Projection and Prospects for Cottonseed in the 1970's[1]

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ABSTRACT

Oilseeds and their products, vegetable oils and oilcakes, are primary agricultural commodities on the world market. The current annual volume is ca. $3000 million and, with increasing world population and income, their production is expected to expand. Improved technology, which allows for substitution of oils from various sources in many products, has narrowed the price spread between different oils. If production increases as predicted, the price of vegetable oils may decline in the future. Oilcakes are used primarily for animal feed at present. Forecasts predict that consumption of oilcake should increase and prices remain stable. Since cottonseed is a byproduct of cotton fiber production, it does not readily respond to fluctuations in supply and demand. Two factors may significantly affect utilization patterns of cottonseed protein in the future. First is development of the liquid cyclone process for production of food-grade protein flour from conventional cottonseed. Second is development of commercially acceptable varieties of glandless cotton, the seed of which can be processed into food without special procedures. Exploitation of these developments could move significant amounts of cottonseed protein into food channels in both developed and lesser developed countries and alter use patterns for cottonseed.

[1]One of 11 papers presented in the symposium "The World Supply of Edible Oils and Proteins," AOCS Meeting, Atlantic City, October 1971.

The recent Foreign Agricultural Economic Report No. 000, entitled "World Demand Prospects for Cotton in 1980," (1) estimates that world cotton consumption will be 30% higher in 1980 than in 1967. This increase is anticipated in spite of the fact that cotton's share of the total fiber consumption is expected to decline from 57% in 1968 to 48% or less in 1980. By 1980, the developing countries of the world are expected to account for about half of the world's cotton production and two-thirds of the world's cotton lint exports. Trade in cotton textiles will increase, and by 1980 it is expected that about one-half of the world's exports of these textiles will originate in the developing countries. It can be seen from these projections that there will continue to be a supply of cottonseed on a world basis to participate as a factor in the world oilseed market.

Although cottonseed oil has been an item of trade in edible oils for many years, cottonseed protein has moved almost exclusively into livestock feed channels. Recent developments involving cottonseed may materially alter use patterns in the future. These developments have the potential for affecting the price structure for cottonseed and perhaps, ultimately, the production patterns and allocation of land resources for cotton production. Cottonseed protein is used primarily in ruminant feeding because of the presence of gossypol, a polyphenolic pigment that is toxic to monogastric animals and man. Techniques have been developed to inactivate gossypol by high temperature processing to convert it to the bound form which is nontoxic. Several mills on the west coast have utilized the prepress-solvent procedure for a number of years to

TABLE I

Estimated Costs of Selected Proteins

	Product	Price (Cents per Pound)	Percent Protein	Price per Pound Protein (Cents)
Oilseed	Peanut flour	7	59	12
	Cottonseed flour	5	50	10
	Soy flour	7-8	50	14-16
	Soy concentrate	18	70	26
	Soy isolate	35-39	90+	39-41
	Soy protein isolate (spun, textured and flavored)	50-80	Variable	---
Milk products	Nonfat dry Milk	21	36	58
	Casein (food grade)	28.0-32.5	85	33-38
	Sodium Caseinate	42.5	90	47
Fish	Fishmeal	7	80	9
	FPC	42	80	52
Single-cell protein	Tarula (Candidis) food	15	50	30
	Yeast feed	4-6	50	8-12
	Petroleum derived Protein-feed			
	Yeast	8	50	16
	Bacteria	8	70	11
	Petroleum derived Protein-food			
	Yeast	17.5	50	35
	Bacteria	17.5	70	25
	Algae	200-550[a]	50	400-1100
	Yeast (active, dry)	40	37	108
Animal products	Steer beef (dressed)	40	13-19	210-307
	Chicken (diced, boneless, cooked)	90	20	450

[a]At rate of 100 lb/day.

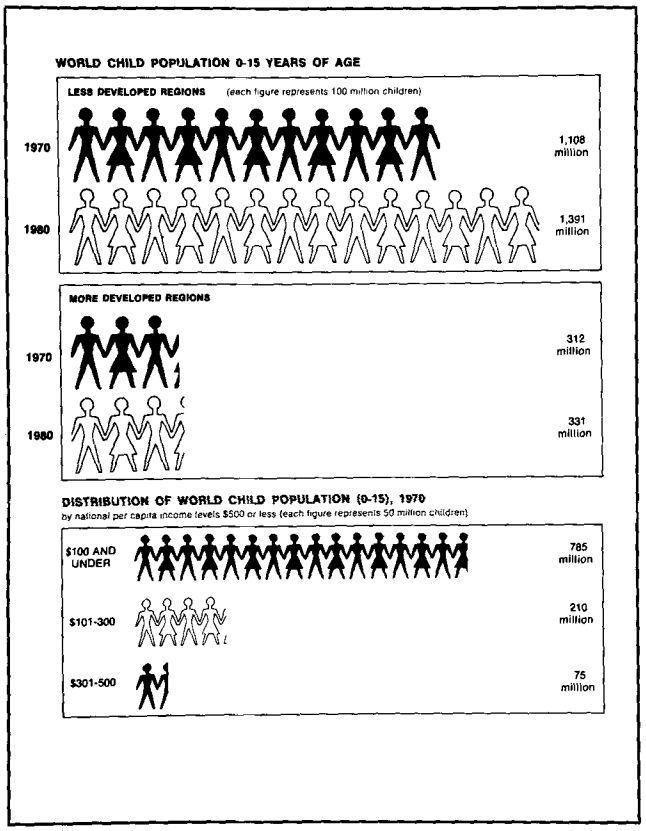

FIG. 1. World child population 0-15 years of age.

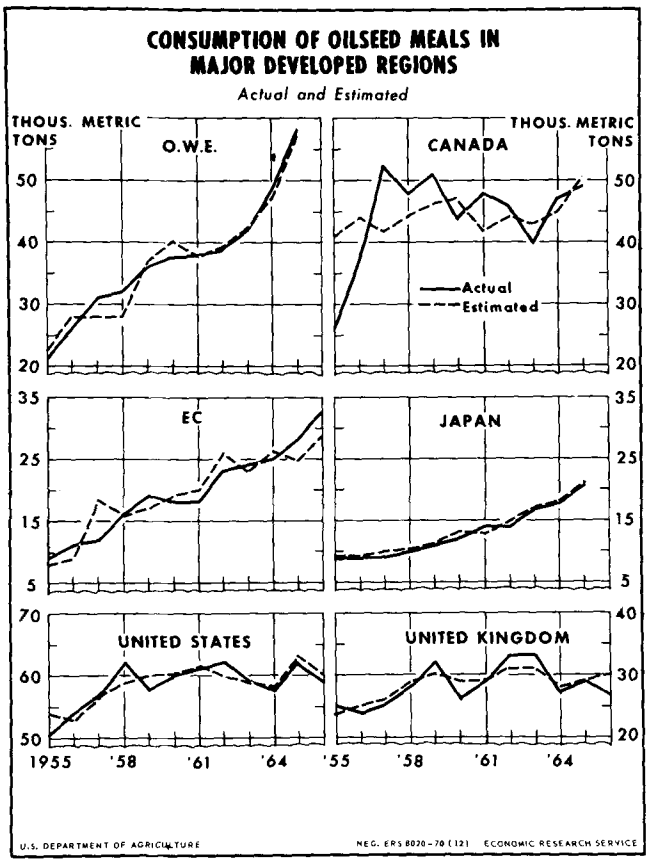

FIG. 2. Consumption of oilseed meals in major developed regions.

produce a low free gossypol cottonseed meal for the egg-producing flocks in that area. Also, research at Texas A&M (2) and elsewhere, as well as commercial use, has demonstrated the efficacy of iron salts in preventing gossypol toxicity in nonruminants, particularly in swine. However the disadvantage to the heat-detoxication of gossypol is that binding occurs primarily on the lysine residues of the cottonseed protein, resulting in a reduction of the nutritional value. Gossypol is also a liability in the cottonseed protein from the standpoint of color, which darkens food products in which it is used.

During the past 10 years, research workers at the Southern Marketing and Nutrition Research Division of the USDA in New Orleans, have developed a processing technique known as the "liquid cyclone process" (3). This process involves disintegrating low moisture cottonseed kernels in an organic solvent, such as hexane, without rupturing the pigment glands and pumping the resulting slurry through liquid cyclones where centrifugal force separates the intact pigment glands from the smaller and lighter protein particles. Approximately 50% of the cottonseed protein is obtained as a high protein material which is quite bland in flavor and light cream in color. It contains from 68 to 70% protein and less than 1% residual lipids. The content of free gossypol is between 0.02 and 0.04%, which is acceptable for food grade material. The product is suitable for use in swine and poultry feeds as well as for human foods; however, initially at least, it is probable that price will prohibit its use as animal feed. A pilot plant using this process was erected in India in 1969, and the Plains Cooperative Oil Mill in Lubbock, Texas, is in the process of installing a facility using this process which will have the capacity of 25 tons product per day and should be in production sometime in 1973. The food industry in the U.S. is eagerly awaiting availability of this material, as it is anticipated that it will have a number of applications in food systems.

The most exciting development in cottonseed today is the advent of commercial varieties of glandless cotton. In the early 1950's USDA cotton geneticists (4) discovered plants that have furnished the genetic material for the elimination of pigment glands from cottonseed by cross breeding. Since that time, cotton breeders of the USDA, state agricultural experiment stations and commercial seed producers have been working on the incorporation of this characteristic into varieties of cotton with desirable fiber characteristics in terms of quality and quantity. These efforts are finally coming to fruition, and in Texas this year there are four commercial varieties of glandless cottonseed available to the cotton producers. It is anticipated that other cotton breeders will release their lines of glandless cotton in the near future. Acreage of glandless cotton has been increasing in recent years, with ca. 13,000 acres being planted in Texas during the 1970 season and ca. 20,000 acres during 1971.

Research on the processing and utilization of glandless cottonseed and its products has been in progress for a number of years at the USDA laboratory in New Orleans and the Oilseed Products Division of the Food Protein Research and Development Center at Texas A&M University. Dehulled, defatted, glandless cottonseed meal contains 55-60% protein and is bland in taste and creamy white in color. The crude glandless oil is as light in color as the usual refined oil from glanded cottonseed. Concentrates containing 68-70% protein can be produced by air classification or by aqueous extraction and spray drying. 90% Protein isolates can also be produced by protein isolation techniques developed by W. Martinez of the New Orleans laboratory (5-7).

Feeding trials, such as ones recently conducted at Texas A&M with laying hens, have shown glandless cottonseed protein to be superior to soybean protein when the two meals are supplemented with methionine and lysine to eliminate differences resulting from the content of these two amino acids. Glandless cottonseed protein products should compete favorably with soy products in the food

trade, since they are not liable to some of the flavor problems of soybean products.

Progress has been made in developing food uses for glandless cottonseed products. At Texas A&M we have produced Tamunuts (8,9) which are toasted, salted, glandless cottonseed kernels. A more recent discovery is that of a whipping agent in the whey produced in the preparation of protein isolates from cottonseed. Other potential uses of cottonseed protein are the fortification of bread and other bakery products, pastas such as macaroni and noodles, snacks, confections, and others. It may be used as an extender in processed meats or for the production of meat analogs such as are now being made from soy protein. USDA researchers in New Orleans (5) have defined the unique acid-solubility property of the major protein isolate which may be used to produce carbonated protein-fortified soft drinks. Such a product could make a significant contribution toward increasing the protein intake of children and adolescents around the world.

Figure 1 (10) shows the anticipated growth in the population of children, 0-15 years of age, from 1970 to 1980 in the developing and developed regions of the world. It is particularly significant that the developing regions, which show a projected increase of 283 million children in this age group as compared with 19 million in the developed regions, are also predicted to be the areas where cotton production will increase. As can be seen in Figure 2 (11), the majority of the oilseed proteins produced today in both the developed and developing regions of the world are consumed by the developed regions with their animal-feeding economies. An examination of Figure 3 (12) reveals that no shift in this pattern of higher meat consumption in the developed countries is anticipated in 1980. However, if available oilseed protein, especially cottonseed protein, in these developing countries can be utilized to supplement the available food grains, nutritional disaster may be averted. Although a majority of the predicted increase in world population will occur in the developing countries, the projected increase in per capita income in these countries in 1980 is relatively small. Certainly it is too small to provide hope of increasing the consumption of animal protein in their diets. Table I (13) presents the estimated costs of selected proteins in cents per pound. The economic attractiveness of cottonseed protein as a low cost dietary supplement is readily apparent when compared with animal products listed at the bottom of the table.

In the past, vegetable oil for food and industrial uses has been the most valuable product of oilseeds. Improved technology, which allows for substitution of oils from various sources in many products, has narrowed the price spread between different oils. If production increases as predicted, the price of vegetable oils may decline in the future. This could result in oilseed proteins becoming a more significant factor in determining the market value of oilseeds. Those oilseeds with proteins most desirable for food applications should profit accordingly. Liquid cyclone protein from glanded cottonseed and flours, concentrates, and isolates from glandless cottonseed should play a vital role in bridging the "protein gap" in this decade, not only in the developing nations but also among the lower income groups in the developed countries.

It may become desirable to produce varieties of cotton with a higher proportion of seed to fiber, in order to increase the available supply of cottonseed. With an increasing use of cottonseed protein for human food, the return to the producer from cottonseed should increase. This will either increase the cotton farmer's total return from his crop or enable him to sell his fiber at a more competitive price or, more likely, a little of both. The net overall effect should be to encourage the production of

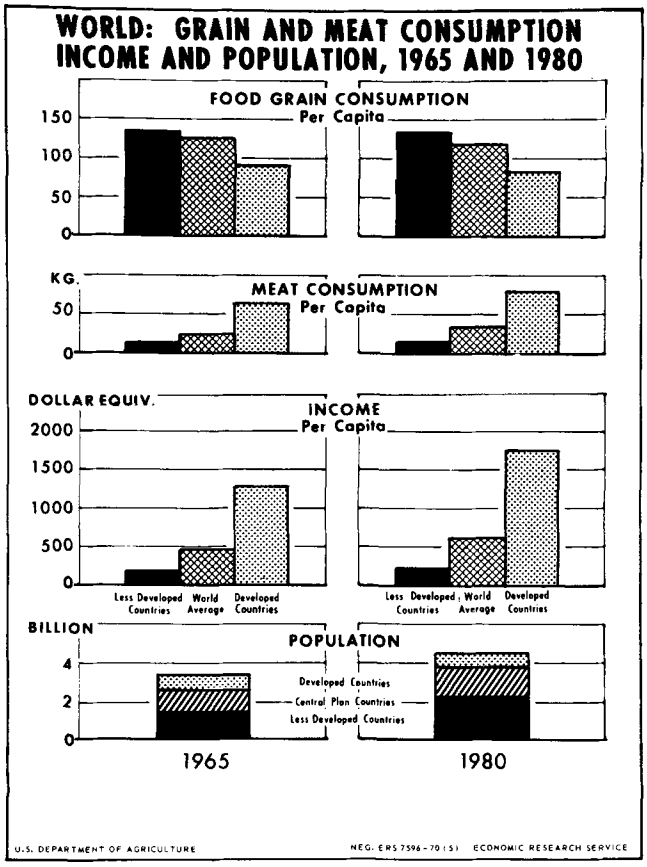

FIG. 3. World: grain and meat consumption, income and population, 1965 and 1980.

cotton. From another standpoint—that of the most efficient utilization of the world's available cultivable land resources in the face of ever-rising population numbers—a plant which can produce from the same stalk protein and oil for man's food, fiber for his clothes and feed for his animals must receive a relatively high priority.

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