SORGHUM AND THE MEXICAN FOOD CRISIS*

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Mexico achieved food self-sufficiency and raised rural living standards in the thirty years prior to the mid-sixties, yet the country is now plagued by a profound agricultural crisis that is manifesting itself in serious natural resource disequilibria, unemployment and underemployment, and inadequate food production. This seemingly contradictory outcome has resulted from an agricultural growth strategy that reoriented production toward agroexports and animal feeds. Understanding the effects of this strategy is essential because these same trends are the most important phenomena in the agricultural sector of many developing countries today (Barr 1981; Winrock International 1981; DeWalt 1983).

Many analyses of rural development have demonstrated that this process of agricultural modernization is destroying old forms of social and economic organization. This transformation has dramatically affected societies throughout the world, as has been shown by dramatic shifts in productive, social, and economic structures as a result of the expanding capitalist world system.[1] What is new is the rhythm in which it is occurring today and its increasingly homogeneous character throughout the world. By means of international dissemination of new technology, new forms of organization of production, mass-marketing techniques, and the spread of new items of consumption, increasingly homogeneous (national) systems are being created. In this process, cultural idiosyncrasies are modified.[2]

The point is that producers at all levels—in the present case, Mexican small farmers, large farmers, food processors, and transnational corporations—find it in their best interests to move toward the

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most modern and productive methods of cultivation, management, and marketing to turn out the most profitable commodities.[3] With the dissemination of information about world-market prices, the search for efficient and profitable lines of production has led to the accelerated diffusion and adoption of technological innovations. On the demand side, too, rising incomes for certain social groups and changing worldwide consumption patterns are pushing farmers toward new products. These processes are integrating individual producers into the new emerging world system. We will analyze the case of Mexican agriculture to explore the problems that arise as this assimilation proceeds.

TRANSFORMATION OF THE AGRICULTURAL SECTOR IN MEXICO

Details of the many factors that have intervened to transform Mexican agriculture have been amply documented in numerous studies (Barkin 1982; CESPA 1982; Rama and Rello 1982; Barkin and Suárez 1985; Austin and Esteva 1987).[4] Here we will synthesize the most important of these factors and trace their impacts on rural Mexico. The two phenomena that have most significantly influenced the evolution of land utilization patterns in Mexico are the notable increase in the area cultivated and the marked change in the composition of crops grown on this expanded area.

The Growth and Intensified Use of Cultivated Area

The agrarian reform carried out as a result of the Mexican Revolution determined to a great degree the expansion and intensification of the area under cultivation. The resulting redistribution of lands and the formation of *ejido* communities opened the possibility of more systematic and intensive cultivation of regions previously abandoned or underutilized by large landowners.[5] Even though a large part of the ejidal grants consisted of marginal lands, the agrarian reform provided small producers with the means to produce basic commodities for family and local community consumption. Together with small improvements in the quality and quantity of inputs (such as fertilizers), credit, and technical assistance available for production of basic grains, increased participation of peasant farmers in production contributed to achieving national self-sufficiency in maize production by the end of the 1950s (see DGEA-SARH 1981; Barkin and Suárez 1986).

A second important factor in the growth in cultivated area has been the increasing availability of irrigation in zones previously not amenable to cultivation. Commissions on developing river basins were organized during the presidency of Miguel Alemán (1946–1952) to expand the production frontiers as a strategy for stimulating agriculture

TABLE 1 *Growth in Basic Agricultural Parameters in Mexico between 1940 and 1982*

Indicator	*1940*	*1982*	*Annual Growth (%)*
Basic grains (in hectares)	5,900,000	16,000,000	2.4
Irrigated area (in hectares)	1,700,000	5,600,000	2.9
Population	19,763,000	71,464,000	3.1

Source: DGEA-SARH 1983a.

(Barkin and King 1970). Emphasis on irrigation is reflected clearly in the public investment programs: between 1940 and 1979, irrigation constituted between 70 percent and 99 percent of the total budget invested in the agricultural sector (Sanderson 1984, 118; Barkin and Suárez 1986). The resources were concentrated principally in the three key northern states of Sonora, Sinaloa, and Tamaulipas (Barkin and Suárez 1986, t. 10).

The result of this policy has been a significant increase in the proportion of the nation's irrigated area from less than 14 percent in 1950 to an estimated 25 percent of the cultivated area (DGEA-SARH 1983a, 21). Although this figure may overestimate the real irrigated area, it should be noted that Mexico has one of the world's highest proportions of irrigated land to total cultivated land.

To summarize, since 1940 the amount of cultivated land has expanded at a rate of more than 2 percent annually. The area cultivated has tripled while the area opened to irrigation increased even more rapidly, more than tripling the area irrigated in 1940 (see table 1). These figures account for the substantial increase in agricultural production during the period, which resulted in a growth in cumulative annual employment in modern agriculture of 2 percent between 1950 and 1980. During this same period, the growth of agricultural employment in Latin America as a whole was less than 1 percent (Couriel 1984, 55).

The Change in Crop Composition

The period since 1940 has also witnessed significant changes in the composition of agricultural production. At first, most policymakers joined with the farmers in emphasizing the production of food for the Mexican population. Both groups were content to increase output of staple crops as a way of improving producer profits and supplying domestic markets. The agrarian reform and the construction of irrigation works were originally defended by policymakers as means of solving

the problem of feeding the population. The agricultural sector was also generating sizable amounts of foreign exchange from traditional agro-exports to fund industrialization.

Large landholders led the change to more intensive utilization of the land. Many were obliged by economic pressures and the threat of further land expropriation to stop treating their land as simply an element of status or prestige, as had often been the case. Politics reinforced the market to stimulate a more intensive pattern of cultivation, one directly oriented toward producing profit. Traditional production of basic food grains became less profitable as small farmers began to cultivate their new plots and urban and industrial groups pressed for price controls on these products.

As a consequence, a new group of commercial agriculturalists made major changes in technology, abandoning the traditional use of land for more capital-intensive exploitation by employing fertilizers, pesticides, improved seeds, mechanization, and other practices to increase productivity and profitability. For example, at the end of the 1970s, the use of fertilizers was growing at an annual rate of 13 percent, and between 1940 and 1980, the number of tractors in the country grew at a rate of more than 9 percent per year (DGEA-SARH 1983a, 27). The increasing availability of government agricultural credit lowered the cost of these and other inputs and facilitated expanding the physical productivity of the land for wealthy farmers.[6] Under these conditions, the volume and value of agricultural production would have increased even without a substantial increase in the area under cultivation.

The trend toward capital-intensive exploitation, however, caused significant changes in the use of labor: permanent employees were replaced by machinery and by temporary and migratory laborers, causing social and economic dislocations. Although employment in the modern rural sector expanded from 32 percent of the total employed in agriculture in 1950 to 51 percent in 1980, an absolute reduction occurred in the number of self-employed agricultural workers (Couriel 1984, 56).

The modernization of Mexican agriculture since 1965 has been characterized by phenomenal growth in the livestock sector. The data in table 2 show that the production of pigs, chickens, and cattle has been growing rapidly. Per capita consumption of eggs doubled in the last forty years; poultry production tripled in the past thirty years to 150 million birds; and hog production grew almost as rapidly to 13 million head in 1980 (Yates 1981, 103–5; USDA 1981, 7). This expansion in the livestock sector has been achieved through a modernization process that has increasingly "industrialized" production. Natural pastures, household wastes, and other similar resources once used for household production of livestock have been replaced by new technological sys-

TABLE 2 *Growth of Important Agricultural Indicators in Mexico, 1965–1982*

Indicator	*1965*	*1982*	*Annual Growth (%)*
Basic grains (in hectares)			
Maize	7,718,371	5,744,249	−1.7
Beans	2,116,858	1,581,000	−1.7
Wheat	858,259	1,017,359	1.0
Rice	138,065	156,317	0.7
Feeds (in hectares)			
Alfalfa	106,252	242,379	5.0
Oats[a]	16,550	251,716	28.1
Grain sorghum	314,373	1,275,212	8.6
Cultivated pastures	6,954	2,044,527	39.7
Oilseeds (in hectares)			
Safflower	58,805	189,045	7.1
Sesame	267,234	91,013	−6.1
Soy	27,466	375,238	16.6
Animals (in tons)[b]			
Pigs	572,894	1,365,414	9.1
Chickens	215,485	482,491	8.4
Cattle	624,956	1,200,544	6.7

Sources: For figures on grains, feeds, and oilseeds, DGEA-SARH 1981; and DGEA-SARH 1983b. For figures on animals, DGEA-SARH 1982b.

[a]These data and growth percentages come from 1971, when data on oats for feed began to be collected.

[b]These data and percentages come from 1972, when the DGEA began collecting data on animal production.

tems that rely on cultivated pastures, improved breeds of animals, heavy use of antibiotics, and confined feeding with industrially produced balanced animal feeds. This process first occurred among poultry producers and has since affected significant parts of the hog and dairy sectors.

As a result, land utilization has been changing rapidly to respond to the well-paying demand for green fodder, feed grains, and oilseeds. The technology used for livestock production has created competition between livestock and humans for the use of Mexico's land and other agricultural resources.[7] The data in table 2 show clearly the displacement of basic grains by soy, alfalfa, sorghum, oats and other

cultivars intimately related to "modern" agricultural and livestock production.[8]

Diversification in the use of agricultural land in Mexico is more complex than a simple expansionary trend toward livestock products. Also notable is an important expansion in the area cultivated with fruits and vegetables, a process stimulated by agroindustrial investment (Feder 1977; Rama and Vigorito 1979). At the same time, in certain parts of the apparatus of public administration, greater concern was expressed for the profitable commercial production of products like cotton, coffee, and tobacco. Expansion in some other important commodities has been stimulated almost exclusively by private initiative reacting to market signals and incentives, as in the cases of growing chickpeas for export and grapes as raw material for national agroindustrial production.

This diversification and intensification reduced the share of basic food crops in national production as other crops proved more profitable. Government policy and the growing influence of world-market prices on producer decisions greatly accelerated these changes. The land area planted in the four basic foods (maize, wheat, rice, and beans) declined from three-quarters of the total at the beginning of the 1940s to less than half by 1980. The land dedicated to maize, wheat, and beans has been generally declining since 1966; these three basic food crops declined from more than eleven million hectares to less than ten million by the mid-1980s, even as the total amount of land under cultivation increased by almost 50 percent (Barkin and Suárez 1986).

Despite the insufficiency of production of basic grains in the country, large areas of rain-fed lands have been abandoned. The government estimated that nine million hectares of arable land were idle during the 1984 summer crop cycle, despite the best rainfall in the past half century;[9] and a similar phenomenon was observed in 1985. This wholesale abandonment of cultivation of potentially productive rain-fed lands has resulted from policies restricting price increases for basic food grains that predominate in rain-fed agriculture, as well as from unwillingness to provide the necessary credit and inputs for the exploitation of these areas.

A direct consequence of this displacement of basic grains for direct human consumption has been the need to import enormous quantities of food to meet the needs of the urban population and, increasingly, of the rural population as well. Between 1980 and 1985, maize imports represented almost one-quarter of national production, rising as high as 35 percent in 1980 and 1983 (Barkin and Suárez 1986, t. 19). Agriculture has not succeeded in exporting enough to pay for the basic grains and other food imports needed during the first half of the eight-

ies (see IDB 1986, 82), at a time when overall economic balance required an effort to increase exports in all sectors.[10]

Displacement of basic grains has become even more pronounced in recent years, now that the expansion of cultivated land has slowed. Because of this trend, the transformation of Mexican agriculture must be viewed not just as a change in the type of products offered but also as a change in the way productive decisions are made, how commodities are produced, and the population for whom they are destined. The dynamics of Mexican agriculture have led to the abandonment of rain-fed lands by small farmers as production has become unprofitable. Research into production of basic foods in rain-fed areas has also been deficient, thus depriving this social group of the kinds of technological innovations that others have used to spur commercial production. Furthermore, small farmers have not received the technical and material support required either to increase the productivity of basic foods or to reorient their production toward more remunerative commercial crops. Although the Sistema Alimentario Mexicano (SAM), the country's much-vaunted drive for food self-sufficiency launched in 1980, briefly slowed these trends, a reversion to the original patterns has occurred following the dismantling of the SAM in 1982 (Austin and Esteva 1987). Subsequent rhetorical commitments to food self-sufficiency have not been supported by changes in the system of relative prices or by government assistance to translate them into reality (Barkin and Suárez 1986).

THE HISTORY OF SORGHUM IN MEXICO

To illustrate some of these trends, it is useful to consider the expansion of sorghum cultivation and use. Sorghum was unknown in the traditional agriculture of Mexico. Except for a few unsuccessful experiments during the first half of the century, it was not cultivated systematically. In 1944, however, foreign agronomists from the new Oficina de Estudios Especiales (established through an agreement between the Rockefeller Foundation and the secretary of agriculture of the Mexican government) began to experiment with sorghum. Their work started with the premise that drought-tolerant sorghum might help resolve the problems of areas that were marginal for maize cultivation, lands where rainfall was either limited or poorly distributed (Pitner, Lazo de la Vega, and Sánchez 1954, 1).

Early experiments met with neither major success nor much interest among agriculturalists. Only at the end of the 1950s was great interest shown in sorghum. In 1957 the Rockefeller Foundation annual report on the Mexican Agricultural Program observed: "Interest in sorghums has grown considerably during the last year principally because

of the rapid expansion of the livestock industry, especially pork and poultry production. As a result of recent heavy demand, the price of sorghum grain in Mexico City has increased from 400 to 450 pesos a metric ton at harvest time in 1955 to 790 pesos in May, 1957" (Rockefeller Foundation 1957, 77). Since 1958, when the government began collecting statistics on sorghum, the crop's history has been nothing short of spectacular. During the period between 1965 and 1982, when the area cultivated in the country was growing at a rate of 2 percent per year, the area cultivated in sorghum was growing at a rate of 9 percent per year (see table 2). By 1984 sorghum was occupying over a million and a half hectares, about one-fourth the area of maize and more than twice that of wheat, the miracle crop of the first green revolution. Today sorghum occupies the second largest area of any crop sown in Mexico. Yet despite having become the fifth-largest producer of sorghum in the world, Mexico is not self-sufficient in this grain. In recent years (1983–84), the country has had to import a third or more of national needs, making Mexico the second-largest purchaser of U.S. sorghum.

The reasons for this green revolution in sorghum involve a combination of technological, ecological, and socioeconomic factors (see DeWalt 1985a). From a technological point of view, the production of sorghum in Mexico benefited from the creation of sorghum hybrids in Texas. Until 1955 production of sorghum hybrids on a grand scale was not possible. With the discovery of male sterile plants, however, sorghum hybrid production increased so rapidly that by 1960, 95 percent of the sorghum in the United States was sown with hybrid seed (Quinby 1971, 17–19). Mexican farmers quickly recognized the productivity of hybrids used by their neighbors to the north and began replacing maize with sorghum or introducing it into newly opened areas. Thus widely adaptable and highly productive hybrid sorghums from the United States were quickly adopted by an important group of relatively large-scale Mexican farmers without benefit of national or international government programs to encourage production, without the sponsorship of any bilateral or multilateral aid agency, and without lessons and technical assistance from any extension agents.

A major factor in creating a burgeoning demand for sorghum was the fact that during the early 1960s, transnational animal feed companies were transforming poultry and pig-raising technology. In 1964, for example, Ralston Purina launched a campaign to promote the benefits of sorghum, discussing the practices necessary to cultivate it and providing U.S. hybrid seed to producers. Finally, the company offered to buy on beneficial terms the total production to use as an input in its diverse lines of nutritionally balanced livestock feeds.

DeKalb, Pioneer, Northrup-King, Asgrow, Funk, and other transnational seed companies responded to the demand for hybrid sor-

ghum seed by establishing research and marketing operations in Mexico, where they were unencumbered by the laws that regulated their activity in maize seed (see Barkin and Suárez 1983, 102–7; Barkin and Suárez 1986; and Barkin 1987). Because virtually all of the sorghum in Mexico is planted using hybrid seed (Barkin and Suárez 1983), its adoption must surely qualify as one of the most successful cases of diffusion of innovations (Rogers 1971).

Yields of sorghum in Mexico have been much higher than those of maize, nearly equaling the average yield of wheat. Aburto found that under similar technological circumstances on irrigated land, average yields of sorghum were 40 percent higher than those of maize (1979, 145). On rain-fed lands, average yields of sorghum were 89 percent higher. Because agricultural scientists agree that maize has higher yield potential, its poor performance must be attributed to the failure of the national agricultural research and seed system to deliver a competitive variety or hybrid. These deficiencies have been compounded by the relative lack of credit and the disadvantageous producer prices fixed for maize as compared to those prevailing in the less-regulated domestic market for sorghum.

Sorghum production has also benefited from infrastructural improvements. Although the Office of Special Studies originally experimented with sorghum for marginal lands, about 35 percent of the sorghum is being grown under irrigated conditions (Barkin and Suárez 1986). Large extensions of land in such productive irrigated zones as Tamaulipas, Sinaloa, and the Bajío (a highly productive area of central Mexico) are planted in sorghum, partly because it requires less water than maize or wheat for successful cultivation. In some regions of the country that have experienced droughts in recent years, like the Bajío, the government has sometimes found it necessary to limit irrigation water because of low levels in reservoirs. For example, Bajío farmers in 1982 were allowed to irrigate only twice rather than four times per season, as had been their practice. Under such conditions, sorghum displays a definite advantage. The drought that hit Mexico in 1982 reduced the maize yield 40 percent below the previous year's level (Walsh 1983, 825), but sorghum yields were not as drastically affected.

Sorghum has also benefited from the Mexican government's policies of encouraging mechanization and the use of agricultural inputs. In most of the country, sorghum cultivation is highly mechanized: tractors are used for plowing, seeding, and cultivating, and combines are used for harvesting. Sorghum has thus benefited from the heavy subsidies accorded to tractor production, operation, and purchase (Yates 1981, 129). Even poor *ejidatarios* interviewed in the Bajío, San Luis Potosí, Sinaloa, Michoacán, Puebla and Morelos use manual labor only for some weeding and for scaring away birds just before the harvest. All

other operations are carried out by rented tractors and combines contracted for harvesting. Hired trucks working in concert with the combines immediately carry the grain to the processing plants.

Sorghum has come to be viewed by farmers as a crop with many advantages over the more labor-intensive maize, which requires between two and ten times as many days of labor per hectare (see DeWalt and Barkin 1987). As noted, sorghum is a less risky crop to undertake because it is more drought-tolerant than other crops. In addition, farmers report that they need not worry about "midnight harvests" of sorghum, which is not grown for human consumption in Mexico. In contrast, a substantial amount of the maize in some areas is stolen by passers-by. The high degree of mechanization is also considered an advantage by many smaller farmers, who have increasingly turned to off-farm employment opportunities to support themselves and their families (Roberts 1982, 1986). For example, in one community that we studied in San Luis Potosí, more than half of the ejidatarios had worked in the United States as illegal migrants within the preceding five years. These individuals continue to farm part-time because little of their own labor is required while seeking more remunerative work in other places (DeWalt and Barkin 1987).

The government price-support system has also helped make sorghum an attractive crop. The most rapid increases in sorghum production came in the mid-1960s. The amount of sorghum produced nearly doubled from 747,000 tons in 1965 to over 1.4 million tons in 1966 (DGEA-SARH 1981). In this same period, production of basic food grains began its downward trend (DeWalt 1985a). This critical turning point in Mexican agriculture saw the confluence of two key government policy changes. First, the government decided to freeze price supports for most grains in 1964 as a result of high costs; the guaranteed price for wheat actually dropped from 913 pesos to 800 pesos per ton. Second, the government initiated a guaranteed price of 625 pesos per ton for sorghum in 1965. The effects of these two actions made wheat and maize less profitable crops than they had been previously while making sorghum more attractive. Many farmers who had been growing wheat switched to sorghum or other cash crops of higher value (Hewitt de Alcántara 1976). A similar pattern emerged on a much larger scale among maize farmers. Although the support price for sorghum has varied between 58 percent and 84 percent of the price of maize during the last two decades (DGEA-SARH 1982b), sorghum's higher yields, lower input costs, and reduced risk have caused it to displace maize in many farmers' fields.

The final element contributing to the growth of sorghum in Mexico has been the steadily increasing demand from the animal feed industry. Between 1950 and 1975, the number of establishments pro-

ducing animal feed grew from nineteen to more than three hundred. Since that time, the number has grown explosively as new firms and farmers compete to produce the relatively standardized product. A few transnational corporations like Ralston-Purina and Anderson-Clayton, along with a government competitor called ALBAMEX (Alimentos Balanceados de México), virtually control key ingredients in this industry (Barkin and Suárez 1980, 135–36). Animal feed for use in industrialized production of eggs, poultry, and hogs can consist of maize, barley, wheat bran, soybeans, and other products, but sorghum supplies 74 percent of the raw material used in processed feeds in Mexico (DGEA-SARH 1982a). The expansion of sorghum production, the emergence of the specialized feed industry, and the growth of poultry- and hog-production have thus proceeded hand in hand.

Despite the phenomenal growth of sorghum production, Mexico remains unable to grow enough to satisfy the demand. In 1983 the country imported 3.3 million tons of sorghum, about 40 percent of the total utilized. This figure declined to 2.1 million tons in 1985, reflecting both an increase in domestic sorghum production and a decline in internal demand for poultry and pork as a result of the deepening national economic crisis. Sorghum thus epitomizes the trends in Mexican agriculture toward *ganaderización*, or production oriented toward livestock (Barkin 1982). That is, a growing share of rural resources are being devoted to fodder production for livestock to provide an affluent diet for wealthy and middle-class Mexicans whose share of national income rose substantially during the 1970s, thus increasing their demand for sources of animal protein (Hardy 1982).

Enormous quantities of natural resources are devoted to the production of meat. The proportion of cropland devoted to animal production has risen from 5 percent in 1960 to over 23 percent in 1980 (Barkin 1982, 66–67); and it has been reported that 64 percent of the national territory is used to produce only three million tons of meat, a yield of only twenty-four kilograms per hectare (García Sordo 1985, 8). The proportion of grain fed to animals has increased from 6 percent in 1960 (Meissner 1981) to over 32 percent in 1980 (DeWalt 1985a), and the Programa Nacional de Alimentación recently estimated the level as high as 48 percent of total apparent grain consumption.[11] Mexican nutritionist Adolfo Chávez has likened this use of resources for meat production to the miracle that Christ performed with the loaves and the fishes—but in reverse (1982, 9).

The Mexican case is an excellent illustration of a pattern noted by Peter Timmer, Walter Falcon, and Scott Pearson: "[H]igher incomes for middle- and upper-income households may increase demand for livestock products and ultimately reduce food intake of the poor. The large conversion factor between feed grain and meat, coupled with high in-

come elasticities of demand for meat in middle- and upper-income households, means that societies with highly skewed income distributions have the potential for very rapid increases in grain demand" (Timmer, Falcon, and Pearson 1983, 51). The problem is that the social benefits of the use of cropland, grains, and the seventy-four million hectares of pasture are poorly distributed. Although per capita consumption of meat is about sixty kilograms per year (DeWalt 1985a), the government itself reported that more than twenty-five million Mexicans (over 35 percent of the population) never eat meat and that less than thirty million drink milk regularly.[12] While many occasionally consume animal products (eggs and milk), the distribution of these products is sharply skewed in favor of upper- and middle-income groups. Malnutrition is widely accepted as one of Mexico's gravest public health problems. One authoritative source reports that between 40 and 50 percent of the population are seriously undernourished (Reig 1985, 43).[13]

OBSTACLES TO DEVELOPMENT: GOVERNMENT POLICY AND THE WORLD MARKET

The modernization of Mexican agriculture has been impressive, and if looked at from a 1940 perspective, policymakers would have predicted that the country's food problems would be solved. One quarter of the cultivated area is now irrigated; Mexico has experienced technologically successful green revolutions in wheat (in which yields have quadrupled) and sorghum (now the second-largest crop); per capita domestic production of grains is almost double the per capita grain utilization of the period between 1940 and 1944; and agricultural production has risen much faster than population growth (DeWalt 1985a).[14] Yet as we have shown, one can still speak of an agricultural crisis in Mexico. About one-half of the population is undernourished, and grain imports in 1983 totaled eight and a half million tons, more than 40 percent of national production. The question then becomes, why has the transformation of Mexican agriculture—its successful modernization, to use the jargon of modern social science—not led to agricultural development and the solution of the country's food problems?

This pattern of agricultural growth without development is part of the broader process of economic modernization and integration into the world market. In all sectors and in all social strata, traditional activities are being reorganized or displaced to make way for a new organization of production based on a growing monetarization of all aspects of economic life. Cooperative labor exchanges to produce crops are displaced by wage labor; purchased capital-intensive agricultural inputs replace labor-intensive forms of production; commercial animal feeds replace on-site consumption of household wastes, natural pastures,

and other products unusable by humans; and processed foods and purchased commodities replace home production, processing, and use of basic foods. Consumption and distribution patterns, technology, and the organization of work and social life are all rapidly being transformed in the image of dominant trends in other countries, especially the United States (Barkin 1985).

The expansion of sorghum in Mexico exemplifies the change in the way in which producers make decisions that create obstacles to further development. Instead of focusing on family or community needs, farmers examine the increased economic productivity (or value) of new crops to determine their profitability.[15] The modern inputs used to produce the crop allow profits for the providers of the seeds, machines, chemicals, and credit. Accumulation is also possible by those who transport the crop, by the processors who transform the grain into balanced livestock feed, by the entrepreneurs who use the feed to produce meat and other animal products, and by the butchers, supermarkets, and restaurants that finally deliver the product to the consumers. The producer share is determined by what remains after the suppliers and the buyers have imposed their conditions. The multiple factors involved in the sorghum boom include the conjunction of technological advance and change, government policies encouraging the modernization of agriculture, farmer decisions based on the greater economic productivity of sorghum, the increasing demand for livestock products, and the investments of transnational corporations and local entrepreneurs in "industrialized" production of feed and livestock.

This new system contrasts strikingly with more traditional patterns of grain production and consumption.[16] In the past, fewer inputs were used, and fewer steps intervened between the crop and its ultimate use. Planting decisions were made on the basis of consumption needs rather than indirect market determinations, which may reflect conditions in other countries or speculative pressures by powerful actors in the market. Most small farmers must stick with their traditional systems and products for lack of resources to plant more profitable crops; many of those who do find nonagricultural alternatives abandon farming completely or relegate responsibility to other members of the family. Lacking credit and having only restricted access to the institutional nexus that facilitates the adoption of new crops and techniques, most rural Mexicans cannot participate in the prosperity generated by agricultural modernization.

"Modern producers" have ceased to make planting decisions on the basis of family or community needs related to traditional patterns of specialization and consumption. With an increasing range of sowable products, and with access to credit, technical assistance, fertilizers, and other modern inputs, farmers now have far more choices as to what

they can produce and how to produce their crops. As information about world markets improves and national governments encourage export production, producers continually search for new, more profitable planting opportunities. The world market's impact is felt on the family farm as producer prices adjust to reflect global changes either autonomously through the market or with the intermediation of official policymakers. Local decisions are increasingly influenced by the relative profitability of alternative crops, regardless of local or national needs. The crops that benefit from this mechanism are those commodities, like sorghum and some fruits and vegetables, that are destined for social groups with the highest and fastest-growing incomes rather than for the workers and peasants who comprise the majority in Third World countries.

Thus the seemingly contradictory statistics presented in this article reflect the search for profitability by Mexican agriculturalists, processors, and businesses. The rising Mexican middle- and upper-class demand for meat coincides with this new productive structure and contrasts with systematic government efforts to maintain low prices for grains destined for human consumption in the hope of stimulating further industrial investment and restraining urban wage demands (De-Janvry 1981). As has been shown, this trend has left most production of maize and beans in the hands of a huge number of small agriculturalists who cultivate rain-fed plots with relatively labor-intensive techniques. They increasingly find themselves with no alternatives but to stop producing marketable surpluses or abandon cultivation altogether. As a result, large extensions of land are no longer systematically cultivated, and underemployment has become an increasing problem. Most commercial farmers do not find it profitable to produce basic grains and thus devote more and more cropland either to producing agricultural commodities destined to be consumed by animals rather than directly by humans or to producing high-valued fruits and vegetables for wealthy domestic or foreign consumers.

The distorted pattern of development of Mexican agriculture has resulted in a generalized move toward a demand-driven model of agricultural production. The "natural" shift toward crops with higher income elasticities of demand has imposed its own "modern" imprimatur on Mexican agriculture: a productive structure oriented toward animal feed, luxury foods, and agroexports.

Because of this trend, and in spite of the ready availability of the necessary human, natural, and manufactured resources, small farmers (peasants) traditionally responsible for staple food production can no longer guarantee the country adequate supplies. As is evident from the history of sorghum in Mexico, neither official technical assistance nor insufficient knowledge of the potential benefits of new technologies is

the primary obstacle to increases in productivity. Like other producers elsewhere in the world, small farmers in Mexico have shown themselves to be innovative and willing to change in response to new opportunities (Schultz 1964; DeWalt 1979; Eicher and Staatz 1984). But most small farmers in Mexico and other parts of the Third World find themselves unable to adopt the new technologies because inadequate private and public agricultural credit programs and misguided price policies hinder or preclude costly inputs of seeds, fertilizers, agrochemicals, and machinery. Peasant farmers are frequently unable to make their productive decisions on the basis of market signals; they are driven instead to abandon cultivation or limit themselves to supplying family needs by subsistence production that requires little or no monetary outlays but produces very low yields.

Most research on farming systems demonstrates that small producers are aware of alternative cropping patterns or planting technologies that could increase yields or profitability or both. Such studies also outline the political mechanisms that exclude small farmers from participating in the process of agricultural modernization (Felstehausen and Díaz-Cisneros 1985). Although farmers in the ejido sector control almost half of the cultivatable land in Mexico (Yates 1981, 154), Sanderson has shown that they have consistently received less than 20 percent of the agricultural credit available (1984, 114). The fact that they nevertheless were producing up to 38 percent of the total agricultural output as late as 1969 is a tribute to these farmers' tenacity and commitment (Yates 1981, 160; see also Barchfield 1979). The continuing combination of cheap food policies and lack of access to credit for reconverting peasant resources to alternative crops or for raising the productivity of traditional crops has forced many peasants to abandon their lands or continue to plant food staples solely for subsistence needs rather than for the market. The result is that Mexico has been transformed into another Third World country suffering from a food deficit, and one of the largest at that.

AGRICULTURAL DEVELOPMENT AND COMPARATIVE ADVANTAGE

Some economic theorists might respond that this modernization has led to greater aggregate productivity in value terms and that importing basic food crops is not, a priori, disadvantageous to the country. The theory of comparative advantage can be readily used to evaluate situations like the one described here: Mexico is probably better off substituting the cultivation of staple food crops for higher-valued products demanded by the wealthier domestic classes or foreign consumers. The analysis supposes that after opening the sector to trade, the small farmers would probably be better off, and more goods would be pro-

duced globally, raising overall welfare levels. Thus any objection to the pattern of development observed in Mexico must address the questions of whether the application of the model of comparative advantage functioned as expected and who are the beneficiaries.

The first part of the analysis must examine the obstacles to modernizing small-scale agriculture. The theory of comparative advantage predicts that such farmers will convert their resources to producing more profitable crops or use more efficient technologies to produce traditional foods. Throughout the country, many studies have documented the rapidity with which traditional communities have adopted new crops and technologies when their evaluation of the risks and benefits has been favorable (DeWalt 1979, 1985; B. DeWalt, K. DeWalt, Escudero, and Barkin n.d.). But the majority of Mexico's peasants cannot participate in this process of productive transformation due to lack of access to modern inputs and inadequate prices for their products. Local, regional, and national mechanisms of economic and political control have systematically channeled the benefits from all available credit and other official programs supporting agricultural modernization toward the wealthier farmers.

While the peasants were the apparent beneficiaries of the agrarian reform, most of them have never been able to transform their parcels into modern productive units. This outcome is not due to ignorance or "cultural resistance," as some analysts might suggest, but rather to want of the complementary material and technical resources needed to make the transformation possible. Despite innumerable government programs created for precisely this function, the history of institutional intervention in Mexico demonstrates a definite socioeconomic bias against most peasants. Even when government programs were explicitly designed to face this problem head on, as was the case with CONASUPO (Compañía Nacional de Subsistencia Populares) in 1973 or the SAM in 1980, the net effect did not structurally improve the lot of the peasants or facilitate their ability to participate in agricultural modernization. Instead, it simply broke down many remaining barriers to peasant production for the market, but without creating permanent mechanisms to permit peasants to adopt new technologies or sow more costly crops (Andrade and Blanc 1987). When the programs were withdrawn, the small farmers found themselves worse off than before because they lacked access to the modern inputs and to the seeds and cooperative labor arrangements that formed the backbone of the inherited productive system.

A second issue related to the theory of comparative advantage is the net impact on Mexican welfare. The main problem with employing the theory in this setting is that it assumes full employment of resources. In Mexico, as in other Third World settings, this aspect is

probably the most vulnerable of the model's assumptions (Robinson 1979, 102–3). Because neither land nor labor is fully used, it is essential to consider the implications of resource underutilization before applying the theory's dictates to the formulation of policy.[17] During recent years, because producing staple foods has become unprofitable and planting alternative crops has not been possible for most peasants, they have been forced to abandon their lands or sow them using traditional methods that require little or no cash outlay and perpetuate low yields. In their consequent search for cash income for basic survival, the peasants have accelerated the pressure on the urban areas, swelled the ranks of the "informal" sector, and joined the large number of undocumented migrants trying to find employment in the United States (compare Gregory 1986).

Serious market imperfections on the consumption side also affect the analysis. Regional political bosses, allied with economic intermediaries, generally control the marketing and transportation networks needed to redistribute food from central points to local markets (Díaz-Polanco and Guye Montandon 1977, 56–62). Thus when food supplies are not available locally, these groups exercise the power of their monopoly (or monopsony or both) to raise prices above official levels or prices prevailing in more competitive markets, primarily in urban areas where political control by official agencies is more effective. Consequently, the rising imports of (relatively) inexpensive staple foods do not translate into direct benefit for the majority of rural consumers and producers but into a disproportionately high rate of inflation for their personal needs because of increasing dependence on high-cost foods purchased from local merchants. The only recourse for rural consumers is to increase their production of food grains for on-farm consumption, a process that explains increases in maize production in the mid-1980s despite disadvantageous producer prices. The benefits from trade that theoretically accrue to the nation are blocked by local market imperfections from reaching most of the countryside, although they probably have a direct impact on the welfare of some groups of low-income urban consumers. The government is keenly aware of this problem and has established direct distribution and sales programs that offer some respite by creating effective competition, it claims, in markets serving 60 percent of urban and 50 percent of rural consumers. Independent studies acknowledge the beneficial impact of these efforts but suggest that the proportions of population affected may be exaggerated.[18]

On the consumption side, therefore, benefits from trade do not go to the rural small-scale producers nor are they available to compensate these producers for their losses because of the inability of government agencies to extend coverage. Given the prevailing institutional situation in Mexico and other Third World countries, we believe that

the only way to assure adequate supplies of food at accessible prices for rural consumers is either to transform them into producers or to assure them direct access to state distribution channels for grain and other basic consumer goods.

ALTERNATIVE POLICIES

Our recommendations for solving the current crisis in the Mexican agriculture and food sector may be divided into two major areas—research alternatives and national government alternatives.

Research Alternatives

The research begun by the Rockefeller Foundation–sponsored Office of Special Studies was designed to spur modernization of Mexican agriculture by adapting techniques learned in the developed countries. The success of this program and its offspring (the Instituto de Investigaciones Agrícolas, now known as the Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias, or INIFAP, and the Centro Internacional de Mejoramiento de Maíz y Trigo, or CIMMYT) is increasingly tempered by recognition that these techniques favored large commercial farmers, conferring many advantages on them that made it impossible for small farmers to compete, and that the capital-intensive nature of the technology is inappropriate for Mexico because of its labor surplus (Hewitt de Alcántara 1976; Roberts 1986). Research by the Office of Special Studies and the impressive system of INIFAP experiment stations that it spawned has yet to pay much attention to the needs of small farmers.

Much more attention should be devoted to developing "small-farmer-biased" technology to make agriculture once again a viable way of supporting a family. The methodology of farming-systems research has developed in recent years as a way of addressing the needs of small farmers (Shaner, Philipp, and Schmehl 1982; DeWalt 1985b). Such a focus, especially if it examines the farm in a holistic way and tries simultaneously to improve crop, livestock, agroforestry, and other resources, has the potential to overcome the drawbacks of reductionistic commodity research (Winkelman 1983). Peasant systems of production have been polycultural, and such systems are more sustainable in the long term than are the monocultural systems of "modern" agriculture, especially when large numbers of individuals already control vast areas of cultivatable land. Despite its potential, however, farming-systems research will have to replace the previous structure of the Mexican research system organized along commodity lines that separated crops, animal, and forest research into different institutes. The recent reorga-

nization of the national research system to put research on livestock, crops, and forestry under one umbrella organization is a step in the right direction.

The Puebla Project in Mexico is one "small-farmer-biased" approach to research that has gained international notoriety. Started by the CIMMYT in 1967, the project was designed to "develop, field test, and refine a strategy to rapidly increase yields of basic foods crops by small landowners" and to "train technicians from other regions about the components and effective use of this strategy" (CIMMYT 1974; see also Redclift 1983; Felstehausen and Díaz-Cisneros 1985). The Puebla Project developed new farming techniques and evaluated existing peasant practices, recommending modifications that would permit small producers to increase yields without large investments beyond their capacity. The program was subsequently taken over by the Colegio de Postgraduados at Chapingo and broadened to include other regions of the country. In practice, the results have been less productive than expected because of the profound conflict between this approach and the institutional support for large farmers prevailing elsewhere in Mexico. Examples abound of errors that reduced the effectiveness of particular parts of the program (Gladwin 1980; Murtaugh 1980). On the whole, however, the Puebla Project demonstrates the potential for using this alternative research approach to improve conditions for production of basic foods.

In the area of sorghum research, some investigators are returning to the original goals established by the Office of Special Studies. Researchers from the International Crops Research for the Institute for the Semi-Arid Tropics (ICRISAT) have been conducting breeding and agronomic tests on sorghum varieties for the high valleys of central Mexico, where the paucity and variability of rainfall make maize a marginal crop. Collaborative work by the International Sorghum-Millet Program (INTSORMIL), INIFAP, and several universities in Mexico is devoting a large component to research on food-quality sorghum that could be substituted for maize in tortillas or other food products (Rooney 1985). The first annual sorghum conference held at the Universidad de Nuevo León in October 1984 led several researchers (including our team) to the conclusion that much more attention needs to be devoted to sorghum cultivation for marginal areas. Drought-tolerant sorghum varieties producing attractive yields would offer profitable alternatives for small farmers and could free up the better rain-fed and irrigated lands to be returned to growing food staples or planted with high-value export crops.

Because the demand for animal products in Mexico and elsewhere will continue, research should be directed toward making these systems as efficient as possible in terms of economics and energy. Much

greater attention must be paid to applying the findings of research on techniques of using animals to convert resources presently of little or no use to humans into high-quality protein. Improving the productivity of marginal lands and forage grasses is one line of research; another important approach is to investigate the possibility of using garbage and household wastes as a feed source for pigs and other livestock (Restrepo and Phillips 1982). It is important for government policies and international agricultural research to move away from present trends that encourage raisers of cattle, poultry, and hogs to use technologies with a high content of raw materials that compete for agricultural resources with human foodstuffs.

These research objectives involve longer-term solutions to some problems in the Mexican agricultural and food systems, but it is important that such research agendas be implemented as soon as possible, especially in universities, international research centers, and government institutions. The efforts of these organizations should be directed toward research that will help counteract some of the most pernicious effects of the trends we have documented. Larger farmers will continue to be served by private research concerns that generate their profits from selling inputs to these agriculturalists.

Government Policies

Many of the problems of Mexico's agricultural and food sector have been caused by government policies promoting the particular form of commercial modernization described above. As a consequence, it is essential that policies in this area be changed.

First and foremost, subsidies need to be restricted and redirected. The primary issue here is the question of the relative price structure for crops that predominate in rain-fed agriculture. At present, producers of basic food grains and the government subsidize urban consumers; rural producers transfer resources to urban consumers and indirectly benefit industrial employers by reducing wage pressures, if only minimally. Even when rural farmers do not produce maize and beans (the major rain-fed farm products for mass consumption), low prices depress rural wages and economic returns from other uses of land and labor. Thus the present price structure for basic food grains must be changed before any improvement in rain-fed agriculture is possible. The question that needs to be faced squarely is, who should pay for the costs of grain production? This question then becomes an issue of the kind and amount of transfer payments to the indigent—rural and urban—whom society decides to subsidize.

A separate but related issue is the variety of subsidies offered to operators in the livestock sector. These include the way in which the

government, through its buying organization CONASUPO, supplies sorghum, soybeans, and other oils used in making feeds to the manufacturers and to livestock producers at low prices (DGEA-SARH 1980, 12). These direct subsidies add to the already-noted indirect subsidies that are given to farmers of these products for credit, farm machinery, and irrigation water. These combined subsidies depress the price of feed for large livestock producers.

The ministry-level Dirección General de Economía Agrícola (DGEA) estimated in 1980 that 450,000 hectares planted in sorghum could be redirected toward other crops if irrigation districts would simply adjust the quotas of water allocated to producers of different crops (DGEA-SARH 1980, 13). In 1987 the figure would approach 700,000 hectares. A policy could be adopted requiring farmers to pay the real costs of the water, thereby encouraging its use for higher-valued crops. Assuming that demand for sorghum remains high, greater production costs would stimulate increased output in the more marginal rain-fed lands, particularly if the research efforts identified above result in varieties that yield well in such areas.

A third measure the government should take is to limit official credit for large livestock projects. Large-scale poultry, hog, and cattle projects have made meat available at beneficial prices to urban areas, but the extent of undernutrition suggests that these sources of protein have not helped the rural population or even substantial segments of the urban poor. Our experience in rural areas is that the most direct way of improving the nutritional status of the rural poor would be to improve their backyard livestock production. Small-scale producers are plagued by hog, poultry, and cattle diseases, problems that could be controlled if the government invested money in providing credit, vaccines, improved varieties, and better care of animals. Small farmers are eager to adopt such practices (DeWalt 1979, 59), and substantial nutritional improvement and income redistribution could result from redirecting subsidies from the large producers to the small.

A fourth important step is to increase the amount of government resources invested in small farmers, particularly those in rain-fed areas. These resources should be invested in research devoted to the problems of small farmers, credit and crop insurance to improve their productive potential and reduce their risks, and preferential price supports for crops grown for direct human consumption (similar recommendations are found in DGEA-SARH 1980, 12). If a large portion of the nine million hectares now uncultivated were returned to cultivation by improving the profitability of small farmer production, Mexico could easily meet its domestic needs for agricultural products. The income and employment generated by this resource mobilization would be the most efficient way to correct the distributional effects of previous rural

development policies. Again, the resources to undertake this program could come from redirecting resources now going to the commercial agricultural sector or to pay for importing foods from abroad.

These recommendations may seem simplistic, but they are certainly feasible. Several of these same policies have been recommended by the government's DGEA in a 1980 report recommending that the national food consumption system be rationalized through a variety of measures (DGEA-SARH 1980, 12–14).

The immediate results of the policies that we are advocating would be to raise the cost of tortillas and meat. In the short run, it could be argued that this increase would adversely affect the nutritional status of low-income persons, especially those in urban areas who now benefit occasionally from access to a relatively cheap source of protein. There are two answers to this objection. On the one hand, the Mexican government already provides huge consumer subsidies for agricultural products of all kinds. These subsidies benefit wealthy, middle-class, and poor Mexicans because they are not targeted. It may be argued that the only ones who do not benefit from the subsidies are the rural poor who are too far from the CONASUPO stores that sell food at reduced prices. But this group is the most needy. Mexico therefore needs to develop policies that will target the needy groups for subsidies (see Timmer, Falcon, and Pearson 1983, 64). Reutlinger and Selowsky's findings (1976) that such targeting is much more cost-effective for developing countries is borne out by data on Mexico. Haber and Nechodom, citing an unpublished World Bank document, have reported that "it has been argued that if Mexico were to limit its maize subsidy to the very poor it could reduce the cost of the subsidy by as much as two thirds" (1985, 132).

The second answer is that these policies will make alternative agricultural products with adequate nutritional value more generally available in Mexico. A diet with meat and dairy products may be desirable for all, but it is basically a luxury that large numbers of Mexicans do not now share. We believe that it is more important to serve the needs of the poor with an adequate diet than to worry about the supply of meat in the diet.

The present emphasis on producing higher-valued crops for dynamic markets need not necessarily compete for most resources in our proposed program to reinvigorate peasant agriculture. Mexico is especially fortunate in having enough land and population to continue to produce most of its present commercial crops as well as substitute domestically produced crops for current imports. If maize and sorghum were removed from the irrigation districts (they presently account for more than one-third of the irrigated land area under cultivation) as a result of the measures suggested here, the total value of production

could conceivably increase dramatically. In the process, several million additional jobs could be generated, which might cause some transitional difficulties in securing sufficient labor to assure this production. Because Mexico has the natural and human resources to support this additional production at present levels of technology, a program of agricultural development based on domestic food self-sufficiency could be anticipated to generate induced demands for employment and production in other sectors where installed capacity is also severely underutilized at present. The cost of such a program is estimated to be less than the recurring cost of importing food and could be financed from savings from reorganizing the subsidy programs discussed above and a rise in the cost of basic foods for urban consumers. The program features the great advantage that virtually all of the expenditures would be in national currency rather than foreign exchange.[19] By promoting the decentralization of production and distribution, local producers could assure adequate supplies of basic foods and create alternative channels for marketing, thereby lowering the real cost of living for a large proportion of the population (see Hewitt de Alcántara 1987).

The question naturally arises as to why these approaches to solving the problem of rural production are not being implemented. The main objections come from political circles that fear the consequences of weakening local and regional political groups. A program of agricultural reactivation would place much economic power in the hands of peasants and their leaders and would alter the nature of the national labor markets. Rural laborers might find it more advantageous to cultivate the land for themselves than to work for others as poorly paid hired hands, while local merchants and politicians might find their monopolistic control of regional markets and other institutions effectively challenged by reinvigorated peasant producers (Fox 1986).

CONCLUSIONS

The major conclusion that can be drawn from the Mexican case is that the modernization of agriculture through improved technology and the application of the theory of comparative advantage have done little to resolve the problems of rural development or eliminate hunger in Mexico.[20] It has been most profitable for farmers to grow foods for those with the ability to pay for luxuries like meat, dairy products, fruits, and vegetables. Government policies have also created distortions favoring the production of these same commodities because they feed the politically articulate upper and middle classes and may be exported to earn scarce foreign exchange. The problem is, as Robinson has stated, that "[m]eeting demand is by no means the same thing as contributing to development. From the point of view of the market,

money is money whoever spends it, for whatever purpose, but from the point of view of development, there is a great deal of difference between one kind of development and another" (Robinson 1979, 87–88).

If the approach of reconverting rural consumers into producers had actually been adopted, as was proposed by the SAM and the Programa Nacional de Alimentación (PRONAL) in the 1980s (Austin and Esteva 1987), the nature of the present financial and debt crisis would probably be very different. Instead of forcing the massive dismissal of tens of thousands of workers and the progressive abandonment of additional areas of land, with a consequent need to import food, the vicious cycle of modernization and impoverishment could have been reversed. More employment and additional food supplies would have induced demands for consumer goods and employment in other industrial sectors. Instead, the austerity program adopted by the present government has reduced the real incomes of most salaried workers, peasants, and the participants in the informal sectors, further accentuating the concentration of personal income and dramatically reducing consumption of basic foodstuffs among the most nutritionally vulnerable socioeconomic groups. The consequent waste of human and natural resources so evident in the unemployment and underemployment of labor, the undernutrition of large portions of the population, the massive decampment of rural dwellers who move to the cities, and the squalid conditions of slum communities all attest to the failure of the policies giving precedence to the wants of a rich minority over the needs of the poor majority.

NOTES

1. This history has been impressively presented by Eric Wolf (1982).
2. The process we are describing has been noted in many realms by other scholars. In economics, it has been described as the internationalization of capital and has been extensively analyzed with regard to agricultural production (Barkin 1985; Rozo and Barkin 1983; Vigorito 1984). Pelto and Pelto refer to the process as *delocalization*, in which formerly self-sufficient local communities and groups become increasingly dependent on the wider world for food, energy, and other resources (1976, 476–81). Illich (1977) has used the term *social iatrogenesis* to describe the process in which individuals and groups increasingly give up or are deprived of control over their own internal states of being and their milieu.
3. The transformations are given much of their impetus by transnational corporations, but the benefits accrue to national capitalists as well.
4. An abundant literature exists on the Mexican rural development experience. For this reason, we summarize only research findings that we and other scholars have amply documented. This approach is not meant as an excuse for the lack of tables and other quantitative material but to explain our choice of concentrating on the underlying forces that have produced the results summarized in this section.
5. Ejidos are groups of twenty or more farmers who organized to receive and work the lands expropriated from the great estates after the Mexican Revolution. In the great

majority of ejidos, land plots have been allocated to farmers who cultivate plots individually. Only a small percentage of ejidos operate communally.

6. The amount of credit available to private farms has always exceeded that available to ejidatarios (see Sanderson 1984, 113).
7. Extensive knowledge exists as to alternative technologies that might provide animal feeds not directly competitive with human nutrition. Gustavo Viniegra of the Universidad Autónoma Metropolitana, a leader in this field, has conducted extensive research on alternative sources of animal feed and the more intensive use of agricultural waste products for food and other needs. Even with this knowledge, the power of the animal feed industry is sufficient to preclude alternative technologies from being considered as long as these corporations cannot find a profitable way to market the alternatives.
8. Strictly speaking, beans are not a basic grain. But they are often described as such and are reported as basic grains by the Dirección General de Economía Agrícola of the Mexican government. We have adopted this usage here.
9. This figure was cited in a speech by Luis Martínez Villicaña, Secretaría de Reforma Agraria, in October 1984 and was reported in the Mexican national press during the week of 15 October 1984.
10. The years between 1981 and 1985 all showed a negative balance of trade for the agricultural sector. In 1986 the balance turned favorable when the undervalued peso greatly stimulated export production and when maize production increased as farmers planted more for on-farm consumption in the face of declining opportunities for cash income and rising prices. But the country still imported almost seven million tons of food products in 1986.
11. The data are cited by Redclift (1981, 14), based on surveys conducted by the Instituto Nacional de Nutrición (INN) during the late 1970s. Extensive analysis of the nutritional situation in Mexico is presented in COPLAMAR (1982) and also in various documents of the Sistema Alimentario Mexicano (SAM). A 1979 survey commissioned directly by the SAM showed that "more than 90 percent of the population suffers from caloric and protein underconsumption. . . . [About 40 percent of this group] have serious deficits that range from 25 to 40 percent of the minimum, or 2,750 calories per day per person" (SAM 1980, 8–9).
12. See *Uno Más Uno*, 10 Jan. 1985, p. 1.
13. See the UNAM-INN study cited in 18 Aug. 1984.
14. Yates estimated that Mexican agriculture grew at a rate of 5.7 percent per year between 1940 and 1965 (1981, 15). He estimates that this rate slowed to an average annual growth rate of slightly less than 2.6 percent between 1965 and 1980.
15. Economic productivity is not to be confused with energy productivity. As Steinhart and Steinhart (1974) and others have shown, intensive monocrop systems are extremely inefficient in energy terms. These researchers have estimated that the energy subsidy of the U.S. food system amounts to nine kilocalories for each kilocalorie obtained as food.
16. It must be understood that we are not saying that sorghum itself is prejudicial to the country. It is rather the manner in which sorghum has been used that is symptomatic of how agriculture, the economy, and the society have been restructured. In other circumstances, the greater productivity of the crop under marginal conditions could help to enrich Mexico and improve the standard of living of its inhabitants.
17. Peter Gregory's (1986) analysis of Mexican labor markets may appear to contradict this affirmation, but the present approach addresses the problem differently. We do not argue that labor markets are out of equilibria (that there is substantial underemployment) at present market prices. We argue instead that given the present managed price structure for rural labor and the dearth of employment opportunities in Mexico, a remunerative price for production of basic grains by small farmers would induce a substantial increase in the supply of labor available to cultivate idle land.
18. The official statistics are provided by DICONSA (Distribuidora CONASUPO, S.A.) and cover 51 percent of the rural target group and 66 percent of the urban target group (defined as low-income). The organization claims to have a 5 percent share of

the national retail food market, climbing to 22 percent in maize and sugar and 17 percent in beans. Although the report itself was not made available to the public, it was summarized in a five-part series of articles by Ricardo del Muro in *Uno Más Uno*, which appeared from 30 Dec. 1984 through 4 Jan. 1985.

19. These calculations were made at the Mexican Centro de Ecodesarrollo and were based on prevailing monetary costs of rain-fed agriculture in those regions where substantial areas of abandoned land have been identified.
20. As we look toward the future, the history of sorghum production in Mexico is already beginning to repeat itself in countries like Brazil, Colombia, the Dominican Republic, Costa Rica, Panama, and others. Larger farmers are increasingly producing sorghum destined for consumption by animals (DeWalt 1985c).

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