus the prices per 100% daily requirement might be three times the value indicated here.

**Prices, Quito, September 1972; Exchange Rate: 25 sucres = $1.00

Best Available Document

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target group individuals from different sections of the country. The number of individuals in the country suffering from malnutrition can be estimated by comparing the retail costs of the typical diets, the costs of diets providing adequate nutrients, and distribution of personal income. With additional calculation, an estimate can be made of those families whose incomes permit adequacy after a reasonable food habit change. This is presented on page 16 of Appendix I.

Costs of purchasing the typical diets were calculated using current retail prices in Quito. A cost per average calorie and other nutrients in the current diet was calculated and multiplied by the number of nutrients estimated to be consumed by the target group family. Assuming then that 80 percent of family income is spent on food, the necessary family income to meet this level of adequacy could be estimated.

Family size and composition is an important data point in this process. Distribution of age, sex, and biological status for the population was developed from the most recent census data for Ecuador. Family size was based on previous research relating family size to income. The sum of the reference families is representative of low-income families in Ecuador, although not necessarily for each region since census data on size and composition was not disaggregated to a regional and urban/rural level. The following table shows the reference families used. It is important to note that each family has several members of employable age, making the total family income requirements credible.

Based on these data, it was estimated that a family of seven, living in Quito, consuming the typical diet, required a monthly income of about $31.00 to achieve about 80 percent of recommended intake. Using the same base 100 percent adequacy can be achieved with a monthly income of about $40.00 or $70.00 per family member per year. These income figures appear to be consistent with income distribution estimates from national and international sources.

REFERENCE FAMILIES IN ECUADOR

	age	sex	pregnant or lactating
urban Sierra	2 yrs.*	female	-
	4 yrs.*	male	-
	6 yrs.	female	-
	11 yrs.	female	-
	16-20 yrs.	male	-
	20-35 yrs.*	female	pregnant
	35-55 yrs.	male	-
rural Sierra	9 mo.*	male	-
	4 yrs.*	female	-
	14 yrs.	male	-
	15 yrs.	female	neither
	16-20 yrs.	female	neither
	20-35 yrs.	male	-
	more than 55	female	neither
urban Coast	6 mo.*	male	-
	5 yrs.*	female	-
	8 yrs.	male	-
	10 yrs.	male	-
	20-35 yrs.*	female	lactating
	20-35 yrs.	male	-
	35-55 yrs.	female	neither
rural Coast	3 yrs.*	male	-
	8 yrs.	female	-
	12 yrs.	female	neither
	15 yrs.	male	-
	20-35 yrs.	male	-
	35-55 yrs.*	female	pregnant
	35-55 yrs.	male	-

*designated as target group members

Sources:

1. "Recomendaciones Nutricionales para la Problacion 1971," Instituto Nacional de Nutricion.
2. "Proyecciones Cuadrienales de las actividades de colaboracion de la Organizacion con el Gobierno del Ecuador," Ministerio de Salud Publica, 1971.
3. "Necesidades de Proteinas," FAO/OMS, Geneva, 1966, p. 24. Not including a 20% allowance for individual differences
4. The effect of the differing temperatures of the Coast and Sierra on Calorie requirements has not been taken into consideration in the INNE recommendations.

Appendix II

INTERVENTION IN DONATED FOODS PROGRAM

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SUMMARY

Feeding programs using health centers as distribution points are examined to determine to what extent increased expenditures would be justified to increase the impact of the programs on the target group. Most feeding programs have some inefficiencies that increase the cost of delivering nutrients to the target group. Many of these inefficiencies relate to the leakage of the food to nontarget group individuals. More effective use of food resources may be achieved by increasing nutrition education and program control procedures.

A. GENERAL

Feeding programs such as those sponsored by CARE, Catholic Relief Services, and The World Food Program can have a direct impact on nutritional status since food can be distributed principally to malnourished individuals in response to evidence of specific nutritional deficiencies. These programs are a part of the larger nutrition system and can be conceived as an effort to allocate nutrients through a special, non-commercial distribution sub-system.

Interventions to affect feeding programs can occur at several levels. A schematic presentation of the feeding program and a brief discussion of program assumptions will indicate some points of intervention. In a later section one intervention will be analyzed. The figure below shows some of the major aspects of a feeding program. Interventions could be made at any of the steps. Throughout the system selection depends upon the opportunities for causing change in the nutritional outcome.

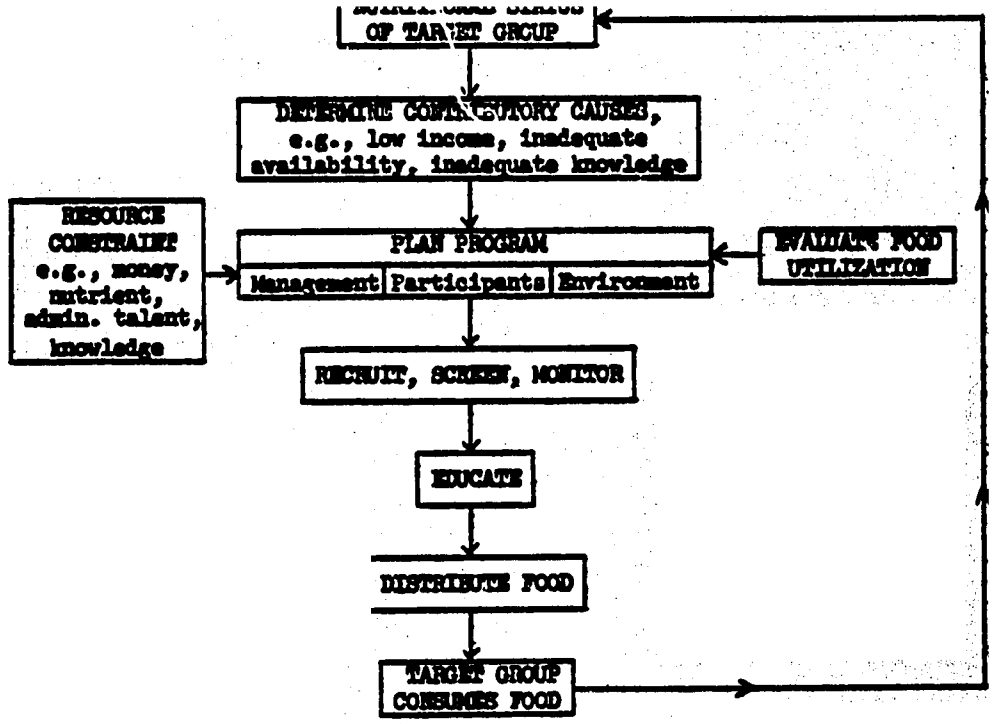


Figure 1 — DONATED FOOD SUB-SYSTEM

E. ASSUMPTIONS

The series of assumptions on which feeding programs are based indicates requirements for program design and monitoring for any feeding intervention to be successful. Included among these are the following.

- That only malnourished target group individuals will consume donated foods, e.g., other family members will not consume the foods and adequately nourished families will not be recipients.
- Donated foods will supplement the current diet, not substitute.
- Donated milk and other weaning foods will not encourage shorter breast feeding.
- Program operation costs will be lowered by linking food donation to existing institutions such as health centers, hospitals, churches, schools or voluntary community centers.
- Donated foods do not inhibit domestic production of similar foods.

these inefficiencies adversely affect the nutrition impact of the program.

In Ecuador it is believed that nearly 60% of all women and young children receiving food are not malnourished. A proposal now under consideration by the donating agencies, USAID and the Government of Ecuador would train physicians, nurses, auxiliary nurses and volunteers in techniques of screening. Additional funds would be provided for promotion of the program among the families most likely to have malnourished young children. However, the nutritional benefits of these additional expenditures have not yet been calculated.

The anticipated costs of this program are high in comparison to current costs of operating a health center which distributes food. Table 1 is the budget of a model health center before program modification is made. Only 20% of regular health center operating costs, e.g., physician salaries, are attributed to the food distribution budget.

FOR PRE-SCHOOL CHILDREN AND PREGNANT & NURSING WOMEN
OF MODEL HEALTH CENTER

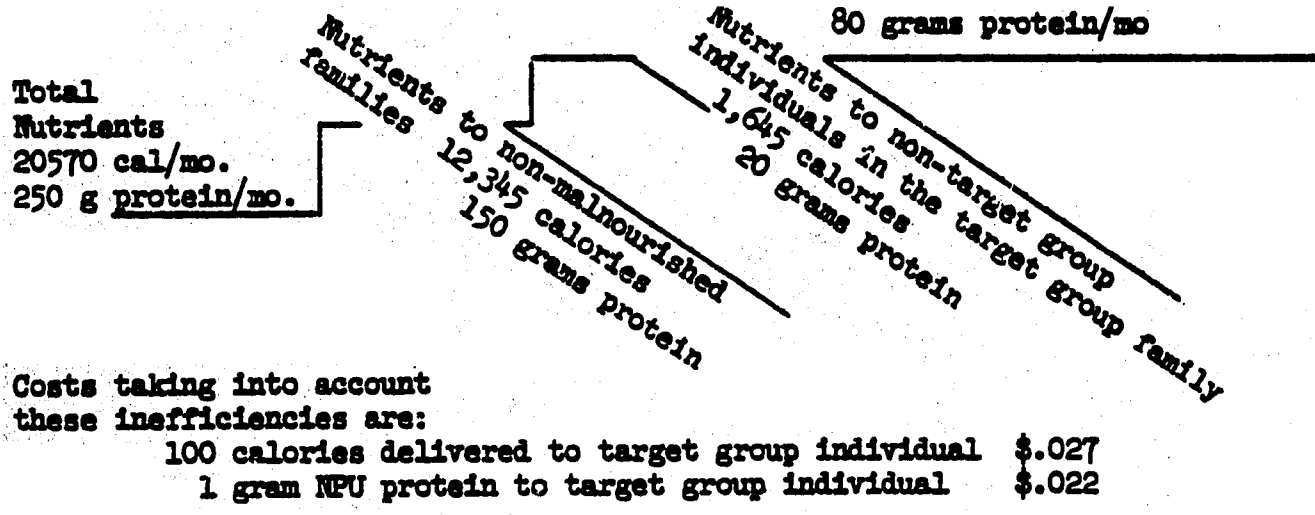
Annual Cost of Building ($7,000 x 20%) (20 years)	$ 70.00
Annual Maintenance ($500.00 x 20%)	100.00
Professional Staff	
(1 physician @ $6,000 x 20%)	1,200.00
(1 nurse @ $2,000 x 20%)	400.00
Equipment Costs (Milk mixer @ $100.00/10 years)	10.00
Food Transport[1] (.10/100 lbs.)	2,640.00
Storage	
Supervision: CARE, CARITAS ($15.00/center)	15.00
Bread Baking[2] ($4.00/100 lbs.)	164.00
Cost of food	
Ministry Overhead ($500.00/center x 20%)	100.00
TOTAL ANNUAL COST	$4,699.00

[1] Based on 11 lbs. food/month/participant
[2] Based on .9 lbs. flour/month/participant
Participant assumptions: 200 participants, 160 pre-schoolers, 40 pregnant and lactating women, 40% of participants are malnourished, 80% of donated calories and proteins reaches target group individuals.
Ration assumption: 20 rations per month/individual yields 20.5% calories and 250 gr. NPU protein every month.

If the model MCH Center, Table 1, were 100% efficient, costs would be as follows:

cost/100 calories delivered to target group individual	$.0087
cost/gr NPU protein delivered to target group individual	$.007

However, as indicated in the "participant assumptions" numerous inefficiencies exist, e.g., all participants are not malnourished and all nutrients do not reach the target group individuals within the family. These inefficiencies are illustrated in this flow chart.



Costs taking into account these inefficiencies are:

100 calories delivered to target group individual	$.027
1 gram NPU protein to target group individual	$.022

Figure 2 — NUTRIENT FLOW IN UNMODIFIED MODEL MCH CENTER

D. ANALYSIS OF PROPOSED INTERVENTION

The proposed intervention modifies the system in two places to lower cost per unit of nutrient delivered to the target group individual. First, recruitment and screening of participants is improved through increased use of trained auxiliary nurses, in-service orientation of physicians, and monitoring equipment (height/weight measures and recording charts). Secondly, intra-family distribution is improved by nutrition education conducted by the auxiliary nurses. However, these activities raise costs of operating the model center. The new budget is as follows:

Table 2

ANNUAL BUDGET FOR FOOD DISTRIBUTION AND OCCASIONAL MEDICAL TREATMENT FOR PRE-SCHOOL CHILDREN, PREGNANT AND NURSING WOMEN IN MODIFIED PROGRAM

Cost of building ($7,000 x 20%) (20 years)	$ 70.00
Maintenance ($500 x 20%)	100.00
Professional staff	
(1 physician @ $6,000 x 30%)	1,800.00
(1 nurse @ $2,000 x 30%)	600.00
(2 aux. nurses @ $1,000 x 80%)	1,600.00
Training (for all staff)	200.00
Equipment (milk mixer @ $100/10 years)	10.00
(height/weight measures $25.00/5years)	5.00
Food transport[1] ($.10/100 lbs.)	2,640.00
Storage	-0-
Supervision: CARE, CARITAS ($15.00/center	15.00
Bread baking[2] ($4.00/100 lbs.)	164.00
Cost of food	-0-
Ministry overhead ($500 x 20%)	100.00
TOTAL ANNUAL COST	$7,304.00

[1] 11 lbs. food/month/participant
[2] .9 lbs flour/month/participant

Participant assumptions: 200 participants
Ration assumptions: 20 rations/month yields 20,570 calories
250 gr NPU protein

The monthly costs/participant are about $2.00 for Model 1 and $3.00 for Model 2. Without actual performance data it is necessary to estimate returns for the new expenditures, with varying degrees of efficiency, to determine incremental benefits necessary to justify the additional costs. These returns can be displayed as follows:

% Efficiency, i.e., percentage of recipients who are malnourished	Monthly cal. & proteins delivered to target grp. individual	Monthly costs of operation/participant 100 calories 1 gram NPU protein							
		$1.70	$1.80	$2.25	$2.50	$2.75	$3.00	$3.10	$3.20
100%	20570 cal. 250 g pro.	.0082 .006	.0087 .007	.010 .009	.012 .010	.013 .011	.014 .012	.015 .0124	
80%	16456 cal. 200 g pro.	.0103 .0085	.0109 .009	.013 .011	.0151 .0125	.0167 .0137	.0182 .015	.0188 .0155	
70%	14399 cal. 175 g pro.	.0118 .0097	.0125 .010	.0156 .0128	.017 .014	.019 .0157	.0208 .017	.0215 .0177	
60%	12342 cal. 150 g pro.	.0137 .011	.0145 .012	.018 .015	.020 .0166	.022 .018	.024 .020	.0251 .206	
50%	10285 cal. 125 g pro.	.016 .013	.017 .0144	.021 .018	.024 .020	.026 .022	.029 .024	.030 .0248	
40%	8228 cal. 100 g pro.	.020 .017	.021 .018	.027 .022	.0303 .025	.033 .027	.036 .03	.037 .031	
30%	6171 cal. 83 g pro.	.027 .020	.029 .021	.036 .027	.040 .030	.044 .033	.048 .036	.050 .037	

The matrix shows a mix of total costs (fixed costs plus variable costs) per unit of nutrient emerging from a gradation of alternative costs and degrees of efficiency in recovering "lost" nutrients. Even though these data are based on estimates, they are useful in comparing alternative resource allocations within a program and for comparing the optimum mix with interventions in other parts of the nutrition system. For example, by identifying costs for operating a program under specific circumstances and serving a specific segment of the target group, comparison can be made with alternative programs serving the same target group goal. The heavily scored boxes in the matrix represent approximate costs for delivering 100 calories and one gram NPU protein to the malnourished target group individuals with the operating costs of Model 1 health center. Project improvements must lower these costs.

Currently we estimate that these health centers are operating at approximately 35 percent efficiency, i.e., about 65 percent of all donated foods are not consumed by target group individuals, although a large portion of the food may be consumed by the families with members in the target group. In order to justify the increased costs of the modified health center efficiency would have to increase to about 70 percent.

Since maternal and child feeding programs may take place under a wide spectrum of conditions, additional models should be developed. These might include programs in the community center or parish manned by volunteers or in a hospital or provincial health center, staffed entirely by professionals. Each of these models can be projected to national or provincial scales, using appropriate factors.

Appendix III

INTERVENTION IN PULSES

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PULSES

SUMMARY

Pulses are generally believed to be low-cost sources of good quality protein, especially if eaten in combination with cereals. The analysis reviews opportunities for increasing bean consumption by 10 percent in Ecuador among low-income families through a credit program that will stimulate production.

A. GENERAL

Pulses are a good source of high quality protein at relatively low costs in Ecuador, if eaten in combination with cereal staples. They are a main protein source for low income rural and urban families, although in recent years rising prices and slow production increases have retarded consumption. A review of what happens to pulses in the food system indicates that interventions to increase consumption by low income families must be made first at the production level. Most pulses are highly acceptable to target group families, and are in lower demand by middle and upper income groups. This fact suggests that most of the increased production of pulses will be consumed by target group families.

Objective of the intervention: increase availability for human consumption of beans by 10 percent.

B. DESCRIPTION AND ANALYSIS OF CURRENT POSITION OF PULSES IN THE ECUADORIAN NUTRION SYSTEM

1. Consumption

Pulses in general are acceptable among all classes and geographic regions in Ecuador, and there are few taboos associated with their consumption except for young infants. However, pulse consumption is not as high in Ecuador as in Latin America as a whole. Calories derived from pulses in Ecuador are compared with similar figures for all of Latin America in Table 1.

Table 1

PER CAPITA DAILY CALORIE INTAKE FROM PULSES

	1956-58		1959-61		1970	
	Number Calories	% of Total Calories	Number Calories	% of Total Calories	Number Calories	% of Total Calories
Ecuador	94	4.6	102	4.9	109	4.9
Latin America	151	6.0	160	6.2	169	6.3

Source: USDA, Agricultural Production and Trade of Ecuador, 1968

These data indicate that Ecuadorians on the average have not reached physiological limitations of pulse consumption. Combined with other data, these data suggest that if more pulses were available at reasonable prices, consumption could be increased among target group individuals in cities and rural areas.

Pulses are most widely consumed among rural families in the Sierra. It has been estimated that 20-25% of the total production is consumed by producing farm families, located primarily in the Sierra. A 1959 nutrition survey indicates that pulse consumption is as frequent on the Coast as in the Sierra, but amount consumed is two-three times greater in the Sierra.

From interviews with low income consumers and public health officials in constant contact with low income families, the impression is that more pulses would be eaten if prices were lower and the supply were more adequate.

2. Production

Nearly all pulses are produced in the Sierra in small plots cultivated by low income farmers. Only 1% of all land under cultivation is devoted to pulses and the harvest represents 4.5% of the value of all agricultural production. This product has a low priority in agricultural research and investment through credit and irrigation in Ecuador development plans.

Table 2

PRODUCTION OF PULSES IN ECUADOR

	1966		1967		1968	
	Hectares	MT	Hectares	MT	Hectares	MT
Frijol	81.7	36.9	79.4	38.3	86.3	35.9
Arveja*	NA	NA	NA	NA	34.2	19.4
Haba*	NA	NA	NA	NA	34.0	20.3

* Averages 1966-1968
Source: Junta Nacional de Planificacion.
Estado de la Agricultura en el Ecuador 1971.

Since pulses are produced mostly by small farmers and have not been the subject of government interest, production techniques remain rudimentary. They are not rotated with other crops and little fertilizer, pesticides or irrigation are employed even though these steps would raise yields. Yields for selected pulses are presented in Table 3 .

Table 3

PULSE YIELDS PER HECTARE

(in kilograms)

Product	1955	1966	1968	L.A. Average 1968	Peru
Beans, Dry	580	450	481	660	770
Broad Beans	740	590	591	530	890
Lentils	105	320	372	470	1,030
Peas	-	-	635	600	730
Lupine	-	-	910	1,200	1,090
Peanuts	-	664	-	1,140	1,670
Soybeans	-	1,000	-	990	1,380

Source: Junta de Planificacion

Pulses are low-cost of production protein and calorie sources Under improved methods, costs of production are the following:

Table 4

COSTS OF PRODUCTION

	Costs/100 pounds*[1]	Cost/100 Calories	Cost/1 gram NPU Protein
Average	$3.30	-	-
Common beans	3.68	0.0023	0.0011
Lentils	4.30	0.0028	0.00145
Soybeans	3.29	0.002	0.0004
Peas	2.85	0.0018	0.0009
Broad beans	1.61	0.0010	0.00035
Lupines	0.88	0.0004	0.00007

* Average weight

[1] Source: Ministerio de Produccion, Fomento Agricola, 1972. Costs include expenses for all farm labor.

3. Marketing and Processing

Only about 50% of the total production reaches non-farm consumers. Waste of pulses through spoilage, rodents and pests averages about 15% of total production following harvest. The remainder of the crop is consumed on the farm or used for seed.

Pulses, with the exception of soybeans which are used as oil seeds, are not extensively processed in Ecuador. Shelling, sorting and cleaning are done on the farm, in the market or by the consumer.

Marketing is done through middlemen who buy pre-harvest contracts on crops or after harvest and sell to other middlemen, transporters or directly to retailers. About 50-60% of the retail price of pulses is accounted for by marketing margins and transport costs.* This percentage is not excessive when compared with marketing costs of other products in Ecuador.

Prices fluctuate during the year reflecting the excess of supplies following harvest and shortages during the preceding months. Storage is inadequate, resulting in high waste and uneven supplies during the year. However, prices do not differ significantly among regions, including the Coast which is not a producing area.

*ITALCONSULT, Comercializacion de Productos Agropecuarios, 1963.

If costs can be kept low, storage may be another appropriate intervention since it would serve to stabilize prices of the dried product and to preserve supply.

4. Intervention Analysis

a. Increased production - Production can be increased by small farmers by applications of fertilizer and pesticides, rotating crops, improved seeds, more land, or irrigation. Since this intervention seeks returns in the short-term, seed improvement, a long-term effort, will not be considered as part of the costs. However, it should be undertaken concurrently so that the farmers identified in this intervention as being receptive to change will be able to participate actively in use of new varieties. Irrigation of cropland presents special problems which are discussed in Appendix VII.

After a cursory review of alternative means of increasing production, the provision of supervised credit for Sierra farmers with 5 to 15 hectares, a large portion of which are devoted to pulses appears to offer promising returns. This credit can be used for a variety of needs that will vary according to the requirements of the farmers.

b. Tentative goal - Production of beans (frijol) has increased about 3.3% annually over the past ten years. The goal is to increase beans available for human consumption by an additional 10% after 2 years of program operation.

The objective of the analysis: to estimate the cost per unit of nutrient of this additional production and the total resources required to achieve it.

Yields from traditional methods of bean (frijol) production are about 17 quintales or 782 kg. per hectare. It is estimated by Ministry of Production specialists that through improved techniques yields can be increased 50% to 1170 kg./hectare. Costs of these techniques and of the traditional methods are compared below.

Table 5

ESTIMATED PRODUCTION COSTS OF BEAN
CULTIVATION PER HECTARE IN CARCHI AND IMBABURA

	Traditional	New
Preparation of land	s/ 300	s/ 360
Fertilizer	-	540
Seed	500	600
Sowing (labor & plow)	75	110
Spreading fertilizer (labor)	-	60
Weeding (labor)	150	150
Cultivation (labor)	75	75
Fertilizer & labor	-	280
Insecticides & Labor	-	240
Harvest Labor	225	225
Bagging	30	30
	s/ 1,355	s/ 2,670

The difference in per hectare cost between the two methods is about sucres 1315 or ($55.00). In other words, specialists claim that an additional $55.00 employed wisely will yield an additional 850 pounds of beans, valued at the farm gate at about $85.00.* However, conclusions at this point are premature since true costs have not been considered, nor have inefficiencies in the credit and cultivation program been taken into account.

If the returns to the farmer and his motivation to plant did not have to be taken into account, and the government received loan funds on concessionary terms, the return to the nutrition system could be calculated as follows, under varying degrees of farmer efficiency:

*Farm gate value has been estimated by taking an average of retail prices, and with documented marketing margins, deriving the average price paid to farmers. Generally, farm gate prices are estimated at 50% of retail prices.

Table 6

RETURN ON $55.00/HECTARE LOAN FOR BEAN PRODUCTION

	A	B	C	D	E	F
Value of Increased Production	$85	$75	$65	$60	$30	$20
Cost of Credit[a]	20	20	20	20	20	20
Return on Credit	$65	$55	$45	$40	$10	0

[a]Credit costs include delinquency, administration, interest charges, and opportunity costs.

However, the farmer has different costs of production. Since production loans tend to be short-term, sometimes just for the growing season, the farmer must include in his accounts the total repayment of the loan. His returns look like the following:

Table 7

RETURN TO FARMER OF $55/HECTARE LOAN FOR BEAN PRODUCTION

	A	B	C	D	E	F
Value of Increased Production	$85	$75	$65	$60	$30	$20
Principal & Interest on Loan	60	60	60	60	60	60
Return	$25	$15	$ 5	0	($30)	($40)

Under these assumptions the farmers will not invest unless they can realize level C efficiency, producing at least 650 pounds addition beans per hectare. However, it is most likely that even higher returns will have to be demonstrated before small farmers would risk borrowing funds.

c. Nutrient Value and Cost of Additional Nutrient Production

In order to compare a bean cultivation credit program with other interventions, the costs of producing marginal nutrients must be

calculated. In addition, the costs to the government of supplying credit to the bean farmers to achieve the desired 10% increase in bean availability must be shown.

Table 8

COST PER ADDITIONAL UNIT OF NUTRIENT:
ONE HECTARE OF LAND UNDER BEAN CULTIVATION

Levels of Efficiency	A	B	C	D
Additional production (lbs)	850	750	650	600
(kilograms)	385	340	295	270
Nutrient value*				
Calories	1,300,000	1,150,000	1,000,000	915,000
Proteins (gram)	36,000	31,000	27,700	25,300
Costs of Production for government	$20.00	$20.00	$20.00	$20.00
Costs/unit of nutrient				
calories (100 calories)	.0015	.0017	.002	.0021
protein (one gram NPU)	.0005	.0006	.0007	.0008

* Nutrient value: 339 calories and 9.4 NPU grams per 100 grams dry weight.

In order to increase availability of beans by 10%, the government will have to loan bean farmers $55.00 per hectare on several thousand hectares of land currently in production. The table below shows annual costs to the government, credit and land required, under several assumptions about additional yields per hectare.

Table 9

ANNUAL RESOURCE REQUIREMENTS TO INCREASE
BEAN AVAILABILITY BY 10%

Levels of Efficiency	A	B	C	D
Additional Production/ hectare (kilograms)	385	340	295	270
Land required (hectares)	2,313	2,400	2,500	2,570
Costs of Credit	$ 46,260	$ 48,000	$ 50,000	$ 51,400
Credit required	$127,000	$132,000	$137,500	$141,000

d Nutritional Result of Increased Bean Production

Because beans are consumed in greater quantities by lower-income groups, and by many target group families, than by more affluent sectors, a proportionally larger amount of the increased beans available would be consumed by the target groups. Based on data from several sources, it is estimated that the lower 50% of the population consumes 70% of all pulses available for human consumption.*

An additional 2,240 MT will be produced under the proposed credit program. According to assumptions about consumption patterns, target group consumption of beans will increase from approximately 15 to 16.5 grams daily. This will yield an additional 5 calories and .15 grams NPU protein. This is a modest increment in protein and calories intake.

Certainly a larger credit program would increase bean availability. However, the successful nutrition strategy will not attempt to solve all of the deficiencies with one program or nutrient source. At some point, the returns from this type investment begin to diminish and costs per unit of nutrient delivered to the target group become unacceptably high compared to other alternatives. A bean or pulse program will serve best those who are currently not consuming their desired intake of these foods, and it will yield the greatest returns from those farmers who are receptive to the changes in farming techniques implicit in this intervention.

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*Junta Nacional de Planificacion, Instituto Nacional de Estadisticas, "Gastos Promedios Anuales por Familia de las Familias Clasificadas por Niveles Economicos, Quito 1965 and Cuenca 1968; ICNND Survey 1959; J. Perisse, Sizaret and Francois, "The Effect of Income on the Structure of the Diet," FAO Nutrition Newsletter, Vol 7, No. 3, July-Sept. 1969.

Appendix IV

INTERVENTION IN MILK AND MILK PRODUCTS

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MILK AND MILK PRODUCTS

A. DESCRIPTION OF PRODUCTION, DISTRIBUTION, PROCESSING, AND CONSUMPTION

SUMMARY

Ecuador has inadequate supplies of milk to meet demand and to fill nutritional needs; a loan now in effect promises to fill some of this need; however, continuing high milk prices and inadequate supplies will still prohibit low-income urban families from increasing milk consumption. The interventions proposed would encourage milk consumption by low-income families in Quito and Guayaquil by subsidizing the retail price of a portion of the fluid milk supply. Another intervention would tax dairy farmers, the proceeds of which would be used for a milk consumption campaign. The costs for delivering an additional gram of protein and 100 calories by these methods are calculated and compared.

The analysis begins with a description of the milk system, bringing together and reconciling conflicting data from several sources. From the description it is apparent that even with the increased supplies from the loan-assisted dairy farmers, low-income families will not increase consumption. The analysis also makes clear that the most effective point of intervention to achieve increased consumption by Quito and Guayaquil target group families is in the consumption subsystem.

1. Production

a. Location of Milk Production

The valleys of the Sierra region are the principal milk producing areas of the country. Pichincha, the province of the capital city, Loja, Azuay, Cañar, and Cotopaxi produce nearly 61% of the national supply. On the Coast only one province, Manabí, produces significant quantities of milk. Guayas, the province of Guayaquil, the largest liquid milk market produces less than 10% of its needs. Table 1 shows daily milk production by province for 1971.

TABLE 1

Daily Milk Production by Province: Ecuador
1971
(liters)

Sierra		
Carchi	43,909	
Imbabur_	53,812	
Pichincha	301,934	
Canar	46,962	
Loja	140,148	
Bolivar	47,090	
Cotopaxi	102,636	
Tunguarahua	60,739	
Chimborazo	72,888	
Azuay	111,276	
Total Sierra	981,341	
Coast		
El Oro	15,870	
Esmeraldas	17,105	
Guayas	149,003	
Los Rios	38,678	
Manabi	155,428	
Total Coast	376,084	
TOTAL ECUADOR		1,357,425

Source: Comision de Fomento y Comericio y Banca. 1972

b. History of Milk Production

Despite inaccuracies in national statistics on milk production, a trend in production can be established. Milk production in the Sierra was stabilized until recently, but with the assistance of a loan and INIAP, production is being increased. On the Coast, production appears to be diminishing.* Table 2 shows general trends in milk production. Population projections for the same period suggest a declining amount of milk available per capita.

c. Farm Management

The quality of the herds and their management varies widely throughout the country. Farms with larger herds and easier access to credit tend to improve pastures, practice controlled breeding, and have better sanitation. On the average of every 100 cows, only 68 reproduce, and 21 percent of the new-born calves die before weaning because of poor nutrition and sanitation. Generally the heifers do not begin breeding until 3 to 6 years. The same slow rate of maturation can be seen in other livestock. Most experts attribute this to poor nutrition.** The World Bank estimated average daily yield per cow to be about 5 liters while the FAO expert estimated the Sierra average somewhat lower. Yields for coastal herds are believed to be about one-third less than in the Sierra. Herds on efficient farms in the Sierra yield as much as 15 to 20 liters per animal.

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*Dr. Francisco Mora Solorzano, "Situacion de la Produccion Lechera," presented in Semenario de Nutricion del Nino y la Familia, Guayaquil, 1971

**Ecuador, Comision de Preparacion del Proyecto, "Tercer Proyecto de Desarrollo de la Ganaderia: Ecuador," no date, p. 6.

Table 2

PROJECTED DAILY MILK PRODUCTION
1966 - 1973
(Liters)

	Total Sierra	Total Coast	Total Ecuador
1966	817,873	320,621	1,138,494
1967	847,641	311,015	1,178,656
1968	879,791	341,748	1,220,539
1969	911,394	352,829	1,264,223
1970	945,547	364,271	1,309,818
1971	981,341	376,084	1,357,425
1972	1,018,888	388,277	1,407,165
1973	1,058,278	400,871	1,459,149

Source: Comision de Fomento y Comericio y Banca, 1972.

The pastures from which cattle get much of their nourishment are poorly managed. On the average each hectare currently supports between 0.5 and 1.5 animals. With good management and fertilization each hectare should have a capacity of two animals.* Below 3000 meters altitude Kikuyu (Pennisetum clandestinum) has invaded much of the pasture land. This grass is considered poor for hay or grazing and smothers better grasses. Above 3000 meters maintenance of pasture land is much cheaper.

Also contributing to low production and reproduction rates are parasitic and infectious diseases which affect the herds on the coast and in the Sierra. The World Bank study team found intestinal parasitic infestation rate at 90 percent in the Sierra, leading in some zones to a 50-percent mortality among calves. External parasites are common in the tropics reducing cattle resistance to other diseases.

*Ecuador, Comision de Praparacion del Proyecto, p. 6.

In the Sierra herd size is much smaller than on the coast (Table 3) but exploitation is more intensive. Although data are not sufficiently disaggregated to offer evidence, it is suspected that the large, industrial scale dairy farms of the Sierra skew production data to favor the Sierra, while the small farmers in both regions suffer many of the same problems limiting production.

Table 3

ANIMALS IN PRODUCTION

	Animals in Production	Percentage
Sierra	277,188	60.1
Coast	144,329	37.1
Oriente and Galapagos	15,743	44.1
Total	437,260	49.3

NUMBER OF ANIMALS PER FARM

	Animals Per Farm	Animals in Production per Farm
Sierra	3.4	2.9
Coast	9.5	4.9
Oriente and Galapagos	6.0	3.3
Total	4.8	3.4

Source: FAO, Federico Schaerer, "Bosquejo Analitico Sobre La Industria Lechera del Ecuador," March 1970.

2. Milk Processing and Distribution

a. General

Of all the foods commonly consumed in Ecuador and considered to be good sources of protein and calories, milk has generated the most intense disputes over the level of production, prices at all levels, and product quality. Production of milk and milk products is insufficient to meet the dietary standards set by National Institute of Nutrition of Ecuador (INNE). Additionally, it appears as though present production is insufficient to meet consumer demand at current prices.

Of total milk, 50% is sold immediately as liquid milk to pasteurizing plants, to small local cheese-butter producing plants, or to the public directly, without any processing. The other half is either consumed in liquid form on the farm (26%), processed on the farm for later sale (16%), or fed to calves (6%). The milk that is sold to the large pasteurizing plants represents 36% of all milk sold in liquid form. About 373,000 liters per day are delivered to 14 pasteurizing plants.*

Slightly more than one-half of all milk is processed in large, relatively modern pasteurizing plants. On the average, 75% of all crude milk delivered to the plants is for liquid consumption. The rest is used for milk products.

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*Federico Schaerer, "Bosquejo Analitico Sobre La Industria Lechera iel Ecuador" FAO Mision, March 25, 1970.

The most recent data on pasteurized milk products are the following:

Table 4

MILK PRODUCTION OF FOURTEEN PASTEURIZING PLANTS IN ECUADOR 1971 (Liters/Day)

Pasteurized milk	269,000
Sterilized milk	10,500
Cheese	38,100
Butter	26,500
Powdered milk (kg)	20,000
Other	9,000

Source: FAO, Federico Schaerer, 1972

Milk and milk products sold outside these plants constitute nearly 50% of all milk sold. Most of this is distributed as unpasteurized liquid milk. Some municipalities in milk-producing regions which lack pasteurizing plants have required farmers or milk intermediaries to sell a portion of their milk in the community rather than permitting it to be bid away to the larger cities which enjoy a processing plant. These laws, plus the advantage of non-payment of retail sales tax, encourage the withholding of milk from the large plants. In addition, an unknown quantity of smaller dairy farmers live in areas outside the plant milksheds. Illegal sale of liquid milk or cheese manufacture are the only alternatives for these farmers.

Of the 150,000 liters daily for Quito, 132,000 are pasteurized and the remainder enters as crude milk for direct consumption. Likewise, in Guayaquil 135,500 liters are pasteurized while 95,000 liters are consumed in crude form. The figures on the amount of pasteurized milk delivered to the two cities appear to be somewhat exaggerated since in the whole country only 269,000 liters of pasteurized milk are produced daily. It is likely that some of the secondary cities also share in the supply of pasteurized milk.

Table 5

SUPPLY ZONES FOR CRUDE MILK
FOR QUITO AND GUAYAQUIL
(Liters/day)

Quito		Guayaquil	
Province and Canton	Quantity	Province and Canton	Quantity
Pichincha	140,000	Carchi	3,500
Quito	60,000	Pichincha	36,000
Ruminahui	40,000	Cayambe	1,000
Mejia	40,000	Machachi	32,000
		Sto. Domingo	3,000
		Cotopaxi	100,000
Cotopaxi	13,000	Chimborazo	20,000
		Azuay	15,000
		Manabi	20,000
		Guayas	40,000
Total	153,000		234,000

Data as of December 1971.

Source: Data given by pasteurizers and estimators of the Department of Livestock Development, Milk Products Section, Ministry of Production, as cited in Dr. Alberto Proaño and Federico Shaerer, "Historia de la Industria Lechera en El Ecuador."

b. Milk and Milk Products Available per Capita

In Quito and Guayaquil all liquid milk and milk products provide an average of .270 liters/capita daily and in the other areas, marketed milk availability averages about .100 liters/capita daily. Milk producing rural areas undoubtedly have a somewhat higher consumption because of on-farm-consumption, but this figure cannot be estimated with any accuracy. Large dairy farmers market nearly all their milk and even the smallest farmers, realizing the high cash value of milk, market a high proportion of total production. All that seems certain is that Quito and Guayaquil have the greatest share of liquid milk and milk products and that some provinces which produce only small quantities have grossly inadequate supplies. The location and type of milk processing in Ecuador limit the feasibility of supplying small non-milk producing markets. Table 6 shows supplies for Quito/Guayaquil and other areas.

TABLE 6

Daily Flow of Milk and Milk Products

	Total Sold as Liquid Milk	Quito-Guayaquil	Amount Remaining
Carchi	53,800	3,500	50,300
Imbabura	29,508		29,508
Pichincha	357,352	176,000	181,352 (excl. Quito)
Cotopaxi	97,053	113,000	
Tunguarahua	19,070		19,070
Chimborazo	32,065	20,000	12,065
Bolivar	3,225		3,225
Cañar	104,987		104,987
Azuay	49,562	15,000	
Loja	75,417		75,417
Esmeraldas	6,645		6,645
Manabi	38,185	20,000	18,185
Los Rios	9,032		9,032
Guayas	19,945	40,000	(excl. Guayaq
El Oro	5,326		5,326
	881,277	387,500	515,712
Per Capita daily availability (liters)		.270	.109

NOTE: Disparities among data in table are caused by the use of several sources in compiling statistics. All figures are approximate.

c. Retail Distribution of Liquid Milk

Liquid milk is processed into three classes of milk: (1) popular-priced whole milk, sold in bottles, (2) whole milk packaged in paper cartons, and (3) vitamin-enriched whole milk. The latter two types are higher priced than the former and are retailed in fewer outlets. Because of their paper-carton packaging, it is believed that the milk is less susceptible to adulteration with water and vegetable oils.

The popular priced milk is of greater concern to this study than the others because it has the largest volume of production, the widest distribution and the highest consumption by low-income groups.

Milk is retailed through a variety of outlets: corner grocery stores, supermarkets, and central markets. Pasteurizers do not own their own retail stores. Except in the few modern supermarkets, milk is not well cared for before sale. It is frequently permitted to remain in the sun or exposed to unhygienic conditions, reducing shelf life and increasing the possibilities of contamination. The low margin permitted the retailer, less than 5%, is reported to be the cause of this neglect. However, few retailers have refrigerated cases for any products.

While retailers may receive milk in liter bottles, it is often sold in low-income neighborhoods and small towns in smaller quantities. Since milk is most frequently used in cooking or added to other foods in small amounts, rather than as a beverage, this method of purchase is most sensible for those who lack refrigeration in their homes. This purchasing practice encourages sale of milk in bulk to the retailer, and it is most likely to be unpasteurized. Thus in Guayaquil and Quito, there is unused pasteurizing capacity while large amounts of unpasteurized milk enter the retail market directly.

d. Wholesale Distribution of Milk

All pasteurizers except one contract with truckers to distribute milk to retail stores. According to one interview at a pasteurizing plant, truckers prefer to distribute to retailers in more affluent neighborhoods since demand is higher, they are more accessible and delivery costs are lower. Other distributors deny that this pattern exists. Nevertheless, low-income neighborhoods periodically report shortages of supply while the supermarkets of the upper and middle income areas have adequate stocks.

e. Prices

Prices for milk as with some other foods are established at two levels - national and municipal. At the national level, a minimum price is fixed which the processor must pay the farmer or intermediary. At the municipal level, the maximum retail price is established. In the case of milk, the National Milk Commission fixes the minimum prices and attempts to oversee the margins allotted to other parts of the price chain.

The most recent information on the price chain indicates the composition to be the following:

Table 7
MILK PRICE CHAIN
(sucres)

	Liter
Sale to Processor	s/ 1.80
Costs of processing	.30
Sale to Wholesaler	2.10
Wholesaler Margin	.10
Sale to Retailer	2.20
Retailer margins	.10
Sale to Consumer	s/ 2.30

Source: Proaño and Schaerer, "Historia de la Industria Lechera En El Ecuador," no date.

Since these figures were compiled, milk prices have risen at the consumer level. It is not clear who benefited by the increase.

Two important characteristics of retail milk prices should be noted. First, retail prices vary markedly among regions. In June 1971 the lowest priced milk sold for s/2.00 in Cuenca, s/2.45 in Quito, and s/3.03 in Guayaquil. The complete reasons for price differences are not clear. In part, the differences can be accounted for in transport costs from producing regions in the Sierra to the Coast. Also, there

Sierra with higher prices.

Another important characteristic of milk prices is their gradual but constant rise. Using 1965 as base year, the official price index for milk, milk products and eggs was 148 in May 1972 for Quito; prices have increased a somewhat lower rate in Guayaquil. In most recent years, official prices of pasteurized milk have been maintained below general cost of living increases.

f. Consumption

There are few taboos against milk or milk products in Ecuador, however milk is not a common beverage, except among the upper classes. In the lower income groups, the small quantities purchased are most frequently used in soups and puddings. High prices, inadequate supplies in low-income neighborhood stores, lack of refrigeration in the store and home and absence of the milk-drinking habit contribute to low consumption.

In the absence of data on quantities of milk purchased per capita according to income groups, it has been estimated that milk consumption in Quito and Guayaquil follows distribution of income. According to this approximation, 40% of the population with the lowest incomes consume about 14% of all milk while the remaining families consume 86% of the supply. On the average, a family of five in the low income group would consume 0.5 liter per day or about 90 grams per capita. On the other hand, the average family of five in the upper income groups would consume about 2 liters daily or 370 grams per capita daily.

B. ANALYSIS OF INTERVENTIONS

1. General

The possible interventions examined in this section have been prompted by a massive loan and Ecuadorian Government investment in milk production. Nutritional impacts have not been considered in the

design and implementation of the project since the project investments do not extend beyond the dairy farm, and small dairy farmers are excluded from participation. The proposed interventions attempt to increase consumption by target groups of the additional milk resulting from the investments.

2. Production Investment Description

The Central Bank of Ecuador and an international lending agency are collaborating in a 3-year investment of $7,300,000 to increase and improve milk production on 300 of the most promising large dairy farms in the Sierra. The project contemplates increases in yield per cow from a current level of 6 to 8 liters per day to 10 to 12 liters, with no additional pasture acreage required, by better breeding, pasture cultivation, and related activities. By the end of 5 years, the investment is expected to add 84.5 million liters annually to milk production.

All milk produced from this investment will be marketed as pasteurized liquid milk and other products to be consumed primarily in the largest markets--Quito and Guayaquil. For the purposes of this analysis it has been assumed that all of the production will be absorbed by these two cities.

3. Proposed Impact

In the absence of any consumption-related interventions, the additional 84.5 million additional liters of milk generated by the project in the fifth year will be consumed almost entirely by upper income groups or will be exported. In other words, the additional output will have little effect on the milk consumption or nutritional status of target group individuals.

This estimate, incorporating current population and income estimates, also assumes that the price of milk in relation to that of other nutrient sources will remain the same.

Lower income groups currently spend between 60-80% of their income on food, so that little is left for additional milk purchases. Though it is difficult to estimate the precise number, a group of target group families could be identified whose incomes and food habits will permit expanded milk consumption. However, under current conditions effective demand for additional milk among most poor urban families is low.

In order to increase consumption among target group families, interventions must be made in other parts of the nutrition system, linking them to the outputs of the production intervention.

4. Improving Impact on the Target Group

The milk example shows how a production intervention, unaccompanied by careful review of implications for the target group and attention to all elements in the nutrition system, can lead to dissipation of nutrients among those least in need of them. Improving nutritional impact on the target group requires more extensive delineation of family expenditure, consumption and internal distribution patterns than was necessary in estimating gross deficiencies and impact. Increasing target group consumption requires appraisal of (1) absolute and relative price elasticity of demand, (2) income elasticity of demand (3) possibilities for increasing demand by education, (4) possibilities for modifying intra-family consumption favorably, and (5) consumption from increasing availability of milk. Accuracy of these appraisals depends on the quantity and quality of data about consumer patterns. Though available Ecuadorian data are sparse, it is possible to assemble information useful in estimating demand for milk among target group families.

a. Price Subsidies

Milk experts in the Ministry of Production estimate that consumption of milk would increase substantially among target group families if the price of liquid milk were reduced relative to other foods. The

cost implications of a price reduction intervention have not been explored in Ecuador. An order to compare its nutrition impact with other interventions to affect urban target groups, the assumptions on which calculations are based must be made clear.

(1) Consumption

Low income families consume about 90 grams of milk per capita daily. At current prices of 2.66 sucres in Quito and 3.80 sucres in Guayaquil per liter, low income families of five spend daily about 1.33 and 1.90 sucres in the two cities for milk.

For purposes of this assumption, it is assumed that if prices were reduced by 10%, consumption of milk would increase by 10%. This assumption is based on consumer behavior of purchasing milk by the quantity of money rather than quantity of food. Based on this assumption, the low-income group will increase consumption from 90 grams daily to nearly 100 grams daily, approximately one half of the recommended amount.

(2) Retailing

Many retailers sell pasteurized milk in portions smaller than commercial bottles. It is assumed that retailers will actually dispense milk at the subsidized price.

(3) Marketing Margins

The subsidy will be made at the processor level, either by paying part of the costs of processing or by paying part of the price to the farmer. It is assumed that margins will remain the same after the subsidy as before, so that a 10% reduction in wholesale price will yield a 10% retail price reduction. By subsidizing at the processor, the government will save program costs.

(4) Administration of Subsidy

Administrative costs will be zero, assuming that the same methods of price control currently in effect can be employed in this milk program.

(5) Leakage

Of all the milk pasteurized and supplied to Quito and Guayaquil, 15 percent will be subsidized and given a distinctive package. Of this amout, all but 5 percent will be consumed by the target group. This assumes a very efficient delivery system which may be unrealistic for Ecuador. The cost of subsidizing 15 percent of the supply is $117,165.

Bringing together these figures and assumptions yields the following cost for the additional consumption by the target group of 100 calories and 1 gram of protein.

Table 8

INCREASED MILK CONSUMPTION AND COST PER UNIT OF NUTRIENT AFTER 10% PRICE SUBSIDY

	15% Total Pasteurized Milk Annually Quito & Guayaquil (liters)	Value of This Milk at Processors $.08	Cost of Subsidy	Increased Milk Consumed By Target Group (Liters/ Year)	Cost per Additional Liter	Cost per Unit of Nutrient	
						100 Calories	One Gram Protein
1972	14,645,625	$1,171,650	$117,165	1,366,925	$.08	$.012	$.003

(6) Limitations of the intervention

A 10 percent increase in milk consumption will increase daily intake approximately 8 calories and 0.2 grams of NPU protein. Attempting to fill the protein gap through milk price subsidies will probably become increasingly expensive after initial small gains because of the willingness to consume additional milk, in spite of lower prices, will gradually diminish. Supply problems may also be encountered.

b. Income

Although the income elasticity of demand for milk may be high, resulting opportunities for favorable intervention are few, because of the difficulties of increasing or redistributing income.

increasing the consumption of milk by advertising and education, to improve nutrition, assumes that additional purchases will be made at the expense of non-food or low-nutrient items. Campaigns encouraging supplemental infant feeding practices may seek only to modify intra-family distribution without any necessary increment in total family milk consumption. The high percentage of family income spent on food suggests that any further milk purchases are likely to be in lieu of other food purchases. However, prospects for a milk consumption campaign that will improve nutrition deserve investigation since it is believed by many in Ecuador that low-income families do not recognize the nutritional value of milk.

It has been suggested in Ecuador that a portion of the value of crude milk sales be set aside for a milk consumption campaign. Using a budget of $37,000 (about s/.01/liter sold) a campaign could be conducted through physicians, community centers, media and other means, directed at low-income neighborhoods in Quito and Guayaquil. Assuming for illustrative purposes that the additional milk purchases do not displace other foods and that consumption among target group families increase by 2%, the cost/additional nutrients can be calculated as follows:

Table 9

PROMOTIONAL CAMPAIGN, INCREASED MILK CONSUMPTION AND COSTS PER ADDITIONAL NUTRIENT

	Cost of Promotion	Increase In Consumption	Cost/Additional Liter	Cost/Additional Nutrient	
		by target group families 2%		100 Calories	One gram Protein
1972	$37,000	371,688 liters	$.10	$.015	$.004

The costs of this intervention would not be incurred every year since the effect of consumer behavior change would extend beyond the project life-time. Assuming that consumption would continue at the estimated higher levels for three years, costs per additional liter would drop by 66%.

Appendix V

FORTIFICATION OF WHEAT

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PROTEIN FORTIFICATION OF WHEAT

SUMMARY

Fortification of wheat flour with Lysine may provide additional high quality protein to urban consumers in Ecuador. The study begins with a discussion of necessary conditions for making lysine fortification an effective method of increasing high quality protein intake among low-income families. After analysis of these conditions in the context of Ecuador, it is concluded that until wheat product consumption increases among low-income families, fortification of this cereal is not a preferred alternative. Nevertheless, the costs of supplying an additional gram of protein are presented as an illustration of the methodology. Three hypothetical programs are considered: one in which the government assumes all costs, another in which fortification costs are passed on to the consumer, and a third program which involves the fortification of wheat flour used in the donated food program.

A. GENERAL

For several years fortification of the protein contained in cereals has been technically feasible. Costs for some of the fortifying agents such as soya, non-fat dried milk, and synthetic amino acids have now been reduced to levels acceptable for government subsidy of the fortifying agent or to passing the increased costs on to the consumer. Fortification with the amino acid lysine, a limiting component in the protein pattern of wheat, corn, rice, and other cereals has met with the greatest success, in large part due to the lower cost of lysine production compared with other amino acids and to the lack of any changes in taste, smell, and appearance of the fortified product or modification of the baking process. Experiments are now underway in Japan and India to test the acceptability and nutritional effect of lysine fortification. Results reported to date indicate that there has been little acceptability problem, either by the consumers or cereal product manufacturers. Nutritional impact of these field experiments has not yet been determined, but laboratory animal and human infant feeding tests have demonstrated the efficacy of lysine fortification of cereals.

other fortification programs, lysine fortification of cereals may be a practical and economically feasible method of increasing good quality protein consumption if the following conditions are present:

1. Target group individuals have an adequate calorie intake.
2. Cereals are a staple in the target group diet.
3. The cereals are not normally eaten in combination with foods which have an abundance of lysine such as milk, meat, eggs, and some legumes.
4. Lysine is naturally in short supply in the cereals.
5. The cereals are milled in a few central locations and a government agency is capable of controlling the fortification process.
6. The method of introducing the fortifying agent gives an acceptable product.
7. The costs of delivering the additional utilizable protein through lysine fortification compare favorably with other protein sources.

B. CONDITIONS NECESSARY FOR INTERVENTION

1. Caloric Adequacy

According to nutrition surveys, food balance sheets and estimates based on diet and income, a substantial number of target group individuals have inadequate caloric intakes. Some nutrition authorities believe that if the caloric intake is inadequate, increased protein consumption will be used for energy, instead of maintenance, repair or growth of tissue.* Other specialists believe that "This is an absurd negation of the mass of nutritional knowledge."** This issue cannot be resolved here; however, it is evident that lysine at economical fortification levels will not

*"Effect of Lysine Supplementation on Growth of Rats Fed Cereal Diets," Indian Journal of Medical Research, Volume 59 (May 5, 1971).

**Dr. George Graham, Johns Hopkins School of Hygiene and Public Health.

have assumed that any caloric deficiency is dealt with through other supplementation arrangements.

2. Diet

The staple foods of the low-income people in Ecuador are cereals and tubers. Of all the cereals, only wheat meets the tests set forth in conditions 2, 3, 4, and 5 of the above section. Rice, corn, and barley are all deficient in lysine, but all three are milled or processed in very decentralized locations. Corn and barley milling for direct human consumption are essentially cottage industries, except for a small amount which is industrially milled. There are innumerable rice mills scattered over the coastal areas. Although rice is eaten at nearly every meal by rural and urban low-income families, fortification of rice present special technical problems because of the methods of preparing rice in the home. Rice is carefully sorted to take out foreign matter, often present in the locally milled rice, and it is thoroughly washed. In both steps the lysine tends to be discarded, either when it is encapsuled in a simulated rice kernel or when it is sprayed on all the kernels during milling.

Wheat meets the prerequisites for more intensive investigation of fortification possibilities. Its greatest shortcoming is that it is not eaten in the same quantities as are barley, corn and rice. Moreover, intervention to fortify wheat would benefit only urban families, since wheat products are rarely eaten in rural Ecuador, except in wheat producing regions of the Sierra.

From the earlier section on diets and food habits of the low-income families in various parts of Ecuador, it is evident that bread and wheat products have an important part in supplying calories for the urban diet. It is significant to note that bread is most frequently eaten by the low-income groups in the morning, alone with coffee. It is also a snack food, eaten during other times in the day. In addition, infants

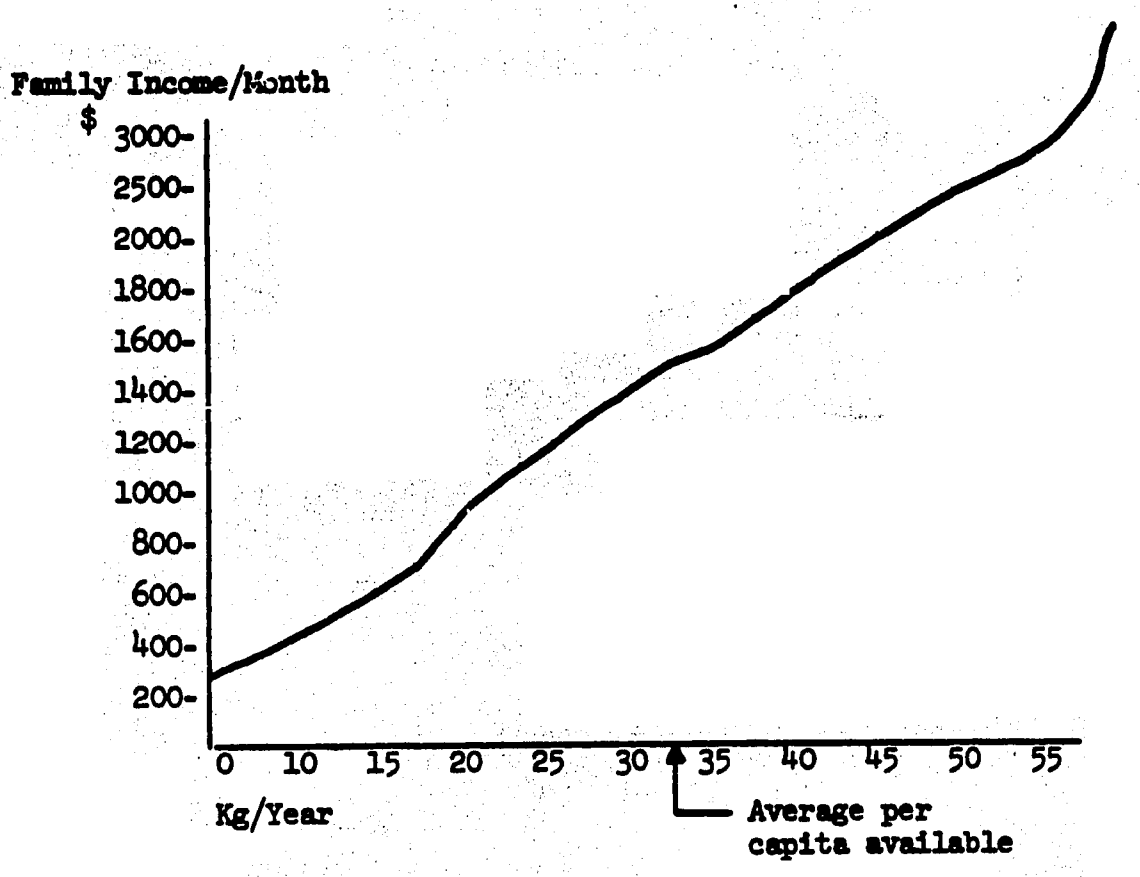
urbanized, consumption of bread should increase. However, low-income Ecuadorians do not eat bread as much as other Latin Americans.

Among the low-income urban families, bread consumption follows income distribution, with the lowest income groups relying more on barley, corn, yucca and plantain than on bread for bulk and calories. The upper sectors of the target group and the middle class are the bread eaters of Ecuador, and for this reason a fortification intervention of all wheat flour must expect utilization by non-target group families. Fig. 1 is an estimate of wheat products consumption.

Bread production absorbs approximately 70 percent of all wheat flour. The second largest wheat flour product is pasta which is eaten in rural and urban areas alike. It is most frequently eaten in soup, "sopa de fideos" composed of noodles, potatoes, or yucca, corn and perhaps some vegetables. Meat or fish may be added on rare occasions.

Figure 1

BREAD CONSUMPTION IN URBAN ECUADOR



Source — ATAC estimates based on ICNND Survey and Junta Nacional de Planificacion, Instituto Nacional de Estadisticas.

The addition of lysine improves the quality of wheat protein more than that of any other cereal. Lysine is not absent entirely from wheat, but because of inadequate quantities, full utilization of other amino acids present in wheat is not possible. The following table shows the increase in utilizable protein with lysine fortification.

Table 1

Effect of Lysine on the Nutritive Value of Wheat Protein

Food	Reference	Protein (by chemical analysis)	Utilizable Protein	Increase in Utilizable Protein per 100 gr.food
White wheat flour	1	13.75	3.20	2.14
White wheat flour plus .2% lysine HCL		13.94	5.34	
Water bread	2	15.00	7.3	2.7
Water bread plus .3% lysine		15.00	10.0	

1. Hegsted, D. M., "Protein Enriched Cereal Foods for World Needs."
2. Jansen, G. R. (1969) Amer. J. Clin. Nutrition 22.

Source: AID, "Improving the Nutrient Quality of Cereals," June 1971.

4. Wheat Milling: The Opportunity to Introduce a Fortifying Agent

Ecuador has several large mills in Quito and Guayquil which produce 60 percent of all wheat flour. In Guayaquil alone there are three mills which produce 52 percent of the national flour supply. (Espinal R., "La Industria de Alimentos en El Ecuador," 1970.) Although Ecuador's wheat milling is not as centralized as Peru's where most of wheat is milled in five large plants, the education program to achieve acceptability at the mill level in Ecuador will require much less time and expense than a similar program with the thousands of bakers or a nutrition education program at the consumer level.

vention after an approximately 10 percent loss of the lysine in baking.

Table 2

MODEL 1 — Government Assumes All Fortification Costs

Year	Domestic Flour Supply	Cost to Purchase Lysine to Fortify Flour Supply .27% Lysine (1)	Mixing Machine Costs Over Ten Year Life of Machines (2)	Administrative Costs of Program	Total Costs
1969	82,926	$446,000	$3,000	$10,000	$459,000

MODEL 2 — Government Buys Only Machines; Miller absorbs or Passes on Cost of Lysine

1969	82,926	-0-	3,000	10,000	13,000

(1) Lysine at $2.00/Kg
(2) 15 Machines at $2,000 @

The costs of the mixing machines for each mill are amortized over their expected life. If at a later date the government decided to also enrich flour with vitamins and minerals, the machine costs could be divided between the two interventions. The additional costs of administering the program include only a modest training program since Ministry of Health food quality laboratories already exist.

The lysine and the mixing machines must be imported and will require use of foreign exchange. The extent to which foreign exchange expenditures increase the cost of the intervention to the government cannot be determined at this time. Until this is calculated, it is sufficient to note that this intervention requires this type of cost while some others do not.

mix could be introduced with a minimum of technical assistance now and only limited assistance thereafter. None of the mills currently have the machinery for adding the lysine. However, a simple percentage feeder can be used to meter-in fortification additives. Once the rate is set, minimum care is needed to check settings from time to time.

Quality control of lysine and/or vitamin and mineral enrichment is not complex and can be conducted by trained semi-skilled workers. Toxicity from lysine or the vitamin and mineral additives only occurs with massive intakes. Because of the expense of the additive and the low return for increased dosages, the most important objective of the quality control program is to insure that excessive amounts are not added.

5. Acceptability of Fortified Products

Taste panel tests in several countries have confirmed that at 0.1 percent and 0.25 percent lysine there are no adverse effects on bread, noodles, or crackers. Lysine is a white or tan powder that can be ground to any formulation. Baking and mixing properties are likewise unaffected by the lysine.

C. ANALYSIS OF INTERVENTION

1. Cost of Fortification

Because flour used for breads and pasta is not divided by class and because certain millers cannot be identified as suppliers for bakers in poor neighborhoods, the entire flour production must be fortified to deliver any fortified products to the low-income families.[1] In Table 2 Column 2, the cost for purchasing lysine for fortification of current

[1] Pastry class flour need not be fortified, but estimates of its production are not known.

of lysine on this food, and amount of increased utilizable protein which the target group individuals will enjoy if fortification is undertaken. The cost presented in Column 8 is based on the fortification of the wheat flour supply of 1969. The cost per unit of nutrient consumed by the target group can be lowered if target group consumption of wheat increases in relation to total wheat supply. [1]

2. Cost Increase Effect on Consumption

If all or some of the fortification costs were passed on to the consumers, then total cost to the government would be less. However, it is likely that consumption by the target group would decline since bread is purchased by the unit of cost rather than unit of quantity. For the purposes of this analysis it will be assumed that expenditures for bread by the target group will remain the same regardless of fortification or prices of bread; thus if prices are increased 3 percent then consumption will drop by 3 percent.

Table 4 presents the probable decline in consumption among the target group of wheat products resulting from the price increase realized when the government passes part of the cost of fortification on to the consumer. Based on current wheat flour, lysine, and bread ingredients' prices, retail prices of bread will increase 3 percent if the cost of all lysine is charged to the consumer.

The cost to the government of supplying one gram of NPU protein is markedly diminished under this alternative, by a factor of 50, but the total amount of protein gained by the target group drops by only 3 percent.

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[1] This cost can also be reduced if fortification can be limited to the two classes of flour most frequently used for bread and pasta production. The other class is used mostly for pastry.

Table 3

Costs and Benefits of Lysine Fortification

Model 1 - Government Assumes All Costs

	1	2	3	4	5	6	7	8
	Per Day Consumption of Wheat Flour Equivalents Grams	Per Year Consumption Kg	Current Daily Calories from Wheat KCAL.(1)	Protein from Wheat Products Daily NPU g.(2)	Protein from Fortified Wheat Products NPU g.	Protein Gained Per Day NPU g.	Protein Gained Per Year/ Capita NPU g.	Total Protein Gained in Target Group Per Year NPU Kg
Sierra								
Pre-school	50	18.2	176	1.55	2.55	1.0	365	30,250.8
Pregnant & Lactating Women	60	21.9	211	1.86	3.06	1.20	438	8,719.2
Coast								
Pre-school	40	14.6	141	1.24	2.04	.8	292	32,228.0
Pregnant & Lactating Women	50	18.25	176	1.55	2.55	1.0	365	9,676.0

Total Protein Gain: 80,874 Kg

Model 1 - Cost to government per additional NPU Gram $.0056

Total target group beneficiaries: 361,750

(1) National Wheat used for calorie content.
(2) FAO, Amino Acid Content of Foods (calculated NPU).

Table 4

Costs and Benefits of Lysine Fortification

Model 2 - Costs Passed on the Consumer

	1	2	3	4	5	6	7	8
	Per Day Consumption of Wheat Flour Equivalents Grams	Per Year Consumption Kg	Current Daily Calories from Wheat KCAL.	Protein from Wheat Products Daily NPU g.	Protein from Fortified Wheat Products NPU g.	Protein Gained Per Day NPU g.	Protein Gained Per Year/ Capita NPU g.	Total Protein Gained in Target Group Per Year NPU Kg
Sierra								
Pre-school	48.5	17.70	171	1.503	2.473	.970	354.05	29,343
Pregnant & Lactating Women	58.2	21.24	205	1.804	2.968	1.164	424.86	8,457
Coast								
Pre-school	38.8	14.16	136	1.202	1.978	.776	283.24	31,261
Pregnant & Lactating Women	48.5	17.70	171	1.503	2.473	.970	354.05	9,386

Total Protein Gain: 78,447 Kg

Cost to government per Gram of Protein Gained per year

Total Target Group Beneficiaries: 361,750

3. Additional Benefits of Lysine Fortification of Wheat Flour

Although the analysis thus far has assumed that the fortified wheat flour will only benefit the urban population, additional target group individuals from the rural areas may consume a portion of the fortified wheat flour. Wheat farmers, large and small, have their own wheat milled for home consumption. While much of this is done in small cottage mills, a portion would be processed in the larger mills which would be adding lysine to all wheat passing through their mill. Estimation of the number of small wheat farmers who would benefit is not possible, but each additional gram of fortified wheat consumed by the target group lowers the per unit cost.

4. A Basic Limitation of this Intervention

An important limiting factor of this intervention is that at current prices of wheat relative to other grains, low income urban families do not eat large amounts of wheat flour products, while rural families eat still less. Low consumption, estimated in 1968 at 60 grams per capita daily, limits the extent to which wheat can be used as a fortifying vehicle. In order to increase consumption of fortified wheat beyond that estimated in the preceding tables, Ecuador would have to import wheat, since domestic production is limited, and to lower prices to encourage consumption of wheat rather than competing products of lower protein value. The costs to take these two steps would increase costs per additional unit of nutrient gained beyond the range feasible for government action.

D. LYSINE FORTIFICATION OF DONATED WHEAT

Wheat flour donated under the PL 480 program is used in feeding programs which reach some of the target group families. Food, including wheat is used in a number of programs, such as Food for Work, School Lunch, charitable institutions and maternal and child care centers.

1. Logistics

Amino acid supplementation of the donated food can be done by the baker. Although this requires a greater logistical effort by the donating agency or implementing agencies, these agencies are gaining respect for their abilities to deliver food and other supplies with regularity to remote places.

Theoretically, a donated food program which could fortify only those foods intended for the target group could reduce intra-program losses significantly. Unlike the commercial distribution system where 70-80% of the fortified flour was consumed by the middle and upper classes, the donated food program should be able to select the recipients of the improved foods. Losses which would occur then would relate to intra-family maldistribution or substitution. However, selection of target group individuals from among all those who may apply for assistance is a costly process and one which many countries have not yet undertaken. In many neighborhoods and communities, it is unnecessary if supplies are adequate, since nearly everyone in the target age group is malnourished In other areas, losses from indiscriminate distribution of food may approach 50-70%. At this level the losses are similar to those encountered in the commercial distribution program.

A greater training effort would be required as well. Under the plan for fortification at the mill level, the training would be confined to the mill technicians, relatively few in number. However, addition of lysine in hundreds of bakeries would require extensive motivation and training. Further, personnel of the participating agencies would have to be trained in quality control of the finished products.

2. Consumption

The donated food agencies estimate that each participant in the MCH program receives on the average 0.6 kilos of wheat flour equivalent products per month. Converted into the standard small rolls of Ecuador, this amounts to one 1 oz. (28) grams roll every day for each child, and

adult participating in the program. Each roll contains approximately 20 grams of wheat flour. About 810 metric tons of wheat flour is consumed annually in the MCH donated food program.

3. Cost of Fortification

The following table shows the estimated costs of fortifying the wheat flour donated under the PL 480 program for MCH programs. A 10% annual increase in wheat flour directed to the MCH target group conforms with plans by the government, AID, and the agencies to give increasing emphasis to MCH programs. Administrative costs reflect the need for extensive training and technical assistance for bakers and those who will enforce quality standards. These costs will diminish after the initial program years. Not included in the estimate of the costs are the expenses for improving the outreach into the low-income neighborhoods and communities and the screening of the applicants for food assistance. It is assumed that these efforts will have to be made, regardless of the fortification program.

Table 5

Costs for Fortifying Current and Projected Flour Supply : MCH Feeding Programs

Year	Wheat Flour MT	Cost to Purchase Lysine at .27% Fortification	Training and Quality Control	Total Cost
1971	810	$ 2,187	$10,000	$ 12,000
1972	890	2,403	5,000	7,403
1973	979	2,643	5,000	7,643
1974	1,076	2,905	3,000	5,905
1975	1,185	3,199	3,000	6,199

The benefits for this program are presented in the following table. The table shows in line 7, the amount of NPU gr. protein gained each day as a result of the consumption of the lysine fortified bun. In calculating the total protein gained each day we have reduced the impact of fortification by 10 percent to represent the probability that the bun will substitute for other food which might have been consumed. This estimate is not based on any survey, and in fact donor agencies deny that substitution occurs. However, we feel it wise to include the estimate of the substitution effect for illustrative purposes. Should later investigation demonstrate that this is high or low, appropriate adjustments can be made in the outcome of the chart of benefits.

Line 9 shows the costs per unit of additional NPU protein delivered to the target group individual. Three assumptions are made: first, it is assumed that all of the 115,000 currently receiving food are in the target group. The second assumption is that only one-half are within the group and the third assumes that only 20 percent of those currently receiving the food actually merit it. The differences in cost are dramatic as the effectiveness of distribution improves.

Benefits from Lysine Fortification of MCH Flour Supply

(1)	Per Day Consumption of Wheat Flour Equivalents		20 grams	
(2)	Per Year Consumption		7.3 Kg	
(3)	Daily Calories from Wheat Flour Products		70.6	
(4)	Current Daily Protein from Products NPU g		.62	
(5)	Protein from Fortified Wheat Products NPU g		1.02 g	
(6)	Substitution effect, expressed as losses from #5 - 10%		.10	
(7)	Protein Gained Per Day		.28 g	
(8)	Protein Gained Per Year		102.2 NPU g	
(9)	Total Protein Gained for Target Group,* Assuming:		Costs to Fortify Flour Supply**	Costs to Deliver Additional Gram or Protein
	(a) Perfect Distribution	11,753 Kg	$7,100	$ .000604
	(b) 50% Loss	5,876 Kg	7,100	.0012
	(c) 80% Loss	2,351 Kg	7,100	.0030

* Currently 115,000 pre-school children, infants and pregnant and lactating mothers are being served.

** Costs do not include program start-up costs. Average estimated at $7,100 per year including lysine purchase and administration.

Appendix VI

INTERVENTION IN FISH AND SEAFOOD

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SUMMARY

Fresh fish are considered as a source of high quality protein for low-income families. Current high costs per gram of protein, declining domestic consumption, and the large investment required throughout the nutrition system seem to exclude fish as a viable alternative source for additional protein.

This appendix illustrates some of the false starts nutrition planners may make. Before we could exclude fish as an alternative several weeks of study of available data were required.

After a preliminary review of fish as a nutrient source, it was concluded that unless the retail price of the least expensive varieties could be reduced by 50%, marine fish commercially harvested and distributed was not an attractive nutrient source for further analysis. At current (1972) retail prices, moderately valued fish cost $.006 per gram of utilizable protein. Compared with milk at $.004 and pork at $.0045, fish prices are too excessive to consider as an alternative.

This preliminary conclusion does not mean that the Government of Ecuador should ignore fish as a source of nutrients for domestic consumption. On the contrary, significant changes can be made in the fishing industry that would make more available, although it does not appear that retail costs would be affected until improvements had covered a large part of harvesting and distribution.

Available data indicate that fish and seafood supplies for domestic consumption are declining, while total catches are increasing. In the past ten years, the Ecuadorian fishing industry has changed from marketing about 50% of its product domestically to about 30%. This decrease in supply has probably affected price but since price histories are not available, an estimation of this effect cannot be made.

and handling have been for tuna, the most important export fish. Fish for domestic consumption are caught primarily by artisan fisherman whose methods have changed little during the same period. Losses from improper handling and inadequate storage are estimated at about 20-30% of the product destined for domestic consumption. Losses in the export stream are somewhat less.

Marine fish are not marketed beyond the major cities and small coastal villages, except for salted cod during religious holidays. Fresh water fish are caught in some Sierra and Coastal rural areas and although they encounter no acceptability problem, their quantity does not represent a significant contribution to national or regional supply.

Increased investment for the domestic consumption fishing industry may require a sacrifice of continued growth in fish exports and of savings from import substitution of the fish meal industry. Current policy of Ecuador has favored increasing export earning rather than diverting exports to domestic consumption. Nutrition planners will have to make a persuasive case that:

> Investment in the domestic-oriented fishing industry will yield higher catches and make more available for human consumption
> Growth of supply will assist in lowering prices
> Low income groups will increase consumption of fish
> Returns to the government of such an investment, including the opportunity costs for an identical sum in an export industry, must be competitive with investments in other sources of protein.

Appendix VII

ANALYSIS OF NUTRITION AND INCOME IMPLICATIONS OF CREDIT TO SMALL FARMERS AND IRRIGATION PROJECTS

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SUMMARY

Irrigation and credit investments in Ecuador are examined in terms of their potential for contributing to improved nutritional status of low-income farm families. Three criteria are proposed as the basis for judging the benefits of agricultural investments to nutritional goals: increased income for low-income farm families; increased food supply; and improved nutritional quality of national food supply. We have not calculated costs for producing incremental amounts of proteins and calories through these two investments.

From our analysis, credit to small farmers appears to offer far greater returns nutritionally and economically than irrigation.

The format of the appendix generally follows that of preceding sections: a description of the availability of credit and irrigation and characteristics of programs to date is presented, followed by an analysis of the nutritional consequences of each type of investment. The data used in the description were supplemented by information from other countries and were the base on which the conclusions were made.

A. PURPOSE OF STUDY

The specific purpose of this paper is to consider the means and extent to which two forms of investment in the agricultural sector—irrigation and credit—can contribute to the elimination of malnutrition in Ecuador.

In addition, the paper has a broader purpose in seeking to develop approaches by which the implications of investments generally in the agricultural sector may be considered from a nutritional point of view.

nutritional criteria for judging investments in the agricultural sector differ from economic criteria? Is there possibility of serious conflict between economic and nutritional planners?

To answer the second question first, we believe the dangers of conflict are minimal if economic and nutritional planners well understand each other's motives and objectives.

The economic planner is broadly concerned with increasing production and incomes as a means of achieving (both over the short and long term) higher living standards. The nutritional planner's goal is implicit in the general economic aim. Whereas the economist is concerned with promoting higher living standards in a variety of ways (better nutrition, better housing, better provision of consumer durables, better public services in education, transport, health, etc.), the nutritional planner has a special interest in the particular objective of better nutrition for those who are nutritionally disadvantaged.

Aside from aims, there is also a relationship between the economic planner and the nutritional planner in terms of means. To achieve his goals the economic planner knows that it is important to improve the productivity of human resources. In this respect, better nutrition by contributing to worker health and efficiency is a means as well as an end. Conversely, the nutritional planner has to take into account that higher incomes, better health facilities and other constituents of general economic development are important contributors to the achievement of better nutritional standards.

agricultural investments for nutritional purposes. To a large extent he has tried to do this faithfully and has absorbed from the nutritionist a certain knowledge about the incidence of malnutrition, caloric and protein requirements, etc. Accordingly, with increased frequency nutritional considerations have influenced agricultural sector programming and have been advanced as one of the justifications for agricultural programs.

Nonetheless, while the economist's embrace of nutritional objectives is obvious, he has rarely carried analysis of nutritional impact very far. If a project has to do with the growing of food, improved nutrition will likely be stated as one of the justifications for the project. If the particular food happens to be rich in protein, particularly animal protein, a reference to nutritional advantages of the project is almost certain. All such justifications, however, have little meaning because they are not supported by a specific analysis to show whether or why a particular investment in the agricultural (or food production) sector is likely to have any greater impact on nutrition than another. It is thus not only possible, but has frequently occurred, that agricultural projects which have gone forward partly in the name of improved nutrition have little to commend them in terms of achieving nutritional goals.

The nutritional planner for his part has frequently been naive. Impressed by the nutritional value of a particular food or the nutritional needs of particular groups, he has urged courses of action that are both economically and nutritionally inefficient—inefficient because they cost too much or because the economy won't work exactly the way he thinks it ought, be it in terms of market action, income distribution or whatever.

Not infrequently economic and nutritional planners engage in mutual self-delusion. A typical example is the belief that heroic efforts to increase the production of beef (one of the most expensive protein sources, requiring very heavy capital investment, and whose product goes primarily to the already well-nourished higher-income groups) is somehow going to meet the nutritional problems of people who have little income.

The fact is that the economic planner and the nutritional planner have a mutual obligation and a mutual interest in developing and supporting investment programs that make sense both economically and nutritionally. The analysis of nutritional benefits, therefore, must form an integral part of the process of planning investments in the agricultural sector. To put it simply, nutritional benefits are one of the major payoffs of agricultural investments, and the essential path to follow is to maximize the payoff relative to the cost.

C. PARTICULAR CRITERIA FOR JUDGING THE BENEFITS OF AGRICULTURAL INVESTMENTS TO NUTRITIONAL GOALS

There are essentially three ways in which investment in agriculture can contribute to the elimination of malnutrition:

1. By Raising Low Incomes

As a rule of thumb, the lowest 40% income category in Ecuador (which contains most of our "target group" of families with inadequate nutrition) has an income elasticity of demand for foodstuffs of about 0.6; that is to say that, for every sucre of additional income, this category can be expected to spend about another 60 centavos on food.

Raising incomes of lower-income families, therefore, should have a powerful nutritional impact. While the most direct income effect of agricultural investments will be felt in increasing incomes of the farm population, the indirect effects on raising non-farm incomes (e.g., of those who market and process agricultural commodities) is also important to take into consideration.

2. By increasing the supply of food

While the demand for food in Ecuador is rising at about 5% per annum, agricultural production growth has been lagging at about 3.3%. Among other things this causes an upward trend in prices, which reduces the amount of food the low-income family can buy. Increased production, efficiently distributed, will help keep the price of foodstuffs from advancing disproportionately and thus nullifying gains in food purchasing power resulting from rising incomes. Care needs to be taken, however, to avoid stimulating production to such a point that prices fall below levels that give the farmer a fair return and the incentive to continue to produce. In some instances, of course, inadequate Ecuadorian production can be made up by imports that are cheaper to buy than to produce in the country. This is not disadvantageous either economically or nutritionally if the Ecuadorian resources that might be used for import substitution are more effectively utilized elsewhere in the economy (e.g., production of export crops).

In addition to looking at the supply of foods nationally, it is also important to look at supplies in the respective regional and local markets, particularly in areas of extensive malnutrition.

3. By improving the nutritional quality of the mix of foods available on the market

This point is essentially an extension of the second but is sufficiently important for special attention. Particular foods (e.g., milk and legumes) may be more important in meeting the nutritional deficiencies of lower-income groups than others. It is, therefore, desirable that, within the general supply of food, these items be in good supply at relatively attractive prices. A nutritional gain can also be scored if the nutritional quality of the supply of a given food (e.g., protein content of wheat) can be upgraded.

D. THE POTENTIAL FOR INCREASED INVESTMENT IN AGRICULTURE IN ECUADOR

Like all developing countries, Ecuador has limited public funds to invest in economic development. Agriculture must compete with other sectors for its share in these funds. In consequence, the amount that can be made available to agriculture will be significantly less than the total it might advantageously use. An agricultural investment, therefore, cannot be justified simply on the ground that it will yield benefits greater than its costs. It should be demonstrated that it is likely to yield the maximum benefits possible (balancing nutritional benefits with others) from the quantum of funds that can be invested in the sector.

During the period 1960 to 1971, Ecuador invested approximately $258 million in the agricultural sector. To this should be added $ 17.9 million invested in irrigation. In addition, somewhat increased amounts were provided in credit funds for agriculture through the Central Bank and the Banco Nacional de Fomento.

Over the coming five years, the amount of public investment that can be made available to the agricultural sector should be considerably larger. The current economic development plan* proposes public investments of 24.3 billion sucres (nearly $1 billion) over the next five years. This is about three times as much (allowing for differences in purchasing power) as in the 1966-1970 period. While the plan estimates that 22.5% of all investment (public and private) will go to agriculture, it does not specify the proportion of public investment that will go to each sector. One might suppose, however, that agriculture (including irrigation) could hope for $200 million or better in new public investments. This provides scope for considerably more substantial initiatives than have been taken in the past. Progress in the country in eliminating malnutrition will depend considerably on the extent to which the nutritional impact is maximized in the expenditure of such funds.

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*See Bibliography, item 2

While public investment in agriculture provides the greatest scope for incorporation of nutritional objectives, the nutritional planner should not lose sight of the possibility of public policies that will encourage the direction of private agricultural investments along lines that will be nutritionally most productive.

II. SUMMARY

A. AGRICULTURAL CREDIT

Both in economic and nutritional terms, one of Ecuador's most critical needs is for substantially increased investment in the agricultural sector. Agricultural production generally, and food production in particular, is lagging well behind growing demand. Food prices have been escalating and are likely to continue to do so, with consequent hardship on the low-income undernourished segment of the population, urban and rural. There is already vast unemployment and underemployment in the rural areas, where probably a majority of families have inadequate nutrition and population growth is racing along at an all-time high. Those who are abandoning the farms and hoping for urban employment can expect in large part to find it only if there is a sufficient surge in primary agricultural production to create substantially more jobs in agricultural transport, processing, distribution and export.

The case for agricultural credit as a means of developing the agricultural sector of the Ecuadorian economy is compelling. It rests on the simple proposition that farmers have insufficient capital to develop the sector and that the provision of credit is the only major tool to provide that capital and to help farmers to generate more of it.

The only conceivable alternatives are to reverse the wheels of agrarian reform and invite wealthy citizens to buy extensive landholdings and to make massive investments in their development, to adopt an aggressive program of attracting overseas capital to form large foreign-owned plantations, or to establish nationalized state-financed farms. Even such measures as these, which Ecuador is unlikely to regard as politically acceptable, are hardly likely to obviate the need for increased agricultural credit.

Besides programs to provide agricultural credit, there are, of course, other constructive forms of agricultural investment that can be made. Agricultural research can be undertaken to develop improved

methods of farming, and agricultural extension services can be expanded to provide technical assistance to farmers. However, the fruits of technology provide limited benefits for those who have not the financial means of employing them.

A significant problem in the provision of agricultural credit to small farmers has been the notion that such farmers cannot be expected to use credit effectively unless they have technical assistance provided to them by a formal agricultural extension service. Extension agencies seldom concentrate their work heavily on bank clients. Most farmers utilize many channels other than the extension service to improve their technology; there is little concrete evidence that credit clients who rely heavily on the extension service for advice improve their net worth faster than those who don't. Supervised credit, an excellent purveyor of technical assistance to small farmers who are considered marginal risks, is usually too expensive for extensive application in situations where the number of small farmers worthy of credit far exceeds the number who actually receive it.

The volume of agricultural credit available in Ecuador is extremely low. In terms of number of farms, number of persons actively engaged in farming, or number of hectares employed in agriculture, Ecuador would rank at the bottom of Latin American countries if Bolivia were not trailing well behind.

Indeed, Ecuador's critical problem at this time is not a lack of resources to expand agricultural credit, but rather the lack of machinery to administer agricultural credit effectively as rapidly as resources could be found to extend it. In our calculations, the agricultural sector could absorb somewhere between $200 million and $400 million more agricultural production credit than the approximately $75 million currently available.

The primary need for the expansion of agricultural credit is for small farmers. Obviously the most important reason for this is that small farmers are cultivating most of the agricultural land in the country. Another reason for stressing credit for small farmers is that they currently have practically no access to institutional credit. Large farmers can go to private banks and are already receiving the lion's share of government credit as well.

In nutritional terms, credit for small farmers is essential not only to increase food production but also to stimulate the growth of incomes of farm operators and farm workers at the lower end of the economic scale. This does not mean that a credit program should be designed to look for undernourished families and force loans on them. Farming is a business, and the lending of money is a business also. A credit program must work with the abler small farmers who want credit, can use it effectively, and are likely to repay it. Such farmers will not always correspond with undernourished families.

The essential—and the most practical—aim, both for the economist and the nutritional planner, is to utilize credit to support farmers who will be most effective in raising production and income levels in their communities. An important consideration in the design of credit programs for small farmers is that the term "small farmer" be adequately defined. Too often loan programs, though nominally designed for small farmers, escalate into programs for larger landowners. Conversely, it is both uneconomic and unnecessary to extend the concept of "small farmer" downward to the point of burdening an agricultural credit program with the granting of credit to owners of small plots that have no potential as viable farm units. There can well be substantial nutritional value in a program (which probably ought not to be based on credit) to assist families in better utilizing gardens and subsistence plots to produce for family consumption. But this must be understood as a distinct function from the development of the agricultural economy.

There is also risk in a small farmer credit program of deriving great statistical satisfaction from granting loans to "small farmers" who in reality are city and town dwellers with other capital and credit resources but have acquired small farms as sideline investments to be worked with low-paid help. The primary motives of many such owners are frequently land speculation and recreation rather than production of farm income. Indeed, the question might well be raised whether the growing phenomenon of absentee ownership of small and medium-sized farms by thousands of city bourgeoisie is not potentially as threatening to the development of the rural economy as the old pattern of large hacienda ownership by a few families.

Is there not, however, great risk in lending money to the genuine small farmer—the peasant or campesino? The weight of experience in Latin America appears to indicate that this depends on the effectiveness of the credit agency. If its philosophy is that it serves a social rather than business function and it does not really expect repayments to be made on schedule, it will have a bad record, and this record will probably be worse with middle-income borrowers than with those of lesser means. Well-administered programs have respectable collection records. Admittedly, they are not good commercial banking propositions or the private banks would be in it, but they can show at least some return on capital.

Granting the desirability and feasibility of agricultural credit for small farmers, for what purposes should it be extended? There are always advocates for particular forms of credit. Some think the farmer needs credit for fertilizer and seed; others that he needs loans to acquire sufficient land to cultivate; others that he needs machinery or animal traction; others that he needs funds for land improvement; others that he needs loans for livestock; others that loans ought to be given to stimulate small farmers to grow particular crops needed for export, nutrition, or some other reason of national policy. One program in Ecuador was limited to granting loans in kind in the form of sheep.

small farm economy—more production and more employment—credit must be flexible to meet the particular needs of individual farmers. It must be oriented to serve and work with the farmer in his locality rather than as a vehicle to administer a collection of national policies and prescriptions. To put it succinctly: Almost any loan that makes a farmer a more successful farmer is a good loan, and any other is a waste of credit. The nutritional planner, concerned with the expansion of food production and of incomes of small farmers and farm workers, should strongly advocate credit programs based on this principle.

Within the framework of a flexible program, there are indeed possibilities of working toward some more specialized goals. Thus in terms of nutrition there are potentials of emphasizing credit in particular directions such as (a) to specific areas or communities where malnutrition is high and agricultural opportunities poorly exploited, (b) for the introduction of new seeds or livestock breeds which can economically produce more nutritious foodstuffs, (c) to regions producing important foodstuffs in short supply, or (d) to provide for storage and orderly marketing of crops to prevent seasonal shortages and extreme price fluctuations in food supplies. These emphases need not, however, be bought at the price of excluding other worthy loans, and need not be pursued in credit programs for small farmers alone.

The nutritional planner may also find it useful to question whether some emphases in loan programs are not misplaced. There is currently in Ecuador, for example, a considerable emphasis on loans for livestock. These loans have much to commend them in the sense that there is a strong local market for beef and good potentialities for its export. However, beef production requires heavy investment of capital; it involves very little employment; loans are made to larger farmers who can expect large profits and capital gains; and beef itself does not figure significantly in the diets of low income groups who cannot afford it. While the loans are also partly directed toward expansion of milk production, our

investigations suggest that little of the milk goes to the milkmaid, and milk distributors in Quito distribute little milk to stores in lower-income neighborhoods.

Finally, we believe the nutritional planner should be particularly concerned that lack of credit for the hiring of farm labor may be a serious constraint on the development of small farm production, the absorption of rural underemployment, and the generation of rural income. This proposition, though it may seem implausible to many who have always thought of the small farm family as the exclusive provider of its own labor force, is significantly supported by a recent agricultural sector analysis in Colombia, as well as by data gathered in connection with the present survey. To the extent it is true, it can be of utmost significance to economists and nutritional planners alike in the design of small farmer credit programs. Specific research on employment needs, patterns, and practices with respect to small farms should be undertaken to determine the magnitude of this constraint.

B. IRRIGATION

There is no doubt that over the long run an extensive development of irrigation facilities in Ecuador would be feasible and desirable. Irrigation can double or quadruple the production from much of the land of the country and, when combined with other modern techniques, can result in even more spectacular increases.

The basic question is where priorities should be put in terms of investing resources in the development of the agricultural economy over the immediate future. Generally speaking, irrigation projects (at least those currently planned) are exceedingly expensive in terms of benefits that can now be foreseen. The complete list of projects under consideration by INERHI (Instituto Ecuatoriano de Recursos Hidraulicos) would

130,000 families—about 10% of rural families in Ecuador in the year 2000 if all projects were finished by then. It is claimed that they will increase agricultural production, when all projects are completed and all agricultural operations are fully developed, by about $125 million annually, or roughly 13¢ per year per dollar of project costs. They would cost about $1376 per hectare of land—a sizeable investment considering that the cost of most farmland in Ecuador ranges from $20 to $80 per hectare.

These costs in relation to benefits do not support a policy of stressing irrigation in agricultural development planning at the expense of activities that are likely to provide more substantial and immediate benefits. From the standpoint of nutrition, the projects would likely, if their success approaches expectations, substantially eliminate malnutrition among the families who participated in the projects. However, a nutritional "overkill" in specific localities to be benefitted by irrigation would have less significance in eliminating malnutrition than efforts which might improve nutrition more equitably throughout rural Ecuador, since distribution of regional food surpluses tends to favor Quito and Guayaquil rather than remote rural areas.

The principal farm products with respect to which it is anticipated that the proposed projects would expand production are sugar cane, bananas, and rice followed by vegetables, pineapple, oranges, cotton and yuca. Some projects would also contribute materially to the development of improved pastures. On the whole, this is not an exciting menu in terms of meeting the growing needs of Ecuador for foods for domestic consumption, particularly by lower-income groups. It is also likely that some time will have to pass before any market can be found for some of the items on which production would be materially expanded. For example, it is reckoned that the proposed irrigation projects would more than double Ecuadorian production of sugar cane.

To be sure, some of the irrigation projects under consideration offer better than average returns on investment and some clear nutritional advantages in the expansion of production of important foods. A project currently being developed with IDB financing (Montufar at a cost of $6.9 million) is expected to result in increased agricultural production of about $1.3 million annually in a diversity of marketable crops. A somewhat larger project (Babahoyo), relating essentially to rice production, is now under consideration by IDB and also is projected to offer a considerably above-average return. There are several other projects (some of which have been in process of development over a period of years) that also appear relatively promising. While the aggregate contribution of these projects to nutrition would be modest, nutritional planners could well support them provided they do not require such a quantum of development funds that they would compromise the achievement of nutritionally more important objectives such as expansion of credit for small and medium-sized farmers, and greater attention to the problems of agricultural marketing.

Perhaps the most promising means of securing the greatest economic and nutritional payoff from irrigation development, however, lies in encouraging greater private development of irrigation facilities through utilization of local rivers and other readily available sources of water.

In addition to some 40,000 hectares irrigated through public projects, there are some 420,000 hectares (according to the Agricultural Census of 1968) of Ecuadorian land irrigated by individual farmers and private groups. Much of this irrigation is primitive but could be improved with reasonably modest capital investment. There are also a considerable number of relatively well-organized water users associations which could expand their operations to accommodate increased numbers of farmers.

There are many small farmers throughout the country who have the legal right to use local waters for irrigation purposes but do not do

or how to enforce them, lack of capital or credit, lack of technical know-how, and lack of organization of a local water users association through which they could pool their efforts. This strongly suggests the need for a special program to assist individual farmers and groups of farmers to make use—or improved use—of local sources of water now available to them. Such a program could well be related to an expanded program of agricultural credit for small and medium-sized farmers.

We recognize, of course, the complexities of dealing with a great many small farmers and groups of farmers on small irrigation undertakings A case can well be made that it is easier to plan a complete large-scale project and that the technical results in terms of optimal use of both land and water should be considerably superior. Nonetheless, if it is possible to have successful large projects that irrigate whole districts, it should also be possible to develop successful programs of assisting small farmers to take water out of existing streams and rivers and use it efficiently on lands through which they flow. The latter course, by all indications, currently offers the prospect of larger returns on invested capital, and this is what counts.

C. CREDIT AND IRRIGATION: SOME PRELIMINARY COST/BENEFIT COMPARISONS

What are the relative advantages in Ecuador of investment in irrigation projects as opposed to programs of credit for small farmers? Let us make this comparison first in terms of economic return on investment: then let us proceed further to make it in terms of the three "particular criteria for judging benefits of agricultural investment to nutritional goals" set forth at the beginning of this paper (page 3).

Return on Investment

Under ideal conditions, our research indicates that investments in credit and irrigation could produce approximately the following returns:

Credit:[2]	
For average annual crops	53%
For most favorable annual crop	86
Beef cattle	19
Dairy farming	27
Cocoa	28
Irrigation:[3]	
Average project	6
Most favorable project[4]	8
Small scale local irrigation works	18

[1] Increased profit of farmer after payment of wages, including real or hypothetical wages to self and family, but before payment of interest on investment.

[2] Figures based on data in Part III of this paper, especially Table 4.

[3] Figures based on data in Part V of this paper. The further assumption is made that the value of new production caused by irrigation projects would constitute about 45% profit after wages and before payment of interest on capital investment (a reasonably typical figure for Ecuador).

[4] Montufar.

From these figures it will be seen that investment in credit offers very high returns, especially for annual crops. For irrigation—except on a small local scale—the return is very low. The anticipated returns from irrigation, beef, milk and cocoa are overstated in these figures since they will not be fully realized for five to ten years after the investment (or most of it) is made.[1]

It is important to note, however, that we have stated that these are possible returns under <u>ideal conditions</u>. That means, in the case of

[1] A more sophisticated cost/benefit analysis would discount the benefits of these investments to present values. We have not, however, reached the point in this study of dealing with hard enough data to warrant this refinement. Conclusions are clear without it.

credit, that borrowers will use borrowed funds 100% productively and that there will be no shortfalls in farm results because of deficiencies of management, natural disasters, or collapse in market prices. It means i the case of irrigation that beneficiaries of the projects will make optimum use of the irrigation as to types of farming undertaken, number of crops per year, and method of farming and/or livestock raising; it also means that there will be no cost overruns in the construction of the projects and no natural catastrophes or human failings which result in interruption in irrigation service.

Since these ideal conditions are not likely to occur, it is desirable to discount each of the return figures to the extent a shortfall can be reasonably anticipated. This is not something we can prudently do now. It requires much more careful analysis of specific projects (for example, what kind of credit program?) than is possible with present information. It may very well be that a credit program would have much more shortfall than irrigation projects. However, the margin of return computed on irrigation projects is already so low that prudence would suggest serious concern that the return on such projects might fall to insignificant figures.

Nutritional Criteria

a. How do credit and irrigation compare as means of raising lower class incomes?

We can develop the following figures with respect to income that could be generated by credit and irrigation programs:

Type of Investment	Annual Income Generated per Dollar of Investment[1]		
	Farmer profit	Farm wages (both family and hired)	Indirect non-agricultural income[3]
Credit for Small Farmers:			
For average annual crops	$ .53	$ .25	$ 1.90
For most favorable annual crop	.76	.38	3.69
Beef cattle	.19	.028[2]	.34
Milk	.27	.06	.90
Cocoa	.28	.08	.68
Irrigation:			
Average project	.06	.023	.20
Most favorable project	.08	.034	.29
Small scale local irrigation works	.18	.069	.61

[1] Figures for indirect farm income are not calculated but would not likely change the relative ranking of the types of investments studied. There is some understatement of farm wages with respect to annual crops and probably with respect to the irrigation projects.

[2] Of which about half is payment to highly paid farm administrators.

[3] These figures are derived using ratios developed in the Colombia agricultural sector analysis (bibliographic reference 39). The figures are somewhat high for various reasons, e.g., the assumption is made that all production will be sold on the market whereas part obviously will be consumed on the farm. Further, to the extent goods marketed substitute for imports rather than represent gains in domestic consumption or exports, the income lost in the distribution of imports would have to be deducted to determine net income gain. Accordingly, the figures in this column should not be compared directly with those in the columns to the left. They do serve to indicate rough orders of magnitude.

These figures give us about the same ranking according to attractiveness of investment as did our return on investment figures shown above. Again we assume ideal conditions, and under such conditions credit to small farmers offers far and away the greatest opportunity to increase incomes. Irrigation looks fairly attractive only on a small-scale local basis; since this type of irrigation development requires essentially

loans for irrigation to individual small farmers, in effect it supports the case for credit.

From the standpoint of nutritional policy, what is important is not only the amounts of income generated but whether the incomes are generated to low or high income households. In this respect, it can be assumed that farm wages will mainly go to low income households. With respect to farmer profit, however, it will have a much greater propensity to go to low income households in a small farmer credit program than in an irrigation project, unless the irrigation project is so structured as to benefit only small farmers. Of indirect non-agricultural income generated by agricultural output, probably about a third goes to lower income (target group) households. It should make no difference whether the output is generated through credit or irrigation programs.

b. How do credit and irrigation compare as means of expanding the domestic food supply?

With respect to increases in the food supply, again under ideal conditions, the following results might be expected:

Type of Investment	Increased Annual Food Production per $1 of Investment[1]
Credit for Small Farmers:	
Average annual crop	$ 1.22
Most favorable annual crop	2.33
Beef cattle	.27
Milk	.53
Cocoa	.41
Irrigation:	
Average project	.13
Most favorable project	.19
Small scale local irrigation works	.39

[1] We ignore the fact that a certain proportion of production under credit and irrigation programs would be for non-food products. It would be about the same in each case.

By this criterion we come out again just about the same way as previously. Credit appears to offer vastly more, although small-scale low-cost irrigation projects are in the running.

c. How do credit and irrigation compare as means of improving the nutritional quality of the domestic food supply?

With respect to quality of increase in food supply, most proposed irrigation projects are heavily weighted toward expansion of production of sugar cane, bananas, and rice. The irrigation projects would, therefore, largely serve export markets; this includes rice, for which production would be expanded far beyond domestic requirements. There are, however, a few proposed irrigation projects offering production of a variety of foods largely for limited domestic consumption.

Expansion of credit to small farmers, while it would involve all kinds of products, would be more directly related to the domestic food supply inasmuch as small farmers are more heavily concentrated in such production. A credit program, of course, could also be shaped toward emphasis on the production of foodstuffs generally or of particular kinds.

In both irrigation and credit programs, the Government would have opportunities to intervene in upgrading the nutritional value of foods produced on farms, e.g., through encouragement of use of more nutritional seed varieties. The credit program obviously, however, provides greater scope and flexibility for making this type of intervention. Even with respect to irrigation projects, the chief intervention would presumably be through the credit component of the project—that is, by providing credit to the farmer to utilize the seed or take whatever other action was desired.

Conclusion

The calculations we have made, of course, lack refinement. We are not in a position to compare concrete, fully delineated programs. Rather,

ment in irrigation or credit appears to offer the greatest nutritional opportunities. As can be expected under such circumstances, our data base is not as ample as we would like it. Nonetheless, our analysis appears to have established the following strong presumptions:

1. That the return on investment that can be expected from credit programs to small farmers is likely to be considerably superior to the return on irrigation projects.

2. That funds invested in a credit program are likely to contribute to nutrition through greater increments to incomes of low income families, both farm and non-farm, than funds invested in irrigation.

3. That a credit program is likely to have considerably greater benefits than irrigation projects in expanding the domestic supply quantitatively.

4. That a credit program provides better opportunities than irrigation projects to improve the nutritional mix of the domestic food supply.

5. That small-scale irrigation works using local waters appear to offer the best opportunities for investment in irrigation; loans for such purposes can be incorporated in a small farmer credit program.

6. With respect to protein foods, credit for production of vegetable proteins (e.g., peanuts, sesame, beans) and milk, provided distribution improves, offers considerable advantages in promotion of nutrition over credit to expand beef production.

In general, it may be concluded that economic and nutritional conclusions are in accord as to the relative advantages of the various forms of investment considered. Two possible divergences can be noted: first, the production of beef is far more sound in economic terms than as a contribution to nutrition. Second, economic opportunities to expand exports of certain products might well increase the economist's desire to opt for particular irrigation projects that would permit heavy expansion of production of such products; however, the current outlooks for expanded

international sales of sugar and bananas are not so bright as to make this probable in the immediate future.

These conclusions compare only two forms of investment in the agricultural sector—irrigation and credit. Expansion of the study might well indicate other investments that would be equal or superior. Investments in agricultural reform and marketing would likely be strong contenders.

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Appendix VIII

CONCLUSION

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alternative programs; secondly, suggestions for further investigation; and thirdly, recommendations for action in Ecuador. These two volumes are not intended to be taken as the final word in nutrition planning or in analysis of Ecuador. Indeed, this study represents only a beginning of formulating a realistic approach to nutrition planning. Like planning and analysis in other fields, we can expect nutrition planning to change and evolve as it is undertaken in a wide variety of settings.

A. METHODS OF ANALYSIS

The nutrition planner is faced with an immense task. First, he must convince decision makers that his country has a nutrition problem that is soluble, at least in part, through investments, and that improvement of the nutritional status of the at-risk population is of consequence in national development. Second, the planner must be able to argue persuasively for specific courses of action that will ameliorate the nutrition problem. Thirdly, he must monitor and evaluate programs which claim nutritional benefits although the effects may not be apparent for many years. The planner's job is complicated by inadequate information on which to base recommendations and by unproved, but apparently logical links between conditions in the nutrition system and the nutritional result.

Inadequate data on which to base a diagnosis or recommend courses of action plague national nutrition planners. These data gaps are most observable in the consumer sub-system. In Volume II of this study we have used information pieced together from several sources to construct a reasonable picture of food habits, taboos, and nutritional status in Ecuador. This estimate is sufficient for the first stages of planning. However, as planning becomes more detailed and the feasibility study stage is approached, better data are needed. Since many proposed actions will affect only one region of the country, limited-scope consumer surveys can be conducted. This avoidance of a costly national consumer survey will also assure that valid regional differences are not subsumed in national averages.

gathered from farmers during a supervised credit program may provide valuable insights into production costs of nutrients, the small farmer as consumer, and the nutritional status of small farm families. A major task of the planner is to determine his data needs and identify ongoing programs that may supply these data.

Volume II contains several examples of analyses of the nutritional impact of different programs. As a method of comparing the nutritional impact of these programs, we have estimated the cost of delivering 100 calories and one gram of net utilizable protein (NPU) to the target group. By using this common denominator, we can begin comparison. The pulse production intervention describes the cost of delivering nutrients to the target group through increased bean production by small farmers. By calculating both the costs of an additional 100 calories and one gram protein and the costs of achieving a specific overall goal (metric tons of new production), we are prepared to compare the costs and benefits of this intervention with programs which attempt to achieve similar goals (delivering nutrients to the target group). For example, an Ecuadorian analyst might compare increased pulse production to increased corn production, using the unit costs of delivered nutrients as the basis of comparison.

No single intervention will solve the nutrition problems of Ecuador or even of a specific target group. Although we have not gathered data to support this hypothesis, we strongly suspect that diseconomies of scale will occur as more and more members of the target group are involved in any one program. For example, we have postulated in the donated food program that program efficiency can be increased by expenditures for recipient screening and for nutrition education. This may lower the cost of delivering nutrients to the target group initially, but costs will probably increase as more difficult regions are penetrated and more intransigent families recruited into the program. Likewise, costs of

have to be made in other parts of the nutrition system. For example, in the pulse production intervention, we have assumed that there will be no additional costs for marketing because the present marketing system is adequate to handle the proposed increase. However, should production achieve higher levels, then other investments will be necessary.

In spite of imperfections in the approach, we believe that analysts can begin to make comparisons on the basis of cost-of-delivery data. At the least, these data will yield ranges of magnitude—boundaries—above which costs cannot rise without becoming grossly inefficient.

However, in order to make even these estimates, the analyst must have access to data generated in pilot projects and from ongoing programs. This information can be obtained through studies initiated by the nutrition planner or by his scrutiny of existing records of program costs and outcomes.

Cost of delivery data is crucial in the nutrition planner's two principal analytical activities: (1) initiating proposals of the most efficient nutrition projects; and (2) assessing the nutritional impact of projects without specific nutritional objectives, but which could be modified to affect the nutritional status of the target population. These data provide a common denominator necessary for comparing alternative investments, for estimating the level beyond which further investment should not be made, and for describing probable nutritional results gained when non-nutritional programs are modified.

B. SUGGESTIONS FOR ADDITIONAL INVESTIGATION

These volumes have highlighted a number of topics which require further research and study. While there will be some variation among countries, generally we have found information lacking in these areas:

the introduction of weaning foods through food distribution centers or in the commercial market at subsidized prices, yet the probable effect of this policy on length of breast-feeding has not been studied. In addition, the distribution of CSM (corn-soya-milk) or WSB (wheat-soya blend) through maternal child health centers may also have a detrimental effect on breast feeding.

Public Health Interventions. The alternative policies considered in this volume have treated only programs that would increase food intake. However, there is a growing body of research that suggests that febrile diseases and intestinal parasites require nutrients far in excess of normal demands. In countries where epidemics and parasitosis are common, the gains realized by programs to increase intake may be offset by disease-induced losses. Little research has been done on the nutrition payoffs of innoculation campaigns, improved water supply, or installation of sanitary sewers. The need for these programs is already well accepted by national decision makers and international assistance agencies based on other health requirements. Nutrition planners ought to investigate the extent to which expanded or redirected public health projects could better serve nutrition goals.

Alternatives to Donated Foods. Donated food, such as that provided under Title II of Public Law 480, is often considered free by recipient countries. However, the surpluses that made this program possible are diminishing. Recipient countries may have to search for locally produced alternatives or purchase commodities on the world market if food distribution programs are to continue. The costs of these alternatives should be explored in most countries.

Benefits of Good Nutrition. A quantified statement of benefits, expressed in terms appreciated by development planners, would greatly assist nutrition advocates. Relatively little work has been done in this area; program rationale has usually been its humanitarian appeal.

Understanding the Small Farmer as Producer and Consumer. The lack of information about this population group has been mentioned elsewhere in this study. It deserves reemphasizing. In most countries the small farmer produces the bulk of the national food supply and his family comprises a large portion of the target group; yet little is known about his motivations, habits, and capacities.

Physiologic Intake Limits. A topic of research that will benefit both clinicians and planners is the physiological limits of different foods for both infants and adults. As least-cost diet calculations are applied to human rations this factor becomes an important constraint, yet little is known about this subject.

C. SUGGESTIONS FOR ECUADOR

This study has not provided many answers for Ecuador, although we believe a basis has been established, through this study and by the efforts of Ecuadorian officials working separately, to recommend pilot program investments in several areas. In addition, some broad boundaries of acceptable costs have been established.

Production of pulses by a relatively limited number of small to medium farmers stimulated by a credit program appears to offer one partial solution. Since crop-specific credit for small farmers is uncommon and because there is general skepticism about the feasibility of bean production without more research into disease and pest resistant strains, the program should begin on a limited basis. Costs should be monitored carefully to determine variations from the production model described in this

volume. In addition, the wholesale market and consumer response to increased supply should be assessed.

Credit for small farmers, regardless of the crop, appears to offer excellent cash returns that will be converted in part to food purchases.

There is a large sector of the population that cannot afford additional expenditures for food and will remain malnourished. Food distribution programs can play a role in the amelioration of their problems. However, the programs are admittedly inefficient, i.e., some individuals receive donated food who are not malnourished. Additional program expenditures to increase efficiency at the distribution center level have been made in few instances. Our estimates of costs and inefficiencies indicate that under certain circumstances a modified program would yield additional benefits at relatively low cost. Programs now underway to increase efficiency should be carefully monitored. The results of these evaluations would benefit food distribution programs in other countries as well as Ecuador.

Fortification of processed grains does not appear to be a feasible alternative. Wheat is consumed by few target group individuals and then in small quantities. Milling for other grains is highly decentralized, making quality control difficult. The development of a weaning food is not suggested unless conclusive evidence demonstrates a reduction in breast feeding duration.

The increased milk production resulting from a loan will not benefit directly the low-income population unless additional expenditures are made. Price subsidization of some milk supplies is one approach that appears to offer attractive returns. The difficulties of administering a subsidization program were not fully considered in our analysis, but may prove to be one of its major constraints.