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THE EFFECTS OF POPULATION GROWTH ON AGRICULTURE IN GUATEMALA

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THE EFFECTS OF POPULATION GROWTH ON AGRICULTURE IN GUATEMALA

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This paper has developed out of an earlier project supported by USAID to develop a microcomputer presentation to illustrate possibly harmful effects of the ongoing high rates of population growth on the agricultural sector in Guatemala. In the course of data collection, preparation of an accompanying text, and actual presentations to and discussions with government officials and researchers in Guatemala, other dimensions of the problem of poor agricultural-sector performance also became evident, as described herein. We are grateful to John Freymann, Pamela DeLargy, Harry Wing, Ken Yamashita, and Guatemala officials for assistance and comments on the microcomputer presentation and to the Carolina Population Center for word processing assistance.

The purpose of this paper is to explore the mechanisms by which population growth plays a role in and places demands on the agriculture sector in Guatemala with the intent of identifying issues that are more generally relevant for Central America. We intend to answer, in part, the following questions. What are the key potential linkages and the effects of contextual, institutional factors such as land tenure and government policies? How reliable is our knowledge of the interrelationships, and what key types of data and research analyses are desired? How intractible are the problems of rural Central America, and what recommendations can be proferred?

Central America figures prominently in the popular media these days, but the focus on political problems and pretended solutions obscures the underlying difficulties of achieving development for the key majority of the population living in rural areas. To place the analysis of Guatemala in larger context and implicitly to indicate the generality of the issues for Central America and even Latin America (and to a lesser degree other parts of the Third World), we first briefly review the recent past experience and anticipated future changes in population growth and agricultural performance for the principal six countries of Central America: Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama. This is followed by a more detailed examination of the situation in Guatemala as a case study.[1]

AGRICULTURE AND POPULATION IN CENTRAL AMERICA: A REGIONAL OVERVIEW

First, we note that the total population of the region is growing rapidly, from an estimated 22.4 million in 1980 to a projected 63 million in 2020 (Table 1). The expected annual rate of population growth for the region

as a whole is 2.6 percent (2.7 percent in Guatemala). The projected proportion of the population residing in urban areas will also rise rapidly from .43 to .68 according to the "medium-variant" assumptions of the United Nations.

The growing size of the population implies a necessity to rapidly increase agricultural production to satisfy food requirements. Increasing urbanization implies that the productivity of the labor force remaining in agriculture will have to increase. This can be facilitated by increases in agricultural land. In virtually all developing countries, including those with the highest population density such as China, land used for agricultural purposes has continued to increase in recent decades (Bilsborrow, 1987). Although this has certainly occurred in Central America as well, Table 2 shows that rural population growth has been so high (even taking into account migration flows to cities), that between 1961 and 1983, the density of rural population in each country (except Costa Rica) increased, especially in Honduras, El Salvador and Guatemala. This has implications for the appropriate technology for production, rural employment needs, and pressure on the land, which will be taken up in more detail on Guatemala.

The existence of a recent stagnation in agriculture in Central America is seen in the growth rates of agricultural production in the periods 1971-1980 and 1981-1984 (Table 3). With the exception of Costa Rica, growth in agricultural production has dropped in all countries of the region. (In Guatemala statistics from the Ministry of Agriculture show a recovery between 1984 and 1987, but only sufficient to raise average annual growth rate for 1981-1987 to 0.0 percent.) This stagnation is also evident for food production, which essentially eliminates the effects of the lower world

market prices prevailing for the major exports of the region (coffee, banana, cacao and cotton).

Agricultural production depends on employment in agriculture and productivity per worker (i.e., the level of technology). Table 4 shows value added per agricultural worker for each country in the region in 1970 and 1985. We see that (a) the level of technology is highest in Costa Rica and lowest in Honduras, and (b) except for Costa Rica and Panama, there has been virtually no change between 1970 and 1985. While this illustrates stagnation in agricultural productivity, the sizable differences between Costa Rica and the other countries also suggests that there is ample potential for improving technology.

As a result of stagnating agricultural production and high population growth, the region has come to depend more on imports to meet its basic food needs--an indicator of a growing lack of food security in the region. During the period 1969-71 the percentage imported was less than 10 percent for all countries except Costa Rica and Panama while in 1979-81 it was more than 13 percent in all countries and more than 20 percent in three countries. The percentage doubled in three countries--El Salvador, Honduras, and Nicaragua and in Guatemala it grew by 40 percent (Stupp and Bilsborrow, 1988, Table A.6).

A prominent characteristic of the rural population in Central America (and many other developing countries) is the high proportion living in poverty. In a recent study, with poverty defined as having insufficient income to satisfy minimum needs for food, clothing and shelter (Peek, 1986), there are estimated to be 10 million rural persons in poverty in 1980, with Guatemala, Honduras and El Salvador accounting for some 80 percent of the

total and Guatemala alone for 40 percent. In all countries of the region, except Costa Rica (34 percent), the proportion poor in rural areas is between 2/3 and 9/10 (the highest being Guatemala at 84 percent).

One manifestation of rural poverty is malnutrition. According to surveys conducted by INCAP, the PAHO-affiliated regional nutrition center in Guatemala, malnutrition is a general problem in the region and is especially pronounced in Guatemala. Prevalence of nutrition among children under five actually rose in Guatemala, Nicaragua and Panama over the period 1966-80 (from 36 to 44 percent in Guatemala, 17 to 27 in Nicaragua, and 14 to 16 in Panama), while it has declined in Costa Rica and El Salvador (from 16 to 6 and 30 to 18 percent), according to INCAP surveys (Delgado, 1985).

Rural poverty is associated with historical patterns of land distribution and ownership originating in the feudal systems of the Spanish colonies. Table 5 shows the distribution of land by size of farm (in three categories) and gives the number of farms in each size category. It illustrates (a) the concentration of cultivable land on a relatively few large farms and (b) the concentration of farms in the smallest size category, which is particularly extreme in Guatemala, El Salvador and Honduras--precisely the countries in which rural population density and rural poverty is highest.

GUATEMALA

In this section, we consider in greater detail possible effects of population growth on the agricultural sector in Guatemala. In order to better appreciate the significance of high population growth over an extended period of time, we consider two population projection scenarios, based on high and low future growth rates, in order to contrast the possible

results. Neither scenario is intended as a prediction, but the scenarios almost certainly provide upper and lower bounds on what is likely to occur in the future.

The major potential effects of population growth on rural areas that we subsequently consider are: food security, rural employment, land fragmentation and migration, and natural resources.

Population Projections

In making the population projections, we employ two alternative assumptions about the future course of fertility. According to CELADE, the TFR of Guatemala in 1980 was about 6.0. In the high fertility scenario, we assume a minimal decline in TFR to 4.8 in the year 2030 (many Latin American countries have already dropped below that, including Costa Rica and Panama).[2] In the low-fertility scenario we assume a much more rapid decline to a TFR of 2.0 in 2030, or roughly replacement fertility. Under both projections, mortality is assumed to continue to decline, as in the past in Guatemala and elsewhere, with life expectancies at birth for males and females rising gradually from 57 and 61 in 1980 to 70 and 75 in 2030. Similarly, the percentage urban is assumed to rise from 33 in 1980 to 45 in the year 2000 and 68 in 2030. For simplification and lack of reliable models to postulate otherwise, we assume the future paths of mortality and net rural-urban migration are the same under both fertility scenarios (i.e., invariant with respect to fertility).

Starting from a 1980 base year population of 6.9 million under high fertility the Guatemalan population will reach 37 million in 2030, or more than five times its 1980 population (Table 6). Because of population momentum, even under the assumption of a rapid fertility decline, the total

population reaches 24 million in 2030, over triple its size in 1980. The projected urban populations in 2030 under the high- and low-fertility scenarios are 25.5 and 16.7 million.[3]

Finally, we consider projections of the rural population and the agricultural labor force. The rural population of 4.6 million in 1980 grows by 2030 to 7.2 million under the low scenario and 11.8 million under the high growth scenario. The agricultural labor force is projected by assuming the age- and sex-specific participation rates for the rural population in the 1981 population census remain in effect throughout the projection period (also true of shorter-term projections of SEGEPLAN, the Guatemalan National Planning Agency). Under the low-fertility scenario, the agricultural labor force grows from 1.1 million in 1980 to 2.2 million in 2030, while with high fertility, it grows to 2.9 million. Under the low scenario, it levels off at a maximum in the last decade of the projection, but it continues to grow in the high-fertility scenario (Table 9).

Effects of Rural Population Growth in Guatemala

In the section below, we investigate the possible effects of expected future trends in population on agriculture and rural areas. In each case, we consider what data are available/needed and where current data or knowledge of relationships is inadequate.

(1) Food Security

In this section, we translate the population projections into projections of the demand for food by starting with estimated per capita consumption levels in 1980 (appropriate figures fortunately available from the International Development Bank, 1977) and assuming (with IDB) that per capita consumption increases at 0.3 percent each year.[4] The high and low

fertility assumptions result in food demand levels of 5.5 and 9 million metric tons of food (expressed as cereal equivalents) in 2030 (Table 7). These may be compared to the supply of food that would be available under two alternative scenarios: (a) food productivity per member of the agricultural labor force stays constant throughout the projection, and (b) food productivity per worker increases linearly so that it doubles over the 50 year period. Under either production scenario, there would be gaps that would presumably have to be addressed by increased reliance on food imports (Table 7). In particular, the food gap (food insecurity) in cereal equivalents, estimated as 178 metric tons or 13 percent of domestic consumption (demand) in 1980, would grow by 2030 to a frightening 5,539 metric tons or 64 percent [(8684 - 3146)/8684] of domestic consumption under the scenario of high population growth and low productivity. This would be reduced to 2,393 metric tons or 28 percent with high population growth and high productivity. Under low population growth, the corresponding gaps are 3,120 metric tons (56 percent) and 691 metric tons (12 percent). It is notable that under the low-fertility projection of demand and the more optimistic supply projection, the gap actually begins to narrow after the year 2010 and will eventually disappear. But under the high fertility projection, the gap between demand and supply continues to widen under either supply assumption. In order to fully satisfy food requirements under the high fertility scenario without reliance on imports, domestic production would have to increase at 4 percent per year for the entire 50-year period, which amounts to nearly a tripling in per-worker food productivity.

These increases assume that per-capita consumption remains close to the low 1980 levels, which is pessimistic given the high level of malnutrition in Guatemala.[5] Recent increases in both quantity and quality (e.g., protein) of food consumed have been concentrated among the growing urban populations. While in 1970 30 percent of Guatemalan beef was exported, this declined to 22 percent in 1985 because of the growth of urban demand. Also, per-capita consumption of milk rose from 40 liters per year in 1970 to 48.5 liters in 1985, during which time imports rose from 13 to 32 percent of milk consumed (USAID/Guatemala, 1987): The ratio of urban persons to be fed per agricultural worker increases 430 percent (from 2.0 to 8.7) in 50 years under the high-fertility scenario and 370 percent (from 2.0 to 7.4) under the low-fertility scenario. Thus, most of the projected increase in food demand will be in urban areas. The effect of urbanization of the population on demand is not taken into account in the projections above, implying they are conservative. Properly taking into account the effect of urbanization ideally requires consumption parameters for commodities from household consumption surveys undertaken in both urban and rural areas. Even the ambitious ECIEL survey program in Latin America covered only selected large cities and did not include Guatemala, so appropriate data are not available.

On the other hand, the projections of food demand may be considered unduly pessimistic because we have not taken into account differences in the age distribution of the population: The high-fertility scenario has a larger proportion of, e.g., child dependents (the percentage under age 15 is 43 vs. 28 under low-fertility), so the differences in demand are somewhat overstated in terms of adult equivalent consumption units. This could be easily adjusted for by using any of various sets of age-specific consumption

weights found in the literature and undertaking the appropriate computations.[6]

In the present illustrative analysis, we have not done this because we believe the supply side is even more problematic. That is, it would be preferable to project supply more explicitly with, e.g., agricultural production functions embodying future projections of not only labor but also land, capital and technology specific for each major product. We initially explored using the FAO agricultural model CAPPA (FAO, 1985) to project supply, but its usage is so cumbersome and requires so many technical assumptions, we are not prepared to make that we opted for the simple approach above. In its defense, it should be noted that it <u>does</u> explicitly take into account the effect of the growing rural labor force on outputs, unlike some early "crisis" models.

The critical elements in the projected domestic food gap are the assumptions of rapid urbanization (proportion in urban rising from 33 to 68 percent) and continual stagnation in the food productivity of the agricultural labor force. Food productivity in 1979 was calculated as 1.081 metric tons of food produced per member of the agricultural labor force. In reality, only 37 percent of land in use in 1979 was used for basic food production (down from 41 percent in 1964). Food productivity could thus be improved by simply increasing the proportion of land (and labor) engaged in food production. But to evaluate whether this is sensible would require information on future returns to land and labor used for food versus other agricultural production. It has been suggested that small farmers would benefit from growing vegetables for export rather than their current corn and bean production for domestic consumption (e.g., USAID, 1987). But do

they themselves benefit, or are the gains sopped up by middlemen, including exporters and those involved in the chain bringing imported food to consume.

The many successes of hybrid seeds combined with appropriate complementary inputs, spawned by the various international agricultural research institutes and initially dubbed the Green Revolution, are well-known. But it is also true that they have not yet, even after decades, reached the majority of the small farmers living in poverty, producing subsistence food in Guatemala and elsewhere. While several reasons can be adduced, a major one will become apparent in the next section.

(2) Land Fragmentation and Poverty

In this section, we consider the problem of rapid growth in the number of less-than-2 manzana farms that are considered (by SEGEPLAN) too small to provide sufficient production and income to support an average rural family.[7] A closely related problem is landlessness, but estimates of its extent are mostly conjecture (Hough et al., 1982).

Out of a total national territory of 10.8 million hectares, only some 5.2 million, or about 48 percent, is classified as suitable for agriculture. Of this, some 4.4 million (85 percent) was already in farms at the time of the latest agricultural (1979) census, and about half of that was actually in use ("in use" includes pasture as well as land in crops).

Table 8 shows the highly skewed distribution of land in farms by size of farm in both 1964 and 1979, including the regional breakdown. Land distribution in Guatemala is among the most inegalitarian in the world. In 1964, 44 percent of all farmers (with less than 2 manazanas, or minifundia) possessed only 3.4 percent of the land, while at the other extreme 2 percent of the farmers (with large farms, or latifundia) had exactly two-thirds of

all the land. The corresponding figures for 1979 are as follows: the minifundia comprise 60 percent of the farms and had 3.7 percent of the total farm area, while the latifundia with 2.2 percent of the farms still has 67.1 percent of the area.

Between 1964 and 1979 the total number of farms grew from 419,000 to 606,000, or by 45 percent, (2.5 percent per year) reflecting the growth rate of the rural population. There is clearly a substantial increase in--indeed a doubling--of very small farms, while other farms grew hardly at all. We return to this later. Land in farms grew by over a million manzanas, or 13.5 percent, mostly at the expense of forested areas. Such an expansion of the agricultural land area is a usual response to increasing population (density) pressures whenever land is available ("extensification of agriculture"), and tends to precede Boserup's "intensification of agriculture" (see Boserup, 1965; Bilsborrow, 1987). Nevertheless, there is ample evidence of increasing intensification as well, with increases in labor per land area, usage of fertilizers, insecticides and other chemicals, and irrigation in Guatemala, though the latter technological changes are modest compared to, e.g., Costa Rica.

Comparing the data for 1964 and 1979, we see that in all regions most new farmland was in the largest (64+ manzana) size category, particularly in the northern region (Peten), which accounted for 76 percent of all new farmland. In contrast, is the very densely populated northwestern highlands region called the altiplano. In 1979 it contained 40 percent of the farms in the less-than-2 mz. category and 37 percent of those in the 2-to-5 mz. category. Between 1964 and 1979, the number of farms in the larger 5-to-64 mz. category actually declined in the northwest (and central regions), which suggests increasing subdivision of holdings. Even stronger evidence is from

the fact that the number of small farms virtually doubled between 1964 and 1979, not only in the altiplano but generally (Table 6, lower left columns). While farms in the less-than-2 mz. category grew at an astonishing 4.4 percent per annum, land in this category grew at only 1.7 percent per annum. Although not conclusive evidence, we surmise that land is being increasingly fragmented by subdivision among heirs. Further evidence is that the average size of a less-than-2 mz. holding, nationwide, declined from 1.0 to 0.7 mz. between 1964 and 1979. It appears likely that, in lieu of substantial land redistribution, future growth in the number of farms will continue to be predominantly in the smallest size class, and that landlessness will also grow as long as the rural population continues to grow. The process of subdivision of land leads to greater impoverishment of the rural population which contributes to out-migration flows to the capital and other urban areas of the country. Indeed, it seems very likely that the relation of diminishing farm size to employment (or lack of sufficient employment) is the mechanism by which increasing land fragmentation contributes to out-migration.

While we have interpreted the disproportionate growth of farms in the less-than-2 mz. category as a consequence of subdivision among heirs in a growing population, little is actually known about the dynamics of land transfer and colonization over time or the process of land sales by small farmers and consolidation. As plot size diminishes, it is implied that the land is used more intensively, but there is little empirical evidence of what changes in technology or crops grown are occurring. It would be instructive to conduct a farm household economic survey that determines not only how much land is dedicated to various uses, but also how long

households have been in existence, how the land was acquired (inheritance, purchase, colonization) and how the size of the family/nonfamily labor force available to both small and large farms has changed over time (guidelines in Bilsborrow et al., 1984).

(3) Rural Employment and Out-migration

In this section, we consider the potential for increasing rural employment by increasing land in use and the intensity of land use (higher labor-land ratio). Hypothetical numbers of persons employed under various assumptions about these two aspects of rural employment are then compared with projections of the agricultural labor force described earlier.

Of the land in farms in 1979, which is summarized in Table 8, a considerable proportion was not actually in use, mainly in the two larger farm size categories: For the country as a while, roughly half of all land in farms was idle in 1979 (48 percent), with the percentages for the four land size strata being 8, 23, 54 and 57 (for 64+ mz.). Furthermore, we know from studies by SEGEPLAN and the Banco Central of Guatemala that the intensity of labor use per unit of land is much greater on the smaller farms. On the smallest farms, those less than 2 manzanas, 0.69 full-time equivalent persons are employed per year per manzana of land, where we define "full-time" as working 150 days/year. In the 2-to-5 manzana category, intensity of labor use is .37 full-time persons per manzana, or about half that in the under-2 manzana category. The 5-to-64 and 64+ manzana farms employed .18 and .15 full-time equivalent persons/mz./yr., or considerably less labor per unit of land in use. (This is partly explained

by the more predominant role of raising cattle on these holdings, which requires only .033 persons/mz./yr. on average.)

The number of employees whose labor is fully absorbed on the land in use at prevailing intensities of labor use, given the distribution of land in 1979 was some 690,000 full-time workers. Given that the estimated agricultural labor force in 1980 was 1,115,000, it is evident that there was already considerable underemployment in agriculture. Thus, there are two separate static causes of the "rural employment problem"--idle land and low intensity of land use on the land which is used--and that both are closely linked to the prevailing land tenure system. Policies to address these matters are considered in the conclusion.

We now compare the projected sizes of the agricultural labor force under the two population growth scenarios with the employment provided under two alternative scenarios (Table 9). We first project employment by assuming land in use increases at a rate of 1.2 percent per year over the period 1980-2030 (the same rate of increase in land area used as existed between 1964 and 1979), while keeping the average intensity of labor use per unit of land constant at the 1979 national average of 0.22 persons/mz. The initial discrepancy between labor demand and supply is indicated by the ratio 690/1115 = .63, which may be dubbed the measure of "employment adequacy" or EA. The EA ratio under high fertility and constant intensity falls to a disastrous .41, and even with low fertility and constant intensity, it will decline to .53.

In the second scenario, we again assume land in use grows at 1.2 percent/year but also assume that the average intensity of use grows over time to a level of 0.37 persons per manzana in 2030 (the labor intensity on 2-to-5 manzana farms in 1979). It is noteworthy that under this scenario

the gap between available employment and labor force size under the low fertility assumption narrows after 2010, the EA ratio rising to .86. Under the assumption of high fertility with increasing intensity of land use, the employment adequacy ratio remains at .66, but the number of unemployed nearly triples. It is worth restating here that the agricultural labor force projections are made under the assumption that the urban population grows from 1/3 to over 2/3 of the total over 50 years, so that we are already taking into account high levels of rural-urban migration in the projection of the agricultural labor force.

One implication of these figures is that bringing idle land into production is crucial to ameliorate the rural employment problem. In fact, there is a widespread misperception among people knowledgeable about agriculture in Guatemala that it is sufficient to solve the problem. But in fact the increase of 1.2 percent/yr. in land used over 50 years does precisely that: Thus, our projections of employment in Table 9 already implicitly embody such a process of doubling land in use, which essentially requires using all land which was lying idle in large farms in 1979.[9] Moreoever, the current direction of agricultural research in the world has been towards developing technologies that increase yields with less labor per unit of land, not more. The ongoing pace of tractorization in Guatemala and elsewhere in Latin America suggests that rural employment absorption will become a significantly increasing problem in the future and will continue to contribute massively to high rates of rural-urban migration.[9a]

We have portrayed the long-term national prospects for rural employment in Guatemala as a function of population growth and land use. For understanding the short-term outlook for subnational regions, it is

probably more important to understand the relationship between land fragmentation and rural out-migration. Nevertheless, there has been no statistical examination of this important relationship in Guatemala, nor are appropriate data available. What is needed is a specialized household migration survey[8] undertaken in both areas of origin and destination to collect data on land, labor activity and earnings prior to the migration for both migrants and nonmigrants. With appropriate data, the effects of land size (fragmentation) on out-migration can be statistically separated from the effects of other factors by the estimation of appropriate migration functions.

(4) Natural Resources

Environmental deterioration in Guatemala may be seen as a long-run consequence of population growth mediated by such factors as land tenure and land use practices. Aspects of environmental deterioration affecting agricultural development include: deforestation, soil degradation, watershed destruction, and urban encroachment on agricultural land. Others include excessive pesticide use (a severe problem in most of the Pacific river basins because of excessive use in cotton and other crops), fisheries' destruction and groundwater depletion. (An excellent reference is Leonard, 1987. See also ICATA, 1984.) We consider these briefly in this order.

Between 1950 and 1985 half the area coverered by dense forests in 1950 has been depleted. Practically no real forests exist now in Guatemala except for in the Peten in the north, where the forest frontier recedes each year. Actual deforestation is greater than that implied by areal statistics alone. The quality or density of timber stands is also declining due to commercial exploitation of larger, mature trees. Nevertheless, the main

cause of deforestation is not the timber industry,[10] but clearing of land for agriculture, expansion of cattle ranching, and heavy reliance of families on fuelwood for energy.

Soil erosion is equally widespread and directly linked to deforestation, which leads to lack of moisture retention, especially in upland areas. Exploitation of lower-quality lowland areas, characterized by shallow, lateritic soils that can sustain agriculture for only a few years, also results in soil degradation. After a few crops, the land is abandoned as the settlers move further into the rain forest (the same process is occurring in the Brazilian Amazon) or used for cattle grazing--a form of extensive agriculture providing little employment per land area. The erosion problem is greater on the Pacific slopes because the soil is thin, the land sloping, and there are periods of heavy rainfall. Nevertheless, there is also extensive erosion in the western highlands (altiplano), with topsoil losses of 5 to 35 tons per hectare per year in some places, most evident around Lake Atitlan. Another cause of soil loss is the abandonment of ancient Indian practices of terracing and contour planting.

Watershed destruction and flooding occurs on the Pacific slopes, in large areas towards the Caribbean basin and just to the south of the Petén (rivers flowing west into Mexico), where colonization has only occurred recently. In fact, every major watershed on the Pacific side has been denuded of vegetation and suffers from erosion, flooding and sedimentation of rivers (Leonard, 1987, Ch. 4). Another consequence of soil erosion has been sedimentation in major rivers and dams supplying water for Guatemala City, and rapid river runoff has reduced replenishment of groundwater supplies for Guatemala City.

Finally, loss of agricultural land to urban areas is primarily an issue in the region immediately surrounding the one large urban area, Guatemala City. While the amount of land affected is not great, it is deep volcanic soil and readily accessible to the major urban market.

The principal sources of environmental damage in Guatemala and elsewhere in Central America are soil degradation and watershed destruction/flooding, both primarily caused by deforestation resulting from the resort to increasingly marginal lands by land-starved farmers and settlers seeking a means to eke out an existence, to support their large families.[11] This in turn results, on the supply side, from the combination of rapid rural population growth[12] combined with concentration of landholdings in large farms where half the land is idle. On the demand side, pressures to increase agricultural production result from the growth of urban areas and urban incomes, both of which are causing increases in demand for both food products to consume and agricultural exports to finance the import of modern consumer goods, including food, from abroad. The growth of population contributes to both the supply side and demand side changes and, therefore, to deforestation and environmental damage. This damage in turn, over time, reduces the future productive capacity of the land or its capacity for what has come to be called "sustainable development" (among the many references, see WCED, 1987). This concept refers to the capacity of the natural resource base in the country to supply the needs of the population on a long-term basis, so that activities of the present generation do not significantly damage the natural resource capacity of the country to satisfy the needs of future generations. It is evident that the current <u>modus vivendi</u> of development in Guatemala (and most other Third World countries) is not sustainable.

CONCLUSIONS AND RESEARCH NEEDS

The purpose of this paper has been to stimulate recognition of the key linkages between population growth/distribution and agriculture, including environmental stress, based on an overview of the situation in Central America, particularly Guatemala.

The four problem areas described are not unique to Central America: (1) growing lack of food security and dependence on imports, (2) increasing land fragmentation and rural poverty, (3) rural underemployment and out-migration, and (4) deforestation and environmental stress in rural areas.

In the course of the paper, we have tried to indicate: (a) what are the interrelationships between demographic processes and rural development problems (about which far too little is known), and (b) how the problems are interrelated in such a way that policies to ameliorate one problem may exacerbate others (e.g., policies to accelerate rural-urban migration may worsen food security and urban congestion; bringing more land into production to alleviate (1)-(3) is likely to exacerbate damage to the environment). Even policies to redistribute land, or at least fiscal policies to force the productive use of idle land on large estates (via a presumptive income taxes on farm land), to relieve (1)-(3), may have damaging effects on (4) if the increasing use of land is not accompanied by changes in current practices. The same is true of other policies to increase the <u>intensity</u> of land use on existing land (higher labor/land ratio) via shifts (in crops or animals raised or technology (hybrid seeds, fertilizer and chemicals, irrigation, etc.).

While population growth is not the only factor or even the principal factor affecting each of the four problems, it is related to each. Therefore, lowering the rate of population growth will allow more time to

implement the other policies needed. Even in the absence of explicit policies to lower fertility, agricultural policies should be developed with an understanding of the long-term implications of population growth and urbanization.

FOOTNOTES

[1]For further details and additional bibliography, see Stupp and Bilsborrow (1988).

[2]In the latest (1987) national fertility survey, total fertility rates were estimated as 6.5 in rural areas, 4.1 in urban, and 5.6 in Guatemala as a whole. Levels of contraceptive use and fertility decline remain quite modest (INCAP, 1988).

[3]The only large city is the capital, Guatemala, which grew from 406 thousand in 1950 to 1 million in 1980 and is projected to exceed 2 million by the year 2000. As elsewhere in the Third World, much of its growth is due not to migration but to high rates of urban fertility relative to low urban mortality: The United Nations estimates that 2/3 of its growth between 1964 and 1973 was due to natural population growth (UN, 1980).

[4]The IDB first calculated domestic consumption of all major food items as equal to production plus imports minus exports. Using calorie equivalents for each food (e.g., bushel of wheat, pound of apples), it then computed the number of calories provided by the aggregate consumption of each food. All consumption figures are then converted to thousands of metric tons of cereal equivalents. Clearly these computations can generally be made in a country for exercises such as this.

[5]A national survey of nutritional levels in school-age children in 1986 by the Ministry of Education shows malnutrition (percent of children aged 6-9 less than the 90th percentile [EHO] of height for age) to be over 20 percent in all provinces of Guatemala and over 40 percent in the most densely populated rural areas.

[6]The projection of food demand above also is independent of (unknown) increases in future income. Past trends in growth of per-capita income could be used to project future levels. Then with assumptions about income elasticities of demand for various foods, which have been estimated in various cross-country econometric studies, and have been found to vary with the level of income, future demands can be readily projected by commodity. If future income levels are expected to grow rapidly (as in most five-year development plans in the Third World, though rarely attained), then the <u>proportion</u> of any increase in future demands attributable to the increase in population (vs. increase in income) will be correspondingly reduced, though the role of population is still undeniable.

[7]One manzana equals .7 hectares or .7(2.5) = 1.7 acres.

[8]Or a migration module in a detailed household economic-demographic survey. Recent (1987) household demographic surveys in Guatemala, such as that of the Statistical Office (INE) carried out with UN support and that of INCAP (1987) for DHS have not even collected information for <u>measuring</u> recent migration much less needed economic data on the situation prior to migration as well as subsequently. See Bilsborrow et al. (1984) on the design of migration surveys.

[9]It might be recalled that there still remains in Guatemala an additional 15 percent of the potentially arable land which does not (or did not in 1979) belong to farms and which could therefore be brought into production. However, this provides at most another decade, and most of it is on lower-quality land whose usage increases environmental stress (see 4 below). It might also be noted that the rural-urban migration process could be accelerated further, relieving population pressures on the land. However, this would further erode agricultural production and increase urban food demand, exacerbating problem (1) above. Moreover, as in other developing countries, urban problems of lack of employment, urban services, congestion and pollution are already such that official policy (e.g., of SEGEPLAN) is to attempt to reduce rural-urban migration, especially to Guatemala City.

[9a]Hence, it is absolutely necessary to (a) reduce rural population growth, and (b) develop and apply more labor-intensive methods of agricultural production. Although there have recently been some successes on a small scale in highlands agriculture converting small plots from corn to intensive fruit and vegetable farming (for export), the feasibility of achieving (b) on a national scale seems remote, leading to (a) as a necessary conclusion, whatever one's ideology.

[10]The timber industry in fact is underdeveloped in Guatemala, given its potential under careful management; in Central America it is significant only in Honduras.

[11]A study of USAID (1987) identifies regions of Guatemala where marginally productive land is being used for agriculture, with resulting environmental damage. It compares, for each department, the percentage of land classified as "appropriate for agriculture" with the land area that was already in farms in 1979 (according to the 1979 agricultural census): In the departments in the eastern region, along the Pacific coast, and in the densely populated altiplano, there was already more land in farms in 1979 than classified as appropriate for agriculture. By comparing these areas with the map in Leonard (1987:114-15), it is evident that these correspond to areas experiencing environmental problems. See also Higgins et al. (1982).

[12]An extensive analysis of the relationships between population growth/density and deforestation in Guatemala has recently been completed by Alfredo Mendez of the Universidad del Valle in Guatemala City. Using data from the 1950-1981 population and agricultural censuses as well as from community- and household-level surveys conducted in sample areas in 1987, Mendez (1988) finds significant correlations between population density and deforestation. This is a virtually unique analysis that warrants implementing and extending in other countries.

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Table 1: Population Projections for Central America

	(in thousands)				
	1980	1990	2000	2010	2020
	Total (Urban)	Total (Urban)	Total (Urban)	Total (Urban)	Total (Urban)
Costa Rica	2279 (988)	2937 (1437)	3598 (2012)	4239 (2656)	4837 (3314)
El Salvador	4797 (1971)	6484 (2954)	8708 (4578)	11188 (6673)	13769 (9076)
Guatemala	6917 (2827)	9676 (4289)	12739 (6573)	16125 (9477)	19818 (12911)
Honduras	3691 (1329)	5105 (2239)	6978 (3604)	9394 (5525)	11972 (7804)
Nicaragua	2771 (1538)	3871 (2439)	5261 (3630)	8435 (5046)	9219 (7371)
Panama	1956 (981)	2418 (1308)	2893 (1728)	3324 (2193)	3701 (2641)
	22411 (9634)				63316 (43117)

Source: United Nations, World Population Prospects, 1982 (1985).

Table 2: Agricultural Population per Hectare of Agricultural Land

	1961	1983
Costa Rica	1.3	1.3
El Salvador	2.5	3.6
Guatemala	1.8	2.3
Honduras	0.9	1.4
Nicaragua	0.8	0.9
Panama	1.0	1.2

Sources: FAO, FAO Production Yearbook, 1977, 1984.

Table 3: Agricultural Production Trends in Central America

	(Annual Rate of Growth)			
	Total Agriculture		Basic Foods	
	1971-80	1981-84	1971-80	1981-84
Costa Rica	3.0	3.1	3.1	1.6
El Salvador	3.6	1.5	4.8	1.7
Guatemala	4.6	-2.6	4.4	-0.2
Honduras	2.6	0.8	1.7	0.6
Nicaragua	2.7	-0.3	3.1	2.1
Panama	3.2	0.8	3.1	0.7

Table 4: Central America: Value Added per Agricultural Worker

	(thousands of U.S. 1985 dollars)	
	1970	1985
Costa Rica	3.0	3.3
El Salvador	1.2	1.0
Guatemala	1.2	1.2
Honduras	0.9	0.9
Nicaragua	1.3	1.4
Panama	1.3	1.6

Sources: World Bank, 1985; IDB, 1983; FAO, 1986b.

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Table 5. Land Distribution in Central America, 1975-80

	(Number of farms in 000 and percentage of land in each category)		
	Less than 10 ha.	10-99 ha.	100 ha.+
Costa Rica	153 (4)	43 (29)	48 (67)
El Salvador	251 (27)	18 (34)	2 (39)
Guatemala	548 (16)	49 (19)	14 (65)
Honduras	153 (17)	39 (28)	3 (55)
Panama	55 (8)	34 (46)	3 (46)

Source: Peek, 1986. Comparable data were not available for Nicaragua.

Table 6. Population Projections[1] for Guatemala: 1980-2030

	(millions)		
	1980	2030 (Low Fertility)	2030 (High Fertility)
Total	6.92	23.86	37.37
Urban	2.26	16.68	25.51
Rural	4.65	7.18	11.86

[1]For sources and assumptions, see text.

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Table 7: Guatemala: Projections of Food Supply and Demand

Projections of Demand[a] for Food (thousands of metric tons)

	1980	2000	2030
Low Fertility	1383.4	2715.9	5548.0
High Fertility	1383.4	2899.0	8684.3

Projections of Food Supply (with constant productivity)[b]

Low Fertility	1205.9	1910.8	2428.6
High Fertility	1205.9	1925.6	3145.6

Projections of Food Supply (with productivity doubling in 50 years)

Low Fertility	1205.9	2674.4	4857.1
High Fertility	1205.9	2695.1	6291.2

[a]Assumes consumption per capita increases at 0.3 percent per year.

[b]At 1.081 metric tons of cereal equivalents of food produced per worker per year.

Sources: See text.

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Table 8: Guatemala: Land in Farms and Number of Farms by Farm Size and Region, 1964-79

Farm Size:	Land Area (thousands of manzanas) <2 manzanas		2-5 manzanas		5-64 manzanas		64+manzanas	
	1964	1979	1964	1979	1964	1979	1964	1979
Central	30.8	39.6	58.5	55.8	193.9	193.5	833.5	837.4
Oriental Sur	26.3	30.3	68.1	70.9	225.0	244.1	684.0	699.7
Costera	25.4	25.2	23.9	27.0	111.0	110.9	649.6	740.7
Altiplano	73.2	112.6	147.6	158.2	480.2	479.2	399.5	365.9
Oriental Norte	11.5	16.0	34.1	36.5	121.2	199.6	454.0	471.0
Norte	5.3	25.1	61.8	64.3	171.3	331.9	744.2	1406.5
Total	192.5	248.7	394.0	412.7	1302.7	1559.2	3764.8	4521.3

Farm Size:	Number of Farms (thousands) <2 manzanas		2-5 manzanas		5-64 manzanas		64+ manzanas	
	1964	1979	1964	1979	1964	1979	1964	1979
Central	28.8	66.0	20.2	15.6	12.9	10.3	1.6	1.8
Oriental Sur	21.0	41.1	21.6	24.1	14.4	16.6	2.3	2.2
Costera	30.3	46.9	7.8	8.7	6.1	6.9	1.5	1.5
Altiplano	76.1	144.3	47.1	47.4	39.7	32.8	1.3	0.9
Oriental Norte	10.4	27.1	11.9	12.0	8.3	11.9	1.0	1.4
Norte	7.1	36.2	20.5	20.9	14.3	22.7	1.1	5.9
Total	183.7	361.5	129.7	128.6	95.7	101.3	8.8	13.7

Source: SEGEPLAN, 1987.

Table 9. Guatemala: Projections of the Agricultural Labor Force and Numbers of Full-time Equivalent Employees in Agriculture (thousands)

Agricultural Labor Force

	1980	1990	2000	2010	2020	2030
Low Fertility	1115.5	1425.0	1767.6	2061.9	2247.0	2246.6
High Fertility	1115.5	1424.2	1781.3	2163.6	2552.7	2909.9

Full-Time Equivalent Employees[a]

Persons/Manzana Constant[b]	690.6	776.6	862.2	957.4	1062.8	1180.1
Persons/Manzana Growing[c]	690.6	875.4	1081.6	1323.0	1603.9	1931.0

[a]Land in use assumed to grow at 1.2 percent per year.
[b]Intensity of labor use constant at .22 full-time employees per mz.
[c]Intensity of labor use grows to .37 full-time employees per m. in 2030.

Source: See text.

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