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Cottonseed's Role in a Hungry World

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Already well documented is the fact that the world faces a staggering problem in feeding twice the present population by the year 2000. Although agriculturists believe that current world food supplies can be doubled in approximately 40 years by using known methods, this would still leave the world in about the same predicament that it is in today (1).

In lands where food is plentiful—Europe, Oceania, and North America (exclusive of Mexico)—29% of the world's population consumes 57% of the total food supplies composed of 69% of the animal and fish protein and 38% of the land-grown crops (2). In developing countries where food is scarce and malnutrition is rampant, one-half of the world's population lives on only one-fourth of the total food produced (2). A great paradox exists here, for it is in these same developing countries that much good vegetable protein is available. Those in need often do not know what is lacking in their diet, or, if they do, the available vegetable proteins are not processed into products which they can consume or can afford (3).

The strange thing is that, while the United States has surpassed all other nations in application of technical advances to cottonseed and this industry represents at the consumer level a hefty $1.5 billion segment of our economy, no such industry existed as such before 1870. This contrasts with other lands, as India and China, where cottonseed was well known for its products—oil and meal—even before the time of Christianity (4).

This paper describes (a) the world situation regarding supplies of cottonseed for human nutrition, (b) feeding trials which demonstrate that cottonseed flour can be used successfully to supplement low protein diets, and suggests (c) that proper utilization of cottonseed grown in developing countries would make a substantial contribution toward alleviating protein shortages.

Food Deficit Areas

On a national basis, inadequate diets exist in Central America (Mexico included), South America, Western Asia, Africa, the Far East and Communist Asia (5). Diets exceed minimum standards (6) in the United States, Canada, Australia, New Zealand, Soviet Union, and Eastern, Western and Mid-Europe. In Africa, the Near East, Latin America and some parts of South America, diets are low in animal protein and the population is growing faster than the food supplies (7). These are closely associated with a rapidly developing population crisis (8, 9). Add to this that cultivatable land is in short supply and that the severity of this condition can only increase, it becomes eminently clear that in the future it will be more and more difficult to bridge the gap between supply and demand let alone achieve a reasonable improvement in the level of nutrition.

Nutritional deficiencies in diet-deficient countries expressed in terms of non-fat milk solids, dry beans and peas, wheat and vegetable oil for 1962 and projected for 1966 (10) are as follows:

	1962	1966
	Million metric tons	
Protein and calories in terms of wheat	30.7	34.1
Pulse protein in terms of dry beans and peas	0.3	0.2
Fat in terms of vegetable oils	3.7	3.1
Animal protein in terms of nonfat dry milk solids	1.4	1.5
Total	36.1	38.9

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Roughly speaking, it would require about 40 million metric tons of cottonseed in 1966 to furnish approximately one-fourth of the protein needed by the diet-deficient nations. The estimated 21.5 million tons of cottonseed produced by the world in 1962 would have yielded only 5.4 million tons of flour if all had been used for that purpose. One-fourth of that now potentially available, if processed for human food, would replace the deficit in animal protein in the diet-deficient nations.

Today, the United States is providing food for 77 million people in 112 nations (11) by sending overseas some 2.5 billion pounds of food at a cost of approximately 47 million dollars (12). But with world population going into a steep rate of increase, as shown in Fig. 1, the world food deficit is expected to continue climbing (8).

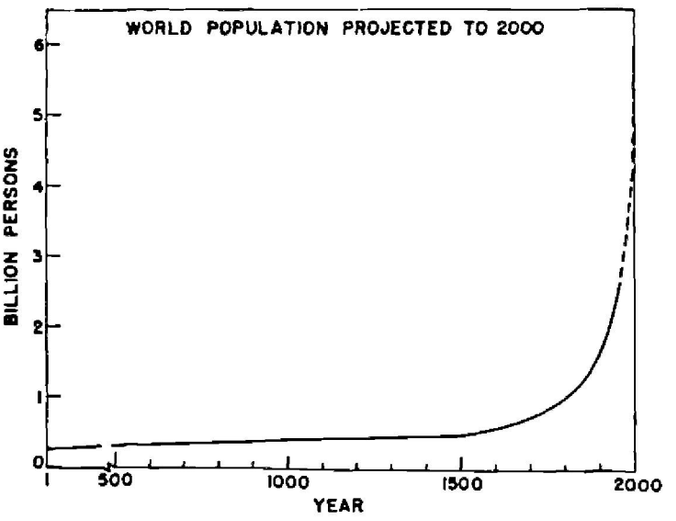

Figure 1.

Cottonseed Flour for Human Consumption

Scientists at the Southern Utilization Research and Development Division have pioneered in research to improve cottonseed meals for animal feeding in cooperation with the National Cottonseed Products Association (NCPA) and the cottonseed industry (13, 14, 15). In this connection, a series of five conferences sponsored by the Southern Division and the NCPA were held at the Southern Regional Research Laboratory in New Orleans between 1950 and 1959 on the nutritive value of cottonseed meal for animals (16). In 1960, the sixth conference, broadened in scope to include "Cottonseed Protein for Animal and Man," was also held at the Southern Regional Research Laboratory (17). This meeting was sponsored by the Southern Division, UNICEF and the NCPA. At this conference, more progress was made in defining conditions for producing cottonseed flour suitable for human consumption. In 1964, increased interest in improving the nutritive quality of the diet and efforts to supply larger quantities of protein to underdeveloped areas of the world focused attention on vegetable protein products and resulted in another conference on "Cottonseed Protein Concentrates" (18). This conference was sponsored by the United States Department of Agriculture's Agricultural Research Service, UNICEF, and the National Cottonseed Products Association and brought to New Orleans many internationally known leaders in this field of research. Members of the staff of the Southern Division were successful in bringing about the technological review of progress to date and in guiding the direction of future research in this area.

Incaparina

More than 12 years ago, a cooperative international institute known as INCAP was established by the countries of Central America and Panama to study nutrition problems of the area, to find solutions for these problems, and to assist member countries in applying these solutions (19). Out of the intensive research conducted by this institute, there has been developed a product known as Incaparina containing 38% cottonseed flour as the principal source of protein (20, 21, 22). Other ingredients are corn, or a combination of other suitable available grain flours constituting 58% of the formula, and torula yeast to which is added 1% $CaCO_3$ and 4,500 I.U. of Vitamin A (19). The cottonseed flour mixed into Incaparina contains 50% protein, 6% fat, 5% fiber, 10% moisture, 0.055% free gossypol, 1% total gossypol, 1.8% free fatty acids, 3.6% available lysine, and 0.1% acid insoluble ash on a dry weight basis (19).

Currently Incaparina is either being produced and marketed commercially or is under market study in Guatemala and Panama in Central America; in Colombia, Brazil, Peru, and Venezuela in South America; and in Mexico. Biological studies (23) with

chicks, rats and dogs in Guatemala showed that the nutritional quality of the protein was good, that it was free of toxic effects and suitable for human feeding. Clinical trials (24) with children one to five years for periods of a few weeks to three months demonstrated favorable acceptability and no intolerance or other adverse effects even though the cottonseed flour furnished from 50 to 80% of the dietary protein. Additional studies with a product containing 30% cottonseed flour conducted in Peru with children of school age and with whole families (25) showed that cottonseed flour as a protein concentrate in a vegetable mixture supplement received favorable acceptance for a period of a year. Other similar products not containing cottonseed flour, which have receive extensive testing are: The Indian Multi-Purpose Food made from peanut flour and Bengal gram; a mixture of dry skim milk, sucrose, cottonseed oil, corn flour, and peanuts produced by Dr. Dean in Uganda; a product known as Saridele made in Indonesia from soybean and sesame; and two products which are currently being experimented with by Dr. Wei in Taiwan, composed of soybean, peanuts, rice and wheat (26). Modifications of the Incaparina formula using soya flour as part or all of the protein concentrate have also been developed by INCAP and successfully consumer tested and marketed.

In Guatemala, Incaparina has been commercially produced since May, 1961, following a series of consumer acceptability and market tests. Retail sales registered a slow but steady growth during the first few years and expanded significantly during July, 1964, to a volume of 50 tons per month. Its acceptability as a low-cost, protein-rich supplement now seems to be established in Guatemala, and future sales growth can be anticipated. A 12-month period of successful market testing has been completed by the Colombian producer in the City of Cali, and production facilities for a volume of 200 tons per month have been installed in order to permit country wide distribution. It is now estimated that the annual sales volume in Colombia will reach 3,000 tons of Incaparina per year. A similar program of acceptability and market testing is being planned by the INCAP authorized producers in Venezuela, Panama, and Honduras for later this year (19).

Production of Incaparina started in Mexico in March, 1963. An initial run of 15 tons was used for market testing the product. Another and larger run of 120 tons is underway for testing consumer reaction. Daily feeding trials for approximately 12,000 consumers have been conducted over a period of six months in and around the area of Torreón in the States of Durango and Coahuila in Mexico. Ten thousand of these consumers are construction workers employed on an extensive irrigation system 80 kilometers in length. Evidence collected thus far indicates clearly that the Atoles prepared from Incaparina have met with favorable reception by several thousand consumers.

The menus have been varied each day but always included the Atole. A daily menu might consist of a rice dish with fish, a bean dish, Incaparina Atole and tortillas. The Atole is prepared in several different flavors and rotated from day to day. The most popular flavors for Incaparina Atole are: Vanilla with rice, Guayaba (guava) and Platano (plantain or banana). A person using the dining hall pays half a Mexican peso (US $0.04) for his meal. "A take-out service" is also provided where servings of each item in sufficient quantity to serve five persons, are sold for half a peso. It is possible, therefore, to secure the same three items as served in the dining hall for a family of five for 1.5 pesos or 12¢ in U.S. currency.

These trials provide the first concrete data which may be used to estimate the possible market potential for Incaparina in Mexico. Approximately 850 pounds of Incaparina have been used daily in these trials. Rural population in this area is approximately 500,000 persons of whom 12,000 have been receiving Incaparina regularly. Assuming that a similar type of program is extended to the total Mexican population of 35,000,000 and that the product will be used in approximately the same proportions as is now being consumed in the Torreón area, it is estimated that the potential consumption of Incaparina in Mexico could reach a figure of 25 tons daily or an annual consumption of 9,125 tons. This is equivalent

to a daily consumption of cottonseed flour of 9.5 tons or an annual consumption of 3,468 tons. Plans for the extension of this distribution program to other areas of Mexica are being made.

The manufacturing process for Incaparina consists merely of (1) milling of the grains used, (2) mixing in the cottonseed flour and (3) addition of the other ingredients, followed by (4) packaging for commercial distribution. The simplicity of manufacture and the reliance on a maximum use of locally available raw materials permit the retaining of the product at a price within the reach of those most in need of such a protein supplement. Incaparina is currently being sold at retail in Colombia for 10 cents (U.S.) a pound (453.59 grams). This quantity of Incaparina is sufficient for the preparation of 22 glasses of a drink having a nutritive value of a similar quantity of milk. A somewhat lower price is granted to hospitals and institutions purchasing Incaparina in bulk quantities. The product may be utilized in a number of different ways in the enrichment of soups, stews, etc., and in baking. Its most popular form of preparation is as a warm drink, called a "colada" in Colombia and "atole" in Mexico, Guatemala, and elsewhere. Its flexibility of use makes it readily adaptable to the varying dietary patterns of different cultures.

One of the authors (R. L. Shaw) in a "Preliminary Analysis of the Market Potential for Human Consumption of Cottonseed Flour in Central America and Mexico," found that, for the year 1963, estimated consumption of cottonseed flour for humans in Mexico and the Central American countries, Guatemala, El Salvador, Nicaragua, and Honduras reached approximately 148 tons. Valued at $110 per metric ton, return on these sales amounted to $16,000. In 1964, production of Incaparina in Colombia and Guatemala, where it is now in full commercial development, reached about two million pounds, utilizing an estimated 230 metric tons of cottonseed flour.

If cottonseed meal—that portion not used for flour—is incorporated into other products as in feeds for broilers and laying hens, as well as other animal feeds, and the flour is used in other products in addition to Incaparina for human consumption, it is esti-

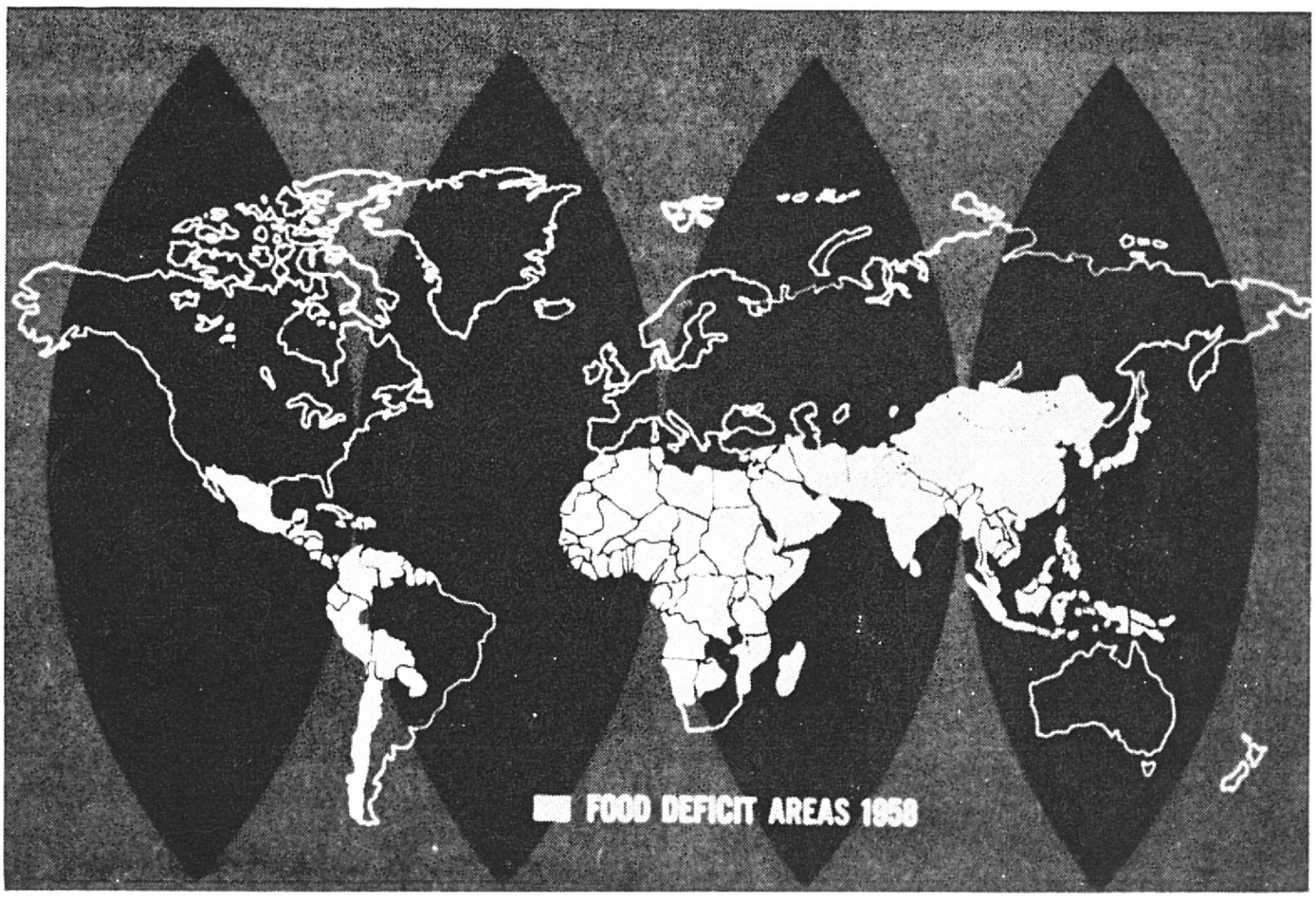

Figure 2.

mated that the total annual potential Mexican and Central American market could swell to nearly 9,000 tons. If this market is realized, sales at current prices in the area could gross about $1,000,000. By comparison, cottonseed flour manufactured in Central America costs considerably less than an imported protein supplement such as soybean meal which is used now in broiler and laying rations.

Assuming that commercial application of Incaparina, or similar types of vegetable mixtures, reaches a comparable degree of marketing success in other Latin American countries as has been already achieved in Guatemala and Colombia, an eventual sales volume of about 30,000 tons per year has been estimated in Mexico, Central and South America. To meet this volume of production will require in excess of 10,000 tons per year of human consumption cottonseed flour, or other suitable protein concentrate, for the Latin American protein-rich food market. No estimates of the possible consumption of cottonseed meal in animal feeds has been made for the Latin American Region.

While it can be safely stated that the imported product could be made available at a cost under its present selling price to the individual and that the imports would act as a stopgap in a critical situation, from a long-range point of view it would still leave the developing nation without a foundation to build on. On the other hand, if the nation itself grows the cottonseed, processes it into flour and then manufactures Incaparina, it may gain thereby an urgently needed source of national economic strength. The farmer may then be encouraged to increase production and care with which he harvests his seed. Producers of cottonseed flour are already being encouraged to market additional products containing Incaparina such as cookies, baby foods, pancake flour, and the like. From this lowly beginning may be visualized a seed of economic independence for developing nations.

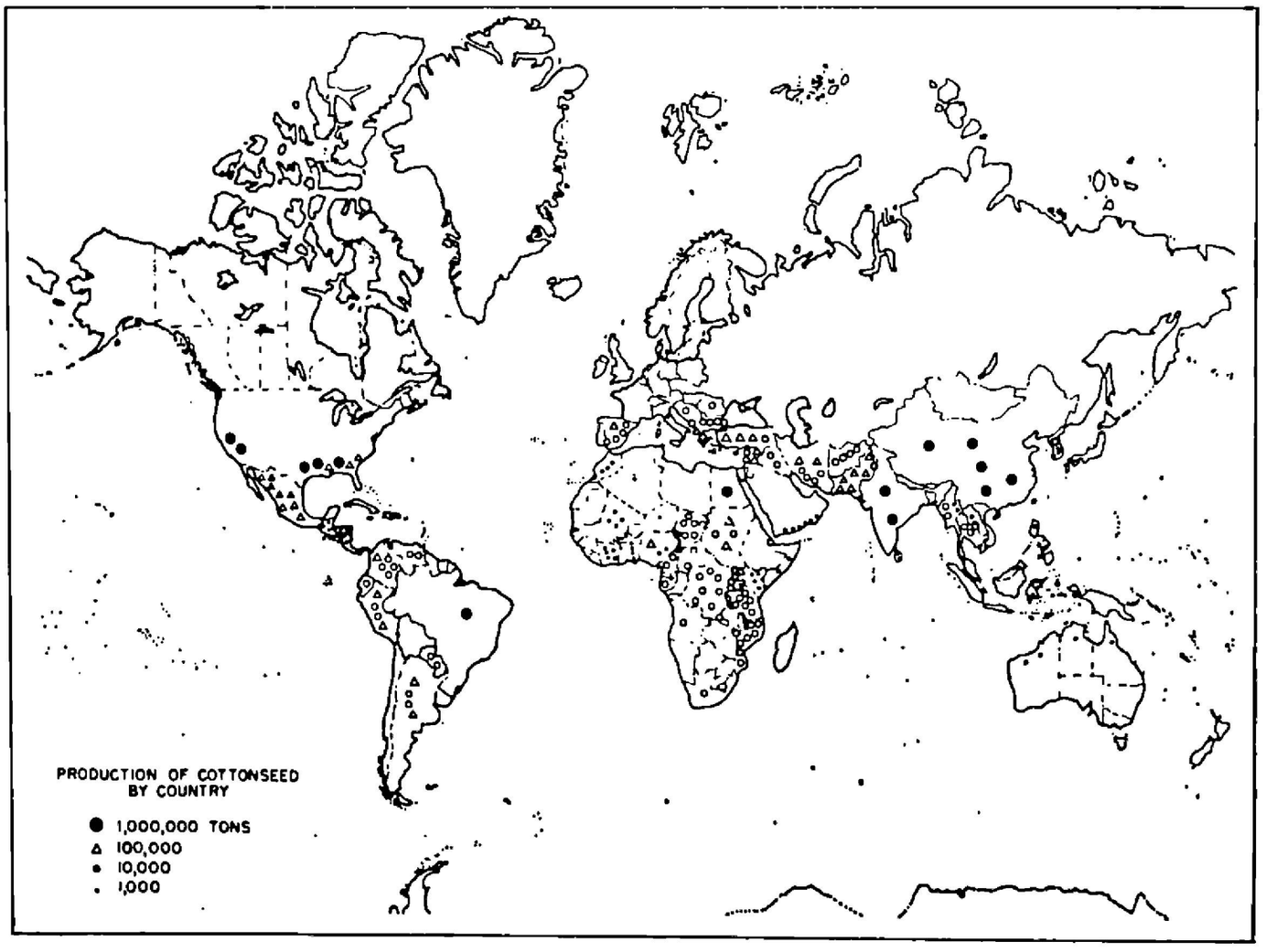

Figure 3.

TABLE 1

REGIONAL PRODUCTION OF COTTONSEED, POPULATION AND ESTIMATED POPULATION SUPPORT FROM POTENTIALLY AVAILABLE COTTONSEED FLOUR

Region	Production of Cottonseed[1]				1961[2]	Percent Potential Supplemental Feeding of Total Population Based on U.S. and C.A. Yields of Flour from Meal	
	1960	1961	1962	1963	Population	33-1/3% (U.S.)	Av. 60% (C.A.)
	(1,000 metric tons)				(x 1,000)	%	%
Europe	200	300	335	445	428,000	1.5	2.6
North America	5,886	5,978	5,800	6,000	204,458	41.6	75.0
Latin America[4]	2,185	2,475	2,980	3,295	214,849	22.0	39.0
Asia	3,245	3,250	3,530	3,795	1,020,000	5.3	9.5
Africa	1,870	1,995	1,730	1,430	261,300	8.0	14.0
Mainland China	4,000	3,750	3,500	3,500	680,000[3]	7.0	13.0
U.S.S.R.	2,950	3,000	3,000	3,000	218,000	19.5	35.0
World Total	20,356	20,748	20,875	21,465	3,078,000	10.0	18.0
World Total (exclusive of U.S.S.R. and Mainland China)	13,406	13,998	14,375	14,965	2,144,800	10.0	18.0

[1] Annual Reviews for 1959–1962 of Oilseeds, Oils, Oilcakes and Other Commodities, Frank Fehr & Co., Ltd. London, Eng., August 1960 to July 1963.
[2] Production Yearbook, 1962, Vol. 16, Food and Agriculture Organization of the United Nations, Rome 1963, pp. 13–15.
[3] Semiofficial estimation.
[4] Central and South America including Mexico.

Potential of Cottonseed as a Supplemental Source of Protein

Practically all areas where food deficits exist are located in tropic or subtropic zones as shown in Fig. 2. World production of cottonseed by country is noted in Fig. 3. Generally speaking, the legend used indicates where cotton is grown and not the specific geographical area. Since cotton grows readily in tropic and subtropic areas where protein deficiency is most common, success of a vegetable protein mixture for human consumption containing cottonseed flour would give that protein and cottonseed an important role in meeting critical protein shortages in these areas. It, therefore, becomes important to determine what proportion of the population in food-deficit areas can be sustained on the minimum animal and pulse protein requirements if the cottonseed grown in the area is used as a protein supplement.

Seventy-five grams of Incaparina provide at least 25 grams of protein per child per day, 20 grams having been set as the minimum reference standard by the FAO (6). Actually 40 grams of protein per child per day is considered ideal. Population support for one year was calculated on the basis that it would require 61 pounds of Incaparina (38% or 23.2 pounds of cottonseed flour) to provide the minimum animal and pulse protein requirements for one child for one year. One metric ton of cottonseed flour, therefore, would provide minimum animal and pulse protein requirements for 95 children for one year.

The potential for feeding the population of a country has been estimated by comparing the potential population support with the actual population of the country. Two figures are given based on different domestic and foreign yields of cottonseed flour from meal calculated as if all the cottonseed was used only for this purpose. However, cottonseed is used for other purposes, and, though some thought was given to the possibility of estimating the potential of a country for supplementary feeding of its population on the basis of availability of a suitable meal for producing flour for human consumption, this was not carried further because of lack of information on how much high quality meal was readily available.

Continentwise, and based on a yield of 33⅓% flour from meal as processed in the United States, North America ranks highest with a 41.6% potential for supplemental animal protein feeding based on cottonseed flour; see Table 1.

Central and South America and Mexico (Latin America) rank next, with a 22% potential, and the U.S.S.R. third, with a 19% potential. This leaves the China Mainland (7%), Africa (8%), and Asia (5%), with very little potential for supplementing diets with a high protein source originating in cottonseed. Europe is the lowest with a potential of 1.5%, but luckily it is also an area where supplemental feeding is not necessary, as meat is plentiful. If the yield of flour from meal averages 60%, as it does in Latin American countries (this figure is based on one year's production by two producers in Latin America), then all the percentages are nearly doubled, and North America becomes capable of furnishing supplemental protein from cottonseed for more than 75% of its population. Latin America and the Soviet Union then have a 39% and 35% potential, respectively. The world potential rises from 10% (33⅓% yield to 18% (60%) yield of flour from meal).

In this connection, it is interesting to note that MacGillivray and Bosley (27) have calculated the average pounds per acre of eight essential amino acids for 36 foods. These seem to fall in three fairly distinct groups, namely, a group composed of soybeans, dry peas, and dry beans from which the highest average poundage of these amino acids could be obtained (13.0 lbs. per acre); a second group of 13 foods including corn meal, brown rice, and such vegetables as carrots, white potatoes, cauliflower, (peanuts), cabbage, and sweet potatoes (4.2 lbs. per acre); and a third group of 20 foods, averaging only 1.6 lbs. per acre. In this group are milk, eggs, broilers, cheese, pork, beef, and lamb, interspersed with a number of green vegetables. Particularly notable by its omission was cottonseed. Values comparable to soybeans as used in this publication were calculated for cottonseed meal. The original amino acid data came from a United States Department of Agriculture publication by Orr and Watt (28) and was used by MacGillivray and Bosley to calculate the data

for soybeans. Using these data an average yield of 7.1 lbs. per acre of the eight amino acids were calculated for cottonseed meal making cottonseed meal rank fourth after soybeans, peas and beans. The data for both soybean flour and cottonseed meal are shown in Table 2.

However, more refined data are now available; so similar values have been recalculated using the amino acid composition outlined in the Annual Report of The Fellows of the National Cottonseed Products Association for the Year Ending 1962 (29) (see Table 2). Calculations which considered the yield of human consumption flour from meal (60% in Latin America and 33⅓% in the U.S.) as applied to the third column of Table 2, indicate that cottonseed flour of Latin American origin averages approximately 4.2 lbs. per acre making it rank tenth after white rice. That of United States origin, "Proflo,"[3] averages 2.33 lbs. per acre which makes it rank seventeenth after sweet potatoes. Like so many other foods of plant origin, cottonseed and its products are much more efficient sources of amino acids acre-wise than milk, meat, eggs, and the like.

Forces Operating in Food Deficit Areas

Lack of minimum food requirements is greatest in those countries that have the least means of obtaining adequate supplies. Four outstanding reasons for this situation are: (a) low income per capita; (b) high ratio of population to land; (c) lack of chemical fertilizer; and, (d) in some instances, exports of food and non-food items to the United States for American dollars.

Because of low purchasing power, it is

[3] It is not the policy of the Department to recommend the products of one company over those of any others engaged in the same business. At that time Proflo was the only cottonseed flour available in the United States.

TABLE 2

AVERAGE POUNDS PER ACRE OF 8 AMINO ACIDS FROM SOYBEAN AND COTTONSEED PRODUCTS

Amino Acid	Soy Flour Med. Fat[1]	Cottonseed Meal[1]	Cottonseed Meal[2]	Cottonseed U. S.[4]	Flour C. A.[5]
			Pounds Per Acre		
Tryptophan	5.4	2.2	1.9[3]	0.6	1.1
Threonine	15.5	6.6	6.4	2.1	3.8
Isoleucine	21.1	7.1	6.0	2.0	3.6
Leucine	30.3	11.0	11.3	3.8	6.8
Lysine	24.8	8.0	7.9	2.6	4.7
Methionine	5.3	2.6	3.0	1.0	1.8
Phenylalanine	19.4	9.8	10.5	3.5	6.3
Valine	20.6	9.2	9.0	3.0	5.4
Average	17.8	7.1	7.0	2.3	4.2

[1] Amino Acid Content of Foods—M. L. Orr and B. K. Watt, USDA Home Economics Research Report No. 4, Dec. 1957. While the reference reports values for amino acids on cottonseed "flour and meal," the values reported here actually calculate out as those for the meal. Since in the United States only 1/3 of a ton of meal eventually becomes flour, values for cottonseed flour should be approximately 1/3 of the above values.

[2] Based on Annual Report of the Fellows of the National Cottonseed Products Association, March 1962.

[3] Value for tryptophan from the Proflo Data Sheet, Traders Oil Mill, Fort Worth, Texas, used for this calculation.

[4] Since in the United States, 1/3 of a ton of meal eventually becomes flour, values for cottonseed flour should be approximately 1/3 of the meal values.

[5] In Central America, 60% of a ton of meal is converted to human consumption flour, therefore, the values in pounds per acre of the 8 amino acids is considerably higher than would be produced in the United States.

highly unlikely that diet deficient areas might increase imports of foods beyond that already projected. Low income indicates a high concentration of population in subsistence agriculture. Until urbanization and industrialization are increased, there will be little incentive for farmers to expand production.

Indigenous seed crops from which protein can be extracted have been selected for intense technological exploitation as a swift solution to protein supplementation in developing and/or over-populated countries (30, 31, 32, 33). In 1963, projected world production of edible oilseeds approached 80 million metric tons (34) of which about 60% were grown in the developing countries. Better than 29 million metric tons or 39% were soybeans and 21.5 million metric tons or 28.5% were cottonseed. However, in the diet-deficient countries only a little more than one million metric tons or 4.4% of soybeans were grown whereas 8.5 million metric tons or 40% of the cottonseed was produced (34).

Of the world total of vegetable oil seeds, almost 80% was crushed for oil, giving oil and meal as products in a ratio of one part oil to three parts meal on the average. In most of the developing countries, the meal is used as feed or fertilizer. Up-grading of the various seed meals for human nutrition gives promise of alleviating some of the shortages of protein now existing. Because other foods, in limited supply, are available in these countries, a supplementary protein need furnish only a relatively minor portion of the protein and calories to raise a substandard diet to the minimum required for the region. As an example, 13 out of 20 countries in Latin America (Mexico, Central and South America) have protein shortages, and 28% (1961) of the population subsist on diets that are below accepted minimum standards caloriewise for good nutrition (35). If this figure be compared with the 39% potential for supplemental feeding based on the yield of cottonseed flour being produced in this region, Table 1, the situation appears more favorable. It is recognized, however, that considerable improvement in technology will be required to increase the potential to meet all the protein shortage in the not too distant future. In Africa, 37% of the population live in calorie-deficient countries and in Asia where the situation is far more critical, 86% of the people live under conditions where calorie intake is below standard. Asia and Africa grow less cottonseed, therefore, protein supplementation in these regions will necessarily be accomplished by combining or substituting other vegetable proteins.

However, the greatest challenge is yet to come. In this century so far, only 1.4 billion people have been added to the earth (36). At the present rate of population increase, there are 3.4 billion more to come by the year 2000 (36). The unfortunate fact is that most of these new people will be added in countries that are least able to feed themselves. Actually, for the entire century, it is esimated that 800 million people will be added in developed countries, whereas four billion will be added in the less developed ones (36). Under these conditions land per capita becomes highly critical in each country. Developed countries have twice as much land per person as undeveloped countries. The land problem can be approached in two ways: either the land base can be increased, or production per acre must be increased, or both.

In those areas where food is abundant, principally in the temperate zone, there are approximately 1.7 acres of arable land per person. In Central America, there are 1.3 acres and, in Africa and West Asia combined, 2.3 acres. In these countries, it is believed that more potentially arable land is available than is being used. This will make possible increases in food production not only from increased yields but also by expansion of the land base. In contrast, the Far East has only 0.8 acre per person, and Communist Asia even less, 0.4 acre. As population expands in the latter areas, arable land per capita will continue to shrink.

Food-deficient countries are also lagging behind in production of fertilizers. The tropical and subtropical areas produce approximately 1.42 lbs. per acre compared to about 36 lbs. per acre in countries of the temperate zone. Huge investments in chemical fertilizer plants and irrigation works will be required, especially in the Far East and Communist Asia before these regions

can be expected to improve their otherwise critical situation (10).

The Central American Governments are keenly aware of the necessity for encouraging outside industries to move in and produce urgently needed chemicals for agricultural expansion. Toward this end five Central American nations, Guatemala, Honduras, Nicaragua, El Salvador, and Costa Rice, have formed the Central American Common Market, commonly known as the CACM. As yet, no report of a fertilizer producer has appeared in Trade Journals, but Hercules Powder has indicated that it is interested in building a plant in Nicaragua to produce Toxaphene, an insecticide used in the growing of cotton and other crops. Another company, Retzloff Chemical Company of Houston, Texas, has already built an insecticide plant in Guatemala for formulating concentrates and technical materials including Hercules' Toxaphene. This company sells now only in Guatemala and finds that country a sufficient market, because local farmers spray an average of 38 times per season (37).

It should be noted that large tonnages of cottonseed flour could not readily be moved into deficit areas and distributed through existing port, inland transportation, and other facilities. Even though cottonseed flour formulated as Incaparina has been found compatible with long-standing food habits in Central American countries, this is no assurance that it will be similarly compatible in other food deficit areas. Furthermore, because of the low purchasing power of the countries involved, it is not desirable to produce the flour in the United States and ship it to the other areas unless special measures are taken to compensate for the low purchasing power.

Public Law 480 provides for the disposal of surplus United States farm products to other countries as grants, gifts, barter, or through concessional sales under Titles I and IV (38). If United States expenditures in a country are small, dollar earnings in that country are meager and payment in local currency will not cause fluctuation in prices, then Title I sales are more favorable to the recipient country. If, on the other hand, United States expenditures in the foreign country are large enough to provide a net dollar surplus after deferred dollar repayment for the commodities, then Title IV sales are more suitable (38).

In addition to the PL-480 program, the United States is now initiating a research program sponsored jointly by the Agency for International Development, the Department of Agriculture in which the Northern and Southern Utilization Research and Development Divisions will conduct research on the production of a full-fat soy flour (NU) and cottonseed and peanut flours (SU) for human consumption, and UNICEF. Implicit in this research program is the training of a selected number of Nationals who will return to their respective countries equipped with the knowledge and skill to produce protein flours from vegetable sources for human consumption... This is the beginning of a concrete effort to place foreign countries in a position where they can best help themselves.

Summary

We have seen that cottonseed, grown in a substantial number of developing countries, is one important source of vegetable protein for supplemental feeding of humans. While the percentage of flour for human consumption currently being produced from this cottonseed still does not provide the total needs for supplemental protein feeding, it is believed that improved technology and handling of this important crop can go a long way toward meeting the critical protein shortage. One promising development is that at least two products have been made containing cottonseed flour and these are being supplied commercially for supplemental human feeding in a number of Latin American countries. In view of the staggering load of expected population increase in the developing countries, some of the aid programs which the United States has underway are reviewed.

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can be expected to improve their otherwise critical situation (10).

The Central American Governments are keenly aware of the necessity for encouraging outside industries to move in and produce urgently needed chemicals for agricultural expansion. Toward this end five Central American nations, Guatemala, Honduras, Nicaragua, El Salvador, and Costa Rice, have formed the Central American Common Market, commonly known as the CACM. As yet, no report of a fertilizer producer has appeared in Trade Journals, but Hercules Powder has indicated that it is interested in building a plant in Nicaragua to produce Toxaphene, an insecticide used in the growing of cotton and other crops. Another company, Retzloff Chemical Company of Houston, Texas, has already built an insecticide plant in Guatemala for formulating concentrates and technical materials including Hercules' Toxaphene. This company sells now only in Guatemala and finds that country a sufficient market, because local farmers spray an average of 38 times per season (37).

It should be noted that large tonnages of cottonseed flour could not readily be moved into deficit areas and distributed through existing port, inland transportation, and other facilities. Even though cottonseed flour formulated as Incaparina has been found compatible with long-standing food habits in Central American countries, this is no assurance that it will be similarly compatible in other food deficit areas. Furthermore, because of the low purchasing power of the countries involved, it is not desirable to produce the flour in the United States and ship it to the other areas unless special measures are taken to compensate for the low purchasing power.

Public Law 480 provides for the disposal of surplus United States farm products to other countries as grants, gifts, barter, or through concessional sales under Titles I and IV (38). If United States expenditures in a country are small, dollar earnings in that country are meager and payment in local currency will not cause fluctuation in prices, then Title I sales are more favorable to the recipient country. If, on the other hand, United States expenditures in the foreign country are large enough to provide a net dollar surplus after deferred dollar repayment for the commodities, then Title IV sales are more suitable (38).

In addition to the PL-480 program, the United States is now initiating a research program sponsored jointly by the Agency for International Development, the Department of Agriculture in which the Northern and Southern Utilization Research and Development Divisions will conduct research on the production of a full-fat soy flour (NU) and cottonseed and peanut flours (SU) for human consumption, and UNICEF. Implicit in this research program is the training of a selected number of Nationals who will return to their respective countries equipped with the knowledge and skill to produce protein flours from vegetable sources for human consumption. This is the beginning of a concrete effort to place foreign countries in a position where they can best help themselves.

Summary

We have seen that cottonseed, grown in a substantial number of developing countries, is one important source of vegetable protein for supplemental feeding of humans. While the percentage of flour for human consumption currently being produced from this cottonseed still does not provide the total needs for supplemental protein feeding, it is believed that improved technology and handling of this important crop can go a long way toward meeting the critical protein shortage. One promising development is that at least two products have been made containing cottonseed flour and these are being supplied commercially for supplemental human feeding in a number of Latin American countries. In view of the staggering load of expected population increase in the developing countries, some of the aid programs which the United States has underway are reviewed.

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