

NATIONAL FAMILY PLANNING AND THE DEMOGRAPHIC TRANSITION: A CASE STUDY OF BOLIVIA

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The Demographic Transition:

A significant movement in human vital rates in which regions move from high birth and death rates to low birth and death rates with the transitional phase in between usually consisting of elevated population growth due to a lag in the decline of fertility alongside steadily declining mortality.

Introduction

Bolivia stands out as the Latin American nation with some of the most dismal social indicators. Given global medical and technological advances, and the ease with which modern methods can be transferred to poorer regions, it seems unlikely that a nation should continue to suffer the human misery that most of the developed world experienced over 100 years ago. Yet, Bolivians continue to die at a rate comparable to some of the poorest Sub-Saharan African nations. Most deaths are experienced by women of reproductive ages and their children and most of these deaths could be *easily* prevented through standard prenatal care, longer birth intervals between children, and higher contraceptive prevalence. Although such preventive measures are not at all particular to Bolivia, what is striking is the fact that women do wish to limit their family size and are often willing to act upon their desires, but do not have the means to do so.¹ Unlike many Sub-Saharan African countries, Bolivia has a great deal of latent demand for family planning services but supply is not effectively nor efficiently disseminated.

Since the persistently high fertility has fostered high maternal and infant mortality, the high fertility can legitimately be viewed as the primary reason that the demographic transition has not resolved into an equilibrium state of low fertility and mortality. (see chart C) It will be the primary focus of this paper to examine the reasons why family planning has not been fully developed on either the supply or the demand side. Specifically, the lack of family planning emphasis by policy makers will be elaborated upon to explain the deficits on the supply side while the cultural and logistical reasons will be studied to understand the deficiencies on the demand side.

Fact Sheet: Social Indicators for Bolivia

-approximately 80% of Bolivian households in 1976 lived in poverty (where family income is less than 70% of the cost of basic needs)

-the share of the population in extreme poverty is triple the Latin American average

-the official rate for maternal mortality is 48 per 10,000 births result in maternal mortality which is twice the South American average but this estimate does not include single women which account for at least 30% of maternal deaths

-a study conducted found that 80% of female hospitalizations were abortion related (1980)

-Bolivia has the highest illiteracy rate in South America (36.2% for the nation as a whole, 53.2% in rural areas)

-the 1976 census put female illiteracy at 43.4% (versus 21% for men)

-approximately 26% of families are female-headed and most of these women live below the poverty level: a survey from one region (El Alto) showed that 34% of working women earned less than one quarter of the cost of the minimum basic needs basket

-as more parents seek work, small children are increasingly left alone or with young siblings, with serious consequences in the short and long run²

-the "Human Development Index" (HDI) which measures three essential elements of life (life expectancy at birth, literacy and GDP per capita) ranked Bolivia as "low" falling at 109 in a pool of 160 countries with only Haiti placing lower for the region

-despite improvements in these indicators between 1980 and 1990, Bolivia can more accurately be compared to Sub-Saharan Africa³ (see Charts A & B)

-infant mortality is twice the average for the South American region at about 110 per 1000 live births and 277 per 1000 live births in some poor communities in the highlands and low income urban areas (even these estimates are probably low due to substantial underreporting)

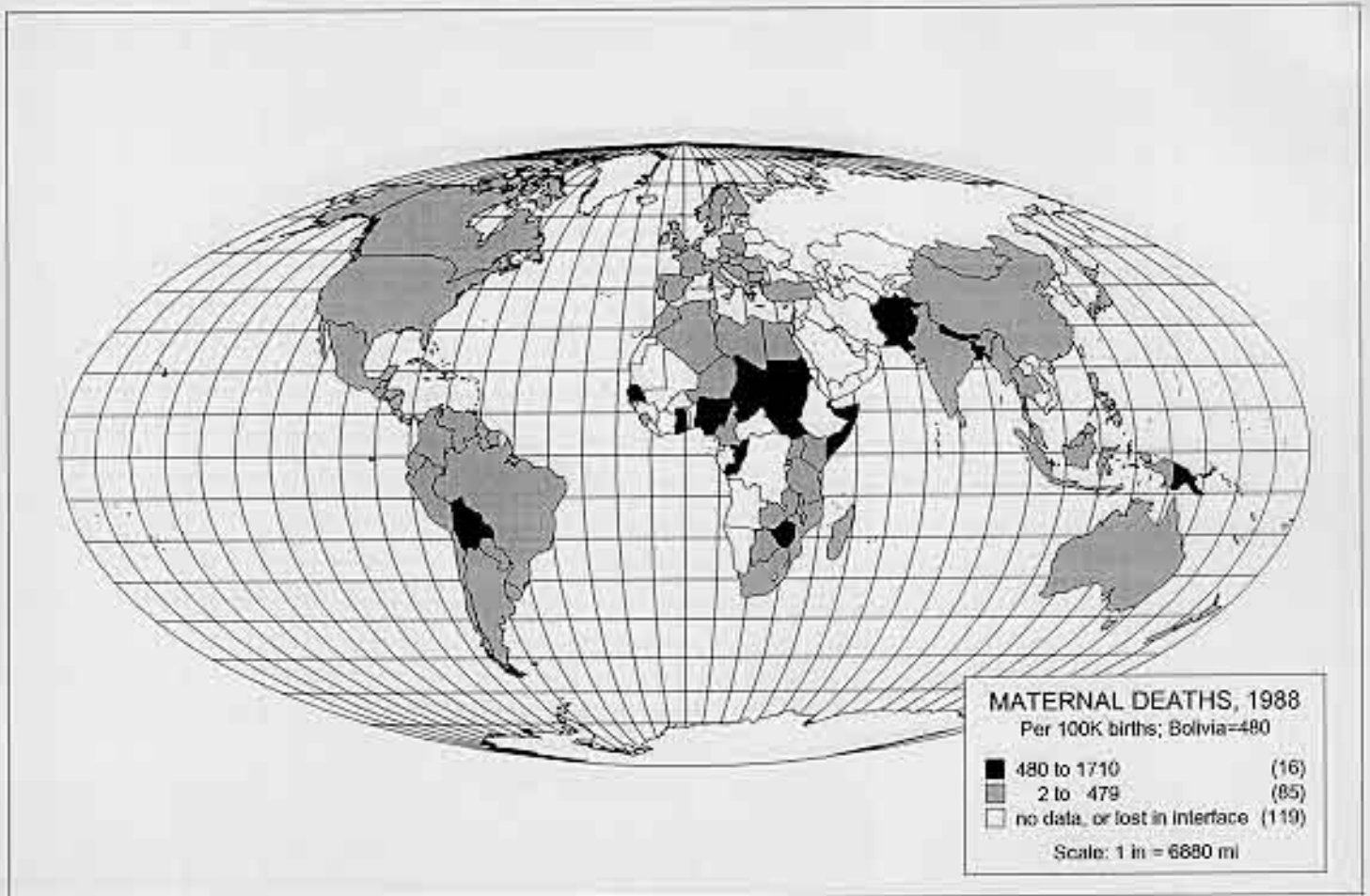
-on average, 65% of the urban population of the four major cities do not have excreta disposal and up to 85% in Santa Cruz, the most rapidly growing city

-only about 1/3 of the Bolivian population is estimated to receive adequate basic health care⁴

-the child mortality rate is 125 per 1000 while it is 60 per 1000 for the Latin American region⁵

-children dying before the age of 5 represent 43% of all deaths in the country⁶

CHART A



Source: World Resources Database

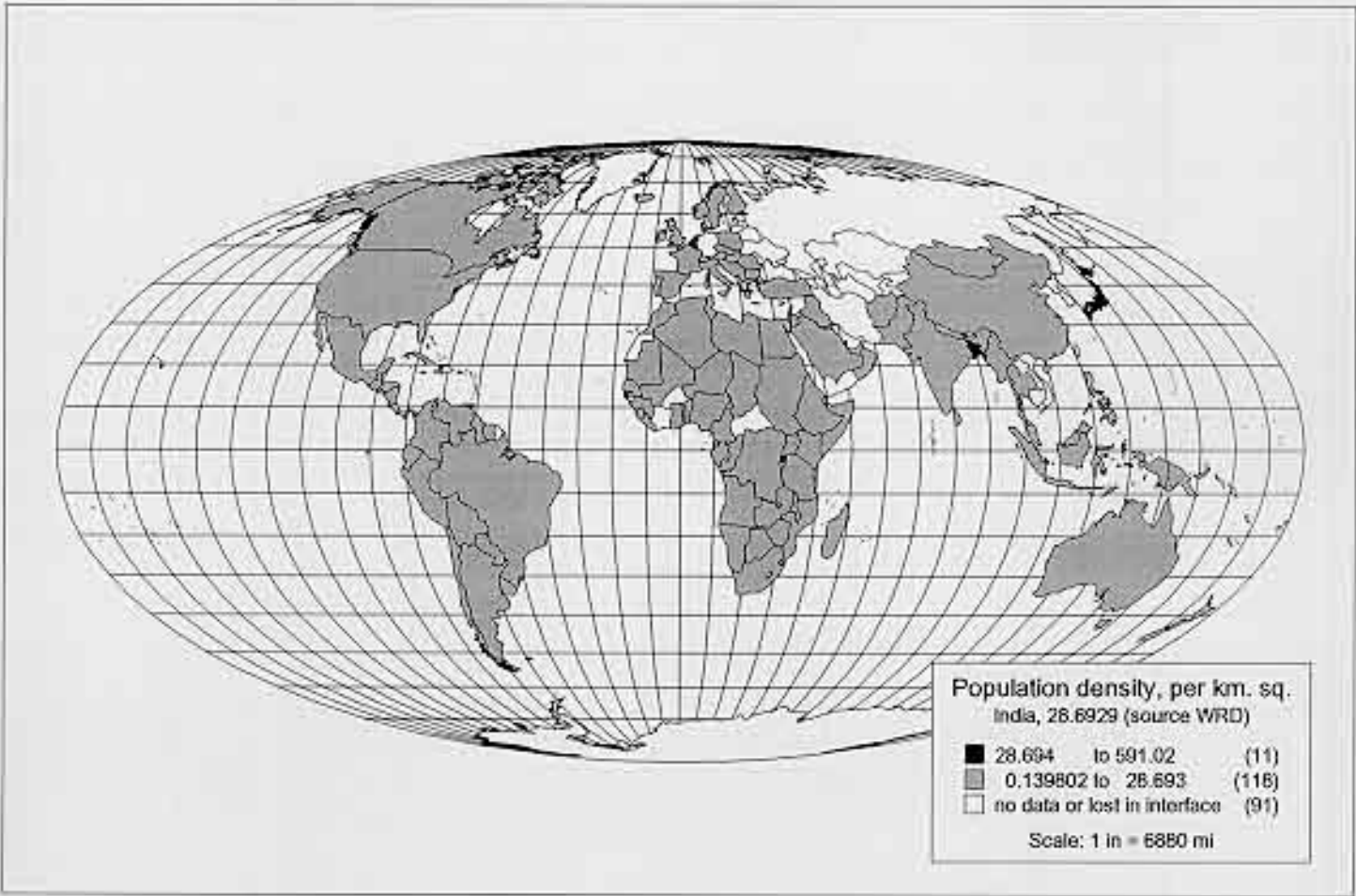
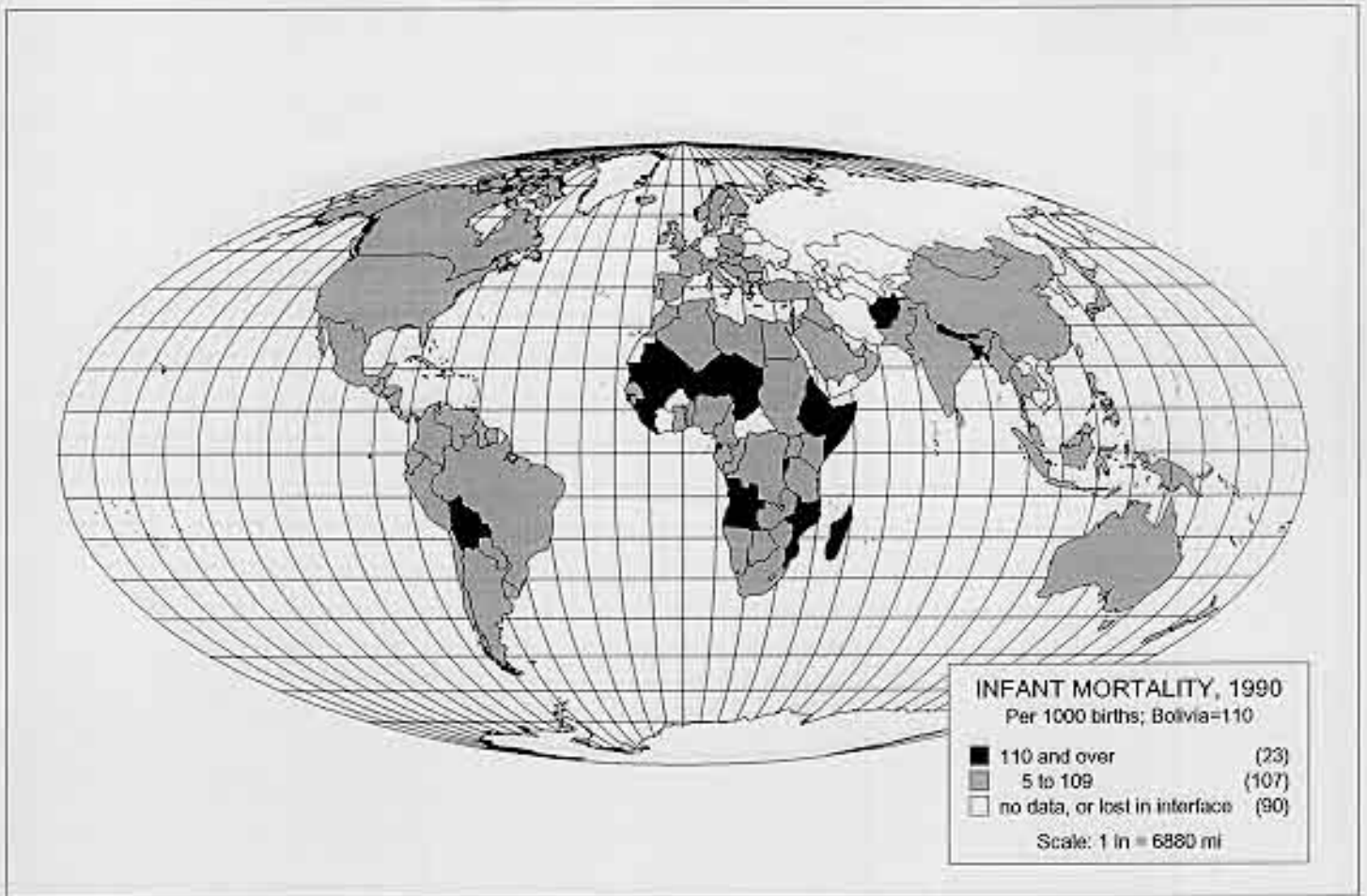
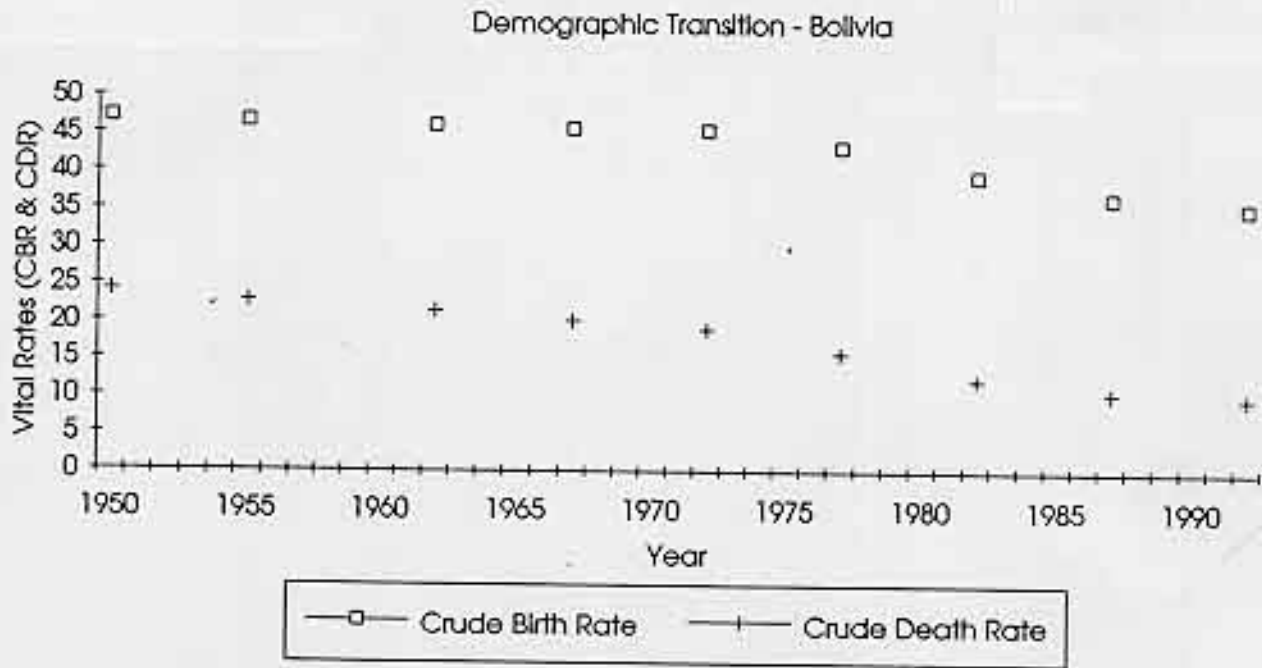


CHART B



Source: World Resources Database

CHART C



Source: World Resources Database

Reasons for the low health status of Bolivians

"Bolivia has the worst health status in Latin America. More children die in Bolivia under the age of 5 than in any other country in Latin America. Fourteen percent of Bolivian children die before the age of 5. Ten percent die before age 1; nearly half of these die in the first month of life and nearly 1/5 during the first week. Deaths of children under age 5 account for nearly half (43%) of all deaths in Bolivia. Among the children who survive, 38% suffer from chronic malnutrition, 28% from recurrent diarrhea, and 20% from acute respiratory infections."⁷

It is painfully apparent from this statement that pregnancy and childbearing are the leading causes for the short life expectancy and poor health of the Bolivian population. Given this scenario of high morbidity and mortality, the logical progression would be towards efforts that reduce the number of children women have and enhance the chances of survivability once children are born. Yet, the obstacles to such efforts are aggravated by an entire network of poor living conditions. As is the case in most developing countries, children are more likely to die in areas with little or no medical care, faulty water and sanitation supply and if the mother has little or no education. Also, children are more likely to die if they are born at an interval of less than two years apart from a sibling⁸ and if they are left unattended by the mother (usually to partake in agricultural work). This setting is especially common place in *rural* Bolivia and begs for family planning programs.

There is substantial promise, however, in that women have expressed a tangible interest in reducing the number of children they have, although they do not seem ready to fully embrace *modern* contraceptive methods. Specifically, out of all Bolivian women of reproductive ages (15-44), fully 72% say they do not want any more children.⁹ Almost the entire remaining 28% wish to space births more but do not do so with any modern contraceptive method. Of those women who do claim to use contraceptive methods, most use traditional methods such as rhythm and withdrawal. Thus, major infrastructural changes are needed to improve living standards, alongside implementation of aggressive family planning programs to improve women's reproductive health. Yet, the government has not initiated a national campaign endorsing family planning, and has not effectively funded public health programs that focus on women's reproductive health although women constitute 75% of the health care patients of Bolivia.

Barriers to the Resolution of the Demographic Transition

The Demand Side

Let us elaborate on the reasons for this anomaly. In a country that is primarily rural, and does not have effective family planning governmental programs, lack of access would appear to be the main obstacle to obtaining contraceptive services. Although accessibility is certainly an issue, it is interesting and valid to note that many women, especially in urban areas, do state that they know a source for obtaining contraceptive services but do not utilize them for a host of reasons. It is this gap between latent demand and usage that is the most relevant in discussing a demographic transition that is slow to resolve to a new and more humanitarian equilibrium.

Particularly relevant on the demand side, are the women in the younger and older age groups who are most likely to die as a result of childbearing. These women are also more likely to have their children die. Older women and adolescents experience a higher incidence of deaths from hemorrhaging and from complications of elective abortions.¹⁰ The high rate of adolescent childbearing is of notable importance if one considers the future implications of continued high fertility. Almost one in ten women ages 15-19 have at least one child and this statistic does not even account for all the young women who conceive but elect to have abortions.¹¹ And yet among women aged 15-19, 41% are not using family planning but say they want no more children or want to space births at least 2 years apart.

Discrepancies in scale can be seen in that rural adolescent fertility rates are more than double the urban rates in Bolivia: 141 per 1000 in the rural regions and 68 per 1000 in the urban regions. Yet, most

existing public and private programs are in the urban centers despite that there is at least twice as much need and little to no existing infrastructure in the rural areas. While it is true that rural to urban migration is noteworthy, it has not been as high in Bolivia as seen in other countries such as Mexico or Brazil.¹² (see Chart D) Thus, the shortcomings are two-fold: government programs do not target the younger and older age groups in any effective manner, and most governmental family planning programs that exist are in urban centers where need is about half of what it is in rural areas.

Infants and children are also much more likely to die in the rural areas of Bolivia although for both rural and urban areas combined, Bolivia has among the highest death rates in the region. This has various implications for the reproductive behavior of women in that hoarding (having more children than desired in order to ensure survivability of at least some children) and replacement strategies (having another child when one dies) are widespread. To comprehend the logic behind this type of behavior, one need only consider that in a survey conducted in one of the poorer rural areas found that only one woman in three had not lost a child.¹³ This dilemma can only be addressed by broader social projects which enhance the overall living conditions of the entire population. This is again a public health issue warranting governmental action.

Nevertheless, given the hoarding and replacement tactics to insure completed family size, there still exists a latent demand for family planning even in the economically deprived rural areas and among women in their peak reproductive years. For women aged 20-24 and 25-29, 57% and 74% respectively wish to stop having children. However, only about 12% of all women of reproductive ages use a modern method of contraception. (Approximately 30% of Bolivian women say they use traditional and modern contraceptive methods - see Chart E for a comparison of Bolivia to African counterparts).

Since Bolivia is primarily a Catholic nation, religious reasons could appear on the surface to account for the hesitance on the part of women to use birth control.¹⁴ Yet, this argument would not go very far in explaining the extremely high rates of elective abortions. Likewise, women do not generally object to media efforts to encourage family planning again implying a certain degree of acceptability to the idea of contraceptive use. Anthropological/cultural reasons also do not fully explain women's reluctance since even indigenous women in the rural areas (where cultural norms are strongest) are expressing a desire to limit family size. Lack of life options is also a major contributor in the reproductive choices of women although it is again interesting to note that despite the fact that Bolivian women have the lowest educational status in South America, they still wish to limit their childbearing.¹⁵

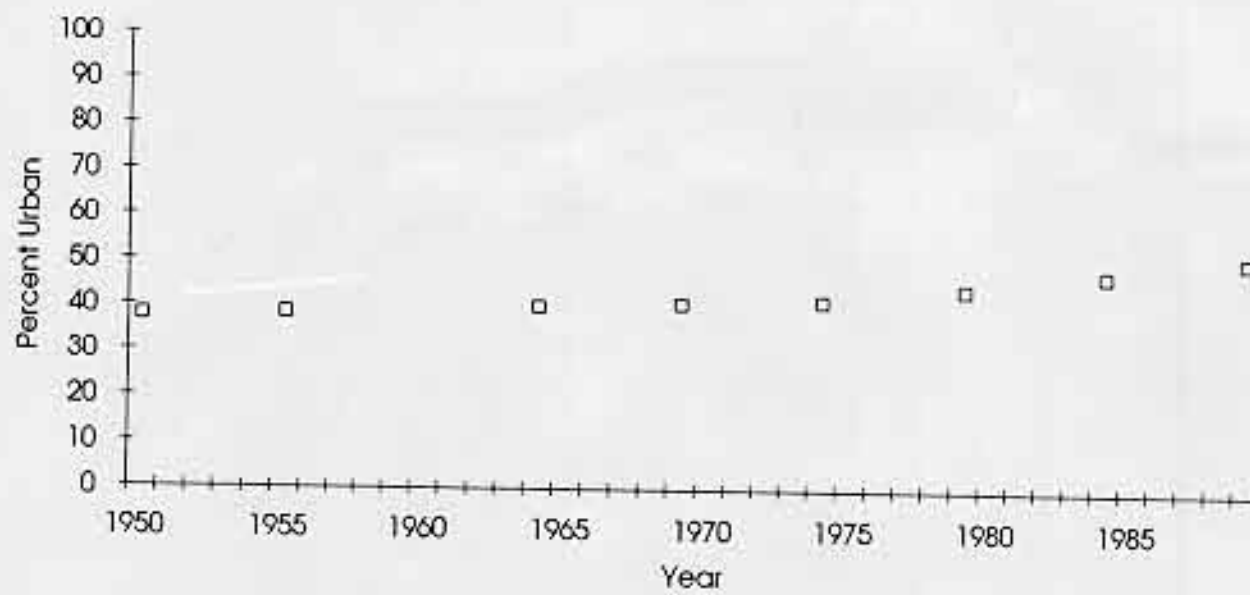
The Supply Side

Having reduced the importance of some of the classic reasons for restricted demand for family planning, we turn to a survey that was recently conducted in La Paz, Bolivia which illuminates the deficiencies on the supply side. A privately conducted survey which "oversampled" the DHS survey of 1989 showed that almost 70% of women in reproductive ages knew of a birth control method and 61% of those women knew of a source. SOMARC and a pharmaceutical manufacturing company, Schering AG, conducted the survey to assess the knowledge and acceptability of its oral contraceptive Noriday. Given that the oversample was for an urban pool of women who are relatively more educated than rural women, it is astounding to consider the lack of knowledge and the prevalence of mis-information about contraceptive methods.

Although 3/4 of the women knew of at least one contraceptive method without prompting any response, almost 40% were unable to name a method when a simple description was given to them. For nearly all the statements heard by the women, the rhythm method was mentioned by more women than any other method, meaning women perceive this traditional method to be more convenient, cheaper, easier to use and obtain, and as having the least side effects/complications. Also, more women believe in the effectiveness of the rhythm method in preventing pregnancy than in the effectiveness of the pill. Only 5.6% thought the pill was the most effective method while 15.3% and 34% thought that the rhythm and IUD methods were more effective. The perception that the pill is quite ineffective probably stems from the fact that most women do not even know that the pill must be taken daily which, of course, reduces the

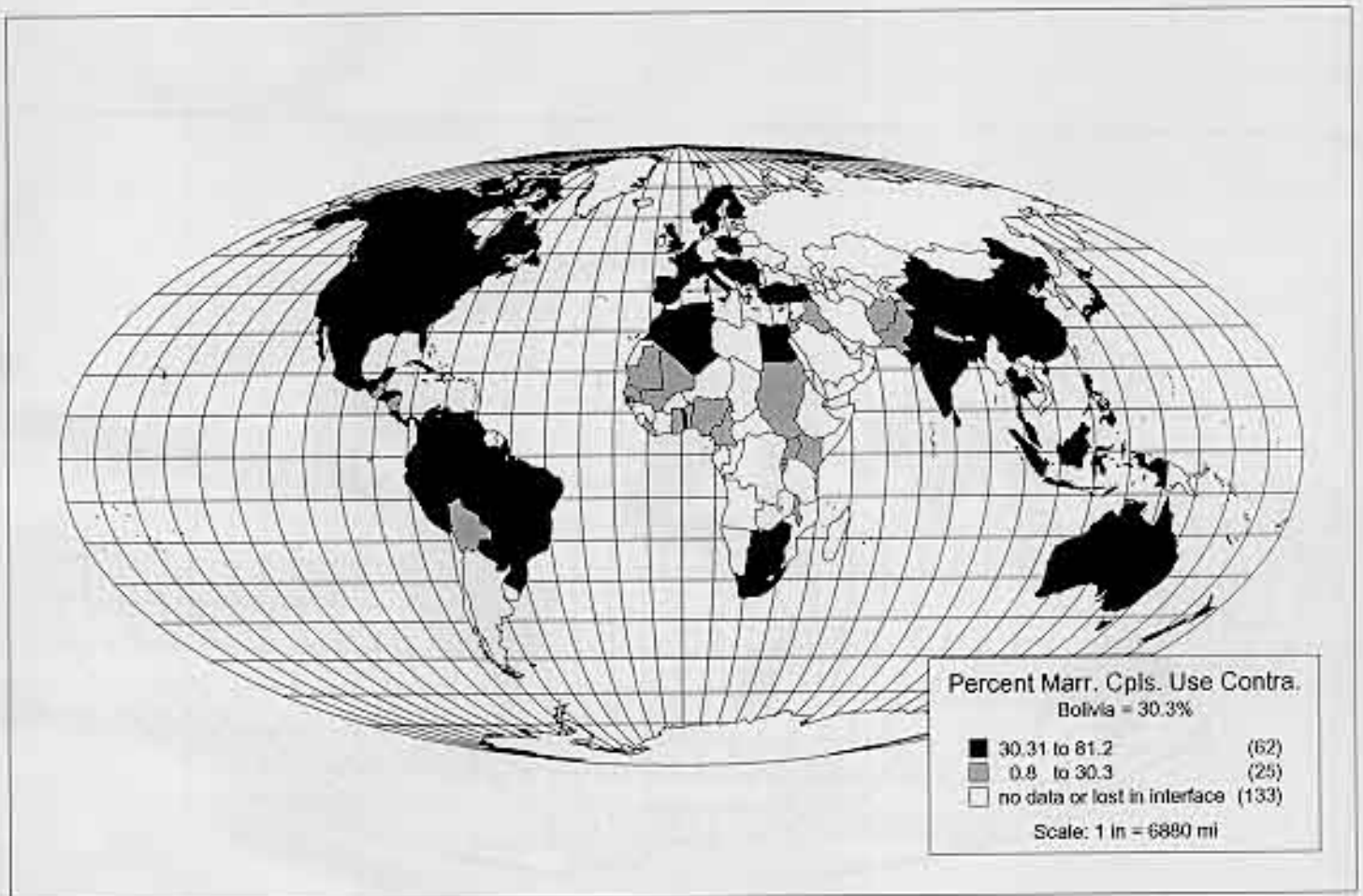
CHART D

Urbanization Transition



Source: World Bank

CHART E



Source: World Resources Database

effectiveness and increases the side-effects such as break through bleeding. On a more serious level, it also becomes apparent that Bolivian women fear oral contraceptives due to the perception that the pill can cause cancer or permanent sterility. 31% of the women thought the pill would certainly cause sterility while 48% were not sure if it could cause sterility. Half of the women were not sure if the pill could cause cancer while 40% thought the pill could *definitely* cause cancer. Such gross mis-information is surprising in light of the fact that in this oversample, only 3.8% of the women had ever even tried the pill.¹⁶ Eradication of the erroneous perceptions is further hampered by the fact that most women think they must go to a private doctor in order to obtain a modern method of family planning. Most women are not even aware of the few public facilities that do exist for female reproductive health due to the poor commitment on the part of the government to launch an informational campaign.

In this light, it is not surprising that women do not have a favorable impression of modern medicine in general. This can especially be seen in the prevalence of medically unsupervised home deliveries. About 60% of babies born in the last five years were born at home and almost half of all babies were delivered at home and without prenatal care. Half of these mothers did not even know of any modern method of family planning. But even this alarming fact is again masked by the issue of rural versus urban scale: twice as many women in the rural areas than in the urban areas lack prenatal care. Therefore, averaging the two distinct regions distorts the reality that most women of reproductive ages in the rural areas have the double disadvantage of lack of contraceptive knowledge and lack of prenatal and delivery care. Perhaps the most detrimental factor in governmental efforts to address maternal and child health has been the inability to incorporate these differences of scale into the design of health care projects.

In the urban *and* rural areas, we find that the vacuum left open by the government is often filled by NGOs who provide about 64% of IUDs and sterilizations and 80% of pills, vaginal methods, injections, and condoms. It is evident, however, that non-governmental organizations are not bridging the gap between supply and demand or total fertility would have fallen more substantially than it has. Given the successes seen in other developing countries in reducing health care costs and improving life expectancy, it is astonishing that the Bolivian government is not meeting supply and vigorously providing a service that could single-handedly reduce mortality by 50% or more.¹⁷

Despite the poor performance of the public health sector, the financial burdens of health care servicing is compromising the economic viability of the social sector as a whole. This is primarily due to the sizeable capital expenditures of the past which have focused on large curative hospitals and secondary care. Despite the lack of reliable data in Bolivia, it is surprising that such capital undertakings took place in a country where the greatest need has always been for preventive and primary care of simple and highly treatable diseases. Need for these primary services has always been more acute in the rural areas. But, capital expenditures for potential rural projects have been crowded out by the expenditures for the operating costs of urban hospitals (which are usually at only 20% occupancy).

But perhaps the poor investments of the past in large, urban, curative hospitals can reveal some of the societal biases that exist in Bolivia. There is a distinct class system in Bolivia which separates the Indians from the (mixed blood) Spaniards and it is clearly the Indians who are perceived as the lower class. It is not inconceivable that in past and even present decision-making, there has been a bias against addressing maternal and child health because most of these illnesses and deaths occur among the indigenous populations. The curative care seen in urban hospitals is geared towards more complex (secondary) illnesses that are more likely to be emphasized if wealthier subpopulations express an interest in obtaining such services. It is specifically these higher class populations that usually have longer life expectancy and are therefore more likely to need secondary versus primary care.

This is where we most clearly see that the differences in the scale of female morbidity and mortality between rural and urban areas has hindered the urbanization transition. Clearly, the lack of lucrative economic opportunities in cities has been the primary cause for the relatively slow rural to urban migration. But we also see that a societal bias against indigenous people (who are primarily in the rural areas) deters them from seeking opportunities in the cities. People are less likely to migrate to areas where

class biases against them exist. The biases are evident in every realm from educational options, to vocational choices, to health care servicing. They only need look to the history of (urban) infrastructural investments in health care to realize the tangible nature and scope of these biases.

Furthermore, women in general constitute another minority whose needs are not at the forefront of policy-making. This is evident in the fact that up until 1989, the Bolivian government had proclaimed a population that was "too low" despite the fact that excessive childbearing was causing women and children to die at a higher rate than anywhere in the region.¹⁸ Since 1989, Bolivia has amended its population policy and now states that its fertility level is too high although efforts to address this have been mis-managed or completely absent. Even the National Plan for Child Survival and Maternal Health launched in November of 1989, which includes family planning provisions, has had very limited success due to poor program design, implementation and evaluation. "The plan lacks clear links between objectives, strategies, programs and specific actions,"¹⁹ indicating the low priority of the issue and probably also the lack of qualified personnel. Thus, any recent efforts to enhance the health status of women and children have been lackluster as is best seen in the Mauldin and Ross study which gave Bolivia a ranking of 23% (out of 100%) in its efforts to address family planning issues. The future implications of this are grave if one considers that the Mauldin and Ross study also found that countries that fell into the "weak" category as Bolivia did, on average saw a only modest 2% decrease in TFR during a seven year period.²⁰ Such marginal declines in total fertility will not go very far in closing the gap of the demographic transition.

Likewise, the government has not been effective in educating women to the extent necessary to reduce fertility levels. Although female education has improved for Bolivian women, still the vast majority of women in rural areas and a substantial proportion of women in urban areas are not educated beyond the primary level (if at all). This has significant implications for the demographic transition as demonstrated by statistical multiple regressions: all else held equal, a 1% increase in the percentage of women educated the the secondary school level would reduce the birth rate by .013 per 1000 women. More tangibly, this can be translated to mean that a 77% increase in the proportion of women who at least attend secondary school, would reduce the number of children born per 1000 women by about one child. This 77% might seem like a large necessary increase in education but it must be put into the context of already very low existing educational levels. Of Bolivian women ages 45-49, only 1 in 10 had reached secondary school while for women ages 15-19, 4 in 10 had reached secondary school.²¹ There is no question that the trend is moving in the right direction as younger cohorts are becoming more educated but there is still a very large proportion of women who do not even reach secondary levels. This is especially true for the rural areas where life options for women are especially restricted which, in turn, perpetuates the cultural norms of high fertility.²² Furthermore, the educated and productive participation of women in the labour force is seriously compromised in this cycle of low educational levels and high fertility. Proper attention must be given to the educational transition as a vital coexisting transition that can serve to either ease or exacerbate the demographic transition to a new equilibrium. Again we find that the government navigates the course of these coexisting transitional phenomena which are so vital to the entire social well-being of the Bolivian populace.

It is difficult to state which transition is more important as a determinant of fertility levels, morbidity and mortality. Different regions have varying dynamics moulded by the past which present a unique puzzle in the attempt to reduce fertility levels. Yet, it is increasingly apparent in the case of Bolivia that it is primarily the lack of a national mandate prioritizing social programs for women that is key. Juxtaposing the desire of women to limit births and the blatant knowledge and accessibility gaps, it appears that both the lack of contraceptive supply and the poorly coordinated efforts at supplying are at the root of the problem. The lack of supply is especially conspicuous in the rural areas where most women do not receive prenatal care or even know of a modern family planning method. The poorly implemented efforts to supply contraceptive methods are apparent in the urban and peri-urban areas where women are mis-informed about the effectiveness and safety of modern methods. The infrastructure necessary to reduce the high rates of disease and illiteracy are also lacking. Likewise, the future prospects

for change in women's behavioral patterns of hoarding and replacing have not been acknowledged as part of the hurdle that must be overcome. The high risk groups (adolescents and older women of reproductive ages) have not been targeted in any effective manner, although they constitute most of the maternal deaths. The government has not endorsed family planning either verbally through the media or through direct interventionary policies, nor have they analyzed the costs and benefits of shifting emphasis from the urban curative centers to the rural preventive ones. The government also has not taken a lead in obviating the inherent class biases. In fact, they perpetuate the cycle of poverty and economic deprivation against the indigenous population by prioritizing urban health centers. Chart F on the following page illustrates this positive feedback loop which fosters the unfavorable living environment for Bolivia's poor.

Unfortunately, the result has been persistently high levels of fertility, maternal and infant mortality as well as very high rates of illegal abortions. The gap between high fertility and mortality still persists in Bolivia as does the gap between contraceptive knowledge and use. There is no question that these voids are highly correlated. Given the cultural, informational, and geographical obstacles, it is only the government through a broad national effort who could fill these gaps through a comprehensive maternal and child health program.

Future Policy Implications

The first step in designing an effective health care project is analysis of the given situation. The Bolivian government must emphasize the importance of obtaining health status data so that illness-specific programs can be targeted to the proper groups.²³ The costs of such informational endeavors need not be great given that in the past few years many non-governmental organizations have conducted in-depth surveys which have essentially captured the thrust of the current scenario. The 1989 Demographic and Health Survey, which is being updated in 1994, is an excellent example of such resources that are already available at no cost to governmental agencies.

The government must reconcile the fact that certain short term losses must be absorbed (such as closing some of the large, urban hospitals) in order to reallocate funds to the rural and decentralized programs that are essential in reducing maternal and child mortality. Such costs must be weighed against the benefits of improving the general health status of the labour force which should further enhance the favorable economic wave that Bolivia is now experiencing through a more productive labour force. Furthermore, investing in preventive care (including family planning) will be much more cost efficient than *treating* illnesses in their advanced stages. This can particularly be seen in the high costs of elective abortions. Approximately 65% of hospital expenditures on social services and public health are spent on complications related to illegal abortions representing 60% of total hospital spending on obstetrics-gynecology. 80% of female hospitalizations were abortion-related; 50% of deaths associated with pregnancy and childbirth were due to complications related to abortion, and 1/3 of maternal deaths are abortion related.²⁴ The government of Bolivia must question if the financial costs of treating these surgical complications are worthwhile when effective family planning requires no physicians, is much lower in cost, and requires no hospitalization. "It costs countries less to invest in prevention and promotion programs than to pay the social, economic and individual costs of providing for women with no possibility for full development."²⁵ A recent analysis proved this by showing that for every dollar spent on family planning, at least \$4.50 cents is saved on future health costs related to pregnancy and childbearing.²⁶

Governmental programs must be properly targeted to the groups with the highest needs. Three-fourths of health care users are women and most of these women are indigenous. Mass media efforts must endorse the idea of family planning to improve contraceptive knowledge and to legitimize contraceptive behavior. There must be significant efforts to reach women with no education, with language barriers and with no daily access to radio or television since this population experiences the highest rates of morbidity and mortality. Maternal and child health programs need to also stress the benefits of prolonged breast-

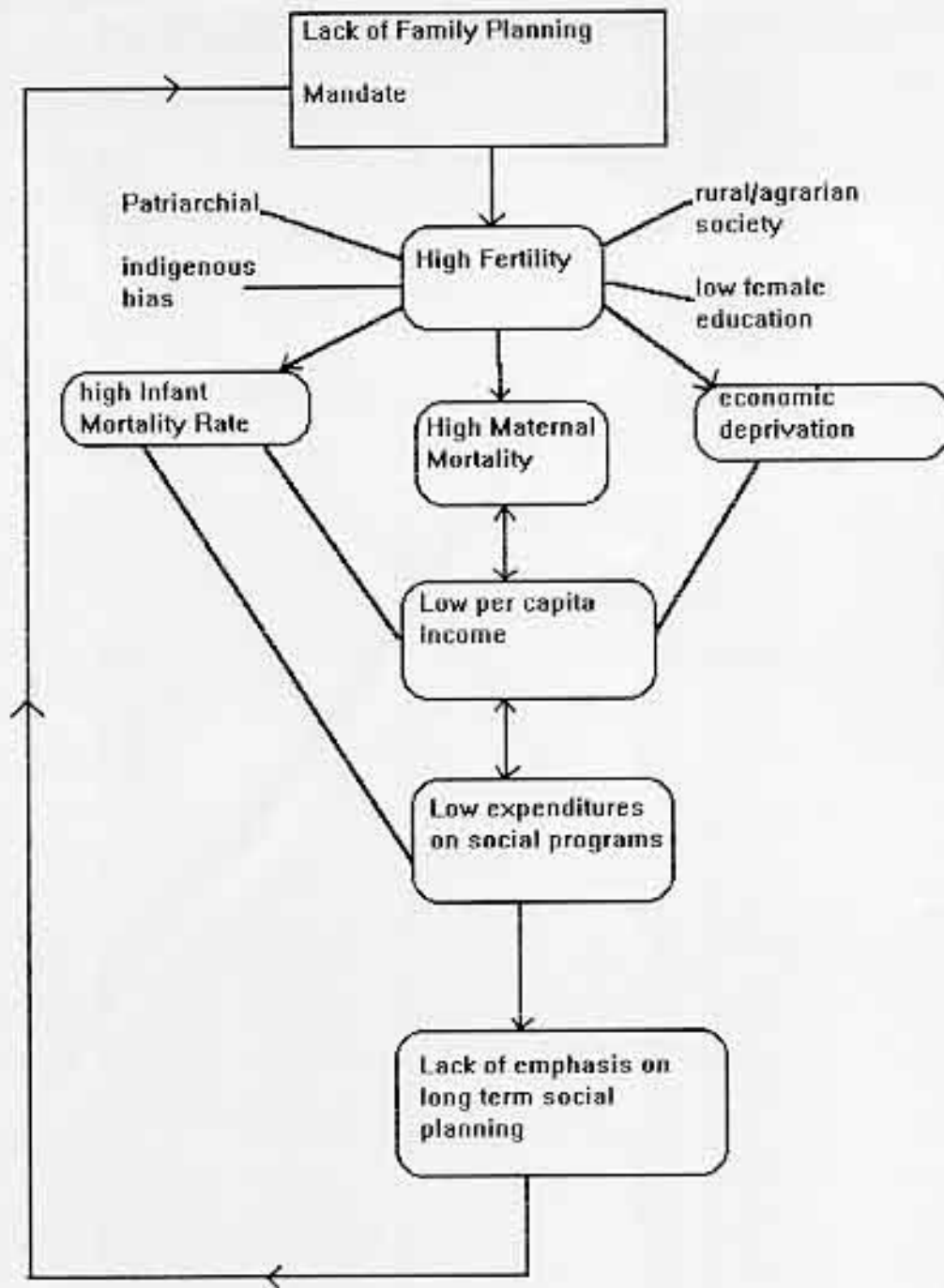


CHART F

feeding since it decreases fecundability and also decreases the incidence of diarrheal viruses attributable to the poor sanitation and water supplies.²⁷ Media efforts should also focus on the safety and effectiveness of modern contraceptive methods, as they should also stress the much higher probability of child survival if birth intervals are 2 or more years apart and if immunizations and other preventions are utilized. Lastly, governmental media efforts *must* demonstrate that the indigenous population is at the forefront of the national efforts.

Community outreach programs to the rural areas should be staffed with personnel who speak Aymara and Quechua. This is of particular importance when one considers that most indigenous women in the poorest rural areas *do not understand Spanish*. Given the transportational and cost constraints that the rural people face, it is also essential for the government to establish permanent rural family planning centers that are within the reach of the indigenous women and men.²⁸

Since midwives are already quite acceptable, the excess supply of doctors in Bolivia should be given training and financial incentives to supply these community family planning posts with qualified personnel to travel to the homes of delivering mothers. Such financial incentives should not be cost restrictive given that doctors in Bolivia are not paid particularly well and that curative care in the urban centers should decline. One can hope that in the short run, the down-sizing of the low-occupancy urban hospitals will help fund the rural maternal and child health care programs. Given the expressed desire of women to limit births, in the medium run one can plausibly expect fertility to decline and the overall health status to improve. In the longer term, a lower fertility level holds great promise for enhancing the educational and vocational options for women. The synergistic effects of increasing educational opportunities and reduced fertility must also be acknowledged so that an integrated approach to resolving these transitions is incorporated into the design of women's programs.

Considering the importance of future reductions in the fertility rate, it is clear that adolescents need to be targeted since the use of family planning among married adolescent women is even lower than the overall contraceptive use in Bolivia. Including traditional and modern methods, women of reproductive ages have a 30% overall rate of contraceptive use whereas only 16% of married adolescents use any given method. These high age specific fertility rates are largely due to the perception, especially in the poorest rural areas, that maternal and infant mortality is high. This prompts early childbearing to better the chances for maternal survival and to increase the reproductive span for women since as many as 1 in 3 children can die in certain regions.²⁹ Adolescent reproductive behavior is even further rationalized by the fact that it is usually older women who experience the highest rates of maternal mortality which, in turn, legitimizes early childbearing. About 40% of these adolescents claim they want to limit or space births but do not have the means to do so. Although the boarding and replacement strategies play a part in the high fertility rates as seen particularly in the rural areas, lack of services also plays a major role in perpetuating high fertility rates among all women of reproductive ages. This is again apparent in the high percentages of unmet need.

Attention must also be focused on the infrastructural requirements inherent in a successful transition to low fertility, morbidity, and mortality. Only 69% of the urban population and 10% of the rural population have access to piped water while 37% of urban and 4% of rural households have sanitation facilities. Such inadequacies are largely responsible for the high rates of disease especially among infants and children. Diarrhea and acute respiratory infections are the two primary killers of young children. Approximately 57% of deaths between the ages of 1-5 are due to diarrhea, 27% are due to respiratory illnesses, and 6% to measles. Clearly, this severely hampers a successful transition in the epidemiological realm. This can also be seen in that immunization efforts in particular have not been very successful with only about 20% of all children between 1 and 2 years old being fully immunized as of 1986.³⁰ Another positive feedback mechanism is definitely in place since the high morbidity and mortality brought about by an unresolved epidemiological transition fosters the boarding and replacement of children.

Further research must be conducted on the dynamics of latent demand versus actual use of contraceptives. Access must be clearly defined and realistically incorporated into the consideration of

maternal and child health care site locations. The willingness-to-pay of clients should be researched so that cost recovery is captured when plausible (such as in the urban centers) and prohibitive payment schemes are not implemented when they place people out of the market (such as in the rural areas). Examining the payment schemes of successful NGOs like PROSALUD might be beneficial in a cost recovery endeavor.

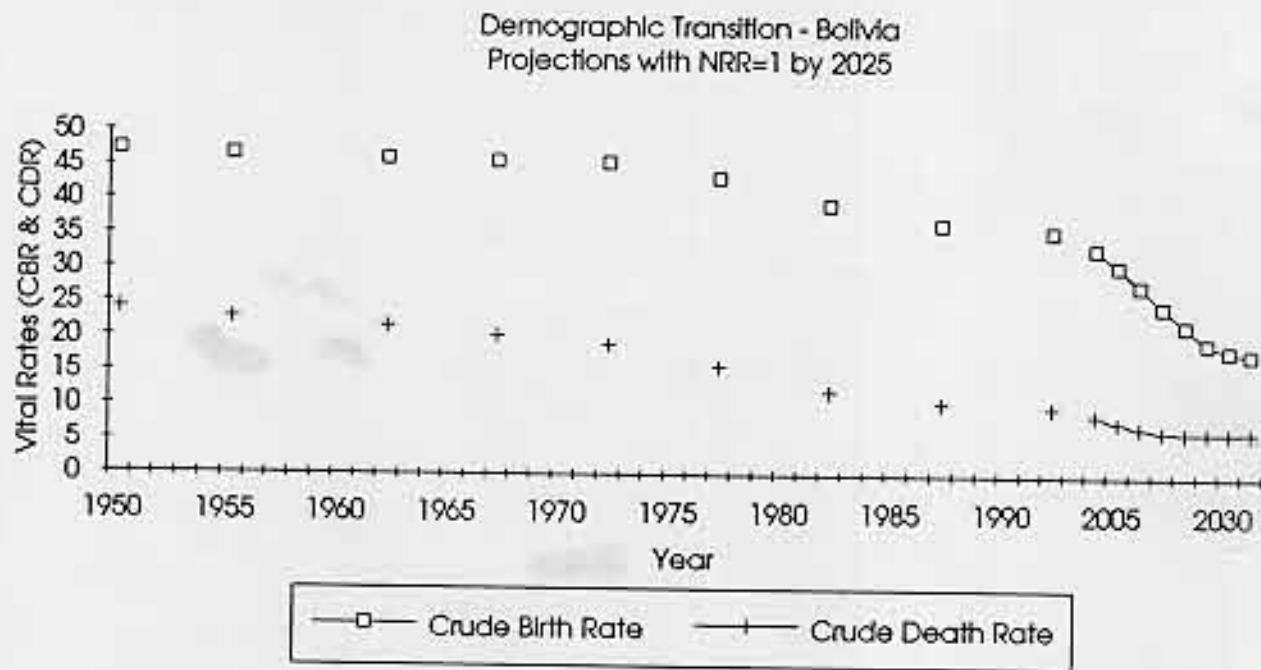
Once the necessary infrastructure is in place, an effective and meaningful informational feedback mechanism should be implemented to ensure that future services continue to meet the changing needs of women. Surveys and interviews must be sensitive to the low literacy rates among women and the high probability of incompatibility in languages. Any program design must incorporate the evaluation of the changing needs inherent in these dynamic transitions.

Conclusions

Vital rates in a given population are an aggregate demographic phenomenon largely responsive to national governmental manipulation. With the drastic changes that have occurred relatively recently in the population growth rate and in the technology of birth control, it is the view of the author that governments must take a leading role in endorsing, encouraging and often implementing family planning programs. Only such macro efforts can help families embrace a new idea which usually is contradictory to the anthropological/cultural norms of past generations.

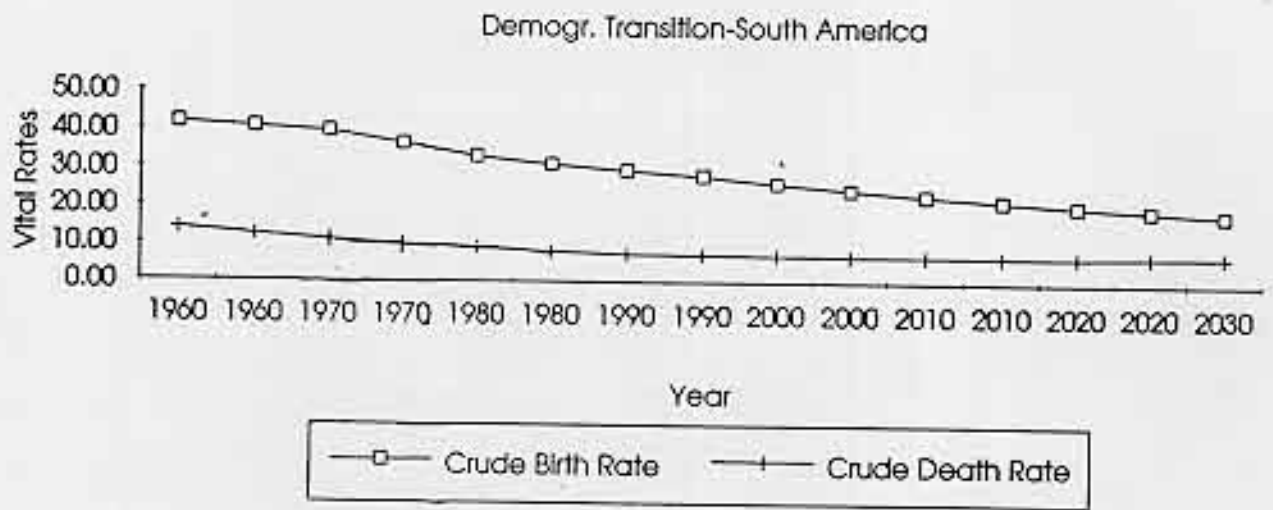
The recent and favorable economic turn in Bolivia should produce sufficient revenues to expand the social sector and attract much needed technocrats who can evaluate the financial feasibility of rural public health care projects. The growth in gross domestic product was on average 2.8% during the 1987-90 period and as high as 4.1% in the agricultural and manufacturing industries. Promising natural gas agreements with Brazil offer even more opportunities for growth. Tax reforms initiated in 1987 have increased revenues almost eight-fold which holds great promise for the expansion of much needed infrastructure.³¹ In addition, the new administration has made some tangible moves towards reorganizing the inefficient government bureaucracy and recruiting much needed expertise. The possibilities seem limitless, especially if the demographic transition can settle into an equilibrium conducive to further economic growth. World Bank estimates of declining fertility show that the demographic transition gap can be closed quickly if the net reproduction rate falls to replacement level³² by the year 2025 (see chart G). Although Bolivia has experienced a significant time lag in the resolution of the demographic transition when compared to other South American countries (Chart H), there is great promise for the nation once such transformation occurs. Optimism is warranted if the appropriate governmental measures are taken to reduce fertility and mortality and enhance the quality of life for Bolivian women and children.

CHART G



Source: World Bank

CHART H



Source: World Bank

Endnotes

- ¹Instituto Nacional de Estadística, Fecundidad y Planificación Familiar en América Latina Reto Para la Década de 1990, 1989.
- ²Bolivia, Country Assessment of Women's Role in Development: Proposed Bank Approach and Plan of Action, World Bank, Washington D.C., September 18, 1989.
- ³Bolivia: Updating Economic Memorandum, Report No. 11123-BO, October 8, 1992, World Bank, Washington D.C.
- ⁴"Staff Appraisal Report: Bolivia, Integrated Health Development Project" Latin America and the Caribbean Regional Office, World Bank, Washington D.C., 1989.
- ⁵Maternal and Child Health in Bolivia, Report on the In-Depth DHS Survey in Bolivia, 1989. Demographic and Health Surveys, Institute for Resource Development/Macro systems, Inc., Columbia, Maryland, April 1991.
- ⁶Gelbard, Alene H., Barragan, Lieselotte de., "Policy Implications of the 1989 DHS", Prepared for the DHS World Conference, August 5-7, 1991, Washington D.C.
- ⁷Gelbard, Alene H., Lieselotte, Barragan de., "Policy Implications of the 1989 Bolivia DHS", Washington D.C., 1991.
- ⁸Infants born less than 1 year apart die at a rate more than 3 and 1/2 times higher than infants spaced four or more years apart. They die at a rate that is nearly twice as high as infants spaced more than two years apart.
- ⁹Latin American and Caribbean Division, "Staff Appraisal Report: Bolivia: Bolivia's Social Investment Fund Project.", World Bank, Washington D.C., March 1990.
- ¹⁰Women over 40 have the highest risk of dying from childbearing and this groups has the highest level of unmet need for family planning.
- ¹¹The South American rate of teenage childbearing is 8 in 10 women aged 15-19.
- ¹²Approximately 42% of Bolivians live in rural areas.
- ¹³Bolivia, Country Assessment of Women's Role in Development: Proposed Bank Approach and Plan of Action, World Bank, Washington D.C., September 18, 1989
- ¹⁴20% of women who do not want another pregnancy cite religion as a reason for not using family planning.
- ¹⁵Out of every 100 women who have no education, 60 will demand family planning services and 48 will not use any method of birth control. Conversely, out of every 100 women with at least a secondary educational level, 78 will demand family planning services and 29 will not be actively contracepting.
- ¹⁶The rhythm method was the most popular method with 33.45% of women ever having tried this method.
- ¹⁷Bolivia: Updating Economic Memorandum, Report No. 11123-BO, October 8, 1992, World Bank, Washington D.C.
- ¹⁸Between 1974-80 Bolivia even had policies that were considered to be pro-natalist although it clearly did not have the infrastructure to absorb such increases in the population base.
- ¹⁹Gelbard, Alene H., Barragan, Lieselotte de., "Policy Implications of the 1989 DHS", Prepared for the DHS World Conference, August 5-7, 1991, Washington D.C., p. 3.
- ²⁰There were 30 criterion measuring effort based on policy activities, service activities, record keeping and evaluation, and accessibility of contraceptive methods. Mauldin, Parker W., Ross, John A., "Family Planning Programs: Efforts and Results, 1982-89", Studies in Family Planning, Volume 22, Number 6, Nov/Dec, 1991.
- ²¹Demographic and Health Surveys, Maternal and Child Health in Bolivia, Report on the

In-depth DHS Survey in Bolivia., Columbia, Maryland, April, 1991.

²²Potential demand for family planning is almost 50% amongst uneducated women while it is 29% for women with secondary school education (Instituto Nacional de Estadística)

²³ Only three national censuses have ever been conducted in Bolivia. The most recent census was in 1976 and the quality of even this data, especially for women is generally poor.

²⁴Bolivia, Country Assessment of Women's Role in Development. Proposed Bank Approach and Plan of Action., World Bank, Washington D.C., September 18, 1989.

²⁵"Adolescent Sexual Activity and Childbearing in Latin America and the Caribbean: Risks and Consequences." Population Reference Bureau. Washington D.C.

²⁶Population Reference Bureau, Riesgos y Consecuencias.

²⁷ Maternal and Child Health in Bolivia. Report on the In-Depth DHS Survey in Bolivia, 1989. Demographic and Health Surveys, Institute for Resource Development/Macro Systems, Inc., Columbia, Maryland, April 1991.

²⁸ Quechua and Aymara communities only have a contraceptive prevalence rate around 5%.

²⁹ "Adolescent Sexual Activity and Childbearing in Latin America and the Caribbean: Risks & Consequences", Population Reference Bureau, Washington, D.C.

³⁰ "Staff Appraisal Report: Bolivia, Integrated Health Development Project" Latin American and the Caribbean Regional Office, World Bank, Washington D.C., 1989.

³¹ Bolivia: Updating Economic Memorandum. Report # 11123-BO. October 8, 1992., World Bank, Washington D.C.

³² Replacement level fertility is reached when women, on average, have one daughter to 'replace' themselves. Even in light of the fertility declines Bolivian women have thus far achieved, a net reproduction rate of one (which is what is necessary for zero population growth in the long run), is a long way from the present total fertility rate of almost five.

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THE IPAT MODEL OF CEREAL PRODUCTION IMPACT IN INDIA

SANJAY S. BALIGA

Introduction

More than a century ago, English social scientist Thomas Malthus predicted a dismal future for mankind, where poverty, disease and death would gnaw away at the human spirit. According to this forward-thinking writer, the ever-expanding numbers of people inhabiting the planet would outpace the planet's ability to produce food, resulting in man's fateful future. Malthus postulated that given an infinite level of technology, food production "under circumstances the most favourable to human industry, could not possibly be made to increase faster than in an arithmetical ratio" (1, 2, 3, 4, 5,...) (Malthus). In contrast, human populations "when unchecked, goes on doubling itself every twenty-five years, or increases in a geometrical ratio" (1, 2, 4, 8, 16,...), so that within a century, there would be no more food to accommodate the ever-increasing number of people (Malthus). In such a ominous setting, famine and disease would certainly prevail, resulting in the decimation of entire populations.

In some regard, Malthus' predictions have come to a fateful fruition for population growth rates in most developing countries after the Second World War have been exceedingly high. Mortality rates (as expressed in crude death rates) have plummeted in the wake of imported western style medical technology and sanitation practices. At the same time, birth rates and fertility rates for most developing countries have remained relatively high even with government policies designed to reduce fertility. The results are obvious with world growth rates exceeding 2.0% in the 1960's and 1.7% in the 1980's (World Bank 1991).

While Malthus did correctly predict a population explosion, he was incorrect in assessing the agricultural productivity potential of his future world. Due to increases in *non-labor* inputs and technologies, agricultural productivity during the last four decades has grown at a higher rate than population. Whereas the population of the world has doubled between 1960-1988, world grain production has tripled in those same years. The expanded use of non-traditional agricultural technologies during the last four decades are collectively referred to as the Green Revolution and represent a hallmark in man's control of his environment.

Notwithstanding, a modern-day Malthus would disregard both the threat of populations going unchecked and resource-saving technologies and suggest that a new evil lay in waiting—that of affluence. To put it simply, richer people consume more than poor people, resulting in greater consumptive character. The dramatic increases in incomes in some countries in the past five years have led to some radical changes in the structure of demand. The world as a whole, most nations in general, and a sizable segment of the population in particular are richer today than at any other time in human history. As such, there is a greater demand for the products of agricultural technologies, thereby putting stress on these technologies to meet demand. If agricultural technology is capable of outpacing population increases that were evident in the past, are these technologies capable of compensating for increases in the demand for food brought about only recently due to increases in income in the developing world? Moreover, in order to keep pace with population growth rates and increases in consumption due to affluence, will technology have to be less sustainable, resulting in environmental harm? These questions are asked by policy-makers interesting in the population-environment nexus. Indeed, the very nature of man's involvement in his environment (environmental impact) is dictated by man's numbers on this planet (population), man's demand for resources of the planet (affluence), and the physical interactions of man with his environment (technology).

The IPAT Model and India's Cereal Production Sector

A useful model that incorporates these four elements, environmental impact, population, affluence and technology into one equation is the IPAT model first formulated in the mid-1960's by Stanford University biologist, Paul Erhlich. According to the model, man's impact on the

environment (I) is based on the multiplicative properties of population growth (P), affluence (A), and technology (T). Erhlich's theoretical equation for the model is as follows:

$I = (P) (A) (T)$	I = IMPACT P = POPULATION A = AFFLUENCE T = TECHNOLOGY
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The three exogenous variables, population (P), affluence (A) and technology (T) can either positively or negatively influence environmental quality (I), depending upon the time and sequence of the variables. There are no absolute environmental impacts, only relative ones.

It is useful to employ the IPAT model on the agricultural sector since this sector is so intimately tied into the environment. Moreover, the model is well suited for discussion of the environmental impact of population growth, affluence, and technology in the demographically important country of India. India has the world's second largest population and is expected to outpace China (the largest) in the 21st Century (World Bank 1991). Its Green Revolution Technologies are well renown as having brought India to feeding its masses. Finally, its burgeoning middle class of over 200 million (second in numbers to that of the U.S.) are demanding more and more. Indeed, the IPAT model is well formulated for discussion of India's agricultural sector--particularly its cereal production sector.

Theoretical Model of Variables Affecting Indian Cereal Production

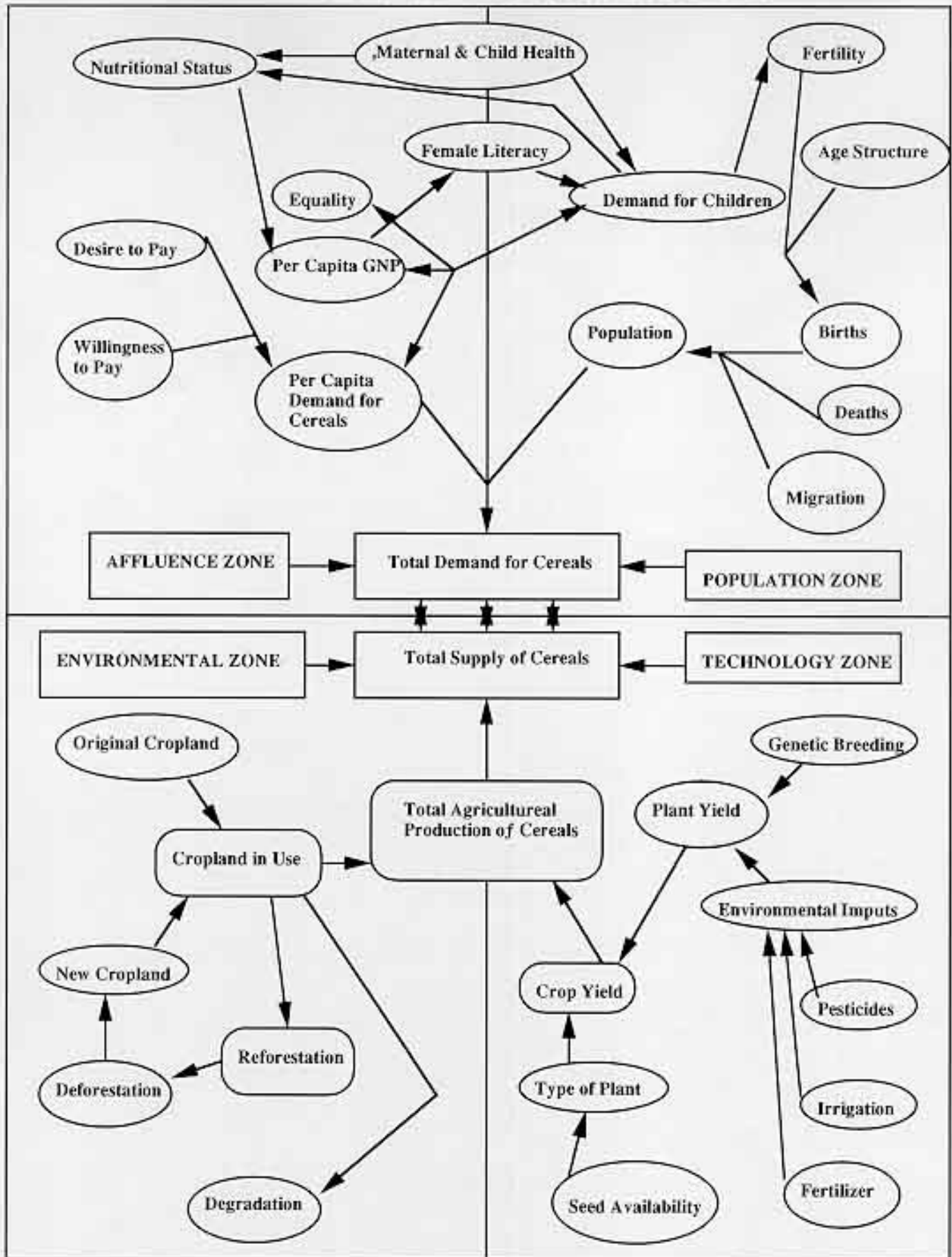
The production of any agricultural product--including cereals--is usually dictated by the neoclassical laws of supply and demand. That is, production is determined at the level where supply meets demand. This holds true in India's cereal markets. One may argue that India's supply of cereal's is limited (supply has not met demand) given that there are millions of starving people in the country. Moreover, one may argue the counter, that India's supply of cereals exceeds its demand because India is a net exporter of cereal grains. However, these arguments are based on micro or policy variables, and not the macro laws of neoclassical economics. As such, in the schematic to be raised, these arguments are irrelevant. What is important is that cereal production follows demand. As demand increases, so to does supply. Any lags between demand and supply are a result of disarticulation and cannot easily be understood using neoclassical economic theories. Now the basic neoclassical laws of supply and demand are illustrated in the IPAT schematic model (next page). The schematic includes the demand variables, population and affluence. That is, population and affluence multiplied together result in a net demand for cereals. The schematic also describes the supply variables, technology and the environment. Indeed, one needs both the surrounding environment (in this case, land and other natural resources) and the means to harness its potential. This media of harnessing physical potential is collectively called technology and includes both knowledge and institutional variables. What is important to note is that population and affluence don't directly affect environmental degradation. Instead, demand created by population and affluence must be met by supply. Supply may be increased due to advances in technology or through robbing the environment of future potential to meet current demand. This robbing of future potential is referred to as non-sustainable technology and is one of the proximate causes of environmental degradation.

Given the schematic of cereal production in India, the Erhlich IPAT model is better understood if the demand and supply variables are kept together. This can only be accomplished with a simply transformation as follows:

$\frac{(I)}{(T)} = \frac{(P) (A) \cancel{(T)}}{\cancel{(T)}}$	$(T') = \frac{1}{(T)}$
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T' is the inverse of Erhlich's Technology variable. That is, according to Erhlich, technology (T) is a demand variable but the schematic model describes technology as a supply variable. Hence, the second equation relates the technology according to demand variables (T) and technology according to supply variables (T'). Rearranging the model yields the following revised IPAT model:

THE IPAT MODEL OF CEREAL PRODUCTION IMPACT IN INDIA



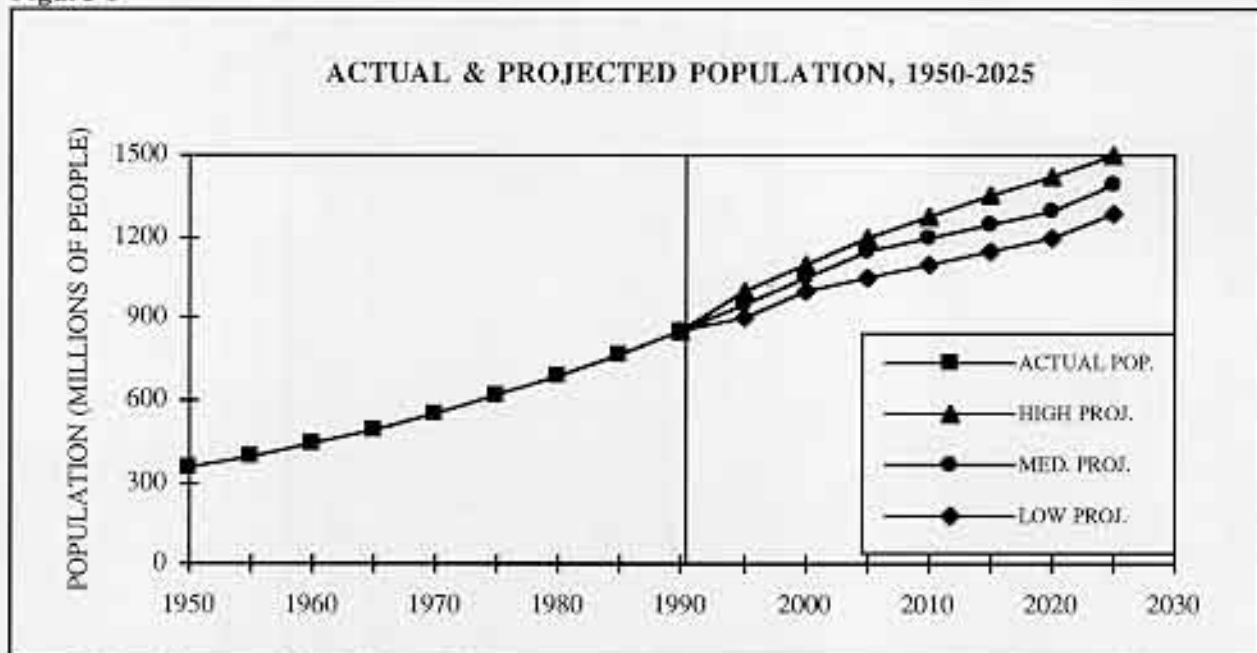
$$(I) (T') = (P) (A)$$

I = IMPACT
P = POPULATION
A = AFFLUENCE
T' = TECHNOLOGY'

The revised IPAT model takes into consideration supply and demand linkages. The right hand side are the demand variables whereas the left hand side are the supply variables. Note that supply is equal to demand. Furthermore, increases in one variable can either be offset by decreases in the variable on the same side of the equation or increases in either variable on the opposite side. In order to delineate the effects of one variable on the other, it is necessary to examine each variable in turn, including population, affluence, and technology. Moreover, population and affluence have interactions that can have profound effects on the other variables. As such, population, population-affluence dynamics, affluence and technology will be investigated. In the end, the environmental impact of past cereal grain production as well as future cereal grain production will be assessed using regression models. The regression model will be useful in predicting future impacts of cereal production to the Indian landscape. Initially, population growth will be addressed.

India's Population Explosion

Rapid Population growth in India is a recent phenomenon. After centuries of mostly slow growth, India's population entered a period of explosive growth in the days following its independence in 1949. As suggested by Figure 1, from 1950 to 1965, India increased its population



from 350 million to 500 million, which corresponds to an annual growth rate of nearly 2.5 percent. From 1965 to 1980, India's growth rate exceeded 2.1 percent. Currently, India's growth rate is 1.7 percent per year. If this current growth rate were to continue, India would double its current population from 850 to 1700 million in just 40 years! In his assessment, Malthus suggested that this population explosion follows the arithmetic ratio. Demographers now know that populations tend to grow in exponential terms. That is, the rate of population growth at a given point is related to the population itself:

$$\frac{d(\text{Population})}{d(\text{Time})} = (\text{Population}) (\text{Population Growth Rate})$$

Figure 1 contains projections for the near future which are calculated based upon these laws of exponential growth.

Now the proximate causes of any change in population are related to deaths, births, and migration. For India, migration tends not to be of significance in the total change in population. Hence, changes in population are simply a function of births and death:

$$\Delta \text{Population} = \text{Births} - \text{Deaths}$$

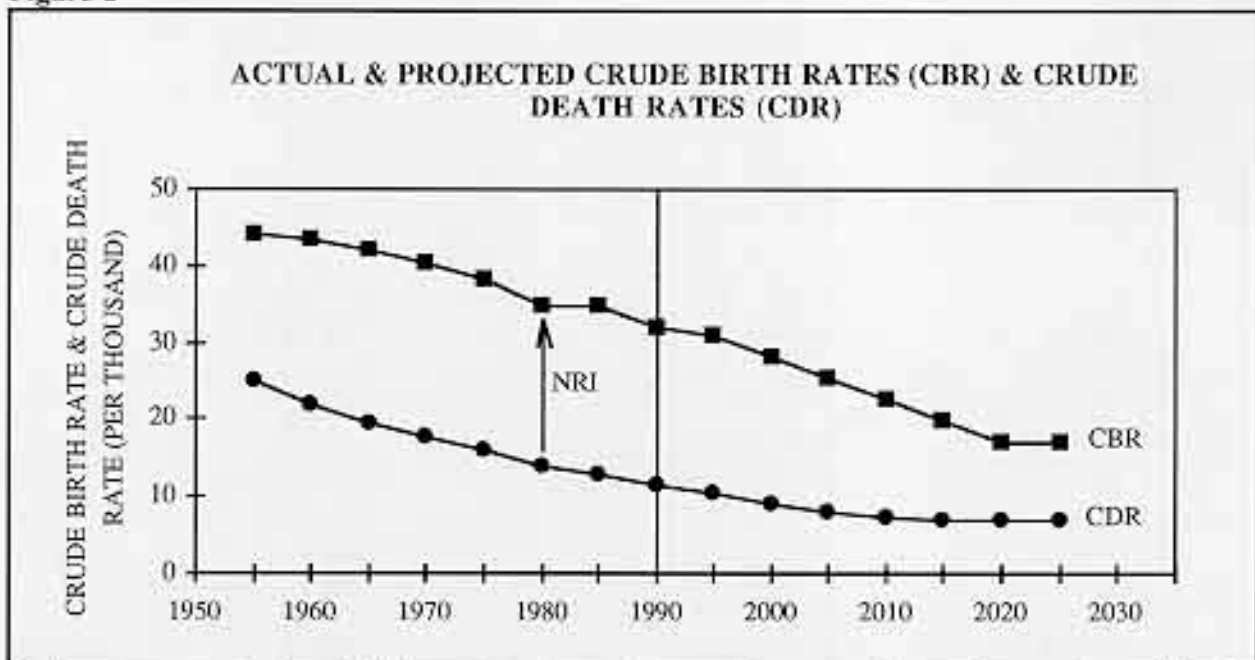
Instead of reporting the absolute numbers of births and deaths, it is often more instructive to calculate crude birth rates (CBR) and crude death rates (CDR) which represent the number of death and births per 1000 people. The difference between crude birth rates and crude death rate is referred to as the natural rate of increase (NRI) and represents the numbers added (or subtracted) per 1000 people from a country's population (if migration is zero). Hence, the change in population per 1000 people is as follows:

$$\text{NRI} = \text{CBR} - \text{CDR}$$

The NRI is related to the Rate of Increase in Population mentioned above in the above equation. This rate of increase in population if measured per annum, is referred to as the annual growth rate of population.

Most of India's population growth since the 1940's is due to public health campaigns which contributed to rapid declines in the country's crude death rates in the 1940's and 1950's without an immediate corresponding decline in crude birth rates. India's recent and projected CDR and CBR are plotted in Figure 2.

Figure 2

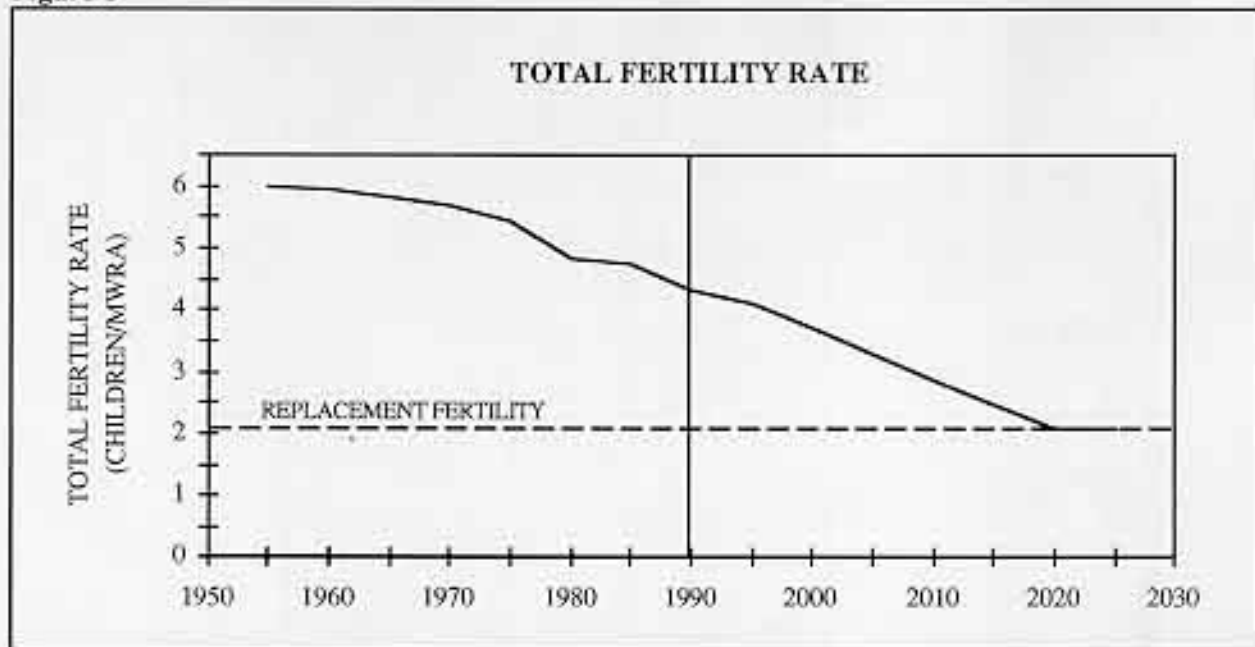


Its important to note that India's projected natural rate of increase will continue to be positive for some time and as such, India will continue to grow (as suggested by Figure 1). While the crude death rate influences population growth rates, its importance is secondary to that of crude birth rates because CDR's are relatively low and cannot fall much lower. However, CBR's are still high and any drastic changes in CBR can result in significant declines in population growth rates. Hence, it is important to delineate the proximate causes of CBR.

Crude birth rates are affected by two key elements, fertility and the age structure of the population. The most distinguishing measure of fertility is the total fertility rate (TFR) which is the sum of the age-specific fertility rates over all ages of the child-bearing period and which gives the

approximate magnitude of the complete family size (Population Reference Bureau). Recent and projected TFR's for India are given in Figure 3.

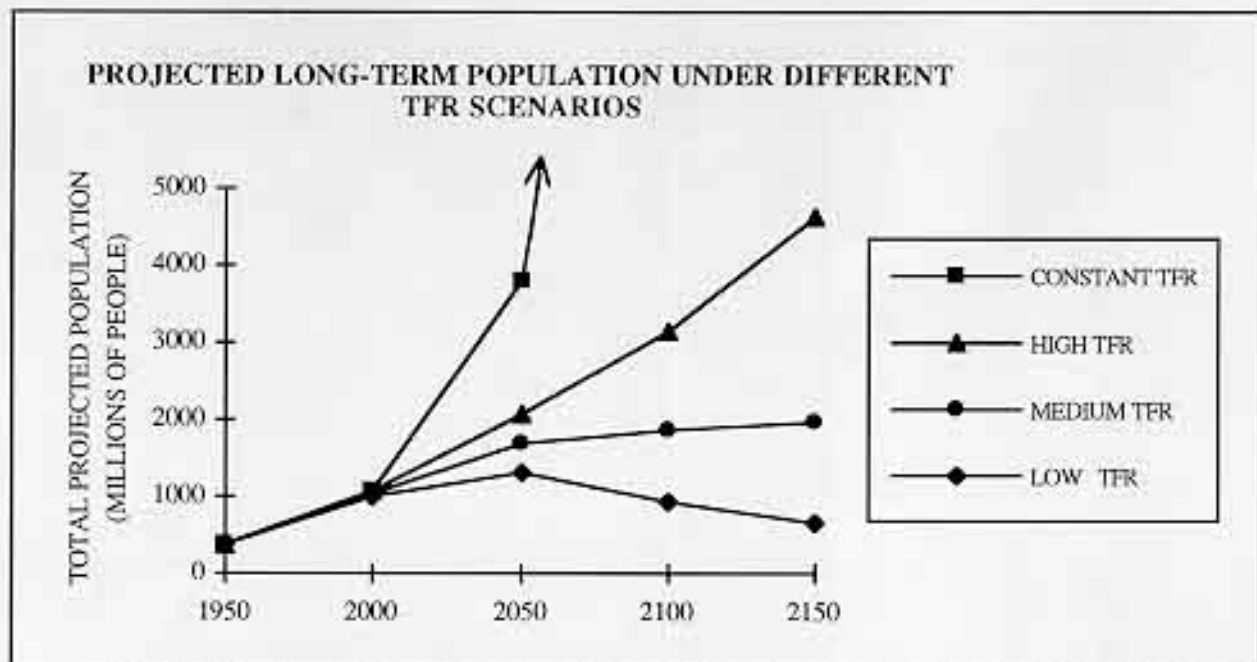
Figure 3



Fertility has declined slowly in India since the start of the demographic transition in India in the 1940's. Since 1950, TFR's have decreased by more than 2 children per women. That is, on the average, women are having 2 fewer children today than they did 40 years ago. Under the current TFR of 4.0, Indian women, on the average are having four children in their lifetimes, which is above replacement fertility. Replacement fertility is the level of fertility at which a cohort of women have enough daughters to replace themselves in the population. This corresponds to a TFR of around 2.1. Hence, India women, on the average are having nearly two more children than is needed to replace them and their husbands. These above replacement fertility children are one of the proximate causes of the crude birth rates being so high. Hence, any decline in TFR can have enormous impacts on the rate of population growth. From Figure 3, it is expected that TFR's will decline to replacement fertility in the year 2020. Until then, India women will have more daughters (on the average) than is necessary to replace themselves.

Of course, TFR "projections are not crystal ball prophecies of the future; they are useful, replicable predictions derived from mathematical analysis of trends in fertility" (Population Reference Bureau 1992). TFR projections determine what the population would be if the major variables affected fertility follow assumptions made in the mathematical analysis. However, often time, these variables affecting fertility do not follow the assumptions and the projections are highly skewed. As such, the United Nations has determined three sets of fertility projections, the high variant projection, the low variant projection, the medium variant projection. The high variant projection assumes that fertility variables will cause the least levels of decline in TFR. The low variant projection assumes that fertility variables will cause the greatest decline in TFR such that TFR falls to below replacement fertility. Finally, the medium variant TFR projection assumes that India will achieve a stationary population in the 22nd Century and is as such not the most likely TFR projection. Indeed, all three projections are likely. However, for convenience, it is useful to take the medium variant projection. As such, all previous and subsequent projections will follow the assumptions made in the medium variant TFR projections of the United Nations. Its important to note that Graph #1 shows population projections given all three TFR scenarios. Hence, the projected population of India in 2025 will be between 1250 and 1500 million. The long-term impact of different TFR assumptions is summarized in Figure 4. Note that different TFR assumptions can lead to enormous differences in long-term population projections. While the high TFR assumption result in a population of nearly 5 billion in 2150, the low TFR assumption results in a total population of less than 1 billion in 2150. Hence, following different TFR scenarios can lead to great differences in projected population size.

Figure 4



Besides fertility, the age structure of the population can affect crude birth rates. If a country has a high proportion of young people, it may take several decades before the population stops growing. This tendency of the population to continue to grow even after replacement level fertility has been achieved is known as population momentum. Therefore, while total fertility rate is assumed to fall to replacement level around the year 2020, the population will not stop growing until around the year 2075. This lag is caused by the momentum of population. As such, even if TFR were to drop to replacement fertility in 1995 (hypothetically), India would continue to grow until around the year 2050.

From the perspective of Malthus' dismal future, India can minimize the absolute numbers of people added within its borders over the next one hundred years if it follows the low variant TFR. Following the high or medium variant TFR projections will result in even greater numbers being added to the country than is the case of the low TFR projections. This can cause substantially less impact on absolute demand for cereals, which can subsequently reduce man's impact on the environment.

However, since there is a population momentum built-in to the young age structure of the Indian population, India policy-makers will have to be satisfied with a minimum population of 1250 million in the year 2025 and 1400 million in the year 2050. Indian policy-makers should acknowledge this population momentum in their agricultural development plans.

Given a high level of fertility, what determinants cause fertility and TFR to decline? While there are many theories that explain fertility decline, one of the most interesting for the IPAT model is the Becker theory and the Caldwell theory, both to be explained subsequently.

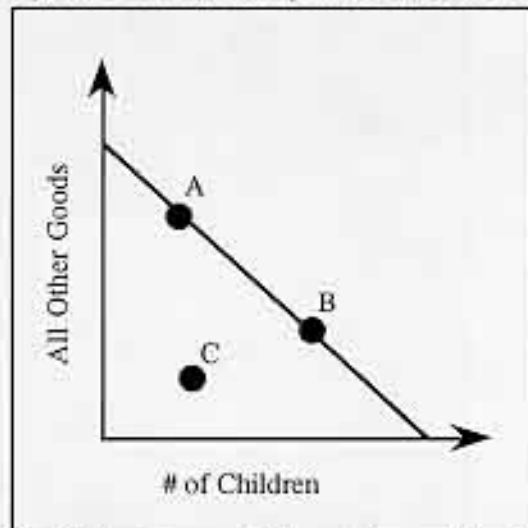
Population-Affluence Interactions

The Nobel Prize winning economist, Gary Becker proposes a fertility decline model based on the principles of consumer choice. According to Becker, children can be considered as any normal commodity to be purchased and are limited not by supply but by demand. The level of demand is determined by what the parents of the children can afford which is influenced by only two variables, prices and income. The mechanism by which prices and incomes lead to demand of children is based on utility maximization, given a budget constraint. In a further analysis, Becker suggests that there can be a tradeoff between quality and quantity of children as there is a tradeoff between any two non-substitutable commodities. This tradeoff is also based on the concept of utility maximization given a budget constraint.

Initially, Becker chooses to keep the quality of children constant to assess how the price of children affect their quantities. According to this model, children can be considered as normal goods for consumers like cars, houses, or pencils. The level that people purchase children (bear children) is a function of two variables--prices and income. Economic mechanisms work on price and income to

decrease fertility for increases in the first and increase fertility for increases in the second. It's important to examine budget constraints and indifference curves to assess Becker's model since much of what he says is based on these economic principles.

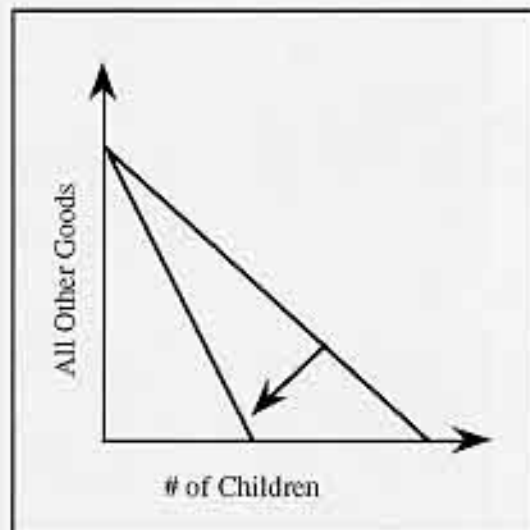
The budget constraint is the formal mechanism of relating prices and income to the amount of children. A budget constraint shows all the appropriate levels of children and all other goods that a consumer can afford to purchase given a constant income. In such a budget constraint, the consumer can be at point A of point B or any other point on the line or within the line.



Since the costs associated with childbearing are different for each family, the total costs of producing children also differ. Hence, budget constraints for different families will be different depending on the marginal utility which is a function of relative prices:

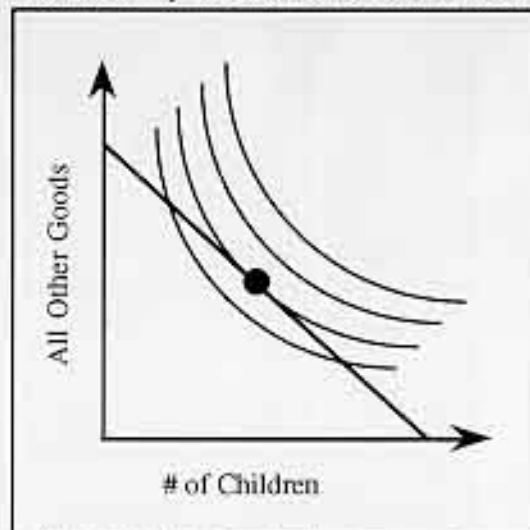
$$\text{MARGINAL UTILITY} = \frac{\text{PRICE OF CHILDREN}}{\text{PRICE OF ALL OTHER GOODS}}$$

The demand for children will partially depend on the relative prices of children in comparison to all other goods. As the costs associated with childbearing increase, the demand for children decreases. That is, if the price of a child were to increase, less children could be afforded and budget constraint would pivot as follows:

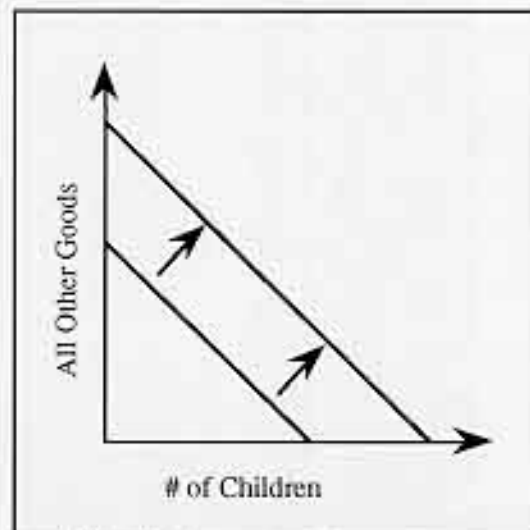


An indifference curve shows all levels of number of children and all other goods associated with a particular level of utility (satisfaction). Assuming all people are rational and want to maximize their utility, people will choose the indifference curve furthest out that is still in contact with the budget

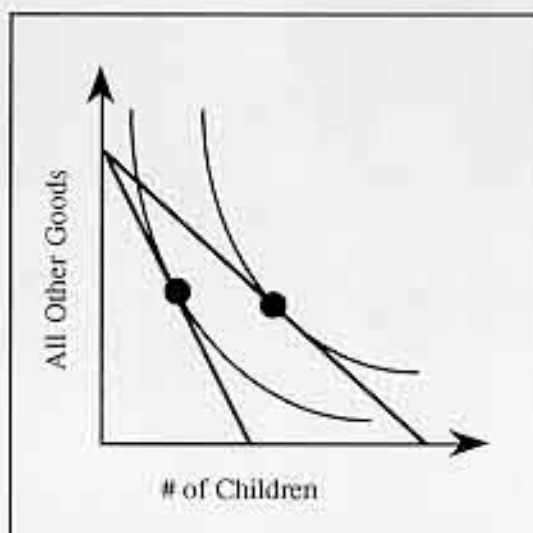
constraint for their particular level of income and relative prices. Becker makes the point that children must be normal goods since there are no true substitutes for them. Since all normal goods have convex indifference curves, the utility function for children must necessarily be convex.



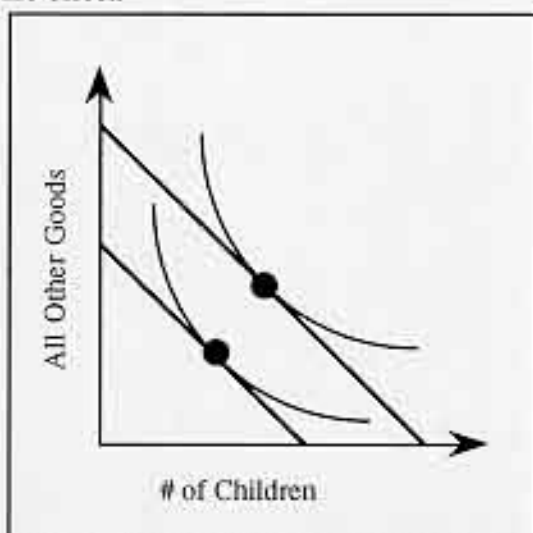
If income were to increase for this individual, the budget constraint can be moved out due to more purchasing power.



What is important in Becker's model is that increases in income can cause two effects. First, there can be an effect on the price of children due to increased opportunity costs of raising children due to increased income. This is the price effect:

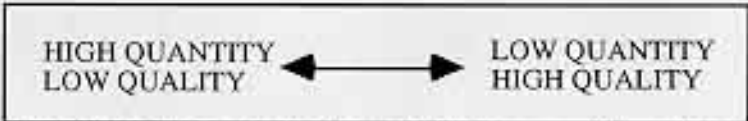


Secondly, a rise in income can increase desire of children since there is more money to afford children. This is an income effect.



The combined income and price affects can lead to more or less children depending on the level of income rise and level of opportunity costs. In most developing countries where per capita household income is low, small increases in income influence the price affect of the budget constraint more than the income affect of the same budget constraint. This is mainly due to the expanding opportunity costs of women's time. That is to say, at low levels of income such as is the case with India, small increases in household income will cause the price of children to outpace the added income so that couples will choose to have fewer children. Hence, as per capita income below a certain threshold level, couples will choose to have fewer children as their per capita incomes increases. Once the threshold level of income is achieved as in the case of the industrialized countries, the small family becomes the cultural norm. This is one of the reasons why the rich industrialized countries have low TFR's.

Becker expands on this initial model by introducing the quantity/quality tradeoff. According to the model, the quantity and quality of children are near substitutes. Of course, there is some interaction between the two variables so that the budget constraint is not completely linear, but slightly curvilinear. As with the case of the former tradeoff between number of children and all other commodities, the level of demand of children is determined by the preference for children (indifference curve) and the quality of children. The quality of a child is defined by the amount of inputs invested in the raising of that child, such as format education and increased health status. As the number of children decrease, there is greater likelihood that the quality of these children will increase due to the substitutability of high quality children for a high number of children.



Becker's model predicts that increases in the household income will result in women choosing to bear fewer children that are of high quality. The affects of this increased quality of children will be discussed shortly.

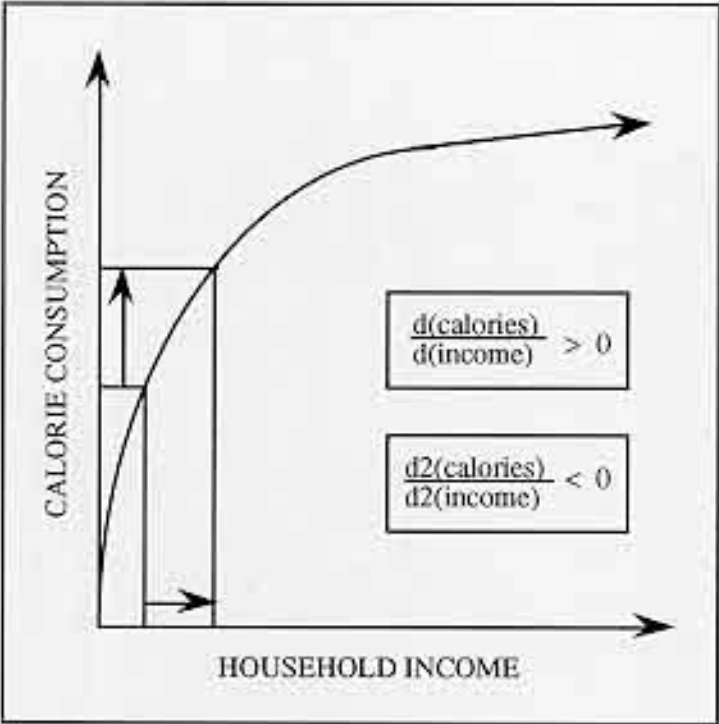
Another affluence-population interaction model was proposed by sociologist, John Caldwell and is referred to as the economic nucleation model. According to Caldwell, in non-industrialized areas of the Third World, the family represents the mechanism of production, whereby familial bonds are used to bolster productive efforts. As markets arise and become all pervasive, the production center is transformed from the family unit to the factory unit and the extended family falls to the nuclear family. Such a reduction of the scope of the family represents economic nucleation and it favors marital relations over familial relations. Economic nucleation can accelerate a reversal in the intergenerational flow of wealth whereby wealth flows from parent to child rather than from child to parent. When such a reversal of wealth occur, there is less incentive to have large families. What is important is the assessment is that markets must first penetrate into family production units so as to bring about economic nucleation. According to Caldwell, monetization, often in the form of household increasing household incomes, yields economic nucleation which can bring about decreased demand for children. Moreover, parents tend to invest more in their children as monetization proceeds. Similar to Becker's model, as per capita household incomes increase and monetization is quickened, couples will choose fewer children of higher quality.

What does this imply for Malthus' dismal future? According to the Becker and Caldwell models, as per capita incomes increase (affluence) fertility is kept in check, and population growth rates are reduced. Because population growth rates affects rates of total demand of cereals, increased monetization *should* result in lower total demand for cereals. However, this is not the case.

Affluence

While population growth rates do decline with affluence, the per capita demand for cereal grains actually increases with affluence. That is, people demand more as they become richer. At low levels of income, parents invest more in their children as they become more wealthy and this investment often takes the form of increased nutritional status of the children. Once a threshold

Figure 5

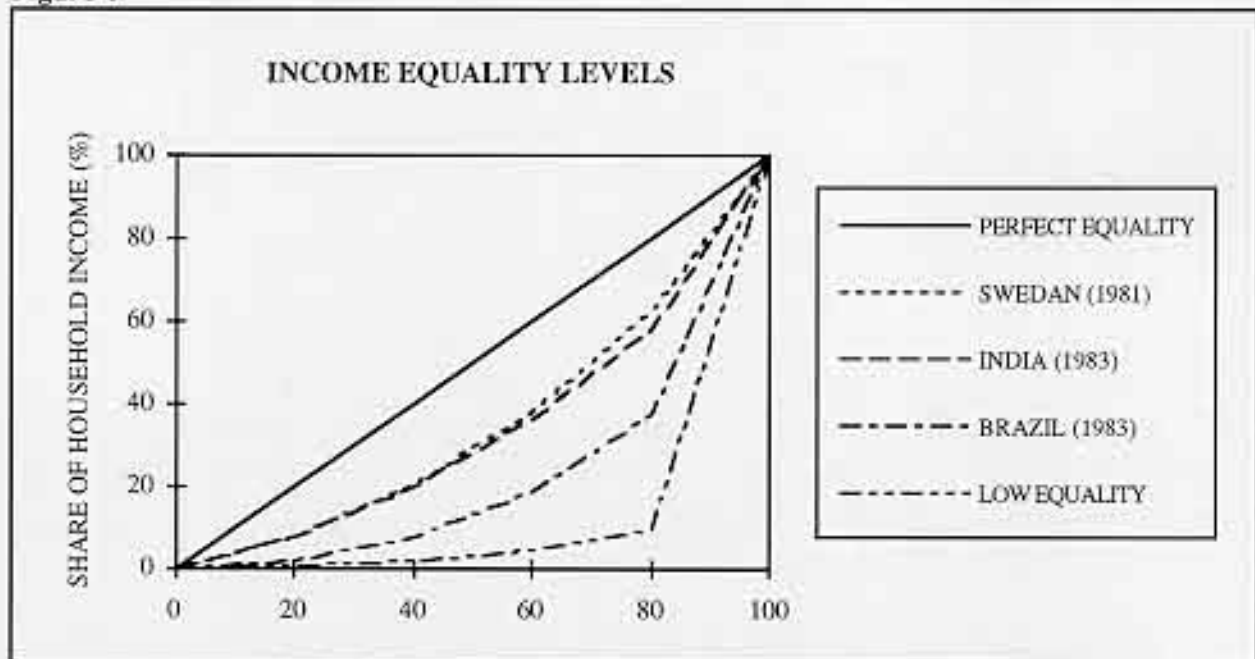


level of per capita income is achieved, high health (and especially nutritional) status becomes the norm. This increased investment in health, particularly at the caloric level, results in a greater per capita demand for cereal grains as summarized by the Figure 5. Note that the relationship between cereal demanded and household income is guided by the laws of diminishing returns, where the first derivative of the function is positive but the second derivative is negative. That is, as incomes rise, so to does demand for cereal. However, there seems to be a leveling off of this effect at higher levels of income. India with a low level of per capita household income appear to be situated in the part of the curve that is steepest. That is, India is at a stage of affluence where the laws of diminishing return of cereal demand for increases in per capita income are least significant. Hence, Indian will demand more and more cereals as incomes gradually increase.

Before examining the mechanisms affecting this relationship between per capita demand for calories and affluence, it is necessary to describe measures of income and monetization, particularly that of per capita gross national product. In the discussion of the Becker and Caldwell affluence-population models, it was suggested that *household* income is the significant variable that influences the quantity and quality of children. While this is true, using household income is infrequently calculated and is of limited usefulness in any statistical discussion. Another measure of income, per capita Gross National Product (per capita GNP) can be employed in a statistical analysis because the indicator is calculated every year in a similar manner.

However, per capita GNP is not necessarily a complete measure of average household income. Indeed, household incomes are determined by both the average income and the distribution of that income. In countries where the distribution of income is skewed to favor the rich, per capita GNP is not a very complete measure of household income. For countries where income is equally distributed amongst all member, per capita GNP can be a very effective measure of household income. Figure 6 shows the income equality levels of certain countries (World Bank 1991).

Figure 6

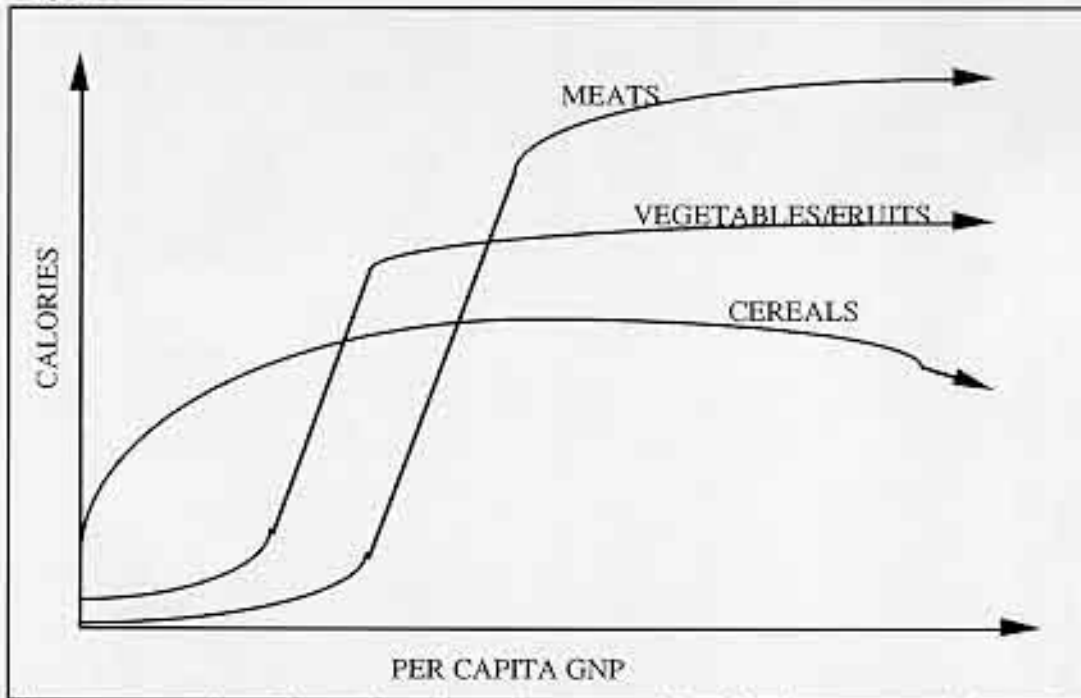


Note that perfect income equality is achieved when any percent of households has its own share of household income. From the graph, Brazil has a more skewed distribution of incomes than India because Brazil's income distribution curve more closely resembles that of the low equality country whereas Sweden and India seem to have similar income distribution curves. Of course, this does not imply that the average Indian is as rich as the average Swede. Instead, India has the same income distribution as Sweden but for a lower level of per capita income. Hence, per capita GNP may be a useful substitute for household incomes. That is to say, per capita GNP can serve as an approximate measure of household income and subsequently, of affluence.

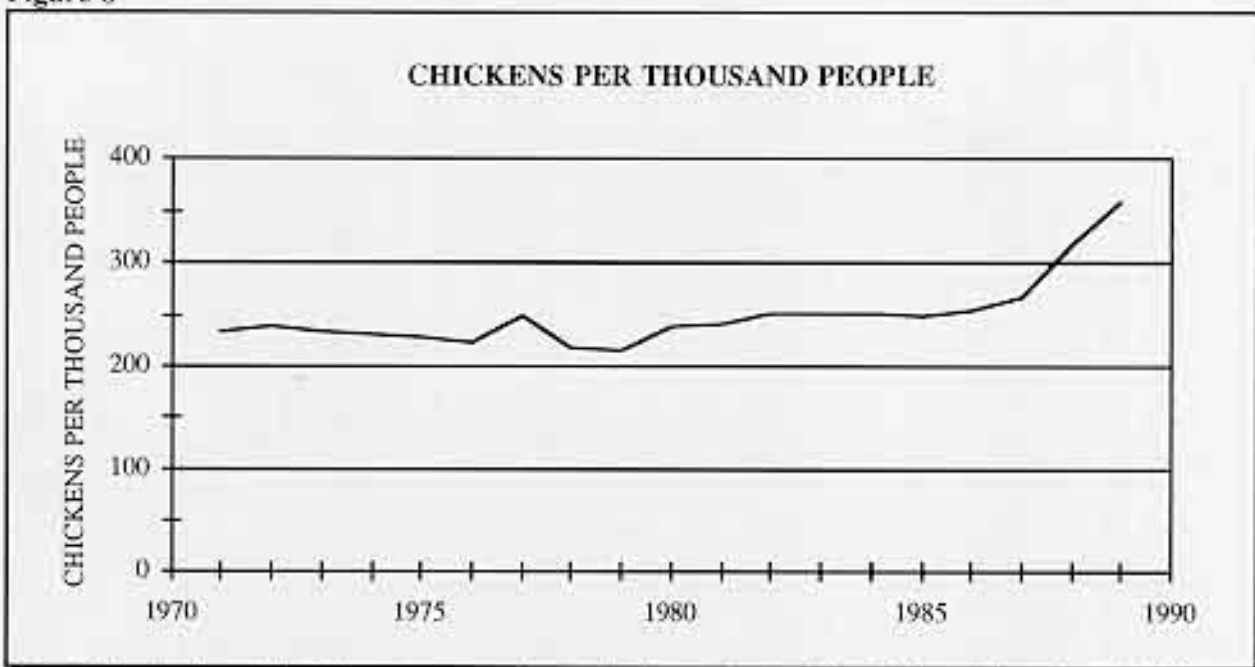
It was previously argued that as household incomes (and per capita GNP) increase, parents trade off quality children for quantity. One method of increasing the quality of children is through increased health status, which may be achieved through eating more food as well as higher quality

food. That is, as affluence rises, people substitute higher quality foods in place of cereal products, which are often perceived as being of low quality. Fruits and vegetables are initially substituted in place of cereals and can dramatically increase health status. As affluence progresses, meat products are substituted in place of both vegetables/fruits and cereals. This is summarized in Figure 7.

Figure 7



While direct consumption of cereal products decreases with rising income, total demand actually increases because cereal commodities are fed to livestock (which are subsequently killed and eaten) instead of eating the grains directly. This relationship is known as the Food-Feed dilemma. This Food-Feed relationship is important in that feeding grains to livestock requires more grain per caloric equivalent than in eating the grains directly. As such, per calorie, it is better to feed the grains to



people than to livestock. In any case, eating animal meat (especially chickens) is a sign of affluence

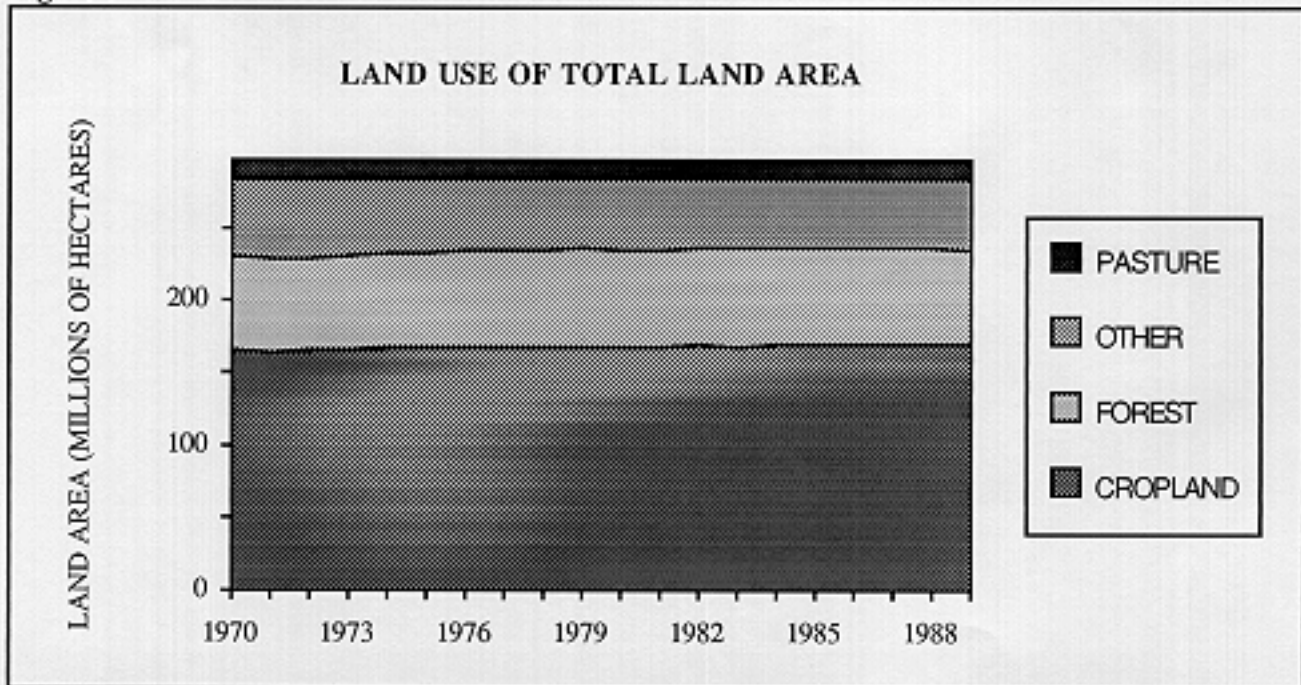
(even in India) and as per capita GNP increases, so does the demand for animal products. For example, the numbers of chickens per capita in India has recently increased as suggested by Figure 8 (World Resources Institute). The upturn in chickens consumed after 1988 seemed to have been caused by liberalization of chicken markets coupled with increasing demand for chicken meat.

In summary, as people become more wealthy, they tend to eat higher quality meals, which can serve to increase per capita demand for cereal products due to the feed/food relationship. Given this increased demand for cereals, the supply of cereals must increase rapidly. More importantly, is India capable of producing enough grains in the next fifty years to compensate for the effects of population momentum coupled with increasing per capita demand for cereal products? To answer this question, it is necessary to examine Indian Agricultural Technology.

Indian Agricultural Technology

Green Revolution technologies have served as the magic wand that has caused agricultural production to outpace population pressures in the past twenty years. The Green Revolution technologies used in India have tended to increase crop yields rather than exploit non-cropland area. Indeed, since 1970, total cropland under cultivation has remained relatively constant as has pasture land and forests as shown in Figure 9 (World Resources Institute).

Figure 9



If cropland area has remained constant in India in the past two decades, it is crop yields that have increased substantially. As suggested by Figure 10, simple crop yields have increased more than fifty percent in the past two decades (World Resources Institute). Simple crop yields are simply the amount of cereal food grown per hectare of land, on the average. The population crop yield is the amount of cereal food grown per hectare and standardized for population size. Population crop yields have also increased in the past two decades, but not as quickly as simple crop yield. A regression of the two yield measures was determined and plotted in Figure 11. These regression lines are natural log based lines and suggest that both simple and population crop yields are experiencing diminishing return. That is, both simple and population crop yields cannot continue to experience growth rates as was the case in the past two decades. Hence, without some sort of added input, population crop yields will eventually stabilize off, leading to an interesting question of whether future Indian agricultural technology can duplicate its successes of the past. If it can, crop yield growth rates can outpace population growth rates. To assess future technology potential, it is necessary to look at previous technology inputs in cereal production, especially genetic breeding, fertilizer use and irrigation.

Figure 10

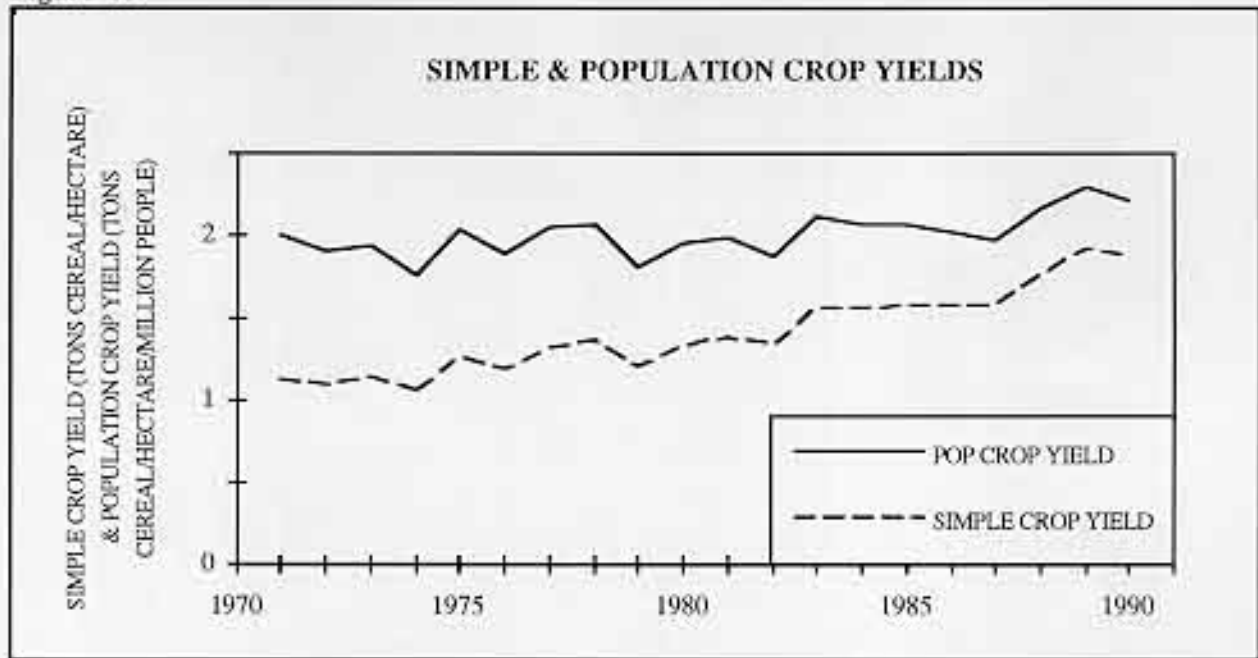
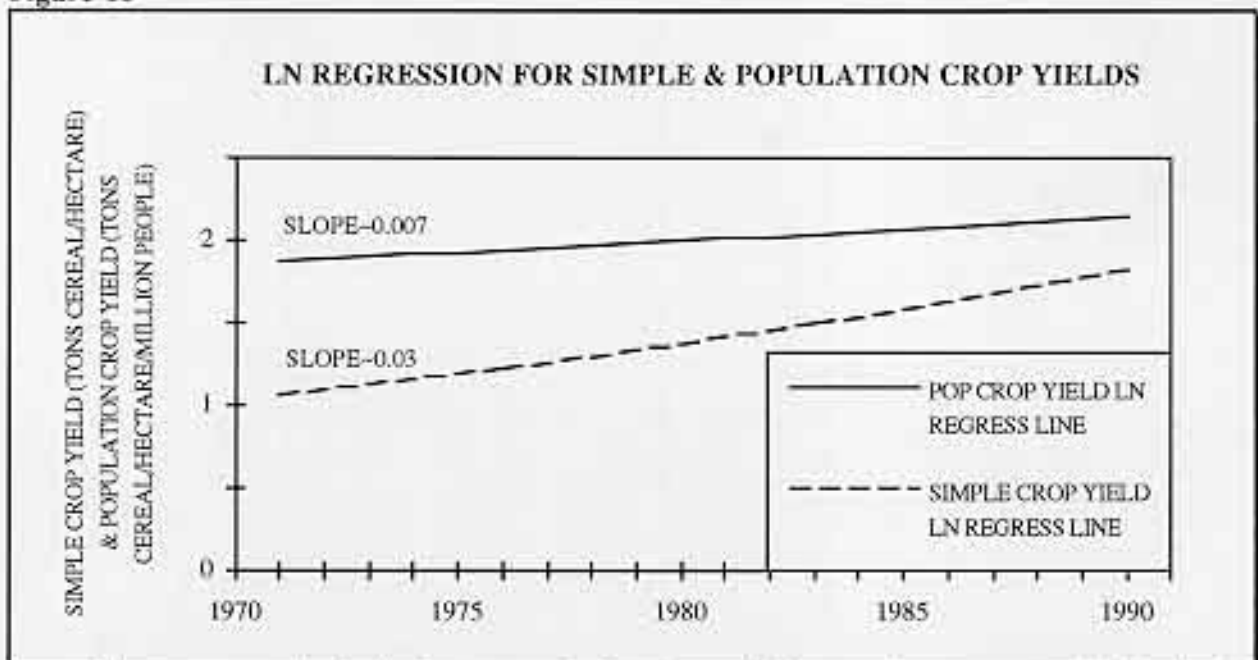


Figure 11

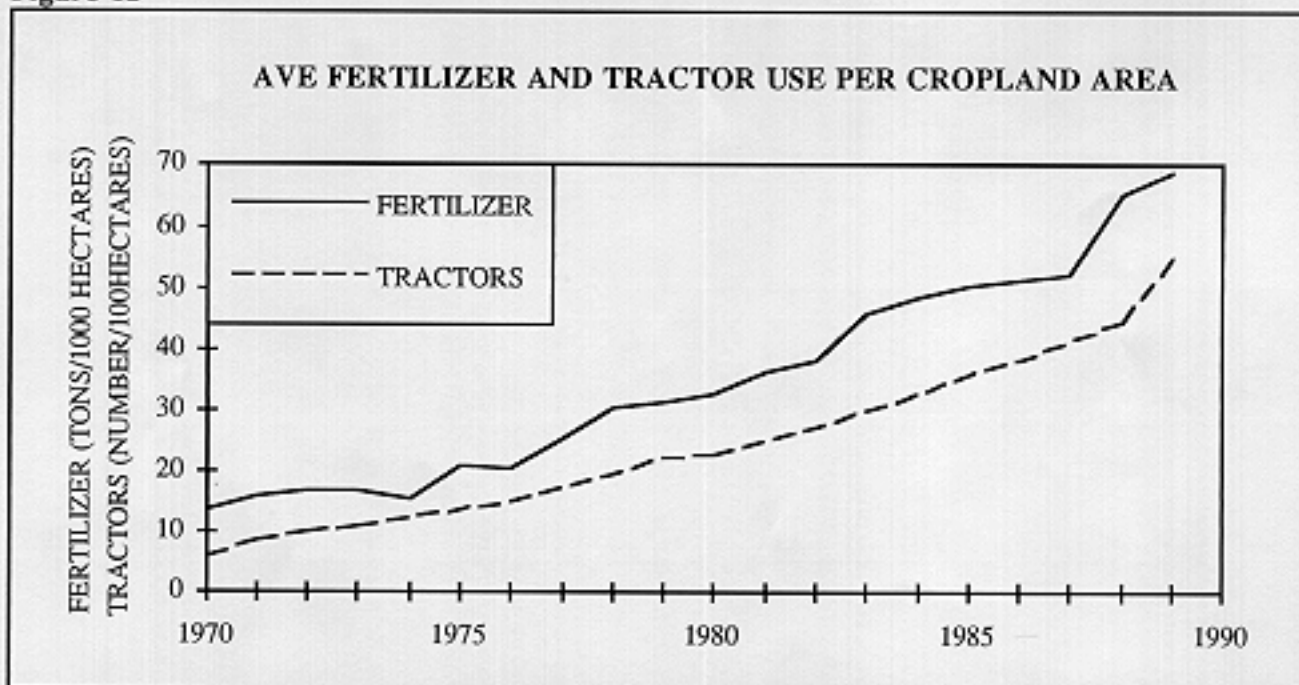


The greatest technological resource that has been called on to increase crop yield during the Green Revolution has been genetic breeding. Genetic breeding is the intentional manipulation of different strains of plants, particularly grain plants, to achieve a single plant capable of increased yields. For example, new strains of Indian super-rice plants have all the good characteristics of the strains from which they derive. Such a plant has no unproductive tillers, 200-250 grains per panicle, very sturdy stems, dark green thick leaves, vigorous root system and multiple disease and insect resistance's. The Green Revolution emphasis on plant breeding has been directed by the International Agricultural Research Centers (IARC's) now banded together under the Consultative Group on International Agricultural Research (CGIAR). These IARC's and its parent CGIAR were formed by the United Nations Food and Agricultural Organization (FAO) and the World Bank in

1971. The CGIAR holds a bank of different strains of plants that is invaluable in increasing crop yields (Plucknett).

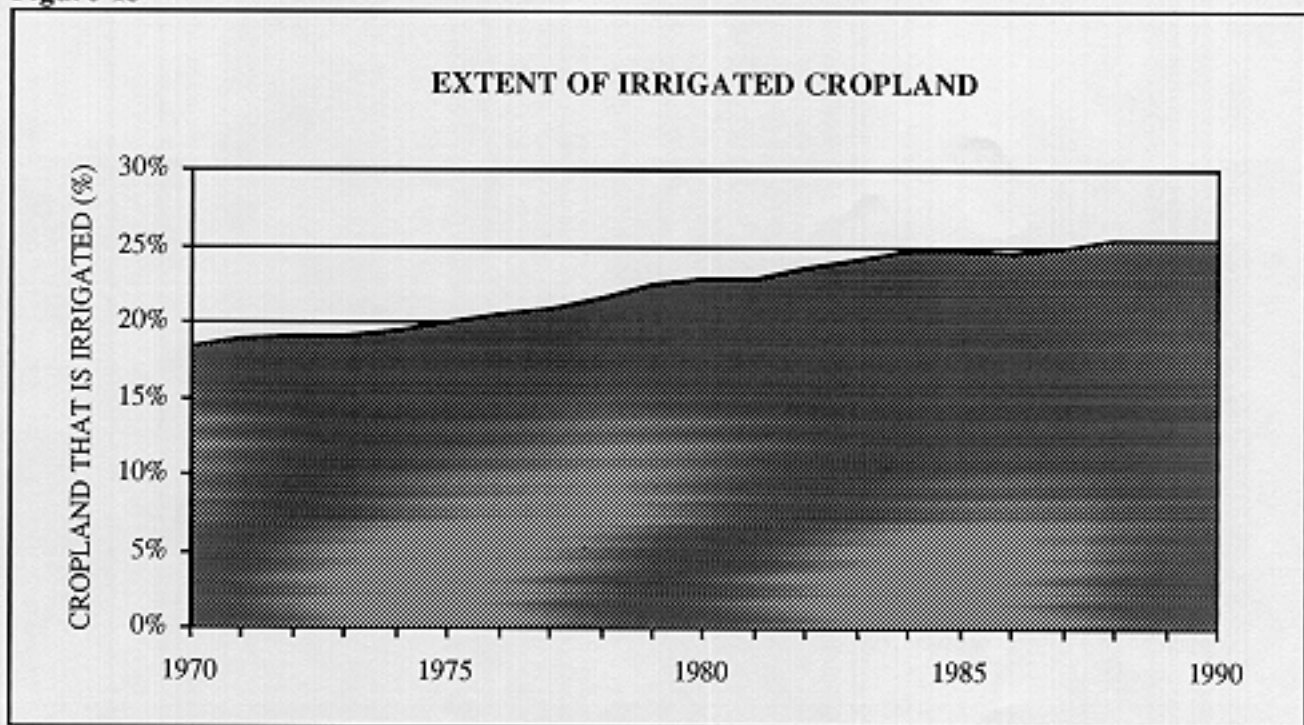
Moreover, chemical fertilizers have increased substantially during the Green Revolution for production of fertilizers is amenable and relatively cheap. Most fertilizers used are nitrogen fertilizers because nitrogen tends to be the most limiting nutrient in most soils. The use of nitrogen fertilizers in India has increased more than fourfold in the last two decades as suggested by Figure 12 (World Resources Institute).

Figure 12



Moreover, tractors which are used primarily to distribute the fertilizer evenly around the area of cultivation are being used more. The number of tractors in India has increased by fivefold in the last two decades.

Figure 13



Besides fertilizer and better yielding strains of grain, irrigation can serve to dramatically increase cereal yield per hectare. As suggested by Figure 13 the extent of irrigated cropland has increased from 18% to 26% in the last two decades. To summarize, the use of all technologies has increased yields substantially in the past twenty years. There would have been more environmental degradation in India if crop yields were not so high. That is, increases in high crop yield have served to decrease the threat of environmental degradation.

Schematic Analysis

Statistical analysis using the IPAT equation is useful for the discussion of cereal production impact in India. The IPAT equation can be thought of as a regression equation using the variables of Technology, Affluence, and Population. Technology, being a supply variable, is best approached by cereal yield. Population and affluence are best approximated using total population and per capita GNP. Since supply is equal to demand in the model, is it appropriate to equate technology with population and affluence. That is:

$I(T) = (P)(A)$	I = IMPACT P = POPULATION A = AFFLUENCE T' = TECHNOLOGY*
---------------------------------------	---

Technology is a function of population and affluence:

$(T') = f\{P, A\}$	I = IMPACT P = POPULATION A = AFFLUENCE T' = TECHNOLOGY*
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Using cereal yields as the technology variable, and population and affluence as the independent variables, it is useful to find a regression equation fitting population and affluence to technology. This regression is as follows:

$\text{CEREAL YIELDS} = - 0.542 + 0.00285(\text{POPULATION}) - 0.542(\text{PER CAPITA GNP})$
--

R²=0.8305

This regression function allows policy-makers to assess and predict technology needed to compensate for increases in population and affluence. As alluded to before the supply variables are twofold: namely technology and environmental impact. The demand variables are population and affluence. Given there is an equilibrium between supply and demand, any changes in population and affluence must be burdened by technology or the environment. The greater the technology, the less will there be environmental degradation.

Some Policy Implications

The IPAT model is useful in that it breaks down elements of environmental impact into three discernible variables. For policy-makers, these variables roughly correspond to sectors. For example, the population variable encompasses the human needs sector. Per capita GNP roughly encompasses the financial and industrial sector. The technology variable roughly delineates the science sector. The model can be used to assess one sector's relationship to another. For example, population-affluence dynamics corresponds to Becker's and Caldwell's theories of fertility decline. There are relationships between the technology variable and population for example. These however, were not covered in this paper. Moreover, there are technology-affluence relationship that can affect the model. What is important to note is that relationship between the variables affect each other as well as environmental degradation.

If environmental impact is of concern, there are three policy issues that must be discussed. Firstly, population must be kept in check. As mentioned before, much of this check occurs with affluence. However, Indian women often don't have the means to reduce fertility even though they desire it. Unmet need for contraception is high amongst these women. It must be the choice of the

policy maker to increase funding and infrastructure of family planning programs so that when women do choose to reduce their fertility, they will have the tools ready. Moreover, as affluence increases, the government must make certain that equality continues to exist. As India enters a phase of rapid growth, income distributions will become more and more skewed. This will result in a delay of average household income rising even though per capita GNP is rising. That is to say, household incomes must rise and this rise can be maintained with equal income distributions. Finally, technologies must continue to evolve for the agricultural sector. Higher yielding strains of rice and wheat must be developed by researchers. It is possible but the funding for research seems to be limited. Hence, there are three policy suggestions made for each IPAT variable.

Conclusion

Malthus was correct in predicting population growth rates. He understood that people are capable of high fertility given certain circumstances. However, he was short-sided in not seeing the technology capabilities of the future world. Indeed, the Green Revolution technologies have allowed India to achieve self-sufficiency in food production regardless of population growth rates. However, Malthus was probably never concerned with affluence and its relationship with consumption. Per capita demand is a new term coined in this century of wastefulness. Indeed, rich countries are affluent wasters of precious resources. It seems that the developing world is headed in that direction. Can affluence be circumvented? Is affluence going to spell the doom for countries such as India? It seems that just as there are mechanisms that allowed technology to outpace population and mechanisms that allowed fertility to decrease with affluence, there will be other mechanisms that will compensate for changes in the other variables. Malthus may be correct of a dismal world if the main mechanism of compensation for population and affluence is non-sustainable productivity.

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DEFORESTATION IN LEGAL AMAZONIA: THE EVOLUTION OF THE FORESTRY TRANSITION IN BRAZIL

Brent C. Blair

OVERVIEW

- **Geography**

Currently there are 9 million square kilometers of rain forest land throughout the world. This represents only 56% of the original 16 million (Mahar 1989). Of current rain forest land 5.5 million square kilometers lie in the Amazon, the worlds largest contiguous tropical rain forest (Browder 1988). This region extends into nine South American countries, but the majority of the Amazon rainforest (69%) is within Brazil (Browder 1988). This 3.8 million square kilometer tract of land lies within a larger, 5 million square kilometer, region of Brazil known as Legal Amazonia. This area has been divided by the Brazilian government into nine political states.

- **The Forestry Tansition in Legal Amazonia**

The forestry transition in Brazil started in the 1960's and has not yet ended. This paper examines two temporal stages of the transition in terms of: the initial period beginning in the 1960s and ending in the early 1990s; and the following period that began in the mid-1980s and continues today. While cattle ranching is the dominate vector of deforestation in the initial stage, logging is dominate in the second. Subsistence farming is of great importance in both stages and will be examined relative to the other two factors. Both stages are dependent on current governmental policy trends in Brazil and rates of timber use throughout the world. One item that has not been included in this analysis is Brazilian population growth. The reason for this is that Brazil, unlike most Latin American countries, has a huge land area with a relatively low population. The population density of Brazil, excluding the forested Amazon region, is estimated to be 23 people per square kilometer, a density comparable to the United States.

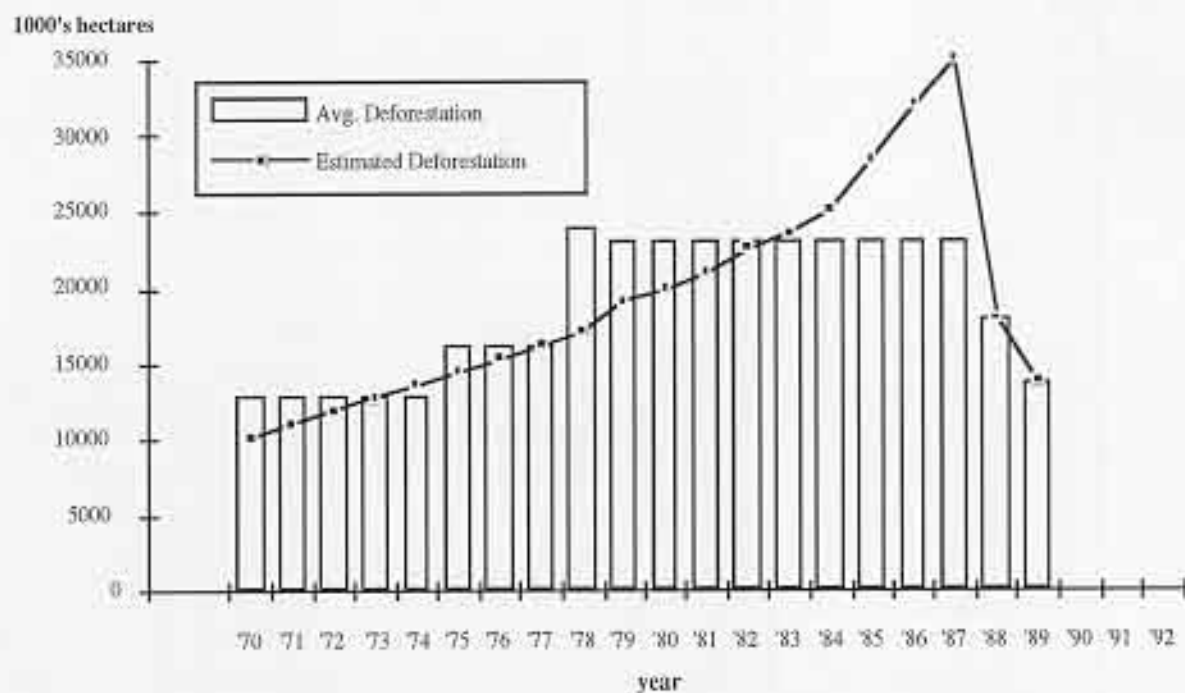
While there is no way to precisely measure deforestation, the most accurate method utilizes visual analysis of satellite imagery combined with information on the time of year the photos were taken relative to the intra-annual seasonal forest felling cycle, and cloud cover. Unfortunately, data presented prior to 1979 was obtained using older less accurate techniques.

Prior to the 1960s the rate of deforestation within Legal Amazonia was low. During the 1970s the rate increased dramatically, peaking in the mid-1980s and declining between 1988-90. Even with

this decline the most optimistic assessments estimate that Brazil is clearing almost 1.5 million hectares per year. The total rain forest alteration that has occurred in Brazil was estimated to be 5.12 percent by 1988 (World Resources Institute 1990). This figure has been criticized as being too low. Other estimates have gone as high as 15% (Browder 1988).

Figure 1 shows rates of deforestation between 1970 and 1990. These data points represent averages obtained between 1970 - 1974; 1975 - 1977; 1978 - 1979; 1980 - 1987; 1988 - 1989; and the rate of deforestation in 1990 (Feamside 1986 & World Resources Institute 1992). The second curve on this graph represents my best estimation of actual rates during this time period and is based on the averaged data points as well as more subjective information found in the literature. Standing alone this graph suggests that the forestry transition is coming to an end, and a hopeful future for the region. However, it does not reflect the complex situation that the Brazilian Amazon faces and represents only the first half of an uncertain forestry transition.

Figure 1
Deforestation in Brazil 1970 - 1989
(Feamside 1986 and World Resources Database 1992)



DEVELOPMENT

- **Early Settlement**

Before the construction of all-weather highways in the 1960s, transportation by land through the Amazon Basin was virtually impossible. As late as 1960, of the 6000 kilometers of roads in the region only 5% were paved (Mahar 1989). In a region with an excess of one meter of rainfall per year this meant that, for much of the year, most roads were not usable and as a result little colonization took place. Rivers were equally ineffective at serving as a route of transportation due to their isolation from populated regions. Many areas simply were not accessible without air travel. This kept economic activity to a minimum.

- **The Rubber Boom**

Rubber tapping began around 1839 with the invention of a rubber vulcanization process by Charles Goodyear (Mahar 1989). This marked the beginning of the Brazilian rubber boom: the first large scale economic activity within the Amazon region.

Between 1870 and 1912 the Amazon rubber industry was extremely prosperous and brought an amount of wealth not previously seen in Brazil. The secret to Brazil's success was twofold: the large endemic supply of wild rubber within Brazilian forests and a booming world demand.

Between 1897 and 1908 the price of rubber fluctuated between .75¢ and \$1.50 per pound. At its height, in the middle of 1910, prices jumped to \$3.00 per pound (Mahar 1989). This initial success rapidly faded as new technology made it possible to extract latex on rubber plantations where more latex could be harvested at cheaper prices. The more traditional gathering technique used in Brazil utilized a large number of indigenous Indians to harvest latex from trees within the forest. After 1910 rubber prices gradually began to decline and by 1914 rubber was selling for .63¢ per pound. The Brazilian government made a concerted effort to encourage plantation farming of rubber. There was some activity along these lines but not a successful shift. After 1910, increased competitiveness made it impossible for Brazil to compete in the world market. By 1914 the rubber boom had ended.

- **Development and the Brazilian Government**

The Brazilian government began expressing interest in developing Legal Amazonia in the 1940s. Two significant accomplishments occurred prior to the 1960s: the creation of a new capital, Brasília, and the building of the 1900-km Belém-Brasília Highway. This all-weather highway was created in the four-year period between 1956-1960, but was open to year-round traffic only after 1964. It now connects the capital with the northeastern city of Belém.

With the arrival of a military government in 1964, Amazon development increased rapidly. One reason, held by the government, was the expectation that development of this region would lead to

significant economic profit for the country. Another important motive, not widely publicized, was that the surrounding countries of Peru and Venezuela were developing their Amazon regions. It was thought then, as it is now, that vast natural resources exist below the rain forest floor (Mahar 1989). By establishing self-sufficient projects the government believed it would be able to protect Brazil's portion of the Amazon from outside intervention.

The first development scheme within Brazil's Amazon region came in 1966 with the creation of the Superintendency for the Development of the Amazon (SUDAM). Created to attract private investment to the Amazon region, SUDAM initiated a number of programs in 1966 and 1967 collectively known as Operation Amazonia. They consisted of a variety of infrastructure projects, colonization plans and incentive programs to attract investment to the region. As a whole it was hoped that these plans would make the Amazon region an integral part of the Brazilian economy.

HISTORY OF SUBSIDIZATION IN LEGAL AMAZONIA

• Subsistence Farming: Infrastructure and Colonization Programs

Although not an overt subsidy, infrastructure has played an essential role in providing the means for individuals and firms to exploit Amazonia at the government's expense. Infrastructure projects were a large component of the SUDAM plan.

These governmental projects promoted large population movements that have caused the Amazon to be used as a kind of "safety valve," much like the "West" in the early settlement of the United States.

The difference between the United States and Brazil is that much of the U.S. has excellent arable land while Brazil's rain forest possesses land that is unsuitable for agriculture. Unlike temperate forests, tropical rain forests hold most nutrients in their vegetation. In general, soil quality is low. When vegetation is burned for slash and burn agriculture or pasture conversion, the nutrients previously in the vegetation, continue temporarily to exist in the soil. After the burn, for one or two growing seasons, crop growth is increased but declines quickly thereafter due to rapid leaching of nutrients from the soil. This is caused by the weathered nature of tropical soils and high levels of precipitation. The process leaves the soil bankrupt of vital nutrients after only a few years. The farmer or rancher who faces degraded land must then find a new area to cut down and burn. Repeating itself indefinitely, this cycle has rapidly deforested large tracts of land.

After the construction of the Belém-Brazilia highway, the next extensive road building task was the Cuiabá-Pôrto Velho highway completed in 1968. This highway stretches 1500 kilometers through the province of Rondônia. Once a sparsely populated region of dense rain-forested land that housed some 100,000 individuals in 1965, the population had reached 500,000 inhabitants by 1985 (Feamside 1986). This rapid population growth was due largely to the increased accessibility that the

highway brought. Since 1980 the population has been rising in Rondônia at a rate of 14% per year (World Resources Institute 1990). The result of this colonization is that 24% of this region was deforested by 1988 (World Resources Institute).

Prior to 1970, the governmental programs which existed were aimed towards large investors, often in the livestock sector. Many peasants were attracted as well due to the large number of laborers needed for the construction of roads. After this work was done the government refused to give them support. Often, after settling on a plot of land, these individuals were forcibly removed when cattle ranchers officially bought this occupied land from the government. This caused an uproar which eventually forced the government to change its policies (Hecht 1989)

This shift occurred in 1970 when the Brazilian government announced the National Integration Program (PIN). This was a formalized statement of the governments intent to colonize large regions of the Amazon. Through this program 15,000 kilometers of roads were funded and other infrastructure projects were carried out (Mahar 1989). These were primarily housing construction projects which were run through a new governmental branch called the National Institute for Colonization and Agrarian Reform (INCRA).

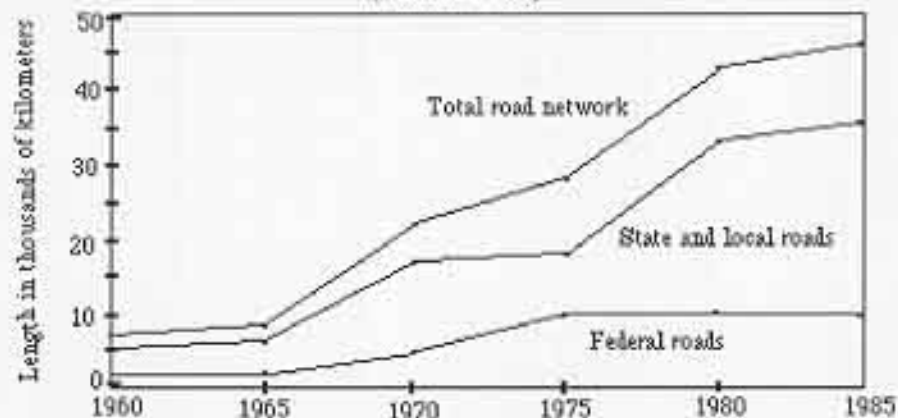
Although the number of settlers was not as great as the government hoped, the impact of this program was substantial. If every settler along the Trans-Amazon highway deforested only fifty of the one hundred hectares that they were given, 650,000 hectares were deforested as the direct result of the PIN program (Browder 1988).

But this direct deforestation accounted for only 14% of that in Para, the state most affected by the program (Browder 1988). Even in the highly subsidized area along the Belém-Brazilia highway, only 54.6% of deforestation was caused directly by governmental incentives (Fearnside 1990). The additional deforestation was largely due to the programs' indirect influences. By providing infrastructure PIN gave easy access to previously secluded regions, attracting large numbers of settlers. Figure 2 shows the expansion of the road network between 1960 and 1985. Federal roads expanded only gradually while the total road network expanded at a faster rate due to feeder roads created by settlers when areas near the main roads were occupied or degraded. This process caused deforestation to occur at a faster rate.

The PIN program carried out two distinct types of colonization projects. Initially it responded to pressure exerted by peasants who were neglected by earlier governmental programs. This was expressed through Integrated Settlement Projects (PICs) that were characterized by both road construction and house building and designed to attract rural farmers as settlers. Later the government introduced Directed Settlement Projects (PADs) that consisted of road construction, eliminated house construction, instead including financial incentives encouraging settlement of cattle ranchers. The PADs largely replaced the PICs as the government changed its development strategy.

An important reason for this switch was that PICs were extremely expensive. The cost for settling families was US\$39,000 per person (Repetto 1988A). Additionally, the government saw that colonists were willing to migrate on their own, without financial encouragement (Fearnside 1986). Interest in large scale development was reinforced by the lobbying efforts of the Association of Amazon Entrepreneurs, a powerful livestock interest group (Pompermayer 1984).

FIGURE 2
Amazonian Road Network, 1960-85.
(Mahar 1989)



- **Cattle Ranching: Financial Incentives**

Most government incentives throughout the history of Brazil have focused on large investors: ranchers, loggers and miners. These incentives take different forms including: investment tax credits, income tax deductions, and reduced rates on loans.

Until recently eligibility for the government's incentive programs, required "development" of the land either before or after receipt of the subsidy. To prove development has taken place, land owners need only deforest their land. This is also the manner of claiming land ownership (Hecht 1989).

Early in the history of Legal Amazonia's development, the Brazilian government formed the Fund for Private Investment and Development of Amazonia (FIDAM) an investment fund created to finance SUDAM's incentive programs (Browder 1988). The fund was administered by the Bank of Amazonia (BASA), a regional development bank. In 1975, FIDAM was restructured and renamed the Amazon Investment Fund (FINAM).

Thought to be the most influential of FIDAM's incentive programs were the investment tax credit subsidies. Begun in 1966, these tax credits allowed Brazilian corporations to deduct up to 50% of their income taxes if they invested these new funds in SUDAM approved investments in Amazonia. In its final form, prior to the demise of such subsidies in 1988, this program was carried out by giving corporations common shares of FINAM stock in the amount of the tax credit. This stock after being

held for a four year period could be held, sold or exchanged for corporate stock in approved projects (Browder 1988).

Depending on SUDAM's view of the project, these tax credits could represent up to 75% of the total cost of a project and could last for up to twelve years. For projects initiated prior to 1972 these exemptions could be as much as 100% (Hecht 1984). Factors influential in SUDAM's decision were: use of regional inputs; amount of employment created; level of technology; effect on the balance of payments; and the location with regard to priority areas (Mahar 1988). Approved projects included new ventures as well as improvement or expansion of old ones (Hecht 1984). Due to the incentive structure there was a rapid expansion of projects between 1966 and 1972, during which 368 projects were approved (Hecht 1984). As seen in figure 3 the number of projects increased dramatically in 1967, and peaked at seventy projects in 1969. Gradually their numbers decreased until 1972 when they dropped abruptly due to the ending of this incentive program. Between 1963 and 1983, 808 projects received tax credits with a cost totaling US\$1.4 billion (Repetto 1988A). This large amount of money went to relatively few investors. Table 1 shows the distribution of these tax credits in greater detail. Almost 35% of the funds went to 59 logging companies and another 42% went to 470 livestock operations (Repetto 1988A).

FIGURE 3
Value of Fiscal Incentives to Livestock Investments, 1965-76
(millions of 1976 cruzeiros)
(Hecht 1984)

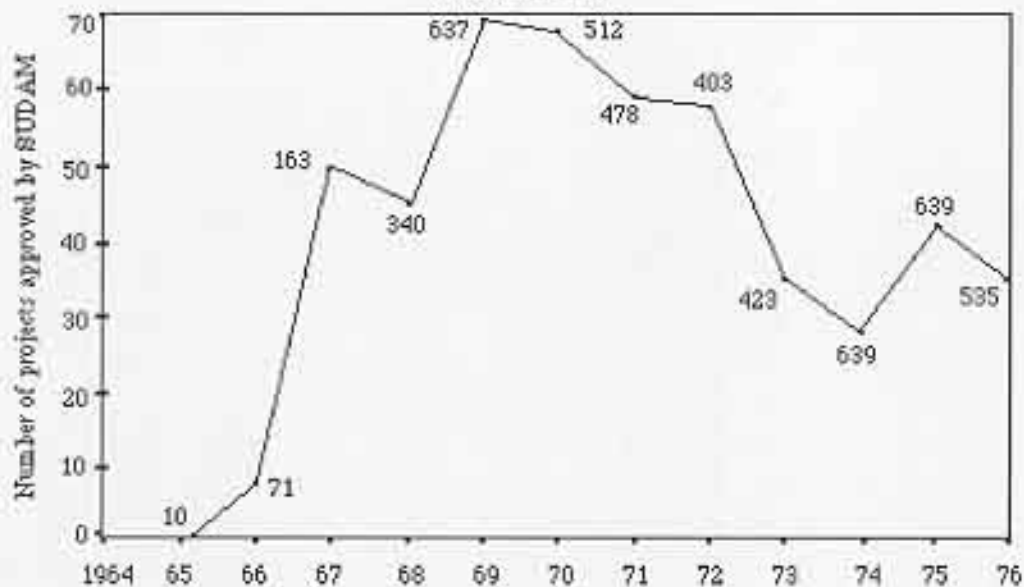


TABLE 1
 Distribution of SUDAM Tax Credit Financing by Sector and Year.
 (thousands U.S. dollars)
 (Source: SUDAM. Taken from: Browder 1988)

Year	Livestock	Industry	Basic services	Agro-industry	Other	Total	Exchange rate
1965	458					458	1.896
1966	527	3,168				3,695	2.222
1967	4,057	5,960				10,017	2.669
1968	8,485	8,219	3,857	24		20,585	3.382
1969	18,007	13,094	1,555	177	179	33,005	4.076
1970	33,631	23,853	8,050	636	1,168	67,339	4.594
1971	28,337	23,390	6,345	1,312	438	59,822	5.288
1972	28,226	17,350	3,929	437	528	50,470	5.934
1973	25,789	22,279	1,639	833	1,419	51,959	6.125
1974	31,182	27,284	320	1,947	2,272	63,004	6.790
1975	52,247	55,617	390	5,034	4,557	117,850	8.127
1976	48,974	41,043	3,943	4,448	6,972	105,380	10.673
1977	53,031	33,211	5,622	1,709	4,785	98,357	14.144
1978	52,690	44,811	11,178	2,871	4,513	116,060	18.070
1979	40,594	46,806	5,813	8,382	8,747	110,340	26.945
1980	40,447	55,310	2,836	2,905	1,651	103,150	52.714
1981	37,975	65,083	3,070	8,674	3,420	118,220	93.125
1982	49,319	77,991	8,957	12,176	4,578	153,020	169.760
1983	44,202	54,160	4,151	12,632	2,418	117,560	434.020
Total	597,710	619,090	71,655	64,197	47,644	1,400,295	
Projects	469	252	31	36	20	808	

In addition to these subsidies, there was an income tax exemption program. If a corporation improved a SUDAM-approved project through expansion, modernization or diversification prior to 1985, it was eligible for income tax exemption on revenues generated by the projects for a period of up to 10 years (Browder 1988). By 1983, 843 projects received income tax exemptions granted by SUDAM. Of these projects, 39% were ranches and 31% were producers of industrial wood products. Additionally, operating losses of SUDAM-approved projects could be deducted from other taxable income, including income made outside of the Amazon region (Repetto 1988A).

Another program encouraging deforestation allowed corporations to receive loans at highly discounted prices. During the 1970s these discounts were as much as 85%-95% below commercial interest rates (Repetto 1988B). Between 1981 and 1983, export-based corporations were given subsidized credit up to the amount of the value of their exports. Companies were able to obtain loans averaging -30% after inflation during this period (Hecht 1988). It was profitable for these corporations to take a loan and do anything with it, including non-investment spending.

Finally, a strong financial incentive that encourages deforestation is cheaper tax rates for agricultural land than for forested areas. The effective tax rate for agriculture is around 6%, while non-agricultural taxes run between 35% and 45% (Browder 1988). It is generally thought that the

purpose of the policy is to encourage the production of food and export goods. The result has been to encourage deforestation.

The programs outlined here have allowed Amazonian large-scale cattle ranchers to flourish. Some effort was made in 1979 to slow deforestation through a law stating that densely forested land in Amazonia would not receive subsidies. Unfortunately, three major loopholes existed within this law.

- 1] Substantial areas of forest which continue to be altered by previous projects are still eligible for subsidies (Hecht 1985, cited in: Anderson 1990)
- 2] The extensive areas which are classified as "transition forests" are eligible. These are areas which are combinations of scrub land and dense forest (Dicks 1982, cited in: Anderson 1990)
- 3] There is a very restrictive definition of "dense forest" (Fearnside 1985).

The Brazilian government suspended tax credits in 1988 and subsequently canceled them in 1989 (World Resources Institute 1990). The reason for this abrupt policy shift seems to be due to public opinion around the world, in addition to that of the World Bank and the Inter-American Development Bank. These two banks, which Brazil depends on for loans to pay import bills and its large foreign debt, were hesitant of loaning to a country subsidizing large-scale deforestation (Lenssen 1989). Whether this segment of the forestry transition has ended remains to be seen. If Brazilian governmental policy continues to discourage cattle ranching this vector of deforestation will likely be permanently diminished.

CATTLE RANCHING

• Influence on Deforestation

Though currently on the decline, cattle ranching is the number one cause of deforestation in the Brazilian Amazon. According to one estimate, it caused the conversion of 70,000 square kilometers of rain forest land to pastures by 1987 (Serrão and Toledo 1990). Other estimates put this figure much higher, to as many as 94,000 square kilometers by 1980 (IBGE 1980, cited in Anderson 1990). The ranches formed out of this land were generally very large. Some of the larger ones include: Liquigas 6,780, Volkswagen 1,390 and the 720-square-kilometer Armour-Swift/Brascan/King Ranch (Browder 1988). Although all ranches are not this massive, 70% are greater than 10 square kilometers (Mahar 1989). The estimated percentage of land deforested by ranches is 72% (Browder 1988).

- **Longevity**

Typically when a pasture is formed, forests are cut and burned in the dry season and then planted with some type of African forage grass. These grasses generally grow well for the first two or three years but growth then starts to slow. Within ten years the phosphorous levels, which were initially boosted by the biomass burning, return to previous levels. At this point pasture grasses are gradually taken over by inedible grasses and shrubs (World Resources Institute 1990). To combat this situation ranch owners hire individuals to periodically cut down unwanted shrubs and burn the area again. Although initially, with increased phosphorous levels, grasses again grow well, the productivity of each additional burning has diminishing returns (World Resources Institute 1990). It is thought that in order to sustain a pasture, during the first year one animal per hectare can be maintained while only .25 animals can be maintained per hectare after the first five years (Mahar 1989).

Table 2 demonstrates the extensive nature of pasture degradation in Amazonia, ranging from 17% to 54% in the 1970's. Since 1981 this problem has worsened (Fearnside 1986). This is not surprising for two reasons: Brazilian pastures are not sustainable for more than ten years without excessive fertilization due to poor soil quality; and ranchers can make more money in the long-term if they overgraze their land. This is shown in table 3. Here it is possible to see the profits made both by the corporation owning the ranch and that of the overall profits of the ranching endeavor. The difference between these values is the percent which SUDAM subsidizes. There is a positive correlation between profits and cattle prices as well as land appreciation. There is only one situation where the rancher loses money: when cattle prices are low and the appropriate level of grazing is taking place. Ranchers can always improve their financial situation by overgrazing a plot of land. Once a pasture is degraded it is possible to recuperate it at a substantial cost. This has not occurred in the past because it was cheaper to move onto pristine land and get new subsidies from the government (Mahar 1989).

The long history of governmental subsidization of cattle ranches in Brazil has resulted in more cattle ranching than otherwise would be present. Several studies have examined the profits that can be made in Brazilian ranching with and without governmental subsidies. Here I will examine two conducted by John Browder.

The first study looks at ranching profits through the cost-benefit analysis of producing a single 125 gram hamburger (Browder 1988). The estimate of the cost of establishing and operating a typical Amazon cattle ranch is US\$415 per hectare over a five year period while, the revenue gained by such a ranch is placed at US\$113 per hectare. This can be seen in table 4. A previous study concluded that it takes approximately 6.25 square meters (0.000625 hectares) to produce one 125 gram unit of beef (the typical size of a hamburger) (Uhl and Parker 1986) Through multiplication

TABLE 2
Estimates of Extent of Pasture Degradation in Amazonia
(Fearnside 1986)

Percent of Pasture Area Degraded	Date of Estimate	Location	Method	Reference
17	1979	Amazon region	Unstated	Serrão 1979.
20	1978	Brazilian Amazon	Unstated	Serrão et al. 1979.
17-24	1980	Amazon Basin	"Unofficial reports. . ."	Toledo and Serrão 1979.
44	1975-1976	and Luciara, Mato Grosso	Barra de Garças	LANDSAT Tardin et al. 1978.
50+	1980	Paragominas, Pará	Unstated	Hecht 1981.
54	1977-1978	Pará	Paragominas,	LANDSATdos Santos et al. 1979.

TABLE 3
Internal Rates of Return to a Typical SUDAM - Approved Livestock Project under Two Scenarios
(percent)
(Source: Mahar 1989. Originally adopted from Hecht, Norgaard, and Possio (n.d.))

Scenario	Increase in Land Value		
	0 percent	15 percent	30 percent
High cattle prices			
Appropriate grazing intensity			
Corporation resources	16	18	24
All resources	-1	2	9
Overgrazing			
Corporation resources	23	24	27
All resources	-2	0	4
Low cattle prices			
Appropriate grazing intensity			
Corporation resources	-3	6	17
All resources	-14	-6	5
Overgrazing			
Corporation resources	16	18	23
All resources	-10	-7	-1

- **Profitability and Subsidization**

it is found that while the cost of producing a 125 gram hamburger is US\$0.26, the revenue earned is US\$0.085. There is a net loss of US\$0.175 per 125 gram unit of beef produced. The difference between cost and revenue must be paid by the Brazilian government if such ranches are to survive economically. Additionally, some margin of profit must encourage them to stay in the business.

In table 5 we see a similar scenario (Browder 1988). Here the benefits many ranches receive from the Brazilian government is included. The analysis considers a typical 200 square kilometer cattle ranch over a period of 15 years, after which it is assumed the ranch will shut down. The study includes both the set up costs and the revenues made from selling the land, remaining cattle and equipment at the end of the fifteen-year period. It is assumed that land prices increase 2% over the rate of inflation.

As in the previous example this firm will lose money without governmental aid. While its total investment is over US\$5.1 million, revenues are only US\$2.3 million. This leaves a US\$2.8 million gap, a 55% loss. Through the sensitivity analysis we see that some profit can be made if cattle prices double. However, raising land prices by 5% per year instead of 2% changes the results only slightly and our firm will still lose a considerable amount.

The second half of this analysis shows the extensive role that the government plays. Once all incentives are put in place the total outlay for investment drops to less than 15% of the original cost. Accordingly, the net present value of the ranch rises by almost US\$4.2 million. Now extremely profitable for its owner, this ranch is quite costly for the Brazilian government.

Until recently, the government spent, on average, US\$5.6 million per year on a typical subsidized ranch. This expenditure is twice as much as if the government had undertaken the investment directly (Repetto 1988A). Subsidizing 470 such ranches over a seventeen year period ending in 1983, gave the government a total fiscal cost of over US\$2.5 billion (Repetto 1988A).

But, between 1973 and 1983 operations subsidized by SUDAM accounted directly for only 30% of deforestation and less than half of deforestation caused by pasture conversion (Browder 1988).

Other forces are at work encouraging ranching including the previously mentioned indirect subsidy of infrastructure. Another possibility is that SUDAM-subsidized ranches are inherently less efficient and thus less profitable than independent ones.

In a 1980 study it was found that more than 50,000 ranches were economically viable under some circumstances (Repetto 1988A). This viability did not translate into profits nearly as favorable as those of SUDAM influenced operations. Here initial capital costs for land clearing, pasture

TABLE 4
 Cost structure and returns on typical SUDAM beef cattle ranch during
 its first five years
 (U.S. dollars per hectare during five-year development period)
 (Browder 1988)

Capital Investment	
1. Land cost	31.70
2. Forest Clearance	
a. Manual	65.95
3. Pasture planting	26.36
4. Fencing	19.38
5. Road building	6.31
6. Miscellaneous constructions	1.25
7. Cattle acquisition	90.87
Subtotal	241.82
Five-year operating costs	
1. Labor costs	26.16
2. Herd maintenance	21.00
3. Pasture maintenance	47.34
4. Facility maintenance	74.35
5. Administration	4.11
Subtotal	173.00
Total costs	414.78
Total revenues	112.50

TABLE 5
 Economic and Financial Analysis of the Government-Assisted Cattle Ranches in the Brazilian
 Amazon
 (Browder 1988)

Net Present Value	Total Investment	NPV/Investment	(1) + (2)
	Outlay (U.S\$)	Outlay (US\$)	
I. Economic Analysis			
A. Base case	-2,824,000	5,146,700	-55
B. Sensitivity Analysis			
1. Cattle prices doubled	511,380	5,143,700	+10
2. Land prices assumed rising 5% /year more than inflation rate	-2,300,370	5,143,700	-45
II. Financial Analysis			
A. Reflecting all investor incentives: tax credits, deductions and subsidized loans	1,875,400	753,650	+2.49
B. Sensitivity Analysis			
1. Interest rate subsidy eliminated	849,000	753,650	+1.13
2. Deductibility of losses from other taxable income also eliminated.	-658,500	753,650	-.87

development and stocking were about US\$400 per hectare. The revenues that these operations received after opening were US\$60 per hectare. Only after seven years would such firms make a net profit. By this time nutrients within the land would be running low and continued ranching would be difficult. These operations are seen to be only marginally profitable (Repetto 1988A).

- **Land Speculation**

A reason often cited for the continued popularity of cattle ranching is land speculation. This, in part, is a result of the extreme inflation Brazil has faced throughout the last ten years. Between 1980 and 1988 the annual inflation rate averaged 188% (World Bank 1990). Figure 4 shows the precipitous rise in inflation between 1970 - 1989. The unpredictable and extreme nature of the Brazilian inflation rate has encouraged people to hold assets in forms other than the rapidly depreciating Brazilian currency. Land, dollars and indexed bonds can hedge an investors' profits from inflation and are extensively used. Land acquisition is popular for two reasons:

- 1] The favorable tax rates for agricultural land, as low as 6%, have made cattle ranching a useful tax shelter (Browder 1988).
- 2] The rate of increase in value of Amazonian ranch land has consistently risen faster than inflation (Hecht 1985).

The amount that land appreciates depends on the region that is chosen. As seen in figure 5, land prices have soared in Rondônia in recent years. Other areas within Amazonia have also appreciated quickly, though perhaps to a lesser degree.

Just as inflation is unpredictable, land tenure is often not secure in the Brazilian Amazon and subsidies are uncertain from one year to the next. This uncertainty has caused land bought for speculative purposes to be used for projects that generate short-term profits (cattle ranching, and timber extraction), and grave environmental losses (deforestation and land degradation). The end of tax subsidies in 1989 should help ease the pressure of speculative land holding, but without a dampening of its driving force, inflation, it can be expected to continue to be a problem. Subduing runaway inflation has alluded every attempt by the Brazilian government and in the short-term appears to be a problem that will persist.

FIGURE 4
Inflation 1970 - 1979

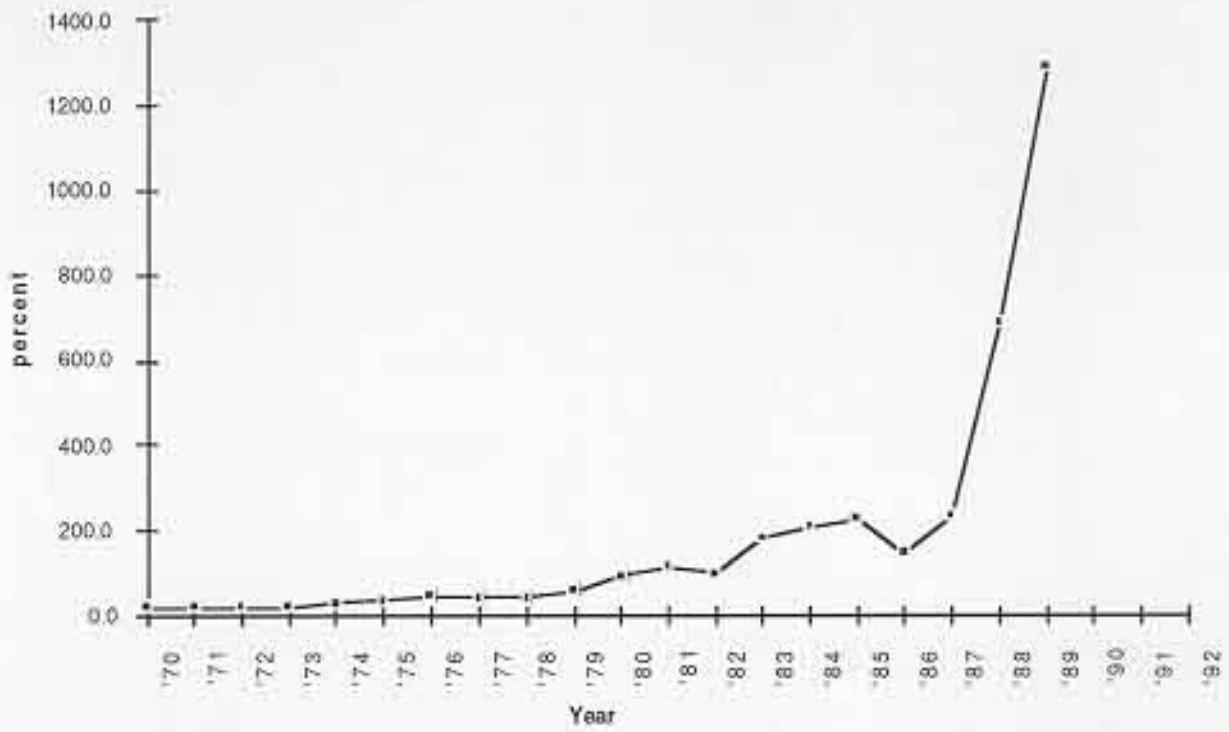
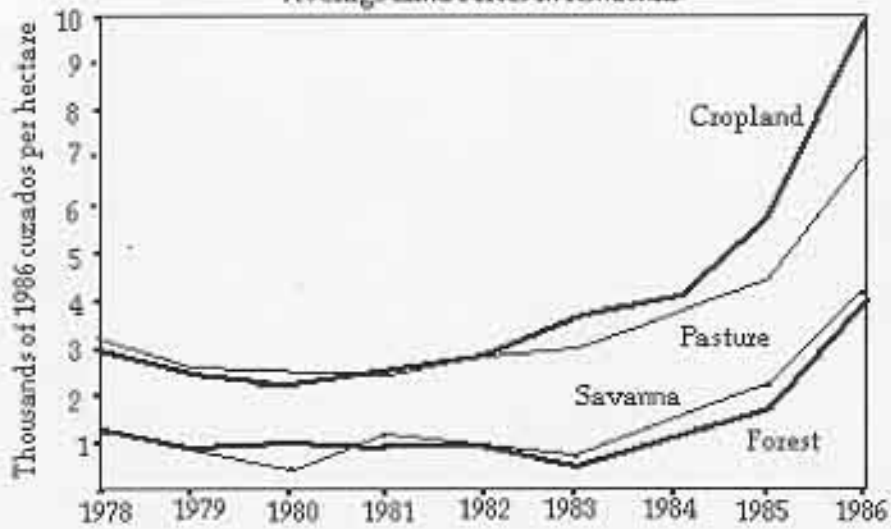


FIGURE 5
(Mahar 1989)
Average Land Prices in Rondônia



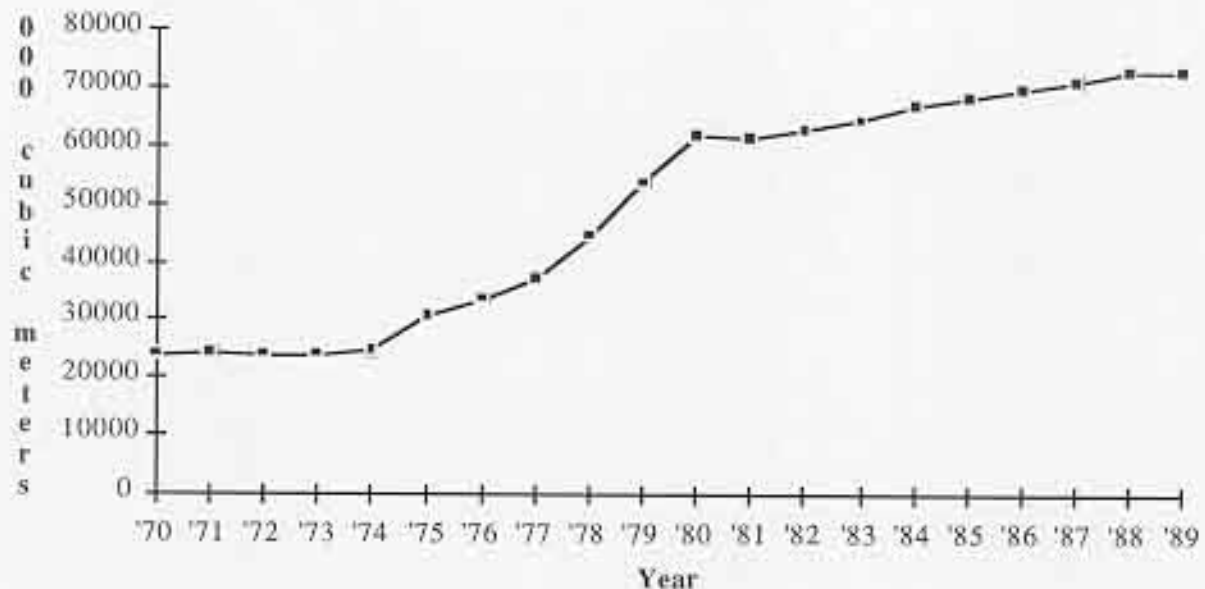
LOGGING

• Current Trends in Brazil

The effects of the timber industry within Amazonia have historically been slight when compared with other forms of deforestation. While Brazil possesses 31.7% of the world's volume of broadleaf timber (Erfurth 1974, cited in: Browder 1988), it supplies less than 10% of the world production of tropical wood products (UNIDO 1983, cited in Browder 1988). This element of the forestry transition is just beginning. Logging is expected to increase over the next several years, largely due to the rapid depletion of tropical forests in other areas.

The logging stage of the forestry transition has started but is still in its infancy. In 1960, logging accounted for only 6.3% of national industrial output, but by 1980 this number had risen to 12.9% (Repetto 1988A). While the timber extracted from the Amazon region of Brazil has been on the rise, other areas within Brazil have not kept pace. Between the years of 1975 and 1985 the share of Amazon timber production has gone from 14.3% of the national total (4.5 million cubic meters per year) to 46.2% (19.8 million cubic meters per year) (Mahar 1989). These numbers do not reflect the very gradual and sporadic evolution of the Brazilian timber industry. Figure 6 shows that roundwood industrial production between 1970 - 1989 although rising, has done so at an uneven pace.

FIGURE 6
Roundwood Industrial Production 1970-1989
(World Resources Database 1992)



The amount of deforestation attributable to logging is unclear due to the extraction practices often used by loggers. Traditionally loggers will harvest timber from tracts of land given to them, for a fee, by the government. In Brazil, loggers often come to recently deforested areas and harvest selected trees causing very little outright deforestation (Mahar 1989). In the short-term this has held true because it is economically profitable for loggers to use existing roads, localizing deforestation. In the longer run these "prefabricated" logging routes will not support timber demand as government road building schemes slow, the available timber is removed and world demand increases. As these timber resources are depleted, loggers are going to more pristine areas. By creating roads loggers encourage extensive deforestation by settlers who flock to the newly opened land.

Many Asian tropical forests are characterized by high densities of commercially valuable trees (Fearnside 1990). In Brazil trees of the same type do not tend to grow together, but instead different tree species are intermingled over large areas. This makes the loggers job more difficult and means that they will tend to extract a very low number of trees per hectare, but will need a vast area of forest to extract a relatively low number of trees.

Selective logging tends to be highly destructive even when the influx of settlers is not considered. While 3% of the trees are removed in a typical timber operation, in the eastern Amazon, one study suggests that 54% of the trees were damaged during logging and road building (Uhl et al. 1989). A second study done near Belém, found that while only 2% of the trees were harvested, 26% of trees with diameters greater than four inches were killed or damaged (Uhl and Vieira 1990, cited in Brooke 1990). Additionally, the canopy cover was cut from 80% to 43%, leaving the forest open to increased damage from winds, rain and fire (Brook 1990).

• **Forestry Transitions throughout the World**

Logging intensity depends upon a combination of the supply of and demand for wood. The sustainability of this situation will depend on whether trees are treated as a sustainable harvest or are mined. Looking at this transition in other timber exporting tropical countries, shows that the potential for extensive deforestation is great. There have been virtually no countries that have succeeded in sustainably managing their tropical forests with the possible exception of Trinidad (Ryan 1991). In 1985, the World Resources Institute came to this conclusion:

"By the end of the century, the 33 developing countries that are now net exporters of forest products will be reduced to fewer than 10, and total developing country exports of industrial forest products are predicted to drop from their current level of more than US\$7 billion to less than US\$2 billion." (World Resources Institute 1985)

Countries begin this transition as large timber exporters. As resources shrink, exports diminish, and these countries become net importers of timber. This particularly bleak forestry transition ends with a very low percentage of forest cover and is not uncommon in tropical, timber exporting countries. Historically within Southeast Asia, exports to Japan, the world's largest importer of tropical timber, have changed over time as timber stocks diminished; beginning in the Philippines in the sixties, to Indonesia in the seventies and finally to Malaysia during the eighties (Nectoux and Kuroda 1989, cited in: Postel and Ryan 1991). Malaysia is presently the world's largest exporter of tropical timber, but it could be a net importer within the next decade if current deforestation rates continue (Postel and Ryan 1991).

West Africa has experienced a similar trend. In the 1970s Nigeria became a net importer of timber after years of being a net exporter. It is feared that Côte d'Ivoire and Ghana will become net importers later in this decade. Côte d'Ivoire already has a declining annual harvest, from 4 million to less than 1 million cubic meters of wood (Poor 1989). In these countries deforestation is not due solely to the timber industry, but logging has played the leading role.

- **Forest Sector Subsidies and Taxes**

Unfortunately, subsidies and taxes are often employed in favor of the timber industry. An extreme case is in the Philippines where revenues made by forest exploitation do not even cover the infrastructure and administrative costs incurred by the government (Boado 1988). The United States is in a similar position, \$100 million is lost every year through a subsidized timber industry. It does this by selling timber, from over 100 million acres of land, at prices below its own growing, road building, harvesting, and selling expenses (Repetto 1988A). The only people who profit from this is the timber industry. In developing countries these logging companies are often controlled by foreign corporations.

The three things that developing countries generally want through logging subsidization are: an increased GDP, expanded employment, and increased foreign exchange earnings (Repetto 1988A). These countries attempt to meet these goals by creating a complex array of taxes, subsidies, and protection.

One especially damaging policy used in many countries is validating a timber concession for a set number of years, usually between 5 and 20. If the firm receiving the initial concession does not believe it will regain access over the area after it expires, it will try to maximize short-term profits. The natural result of this policy is for the logging firm to move in as fast as it is able and extract a maximum amount of timber.

The purpose of this policy is to have companies log certain areas for a stipulated period of time and then allow the forest to regenerate for a specified period. Unfortunately, once roads are built and areas cleared it is very difficult to keep subsistence farming and other activities from coming into an

area. Additionally, governments, eager to increase cash flow, often fail to wait long enough for the second harvesting. In either situation further devastation of the forests results (Repetto 1988A).

The ramification in most timber exporting developing countries is that governments have looked to short-term ways of increasing cash flow but instead have caused "economic and ecological losses [to go] hand in hand." (Repetto 1988A)

I predict that the Brazilian timber industry will have high rates of sustained growth in the near future. In part this may be tied to governmental subsidization, but will be driven by global demand for tropical timber as world markets dwindle. If the World Resources Institute is correct in its estimation of declining global forest resources this situation could occur before the turn of the century. How this stage of the forestry transition results will be dependent upon governmental decisions on how it wants to use its forest resource.

POLICY RECOMMENDATIONS

There are specific steps that the government of Brazil needs to take in order to minimize the amount of deforestation that occurs in the future. Unfortunately, measures instituted now, after thirty years of a concerted effort to develop the region, will be more difficult and costly than if begun before this developmental effort. Thirty years ago development was dependent on governmental infrastructure; Legal Amazonia was essentially impenetrable to large-scale colonization or other development. Early in the Amazon's history the Brazilian government was the engine of deforestation and without it little would have taken place. With roads currently stretching throughout much of the region, more recent development has not hinged on governmental incentives. While ending these programs has slowed deforestation, it cannot stop it; forest destruction can now occur independently of governmental subsidization. Land speculators, the landless poor, and logging companies, with the help of pre-built roads, find it beneficial to exploit the region.

For this reason in addition to ending all subsidization programs the government must enforce laws already in place regarding forest exploitation by actively discouraging new settlers from coming to the region and preventing unauthorized loggers from removing timber and other illegal forest clearing. This policy shift from promoter to active preventor of deforestation has already begun. Through the use of five helicopters and 60 trucks forestry agents have sought out illegal burning and by 1990 had collected millions of dollars in fines (World Resources Institute 1990). A public information campaign has also been instituted to discourage deforestation (World Resources Institute 1992). While undoubtedly expensive, such measures must be sustained if uncontrolled deforestation is to be prevented.

The tax structure should be modified to discourage deforestation of privately held lands but encourage the exploration of sustainable forest products. This could be done by considerably raising

the current 6% tax rate for agricultural land and lowering the rate of forested land to some point below the new agricultural rate. Taxes should also be structured so that agricultural tax rates are higher than tax rates for other non-forest activity to discourage speculation.

Ownership laws, for individuals should be changed to make it more difficult to acquire new land. Ownership should be contingent upon the land's sustainable use, and possible only in regions that have already been disturbed.

Logging companies should be strictly regulated. Concessions should not be made for a set period of time but be contingent on the companies sustainable extraction of timber. The cost of preventing settler migration to areas with new logging roads should be paid for by the timber company.

Policies to prevent subsistence farmers from settling in the Amazon will be quite difficult due to the resources needed to implement them. The first step that needs to be taken is to introduce social programs for the urban poor. Such programs would ultimately discourage movement into the forest. Likewise, similar programs need to be started within the Legal Amazonia for current residents to stabilize their land use practices.

While the population density is 23 people per square kilometer in Brazil, 4.5 percent of the landowners hold 81% of the farmland (Caufield 1984, cited in: Anderson, 1990). Although the per-capita income in 1988 was \$2160, the lowest 40% of the households made only \$360. These factors created great inequities that have caused undue pressure on forested land. Land redistribution would immediately benefit the majority of Brazil and would largely solve the problem of the rural poor. Admittedly, this is unlikely to occur and would require the government to take land from those with the most power within the country. Undoubtedly these individuals would not willingly make these sacrifices and the government's ability to make them do so is questionable.

CONCLUSIONS

Brazil faces serious economic and environmental problems. Whether it is able to improve these two situations simultaneously will depend on actions taken within the government. Such solutions will not be easy. Certain actions can be taken more painlessly than others, but all will demand courage by the government to take politically unpopular positions.

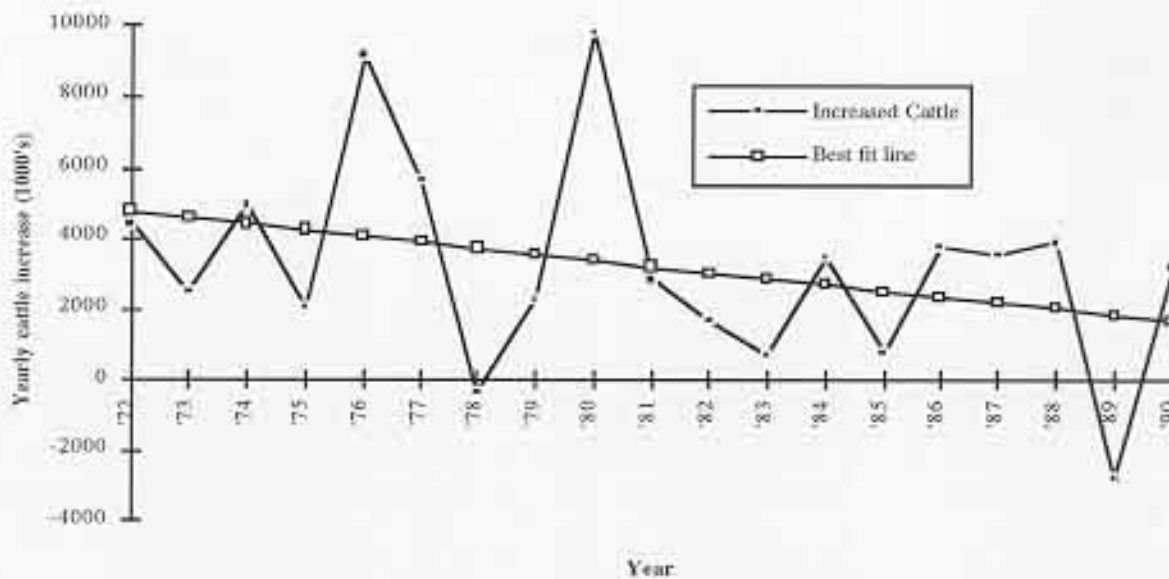
In the past politics has posed, limitations on economic forces that normally exist within Brazil. Market-distorting taxes and subsidies are often imposed as a result of pressure from powerful groups. Typically these groups are not representative of the less fortunate majority but of those who already wield power. As it is throughout the world, this skewed representation is because the disadvantaged tend not to be as well organized or have the resources to wage successful battles.

Within the next twenty years many of the earth's rain forests will gradually disappear. Brazil's Amazon region probably has longer than this due to its vast size. Whether it continues to exist will

depend upon the amount of pressure exerted on Brazil internationally, and the speed of realization by the Brazilian government that their natural environment is an integral part of successful, sustainable development.

The two parts of the forestry transition that I have examined within Brazil have in the past been influenced by and will in the future depend on governmental policies. As of 1988, all subsidies to cattle ranches were suspended. If the government is able to continue this policy, ranching should be reduced over the long-term. The data for the number of heads of cattle over the past 18 years (figure 7), shows that they have fluctuated a great deal, but a line fitted to these points shows the number of cattle overall has been decreasing over this 28 year period. The yearly fluctuations are likely a result of many factors working in concert with one another: inflation, cattle prices, subsidies etc. The longer term decline is more likely due to a decline in the number of hectares of active cattle ranches. This decline does not necessarily reflect the amount of deforestation directly, since an area created as a cattle ranch doesn't necessarily have cattle and may be simply used for speculative purposes. It does however lend support to the notion that cattle ranching is on the decline.

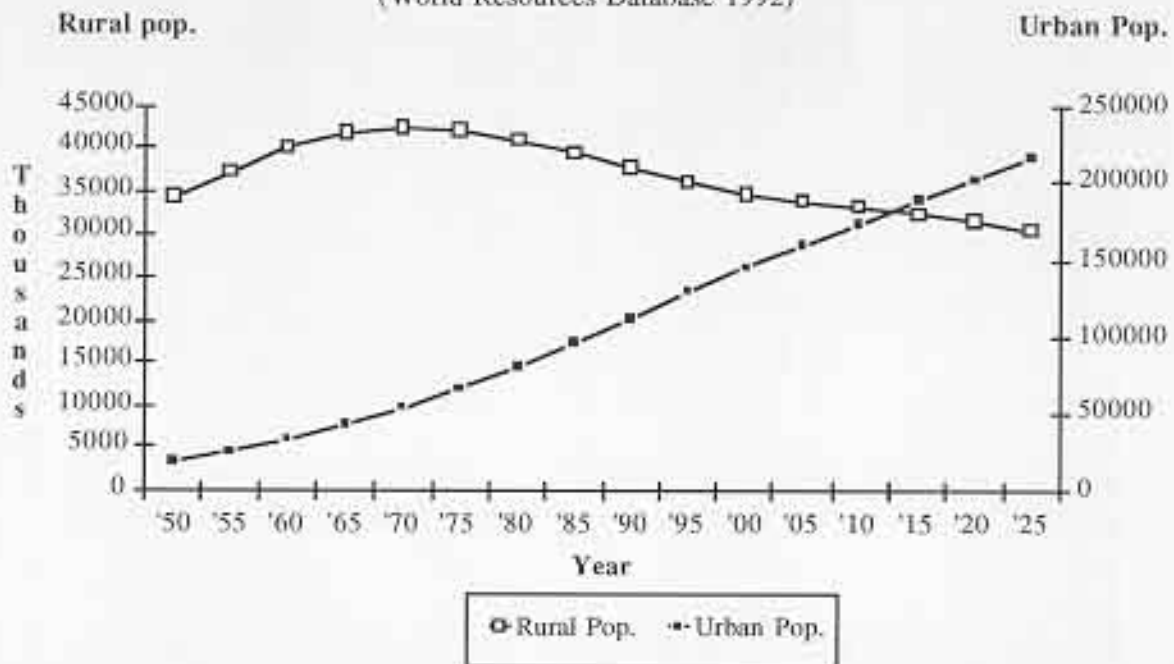
FIGURE 7
Yearly Cattle Increase 1972 - 1990
(World Resources Database 1992)



Even if Brazil continues its cessation of extensive subsidization it will still face the growing problem of land speculation. While land speculation will always be popular in an inflationary environment, it can be reduced and discouraged with proper governmental policies. Changing the tax structure could have a significant and immediate dampening effect.

Subsistence farming in the short-term will continue to be a major concern but should decline in the long-run due to a population shift from rural to urban areas as seen in figure 8. If estimations by

FIGURE 8
 Rural vs. Urban Populations 1950-2025
 (World Resources Database 1992)



the World resources Institute are correct, this should result in decreased farming in forested areas over the next thirty years.

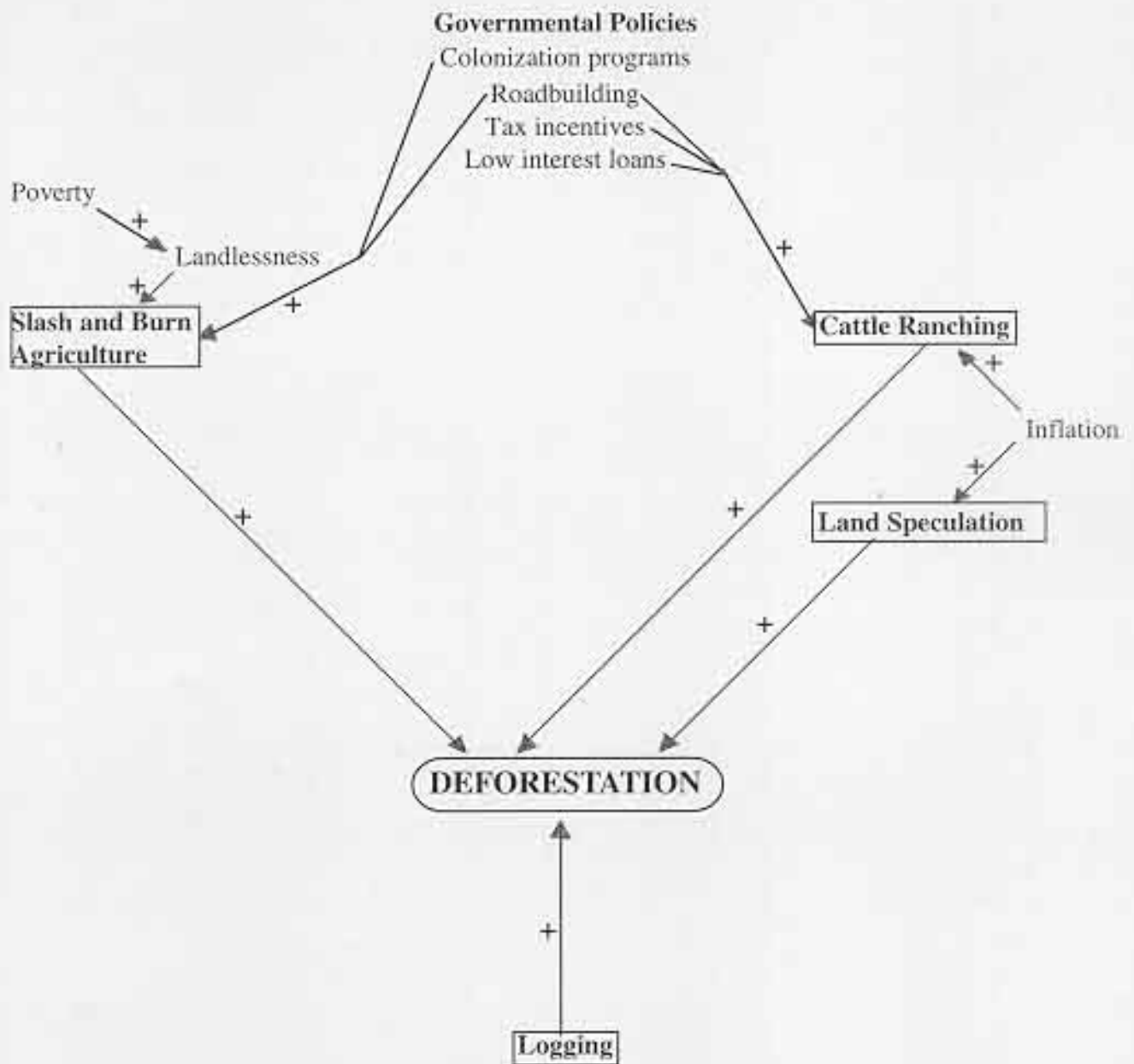
Logging is a sector of increasing importance in Brazil. Undoubtedly, due to limitations in world supply, the Amazon will eventually be under great pressure for timber production. This may cause only a moderate increase in deforestation if appropriate techniques are used to extract only valuable trees. More likely, as in the past, techniques will be quite destructive and as tropical timber becomes scarcer a greater number of species will be deemed economically viable. This could result in a transition that is far more devastating environmentally than the preceding cattle ranching transition. While significant, cattle ranching has until now been responsible for the deforestation of less than 11% of Amazonia.

Logging, unlike cattle ranching, is potentially profitable for both the timber company and the Brazilian government in the short-term. Economic pressures that inherently haunt less developed countries will make logging very appealing and difficult for even a well meaning nation to avoid.

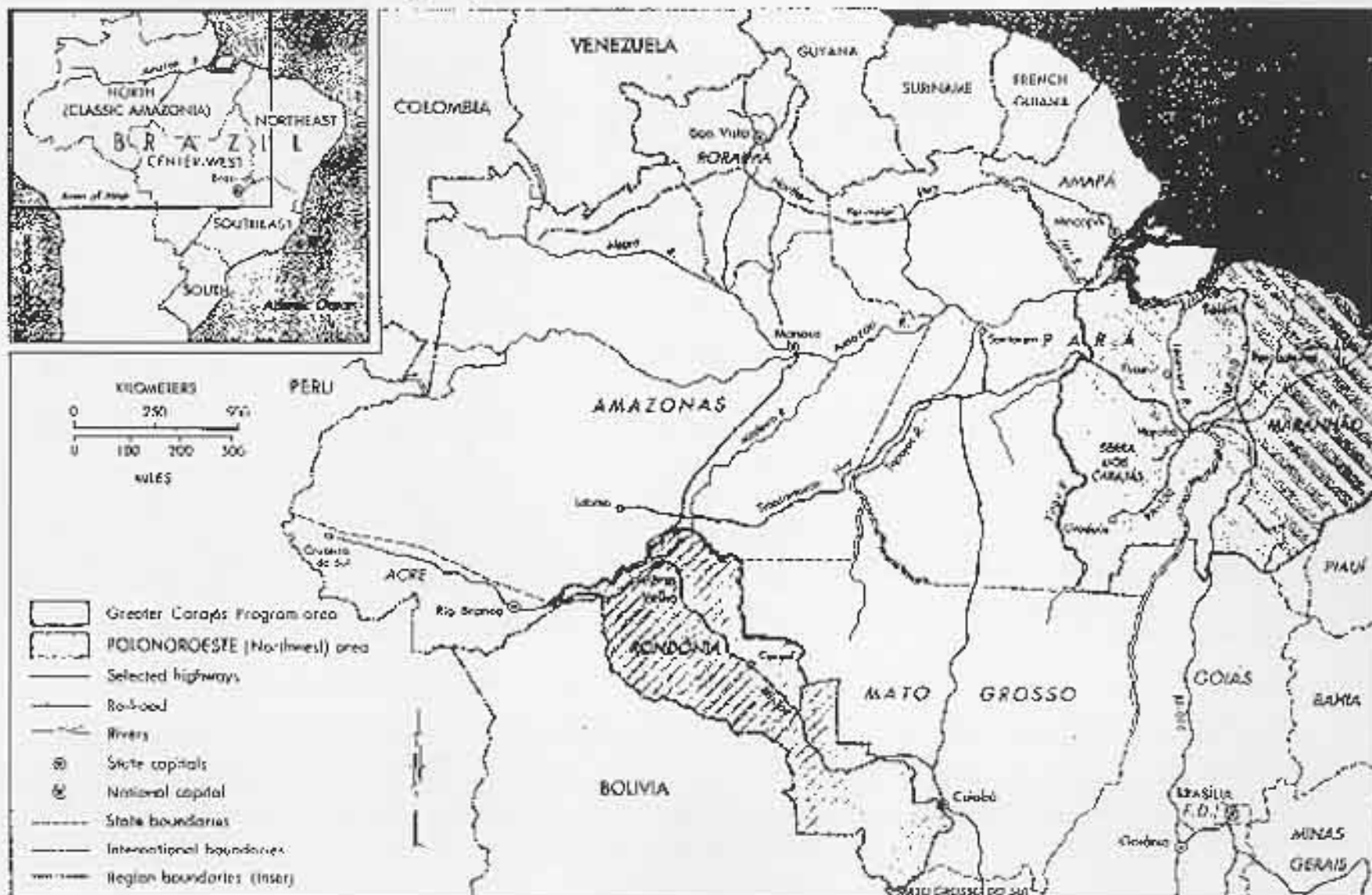
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Major Causes of Deforestation in the Brazilian Amazon



Amazonia: Main Federal Highways



THE TRANSITION FROM A PREDOMINATELY AGRARIAN SOCIETY TO AN INDUSTRIALIZED SOCIETY IN SPAIN

Tamara Carnovsky

Introduction

As is the case with many other countries, Spain today is a modern, industrial, democratic state. However, thirty years ago it was still a traditional, predominately agrarian society. The magnitude and velocity of these changes is what makes Spain unique. In order to understand the transitions of these various sectors and their implications, one has to understand the driving force, the economic revolution. This revolution is deeply rooted in the historical foundations of Spain and has resulted in what has been frequently called the "economic miracle" (Salisbury, Theberge 1976).

Historically, Spain was a country where the land was maldistributed. Until the agrarian reform law of 1932 was passed, approximately 8% of the landowners owned 90% of the land while 92% of the landowners owned 10% of the land (Thuga 1993). Since the land generally served as a symbol of prestige, there was no interest to modernize it in order to stimulate the economy. In addition to the lack of cultivation, there was an absence of a strong, industrialized structure characteristic of developing countries. The societal structure was maintained by a weak interior market, caused by a lack of buying power, and a weak exterior market, due to old industries increasing production costs. Additionally, any capital from foreign exports was not universally distributed. This provoked an increase in prices but not salaries. The inflation that permeated the society resulted in the general strike of 1917. However, the agricultural and industrial revolution was not possible at this time due to an absence of economic reforms which impeded the improvement of social conditions.

Eventually, the orientation of Spain's economic policies shifted drastically beginning in 1953, which led to progressive removal of the extensive isolationist controls that had earlier ruled over Spain's internal and external economic relations. These policies opened the doors for foreign investment and tourism. In 1953, Spain allowed the United States to establish military bases within the country in return for economic, technological, and medical support. With the financial and advisory assistance of the International Monetary Fund (IMF) and the Organization for European Economic Cooperation (OEEC), which was the predecessor of the Organization for Economic Cooperation and Development (OECD), Spain embarked on a stabilization program and a period of development in 1955. The economic growth resulting from Franco's plans of development facilitated further economic liberalization.

In many respects, these plans were criticized because the industrialization process was quite rapid. Thus, there was not sufficient time to obtain realistic objectives. For example, as in other countries, economic development tends to be concentrated in particular areas leaving the rest of the country impoverished and untouched by industrial growth. In Spain as in Italy the north prospered while the south stagnated. Additionally, the urban centers of the periphery drained the surplus population from the impoverished center. These consequences facilitated the need for policy changes on growth and resource mobilization.

This paper describes the complexity of interaction of various sectors of transitions resulting from a society's response to economic stimulation. Additionally, this paper describes society's vulnerability to these sectors and how it can alleviate past problems and make future decisions by reflecting on the historical development of the country.

Transition Theory

In order to study how Spain transformed rather quickly into a modern, industrialized state, I will use transition theory as a guideline. William Drake provides a common framework which he explains population/environmental dynamics as a family of transitions. Within each transition there is a critical period when rates of change are high and societal vulnerability to damage is increased (Drake 1992). Societal vulnerability can be further elevated based on the following factors; timing affects, limited feedback systems and key relationships becoming out of balance. All of these factors influenced Spain's model of development and will be discussed during the analysis of various sectors.

Data and Methodology

The transitions were analyzed at both the national and at times sub national scales. The national data illustrated the general trends. The sub national data examines the capital of Spain, Madrid, the eastern region of Cataluna, the southern region of Andalucia, and the northern region of Asturias. The following map visually illustrates the location of these regions within Spain and provides a clear representation of the country and its boundaries.

Map of Spain

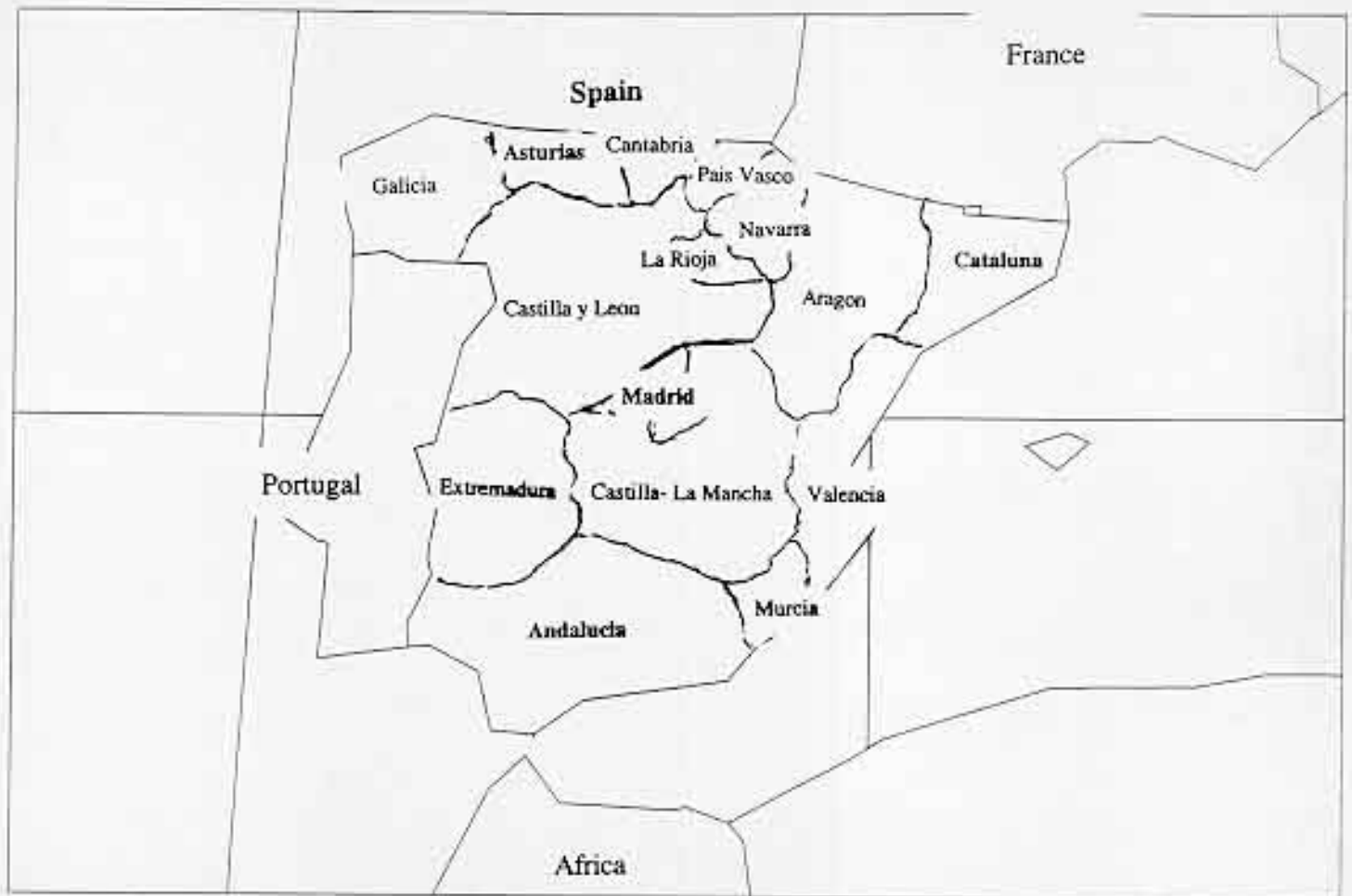


Figure 1

These regions were selected in order to show the imbalance between the industrialized regions, Madrid and Cataluna, compared to the less developed area of Andalucia and Asturias. Additionally, Madrid was selected not only because it is the capital and a rather industrialized area but also as a reference point indicating the historical impact of control it has exerted on the rest of Spain.

Some of the data is from a unit of the Spanish government called El Ministerio del Portavoz del Gobierno. The information was incorporated into a database of economic and social indicators

ranging from 1900-1993. The remaining data was collected from the World Resource Institute's (1992) database and cited literature.

Demographic Transition

This transition measures the increasing and decreasing fluctuations in total population growth over time. In the beginning of this transition, births and deaths are both high accounting for a minimal rate of growth. During the transition, death rates drop dramatically and eventually, after some time, birth rates decline until it is in relative equilibrium with death rates. When birth rates do not decrease with death rates, a population boom occurs. At this time, society's vulnerability to damage is intensified and may be complicated by other transitions occurring simultaneously.

Decreasing death rates usually occur because of better health conditions resulting from an emphasis on technology and education. Additionally, death rates may decrease because of a reduction in political motivated wars and conflicts.

A reduction in birth rates can be demonstrated by a set of mutually shared explanations common to all advanced societies. One interpretation may be due to a sociological change in mentality. For example, as inequality between the sexes narrows, women become more integrated in the workplace devoting less time to raising a family. Another explanation may be due to economic changes within the society. For example, I assume that fertility behavior in response to an economic crisis for an industrialized country is quite different from that in an agrarian country. In an agrarian country, children are viewed as an asset to improving a family's economic situation because there are more hands to help with agricultural production. However, in an industrialized country, there is a higher standard of living and a higher level of education. Therefore, when the incorporation of young adults in the workplace is difficult, there will be fewer marriages and fertility rates will decrease because the costs of raising a family has increased.

In examining Spain's demographic transition, it appears to be in the late stages of its transition. Birth rates have declined to a low of 12.5/000 from a high of 21.5/000 during the baby boom years of 1955-1965. Death rates are rising slightly from a low of 8/000 in 1985 filling in the gap between births and deaths. I would speculate that deaths were extremely high prior to 1939 due to the civil war (World Resource Database 1992). When Franco gained power in 1939, death rates probably decreased sharply from the strong political control of the government. However, death rates probably increased just below the high levels seen during the war days due to isolationist policies obstructing the introduction of outside technology to improve health conditions. Additionally, these policies inhibited economic growth thus, preventing better living conditions and the availability of education. In 1955, birth rates are increasing and death rates are rather low. I would assume that these trends are a direct consequence of the change in economic policies creating a period of development through foreign investment, tourism and industrialization. There

is a significant decrease in birth rates in 1975. This is probably do to the change in society's mentality resulting from the death of Franco in 1975 paving the way to the transition towards democracy.

For example, one apparent change was in the role of women. Until May 1975, married, Spanish women were not able to open a bank account, to apply for a passport, and buy a car or work without permission from their husband. Between 1970 and 1974, open revolutions against the regime existed in hopes of provoking an increase in freedoms. One and one-half million women entered the workplace for the first time and this portion of the population continues to increase. In 1980, 27% of the workers were women while in 1990, this number increase to 33% (Montero 1993).

Additionally, during the latter stages of Franco's regime the economic plan for development enables more people to obtain a higher standard of living. This resulted in the establishment of the middle class. Consequently more families were able to send their children to universities which stimulated a change in mentality concerning social and political freedoms. Additionally, education is available for the newly created middle class formed from the stimulation of the economy (Carr, Fusi 1979).

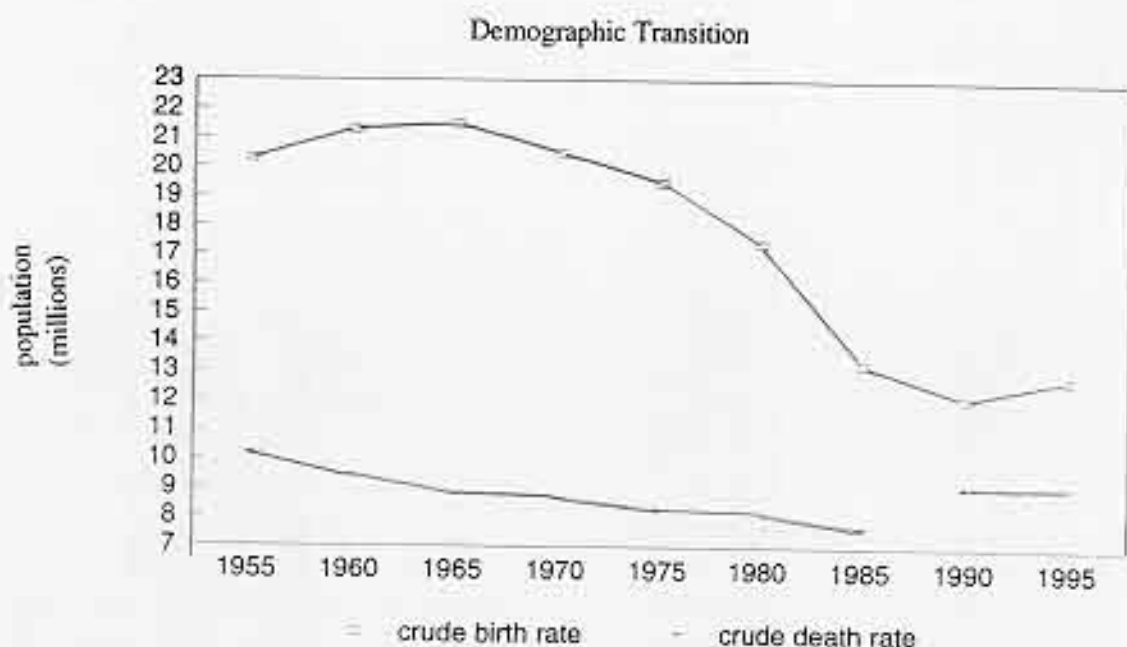


Figure 2

World Resource Institute Database

This table indicates a corresponding increase in education during the years when birth rates decreased significantly. However in order to further illustrate the demographic transition, I will analyze total population, population growth and fertility rates.

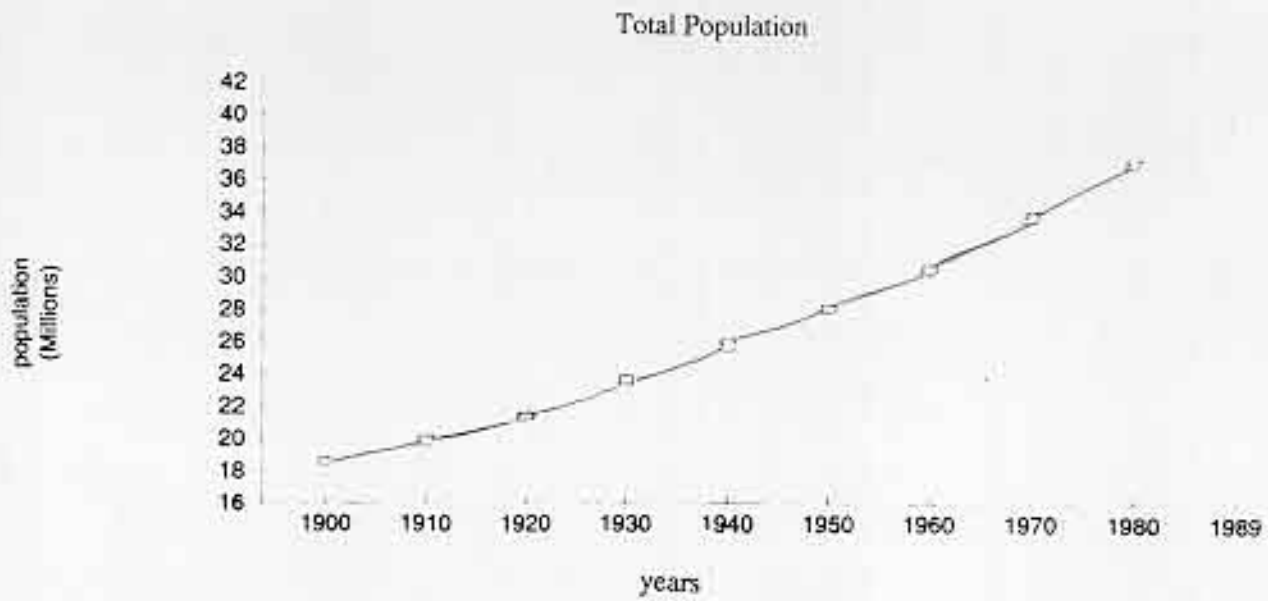


Figure 3
El Ministerio del Portavoz del Gobierno

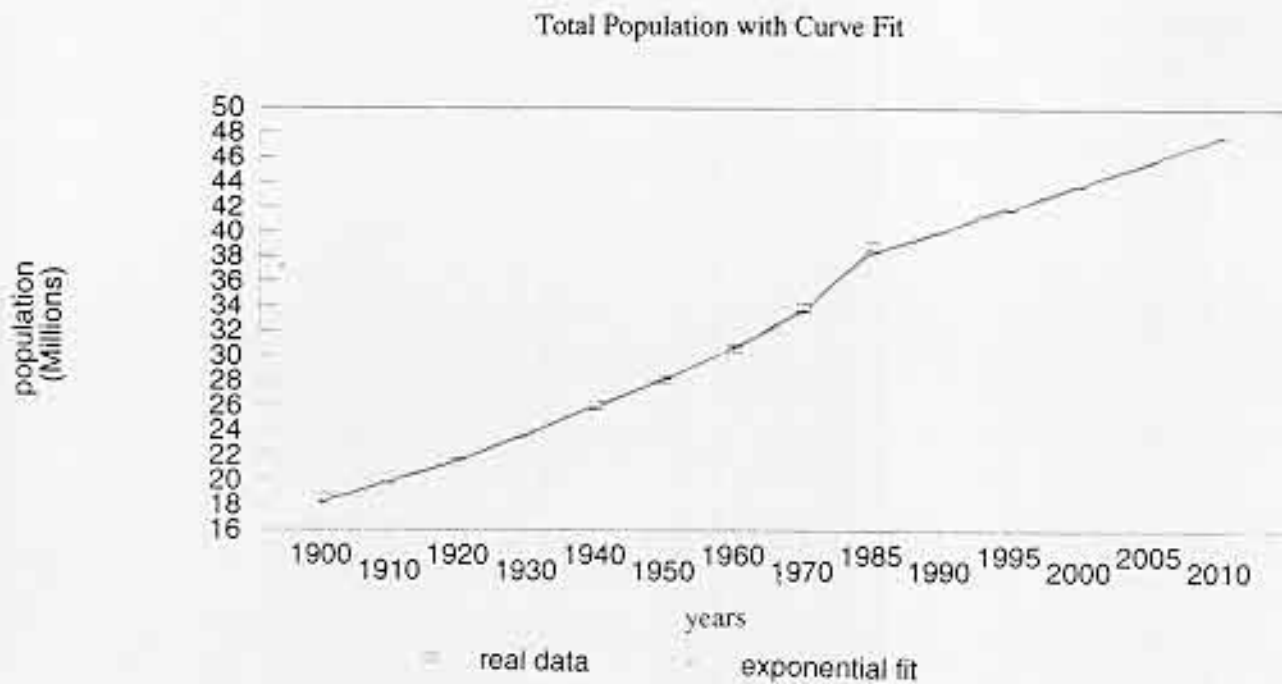


Figure 4
El Ministerio del Portavoz del Gobierno

The population of Spain has risen at an exponential rate and is projected to level off due to the later stage of the demographic transition and the various trends in population growth and fertility.

Fertility Rate

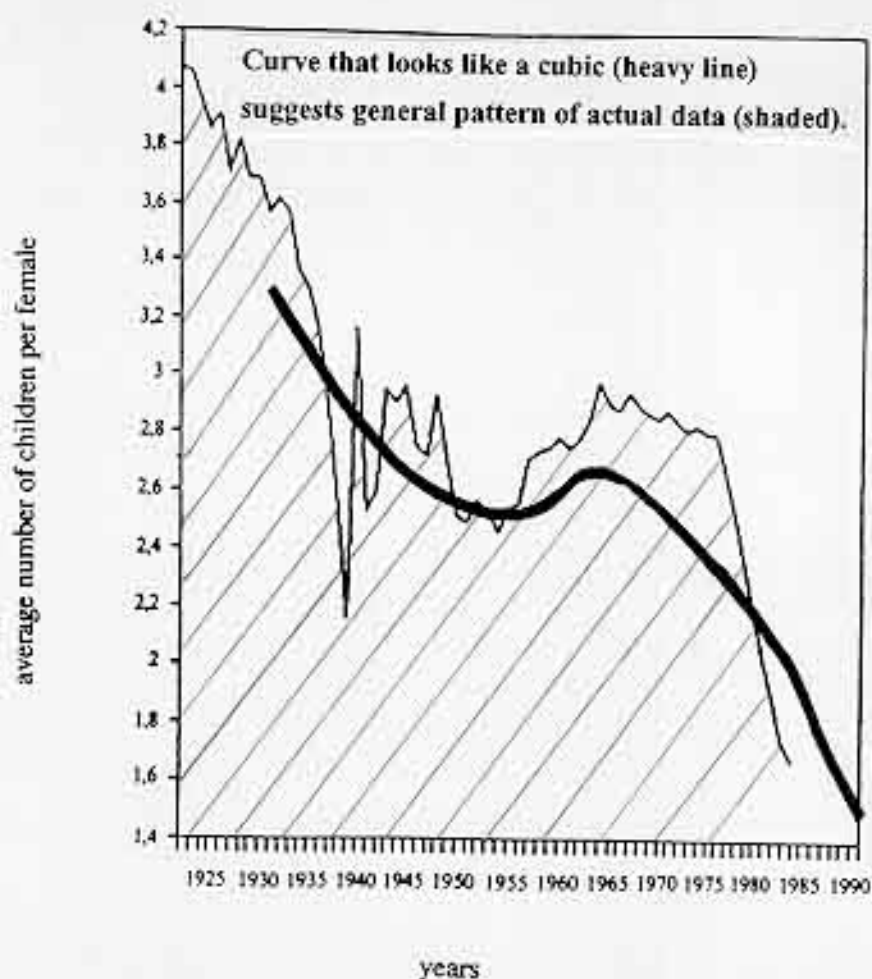


Figure 5
(Cordon 1986)

Fertility rates is another piece of evidence to support the trends in the demographic transition occurring at particular points in time. The fertility rate declines continually, with small oscillations, until it reaches a minimum of 2.16 children per woman in 1939, the year of the civil war. In 1940-1941, the rate recuperates and stabilizes during the 40's at approximately 2.8-2.9 children per woman. In the 50's, the rate declines again until it reaches 2.46 children per woman in 1954. 1955 signifies the beginning of an increasing fertility rate until 1965 when it reaches a maximum of 2.98 children per woman. In 1976, the rate drops to 2.80 and from then on the fertility rate drops dramatically to 1.68 (Antolin 1990). Today, Spanish women of childbearing age now have an average of 1.4 children. One set of evidence to support the decrease in fertility is an analysis of literacy rates.

TABLE 1
Level of literacy between Males and Females
World Resource Institute Database

	Male	Female
1970	93.0	87.0
1990	97.4	93.4

Table 1 indicates a significant increase in female literacy between 1970 and 1990. This increase corresponds to the decrease of fertility rates beginning in 1976. I would speculate that with an increase in literacy more females entered the work force, thus decreasing the amount of time devoted to raising a family. In order to further illustrate the incorporation of women in the work force, I examined the trend of females bearing children in specific age ranges.

TABLE 2
Birth Rate Specified by Age (0/00)
INE, Movimiento natural de la poblacion

	Years		Age Groups				
	15-19	20-24	25-29	30-34	35-39	40-44	45-49
1922	12.2	127.2	234.2	204.1	155.9	66.2	14.7
1932	13.9	130.4	212.2	174.7	128.1	54.5	10.3
1942	10.1	88.1	157.2	131.4	88.9	36.4	8.1
1950	8.3	85.7	155.9	125.2	85.6	33.9	7.0
1955	9.6	91.3	162.6	126.5	80.5	30.9	5.6
1960	9.6	106.1	187.3	139.3	82.6	29.3	3.6
1965	11.4	109.6	193.7	146.2	84.6	30.5	4.3
1970	14.1	121.0	197.2	131.4	76.8	26.0	3.2
1975	21.7	135.4	189.6	122.9	64.7	23.1	2.2
1980	26.6	113.0	144.9	91.5	45.4	14.6	1.4
1982	21.2	96.9	131.9	83.4	40.1	12.3	1.1

This table signifies that not only are Spanish women having less children but also they are younger when they reproduce. Additionally, the largest number of births occurs during a shorter time frame. This data is consistent with the changing mentality permeating Spanish society in the later half of the twentieth century. Spain is rather unique because even though the mentality has changed dramatically within the last thirty years, Spain still adheres to traditional thoughts as illustrated in the following table.

TABLE 3
 Number of Illegitimate Children per 100 Births
 (Campo, Navarro 1987)

Countries	Births
Spain	5/100
Sweden	42/100
Denmark	38.3/100
Austria	21.6/100
France	16/100

The following table exhibits the number of illegitimate births of four European countries compared to Spain in 1982. There is a strong dissociation between marriages and fertility in Spain compared to other European countries. Therefore, a decrease in marriages would also be a good indicator that birth rates were not increasing.

URBANIZATION TRANSITION

The urbanization transition is caused by rural to urban exodus and an increase in central city population growth (Drake 1992). This migration is usually provoked by the availability of employment, educational and health opportunities. All of these factors were present during Spain's period of urbanization. However, what makes Spain distinct from other countries is the rapidity of their urbanization. The rapidity of this rural to urban growth is illustrated in the following figure representing the trends in urban and rural population.

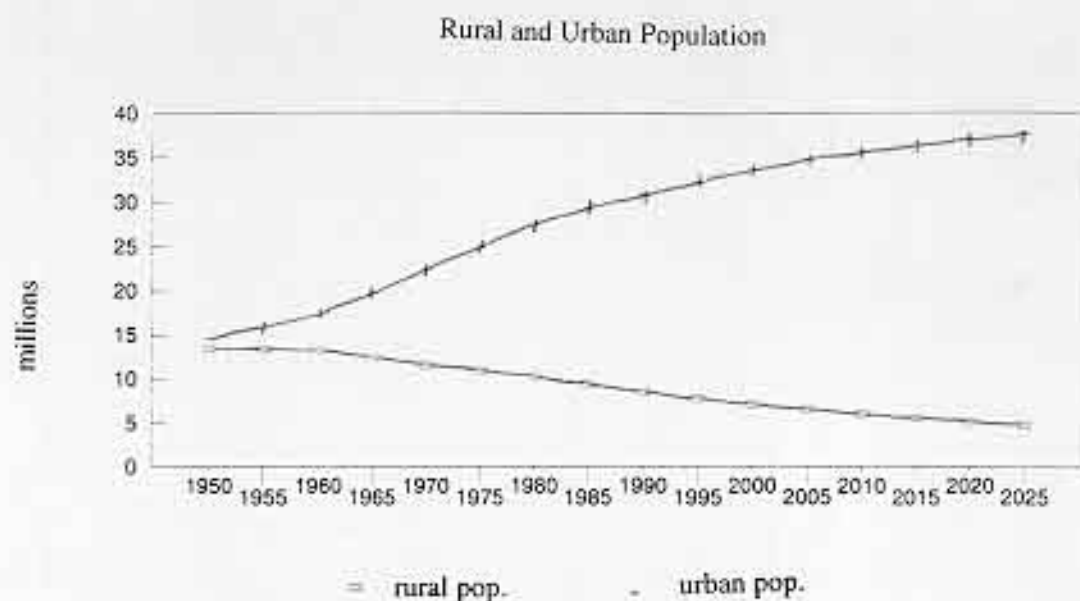


Figure 6

World Resource Institute Database

The influx of rural to urban population began in 1960 occurring simultaneously with the industrial transition. Therefore, in Spain's case the rapid urbanization was a mark of industrial growth. However, urbanization can take place without industrial growth which was common in some areas of Spain during the late nineteenth century. Therefore, the rapid growth of the mid - 1900's tended to strengthen the dominance of particular regions for example Catalonia provinces. However, at the same time Spanish society was more vulnerable due to the rapidity of their urbanization. There was not enough time for sufficient feedback systems which caused a weak approach to urban planning and confusion among competing agencies. Additionally, key relationships were out of balance. For example, the poverty of municipal budgets resulting from a highly centralized system was not in accord with the magnitude and velocity driving urbanization. (Richardson 1980).

INDUSTRIALIZATION TRANSITION

Industrial development in Spain occurred very late, practically in the beginning of the present century. Although, the actual acceleration of industrial development did not occur until more recently, 1950-1975. During 1960-1970, Spain industrial growth was second to Japan among the OECD countries and one of the highest in the developing world (Salisbury, Therberge 1976).

One reason for the lateness in industrialization is due to the shortages in energy sources. Spanish industries exert a 75% dependence on carbon. However, carbon is generally of low quality and difficult to extract. There are three carboniferous zones in Spain; Asturias-Leon zone that produces coal and anthracite, the southern zone, Ciudad Real, Cordoba, Badajoz, and Sevilla, which contains coal deposits, and the Catal-Aragon zone that produces lignite. Spain is almost totally dependent on the importation of hydrocarbons, petroleum and gas.

Another source of energy that is not favorable is hydroelectricity. The lack of rain does not permit the abundant or regular water flowing rivers. Therefore, hydroelectric production is concentrated in three river basins: Mino-Sil, Ebro and Duero.

Nuclear source of energy is dependent on technology in order to minimize the dangerous residues that result. Today, the construction plan to develop central nuclear sites has stopped due to the economic crisis than from the exertion of antinuclear pressure (Unknown 1985).

TABLE 4
Evolution of Energy Consumption in Spain
Ministerio de Industria (1900-1978), Anuario El Pais (1978)

Year	Carbon	Hydroelectric	Nuclear	Petroleum	Natural Gas	Total
1900	96.0%	---	---	---	---	---
1950	74.0%	18.0%	---	9.0%	---	17.400
1960	47.0%	25.0%	---	28.0%	---	28.600
1970	22.0%	15.0%	0.5%	62.0%	0.3%	63.179
1980	19.0%	10.0%	1.5%	67.0%	2.7%	101.303
1985	25.6%	9.9%	8.3%	53.2%	3.0%	87.988

As Spain reduced its consumption of carbon and hydroelectric sources of energy, it needed to find other sources of energy particularly the import of petroleum. From an environmental perspective, it is quite impressive to observe such a large reduction of carbon as a energy source but on the other hand it is not economically beneficial to see a marked dependence on foreign imports.

Spanish industry is concentrated in only four autonomous regions: Pais Vasco, Cataluna, Madrid, and Valencia. These regions contain the largest part of the dominant industries; iron, steel, metallurgic, textile, and chemical industries.

The industrial localization has produced severe imbalances. The period of development (1960-1970) generated a massive amount of emigration from the rural areas, particularly from the interior

regions of Spain. Because, the industrialization process was compounded with urbanization, there was insufficient time to design a suitable plan. Therefore, many industries were constructed in inappropriate areas, degrading and contaminating the environment.

In order to illustrate these industrial imbalances, I analyzed the active industrial population in four regions of Spain; Andalusia, Asturias, Catalonia, and Madrid.

Active Industrial Population

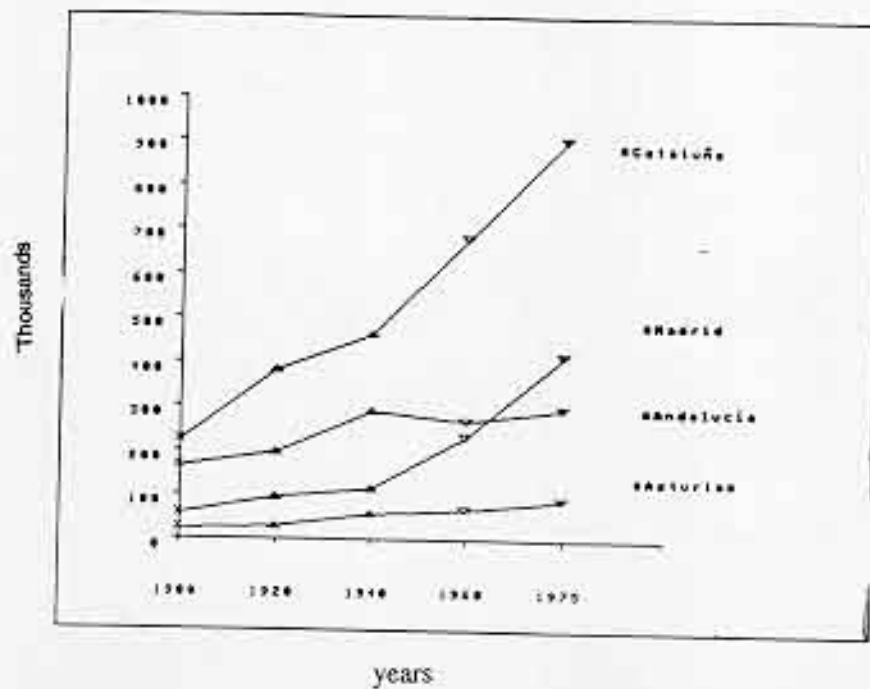


Figure 7

El Ministerio del Portavoz del Gobierno

This figure indicates a dramatic increase in the active industrial population in the regions of Catalonia and Madrid, two of the most prosperous regions in Spain. However, the active industrial population in Andalusia decreases and then stabilizes while in Asturias it remained relatively the same. This data does not represent the disparities within the region itself which is quite significant. The majority of the

industry is concentrated in the capital cities of the regions and not the surrounding provinces.

Today the Spanish government has declared some of these areas zones of urgent

There was a significant rise in cancer related deaths since 1950 in Andalucia and Cataluna. This upward trend of deaths in Cataluna mirrors the increase active industrial population in this region, the number one industrial area in Spain today.

In Andalucia, the rates increase substantially too. However, its active industrial population appears to decrease and then stabilize. I would speculate that this is due to the extensive migration of workers from Andalucia to Cataluna in the 1960's. A possible reason for the continual increase in cancer rates may be the result of the 1964-1972 industrial pole strategy as a means of revitalizing impoverished regions. Government incentives were granted to approved developments, many of them concentrated in southern provinces. This strategy ended in 1972 based on the belief that the proliferation of industrial development poles were undesirable and would increase the possibility of wasting scarce resources (Salisbury, Theberge 1976). Therefore, I would speculate that these industrial developments were constructed in a haphazard way contributing to contamination levels.

Cancer rates were less in Madrid and Asturias. I believe this is due to the fact that Madrid is the number one service sector in Spain and Asturias is a relatively underdeveloped region.

Conclusion

It is certain that Spain has changed more in the last thirty years than in the last century. Today, I would conclude that Spain is in the later stages of its demographic transition and development. Therefore, environmental degradation depends on political pressure from citizens groups and the accumulated wealth available to the society (Drake 1993). An environmentalist lobby is growing in Spain to restrain urbanization of the rural areas surrounding large cities. This is a consequence of the middle class to escape the densely polluted cities.

However, it is difficult to improve Spain's deteriorating environment. I would speculate that one reason is due to competition among autonomous regions. This type of competition has been established since the industrial acceleration (1960-1970) which has created severe economic disparities throughout Spain. Thus, the question that arises is who will invest the initial capital to expand the small industries that predominate the market and to improve technology? This is compounded by the fact that unemployment is the number one problem in the minds of Spaniards and that the society as a whole is aging. Therefore, I would hypothesize that even with political pressure and accumulated wealth in some areas environmental degradation may not improve.

However, on the other hand this hypothesis may not be completely accurate. One reason is due to Spain's fairly recent institutional change in 1975 from a dictatorship to a socialist democracy. After analyzing the short time to adopt to this dramatic societal change, Spain may only be on the verge of instituting policies that are consistent with the new ideology.

re industrialization in order to modernize the most deficient industrial sectors. These zones include Asturias, Barcelona, capital city of Cataluna, and Cadiz, province of Andalucia. According to the figure, I would assume that the phrase deficient industrial sectors may have a few meanings depending on its application. For example, when analyzing the region, Asturias, the deficient industrial sector would correspond to the underdeveloped area. However, when analyzing the provinces, Barcelona and Cadiz, the phrase deficient industrial sector would signify the inefficient technology used by the numerous industries.

Some areas for example, Bilbao, province of Madrid, Huelva, province of Andalucia, have been designated "black points" which refers to areas of adverse climate conditions that has been intensified by a high level of industrial contamination and population density (unknown 1985).

Consequently, there is a direct correlation between industrial contamination and cancer related deaths. Up to 20% of the total cases of cancer are related to the workplace according to various studies from several international agencies for example, The International Center for Investigations Against Cancer. Therefore, more than 12,000 cancer related deaths this year will be from carcinogenic substances in the workplace. Unfortunately, more than half of the workers do not know the possible effects of these substances to their health and almost two-thirds do not have information about preventive measures they should adopt in the workplace (Instituto Sindical De Estudios 1989). The following figure illustrates the increase in cancer related deaths in 1950.

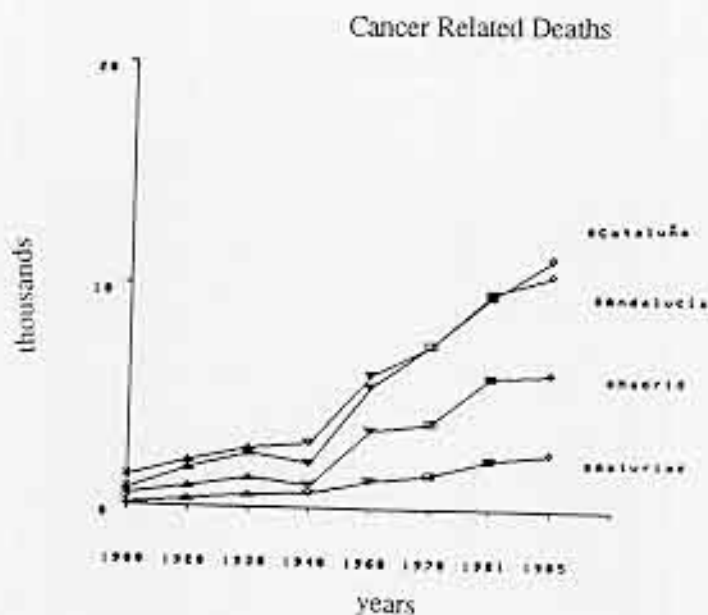


Figure 8

El Ministerio del Portavoz del Gobierno

Therefore, I believe that Spain is facing one of the most critical periods in their society in terms of policy implications and changes. It is at a point in time when it needs to reverse the natural course of industrialization in order to lesson economic stagnation and environmental deterioration. This course has created relatively high per capita incomes but serious pollution problems in some regions while low per capita incomes dependent on agriculture in other regions (Salisbury, Theberge 1976). The political decisions during Franco's era has established a precedent for policy development geared at short term returns.

For example, regional disparities and the maldistribution of land was an effect of Franco's era. Therefore, today Spain has more people per km in relation to their economic resources resulting in a high density of 76.4 people per km (unknown 1985). I would speculate that there would be a shortage of appropriate and affordable housing causing economic and social implications for public policy. This is due to the traditional Spanish economic policy that has focused on maximizing per capita income while enforcing severe constraints on low tax. Therefore, public policy favored productive investment as opposed to infrastructure investment (Richardson 1975). One illustration of the lack of infrastructure development focusing on the availability of housing in relation to total population is exhibited in the following figures.

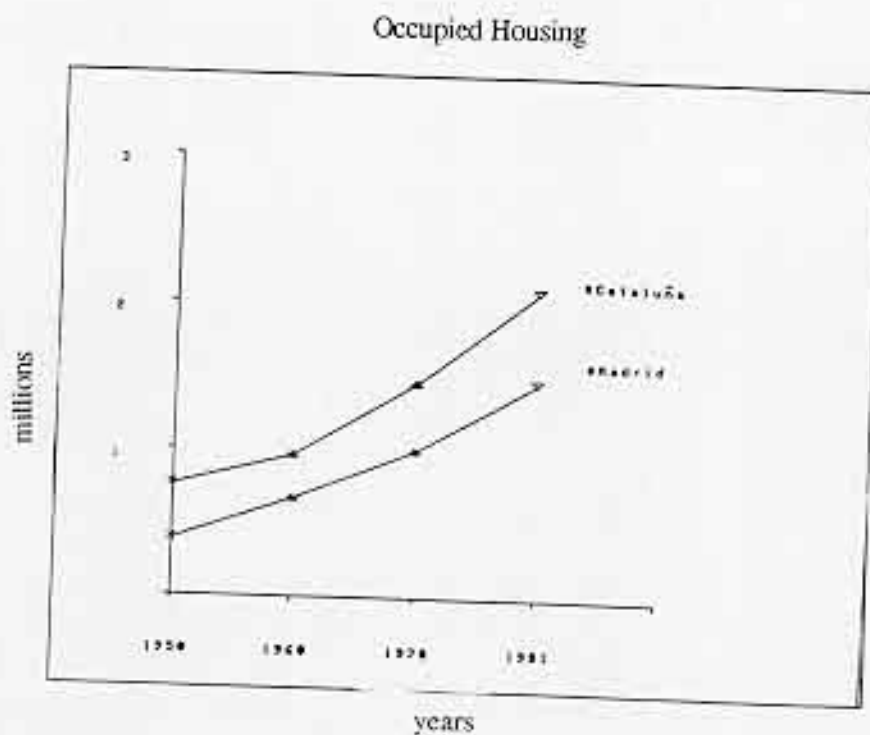


Figure 9

El Ministerio del Portavoz del Gobierno

This figure indicates the increase in housing development of two of the most urbanized regions of Spain, Madrid and Cataluna. The reported data begins in 1950 and extends to 1981. In 1950 and 1960 housing development rises minimally. I would speculate that this is not only due to the lack of emphasis on infrastructure development but also to the limited feedback systems that occurred during this time of rapid change. In 1950, Spain began to reduce its isolationist policies, thus receiving international recognition. In 1960, Spain began its industrial acceleration and rural to urban migration. The simultaneous occurrence of these transitions established a rather vulnerable society in terms of focusing on social services. From 1970 through 1980, there is a greater increase in housing availability. I would speculate that this increase is due to the fall of Franco in 1975 resulting in the establishment of a socialist democracy. I would predict that there is a greater emphasis on the availability of social services after 1980. This re-emphasis is due to a greater period of elapsed time from the height of the rapid transitions occurring in Spain, allowing society to better adapt to institutional changes and government to effectively use its resources in terms of implementing sound regional planning.

Total Population

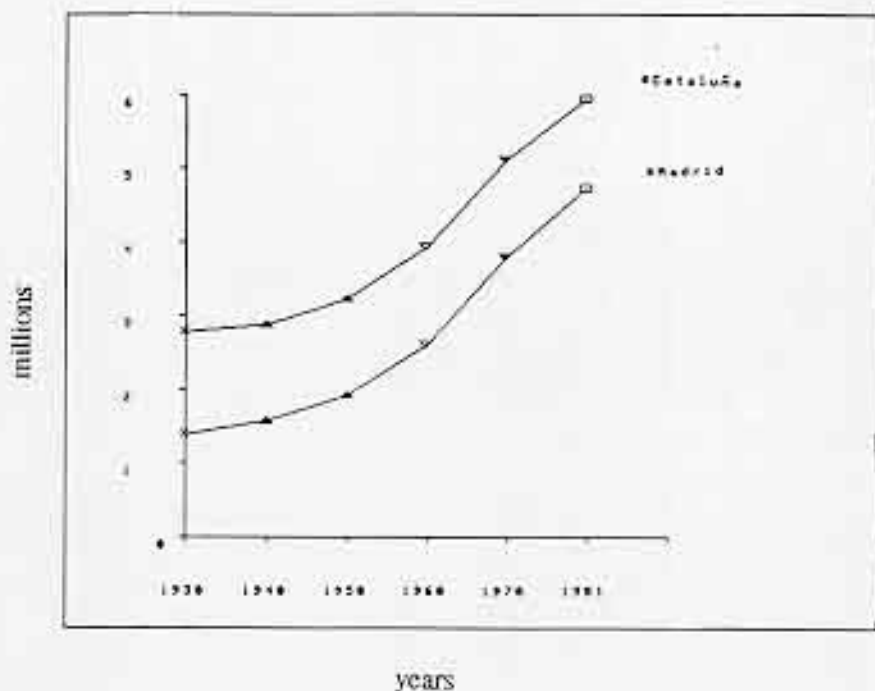


Figure 10

El Ministerio del Portavoz del Gobierno

This figure illustrates the increase in total population in Catalonia and Madrid from 1930 to 1989 in order to draw a correlation between population growth and housing availability. Overall, housing availability increases slowly compared to the increase in total population where the population more than doubles in Catalonia and almost doubles in Madrid between 1950 and 1981.

In order to alleviate past problems of land use, governmental policies should continue to encourage the present trend towards regional diffusion. This trend may be facilitated through educational policies, focusing on the decentralization of professional and scientific training, and urban policies promoting the supply of private land outside current metropolitan boundaries to favor intra-regional decentralization (Richardson 1975).

Another concern in Spain is the continuously declining birthrate which is presently at a low of 1.4 children per woman. The low birthrate may have negative, economic policy implications. Demographers state that in order to maintain a country's population, a birthrate of at least 1.8 children per woman is needed (Emilio, 1993). Therefore, the declining population of workers may not support the aging society of Spain. Consequently, there will be a reduction in social security promoting negative, economic policy implications.

The rapidity in which the industrial sector has developed creates present policy implications. There exists a lack of communication between employer and employee and inefficient technology in industry encouraging the need for policy changes. In order to propose effective legislation to combat these problems, the government needs to make educational, rural development, and environmental policies compatible with the national goals. Once this is accomplished, further policies will be formed. An applied example that incorporates all three policies would be a plan to train professionals to conduct mandatory environmental impact statements assessing industrial production methods and resulting emissions. This plan would force industry to be accountable to the public for the substances they emit into the environment in order to ensure health and safety among workers and facilitate innovative changes in technology.

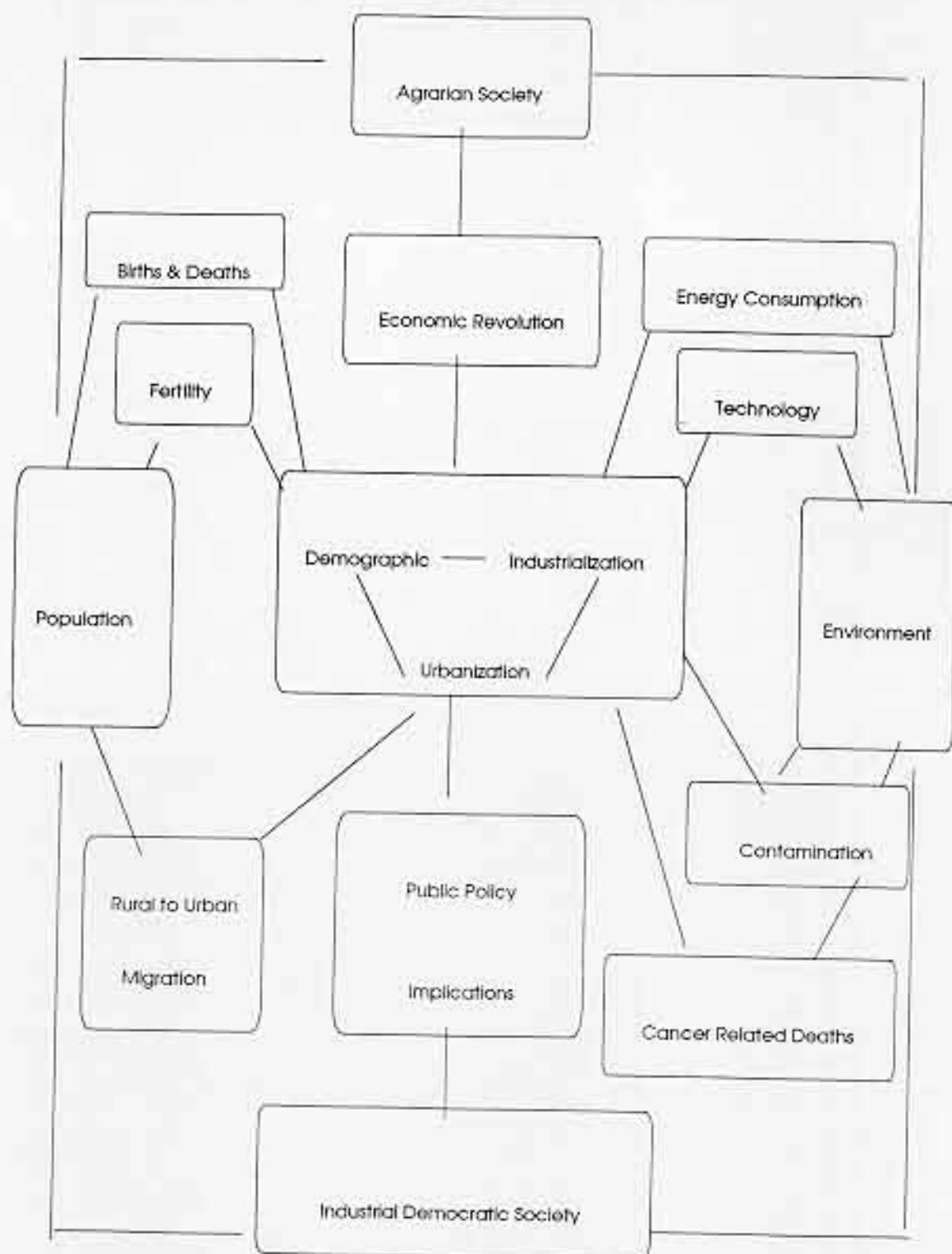
Overall, I feel Spain faces a difficult challenge. However, with the change in societal mentality facilitated by a change in government and the need to compete with other European countries it is possible that the last thirty years of tremendous, societal change will continue to flourish but at a rate consistent with adequate feedback systems.

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**SCHEMATIC MODEL
 SPAIN'S TRANSITION FROM AN AGRARIAN SOCIETY TO AN INDUSTRIALIZED
 SOCIETY : IMPLICATIONS FOR POPULATION/ ENVIRONMENTAL DYNAMICS**



TAIWAN: NATIONAL DEVELOPMENT AND LAND USE

by John Castañon

Introduction.

During the past few decades, the Republic of China (or Taiwan) has evolved economically from a poor, underdeveloped nation to a prosperous nation that successfully made the leap from an agricultural society to an industrial society. A closer look at Taiwan will illustrate the island's unique characteristics as well as the spatial restrictions and historical context that made its development so successful. The intent of this paper is to examine the Taiwanese model of development to 1992, review the brief history of the island since the late 19th century, survey the physical characteristics of the island, examine changes in the population growth rate and composition of the economy, analyze the population-environment dynamics facing the island, and to project the direction of future development the Taiwanese leadership may be advised to take during the next two decades (Figure 1).

In the past fifty years, the Taiwanese government has undertaken several national development plans, in combination with aggressive agricultural and industrial policy measures to accelerate the rate of development on the island. The development effort has taken place under conditions unique to the island itself. In the context of the physical characteristics of the island, the island has one of the highest population to arable land ratios in the world. Over 20 million people live on an island of only 13,900 sq. miles, with three-fourths of the land comprised of rugged mountains. The population density of Taiwan is double that of Japan and more than five times that of China (Copper 1990). Due to most of the population living in the lowlands of the north and along the west coast, the population density to arable land is extremely high. Therefore, the proper use of flat and low mountain land is of prime importance for Taiwan's continued progress along its development path. High environmental costs have accompanied the march to industrialization, along with rural to urban migration, and transportation congestion. These and

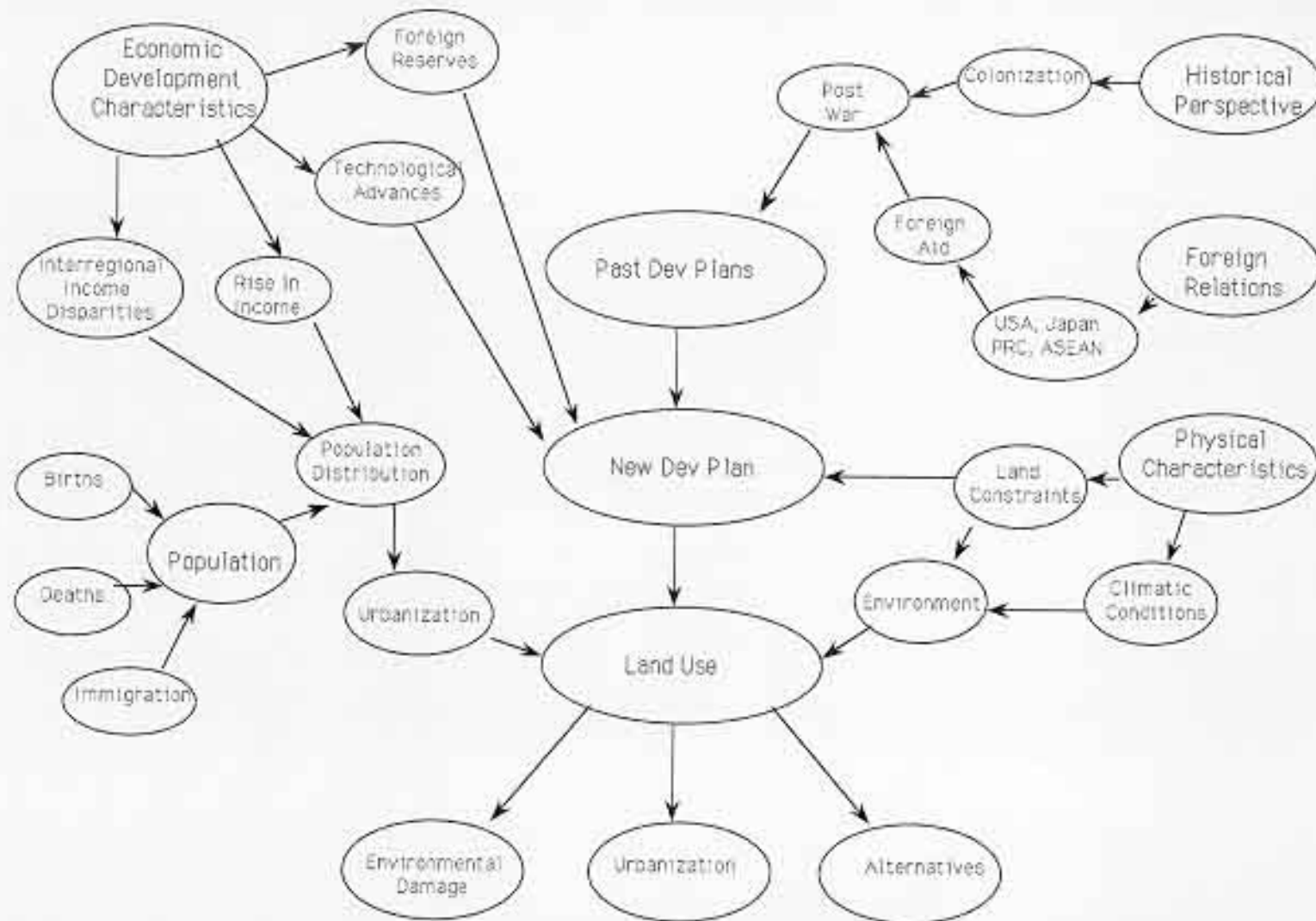


Figure 1: Taiwan National Development Planning and Land Use.

additional land use issues will play an increasingly important role in the future development and economic prosperity of Taiwan.

Physical Characteristics.

The island of Taiwan (Figures 2,3,4) is approximately 250 miles in length and 80 miles wide at its center (Copper 1990). In Taiwan, there are over fifty mountain peaks with elevations in excess of 10,000 feet, 23 percent of the land are plains, 12 percent are low hills, with steep mountains making up the rest (Fuchs and Street 1980). The mountains traverse Taiwan from north to south and are the point of origin for the island's rivers. The longest river is only 114 miles long, and flood control, until recently, was not an issue except during typhoons. Farmers do not depend on the rivers to any large extent for irrigation, and river transport plays a very small role in the island's transportation system (Copper 1990). Rainfall is year-round and the mean annual precipitation is 102 inches, virtually eliminating the risk of drought faced by farmers in many other nations. The climate of Taiwan is subtropical, but varies due to the high mountain elevations. The soil of the plains are rich, alluvial, in contrast to the soil at higher elevations that are acidic, leached and subject to erosion caused by forest timber harvesting. Taiwan imports over 90 percent of its mineral and energy resources, due to the relative lack of natural endowments.

Population.

Taiwan has experienced dramatic changes in its population dynamics, as rapid growth has been eased by substantially lower birth rates. In 1940, the population of the island was 5.8 million, but quickly grew to 10 million by 1960 due to immigration from China following the communist takeover of the mainland in 1949 (Copper 1990). Prior to this time, Taiwan was not considered a highly populated nation. The population continued to grow because of the high birth rate, decreasing death rates and an increase in life expectancy. The government promoted a birth control program in 1971, when the crude birth rate was 25.64 per thousand. In 1991, the crude birth rate was 15.71 per thousand, a large drop from the 1971 rate and far below the 1962 rate of 37.37 births per thousand (Chart 1). The annual rate of population growth in Taiwan dropped from 3.25 percent in 1962 to 1.00 percent in 1991 (Chart 2). At a growth rate of one percent per year, the doubling time of the population is approximately 70 years (Meadows, Meadows, and Randers 1992). The total population of Taiwan increased from 11.51 million in 1962 to 20.55 million in 1991, and population density per square kilometer increased from 320.1 to 571.0 during the same period (Chart 3). A spatial projection of the population densities on Taiwan is provided in Figure 5.



Figure 2: South and East Asia



Figure 3

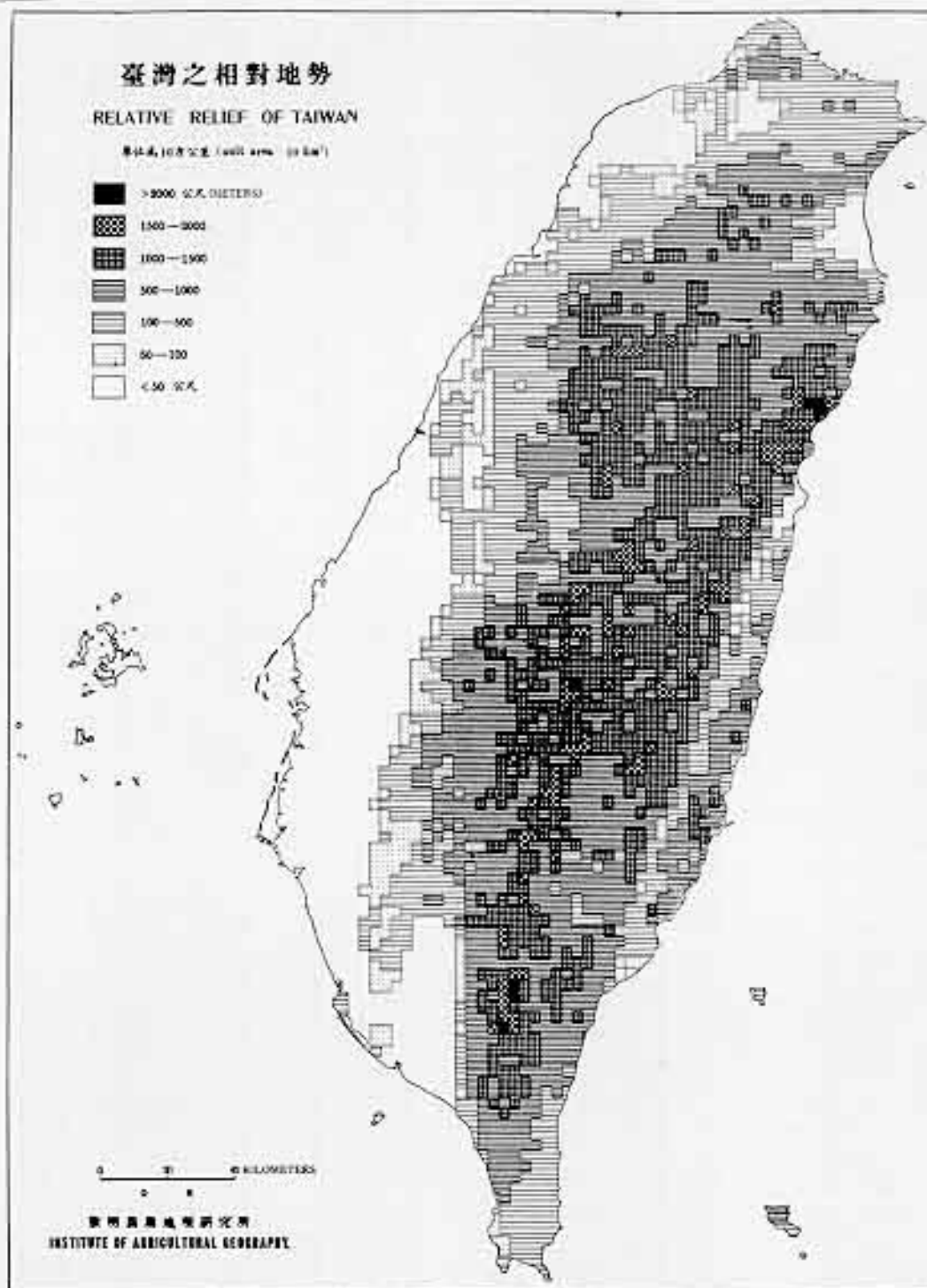


Figure 4

Chart 1: Crude Birth and Death Rates

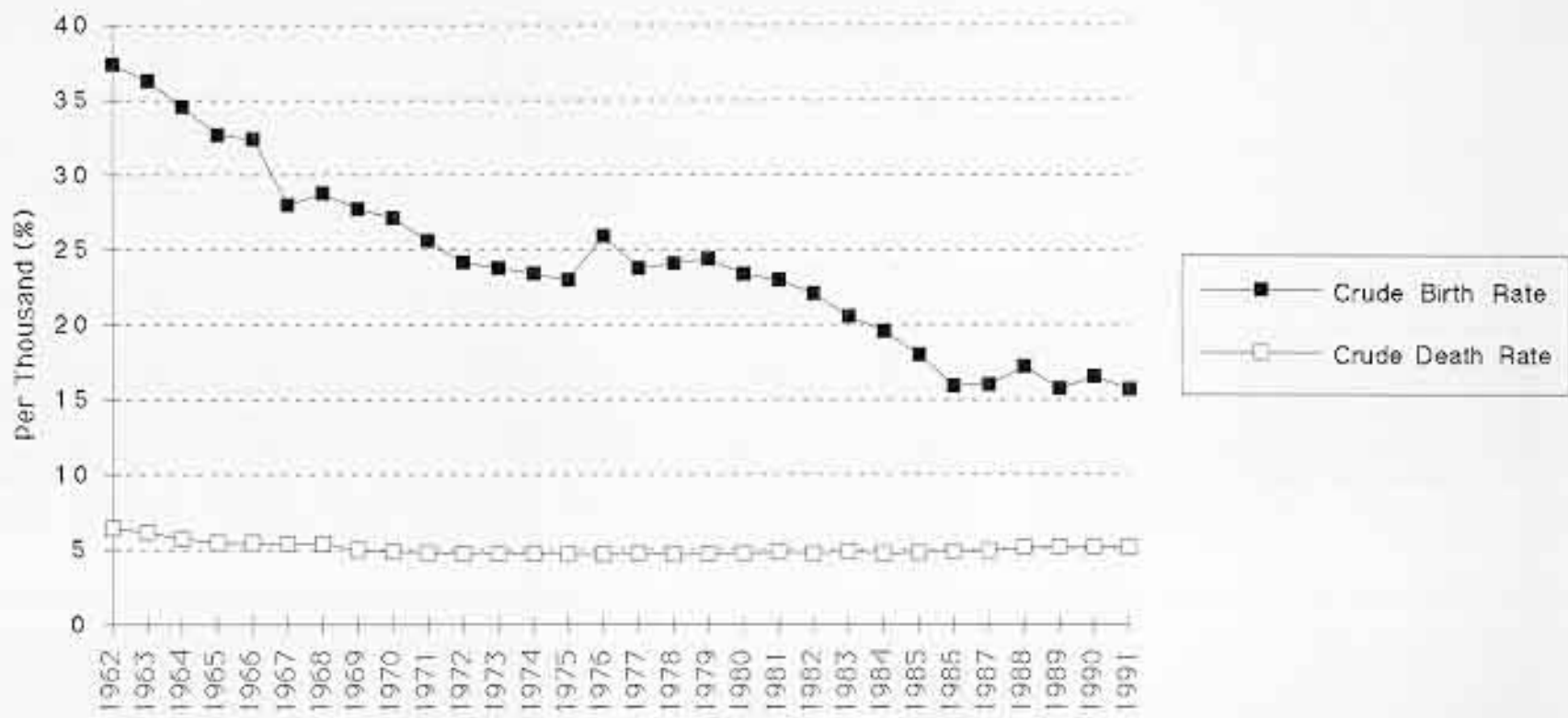


Chart 2: Annual Rate of Population Increase

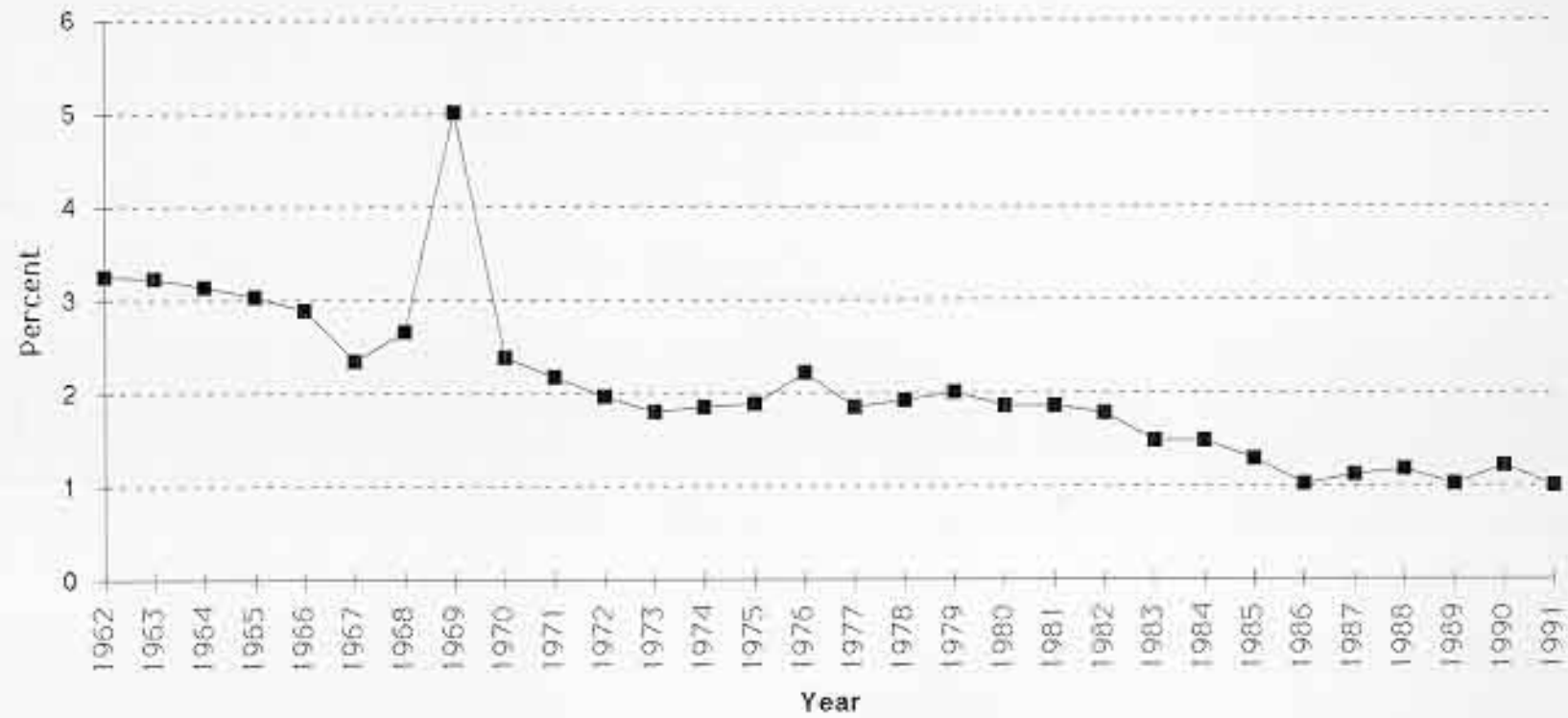
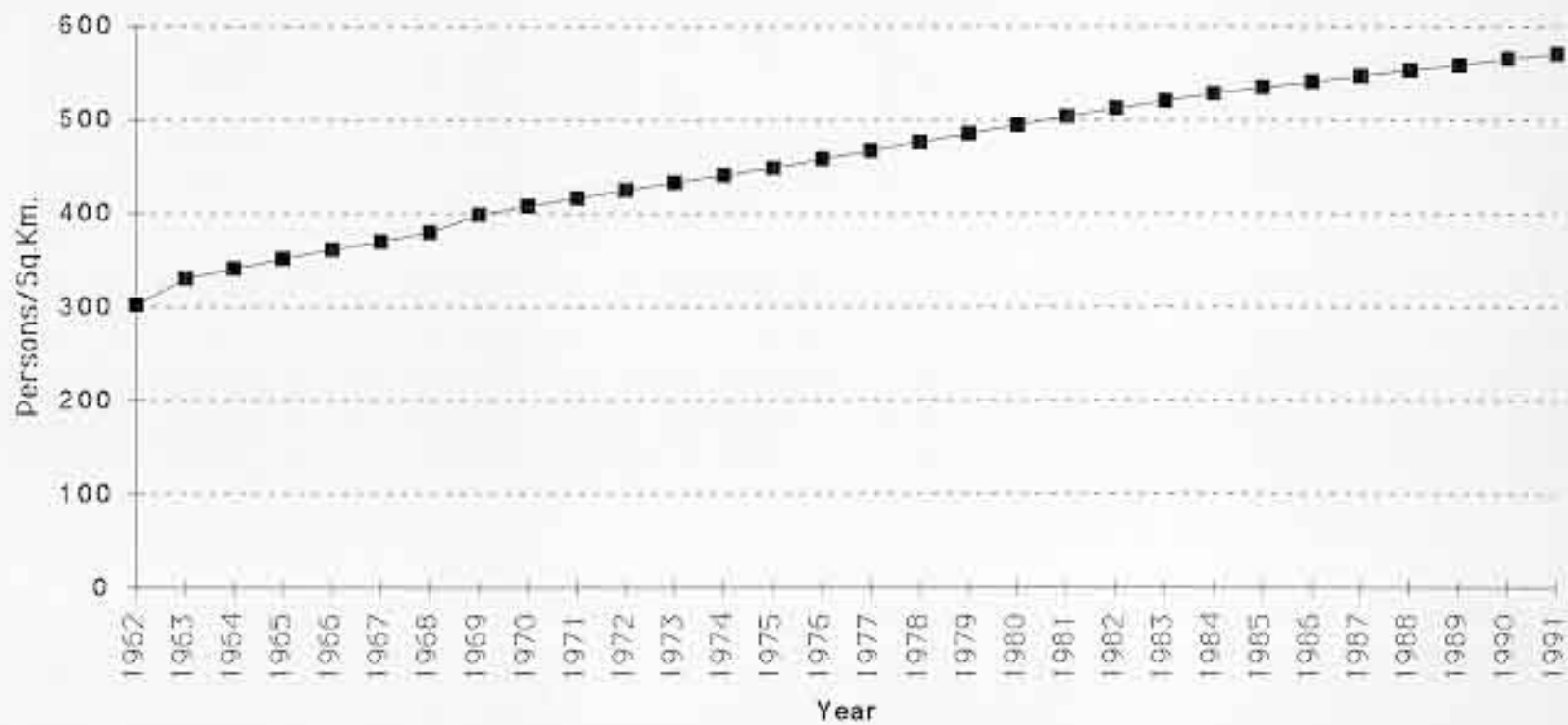


Chart 3: Density of Population per Square Kilometer



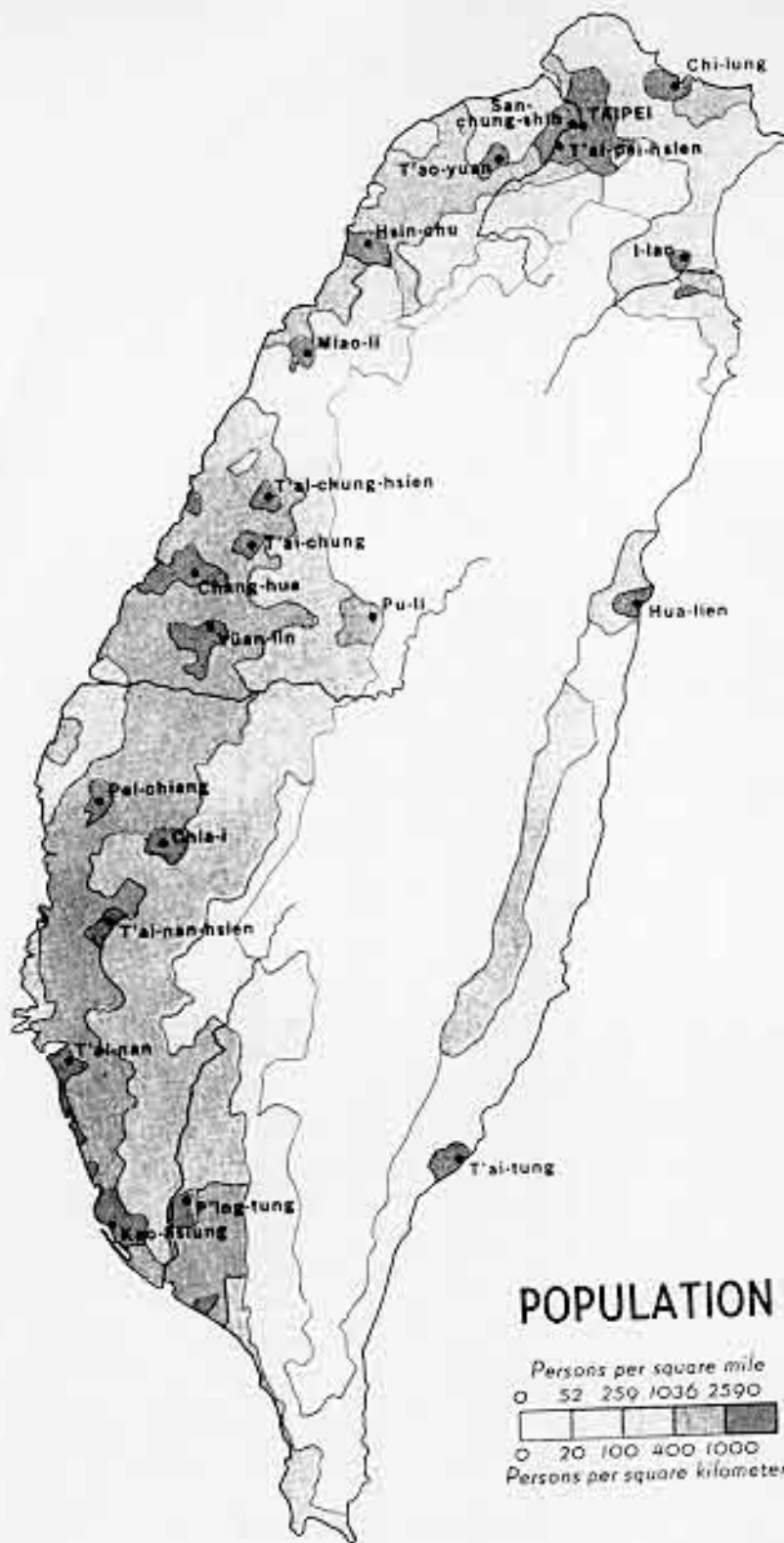


Figure 5

All of the major cities of Taiwan experienced rapid growth in population during the years 1962 to 1991. Many of the largest cities doubled or tripled in size during the thirty year period. A few large cities grew only a very small percentage during those years. As a whole, the total Taiwanese population living in cities of 100,000 persons or more increased from 29.6 percent in 1962 to 55.5 percent in 1991 (Chart 4). At the same time, towns with more than 20,000 but less than 100,000 persons experienced growth until the early 1970s and then slowly declined all the way to 1991. These towns were home to 36.4 percent of the total population in 1962, rose to 52.5 percent in 1973, and then declined to 38.6 percent in 1991 (Directorate General of Budget, Accounting and Statistics).

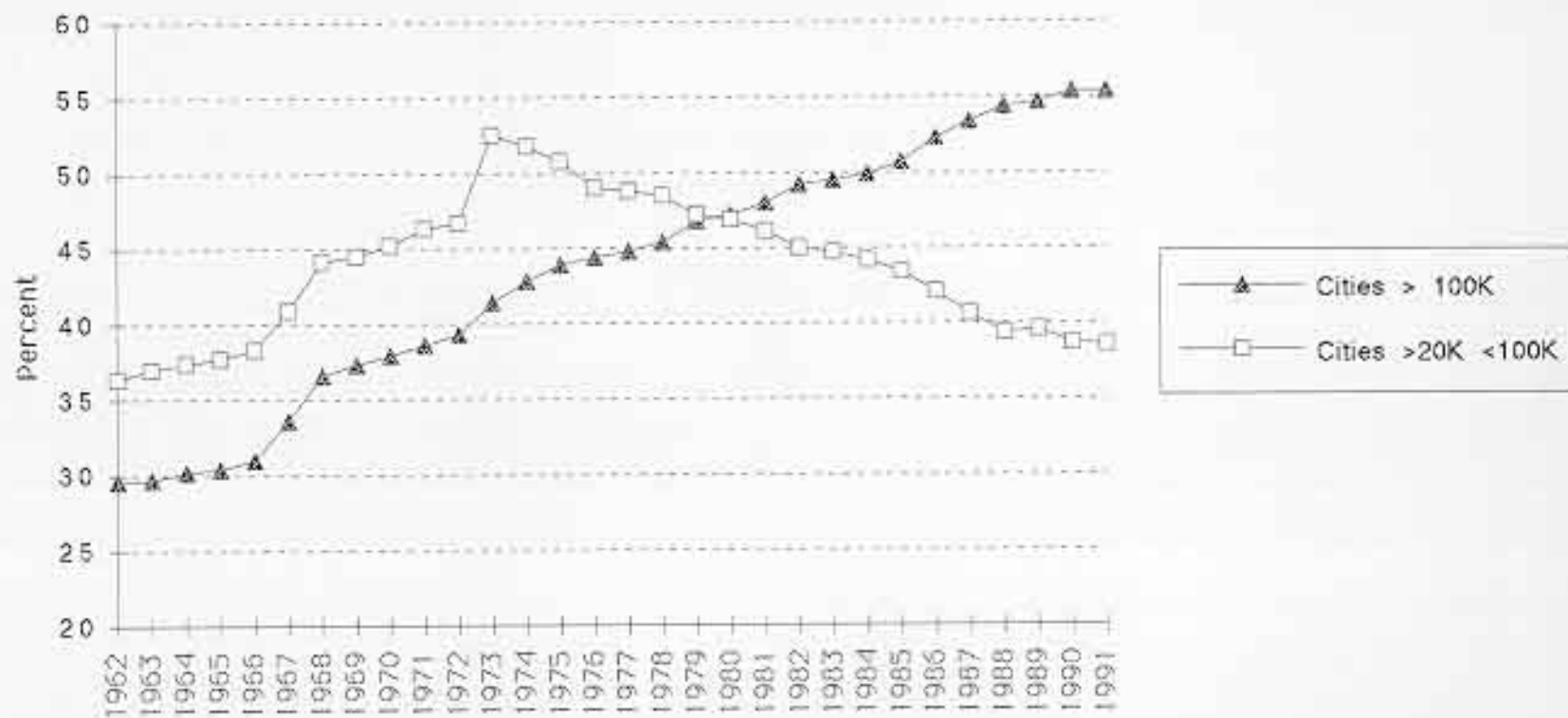
Historical Perspective and Development.

For the purposes of this paper, the review of historical events focus on the Japanese colonization of Taiwan, World War II, and post-war economic development strategy. In 1886, the Chinese government in Peking (Beijing) made Taiwan a colony. In less than nine years, China and Japan went to war, a war Japan won. China ceded Taiwan to Japan and the era of Japanese colonization of Taiwan had begun. Japan ended Chinese migration to Taiwan, but did not populate the island with large numbers of Japanese citizens. The total population on the island grew only by natural increases. The small number of Japanese who did move to Taiwan were farmers, military personnel, government and business officials.

Japan's first priority was to increase the productivity of Taiwan's agricultural sector. Rice and sugar became the two largest crops on the island. By the 1930s, agricultural output of rice and sugar exceeded total consumption on the island by roughly 100 percent for each crop and Taiwan became know as a breadbasket (Copper 1990).

The economic development of Taiwan was, in large part, initiated by the Japanese colonists. Economic infrastructure in the form of roads, hydroelectric generators, harbors, railroads, and communications quickly appeared on the scene. Before 1895, Taiwan had 30 miles of railroad; by 1905 it had 300 miles, and another 700 miles were either planned or under construction. Japan later constructed small factories and mills on the island, along with a banking and monetary system, a public hygiene program, and an education system. After World War I, Japan decreed all non-Japanese foreign enterprises banned from Taiwan. New industries immediately sprang up in the forms of textiles, chemicals and machinery (Copper 1990). During the 1930s, Japan initialized the industrialization of the Taiwan economy as part of its imperial expansionist policies. Prior to World War II, 90 percent of all exports from Taiwan went to Japan and ties between the colony and the colonial power were firmly established (Figure 6).

Chart 4: Percent of Population In Cities



土地開拓之經過
STAGES OF LAND SETTLEMENT

-  荷蘭人以前漢族之拓殖 (1661年以前)
Chinese colonization prior to the Dutch
-  荷蘭人統治時期 (1622—1661年)
Dutch invasion
-  鄭人統治時期 (1662—1683年)
Cheng's occupation
-  清朝統治時期 (1684—1895年)
Tsing dynasty
-  日本統治時期 (1895—1945年)
Japanese occupation

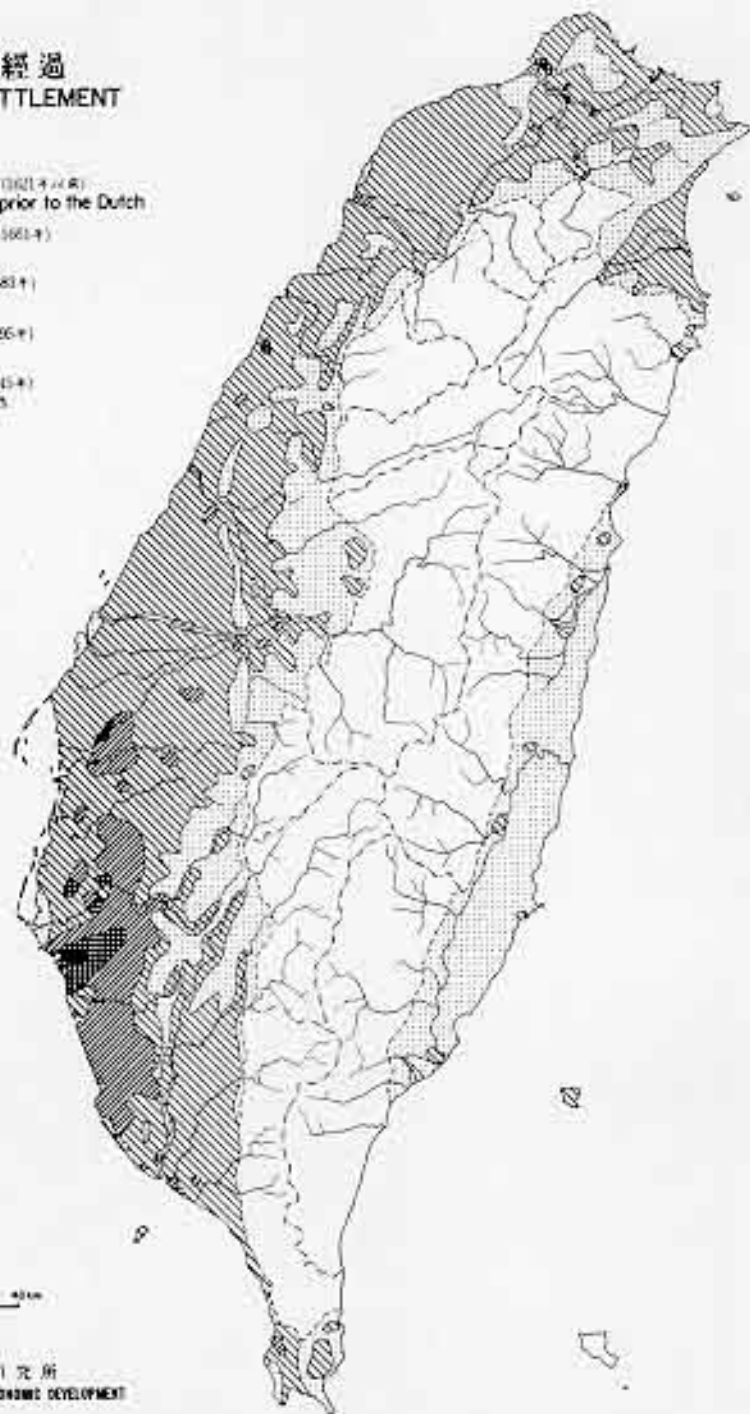


Figure 6

Most nations that have a colonial past find the road to development difficult due to an economic and cultural dualism within their society. Norton Ginsburg wrote about this dualism in a 1973 article entitled, From Colonialism to National Development: Geographical Perspectives on Patterns and Policies. Dualism, Ginsburg wrote, "often appears as two societies within one nation: one modern, the other traditional; one foreign oriented, the other introverted; one involved with the world system of production and exchange, the other predominantly subsistence oriented; and, the two have little to do with each other (Ginsburg 1973)." Ginsburg also comments that the two systems assume well defined geographical characteristics and that another systems develops over the two. That system is identified with the movements of people, goods, and services over long distances and in large number and quantities (Ginsburg 1973):

The sinews of this system is a transportation network designed primarily to serve it, not the traditional sector. That network connects estates, plantations, mines, specialized areas of agricultural production...with the port cities and other redistributive centers. Transportation systems designed to serve only limited purposes, selected regions, and certain sectors of the population are, by definition, not likely to serve all areas or all sectors equally well (Ginsburg 1973).

The Japanese colonial activities in Taiwan were undertaken with Japan's imperial interests in mind. The issue of dualism erected on Taiwan only had 60 years in which to develop. Also, the one and one-half million Chinese who fled to Taiwan, after the communist takeover of the mainland in 1949, played a role in rearranging the dualism on Taiwan. While political power shifts altered the dualism on Taiwan, the physical infrastructure developments accomplished during the Japanese occupation remained intact. The spatial placements of Japanese directed roads, railways and other infrastructure was influenced to a great extent by the geography of the island itself. The mountains forced the sinews of the colonial system to focus on the coastlines and the little flat land that exists on the island. Therefore, in some respect, the colonial transportation system established by the Japanese did not exclude any large geographic and moderately to highly populated areas of the relatively small island of Taiwan.

In the tradition of most colonial powers, the Japanese instructed (within the education system) the Taiwanese in the language of the colonial power, encouraged students to study engineering or other sciences as opposed to political science or social sciences, and appointed a single Taiwanese to be responsible for the conduct of 100 other Taiwanese families. The entire

Taiwanese population was segmented into these 100 family units as a means of more thorough Japanese control over the colony (Copper 1990).

During World War II, Taiwan served as a base for Japanese invasions of the Philippines and other areas of Asia-Pacific. As the war came near its end, Taiwan was spared from any large scale wartime destruction, and this fact is of particular importance in the economic development of the island. The absence of large scale war destruction allowed the Taiwanese to initiate development on the island almost immediately following the war. Following the Japanese surrender and the end of WW2, Taiwan officially became part of the Republic of China. By 1949, the Nationalist Chinese lost the Chinese civil war with the communists on the mainland. The Nationalist Chinese government and one and a half million mainland Chinese moved to Taiwan in late 1949.

The Nationalist government took over political control of Taiwan and, in the 1950s, with the assistance of U.S. aid advisors, instituted land reform and overall economic development plans. U.S. aid came to a halt in 1964, forcing Taiwan's economy to go it alone. From that point forward, Taiwan's economy grew faster, during the next two decades, than any other economy (Copper 1990). During the past 30 years, the Taiwan model of economic development has been comprised of five major characteristics: high investment ratios, small public sector, competitive labor market, export expansion, and government intervention in the economy (Kuznets 1988). Government intervention took the form of land reform, a reduction of trade controls, and periodic drives to expand infrastructure in order to keep up with private sector growth (i.e., The Ten Major Development Projects of 1974, The Twelve of 1979, and the Six-Year National Development Plan of 1991, Kuznets 1988). For example, in 1975, the government paid for six major transportation projects including an island-long freeway, railroads, airports, harbors, and ports (Copper 1990).

The development characteristics of Taiwan create a unique spatial predicament as well. It is intuitive to think that a highly populated island with little natural resources would be more handicapped than most nations and therefore find the path to development elusive. However, it is possible that Taiwan aggressively pursued development due to necessity, whereas nations with abundant arable land and natural resources find it easy to postpone the difficult decisions needed to promote development and arrange for its financing (Kuznets 1988).

The expansion of the industrial sector of Taiwan was possible through the application of seven factors: 1) the expansion of industrial employment; 2) the rise in labor productivity; 3) U.S. economic assistance; 4) privatization; 5) local savings and foreign investment; 6) a solid

economic infrastructure, including transportation and port facilities; and 7) excellent planning by both the public and business communities (Copper 1990). The economic development of Taiwan is illustrated by the shifts in percentage of the work force within sectors of the economy (Chart 5). The chart indicates that employment in agriculture dropped from over 45 percent of the work force in 1965 to less than 15 percent by 1991. Meanwhile, manufacturing rose as a major sector of employment, rising from 16 percent in 1965 to 35 percent in 1988, and dropping to 31 percent by 1991. The drop in manufacturing jobs as a major sector of employment for the Taiwanese work force indicates that Taiwan is beginning to move into the post-industrial age. In future years, knowledge-intensive employment sectors will employ a larger share of the total work force.

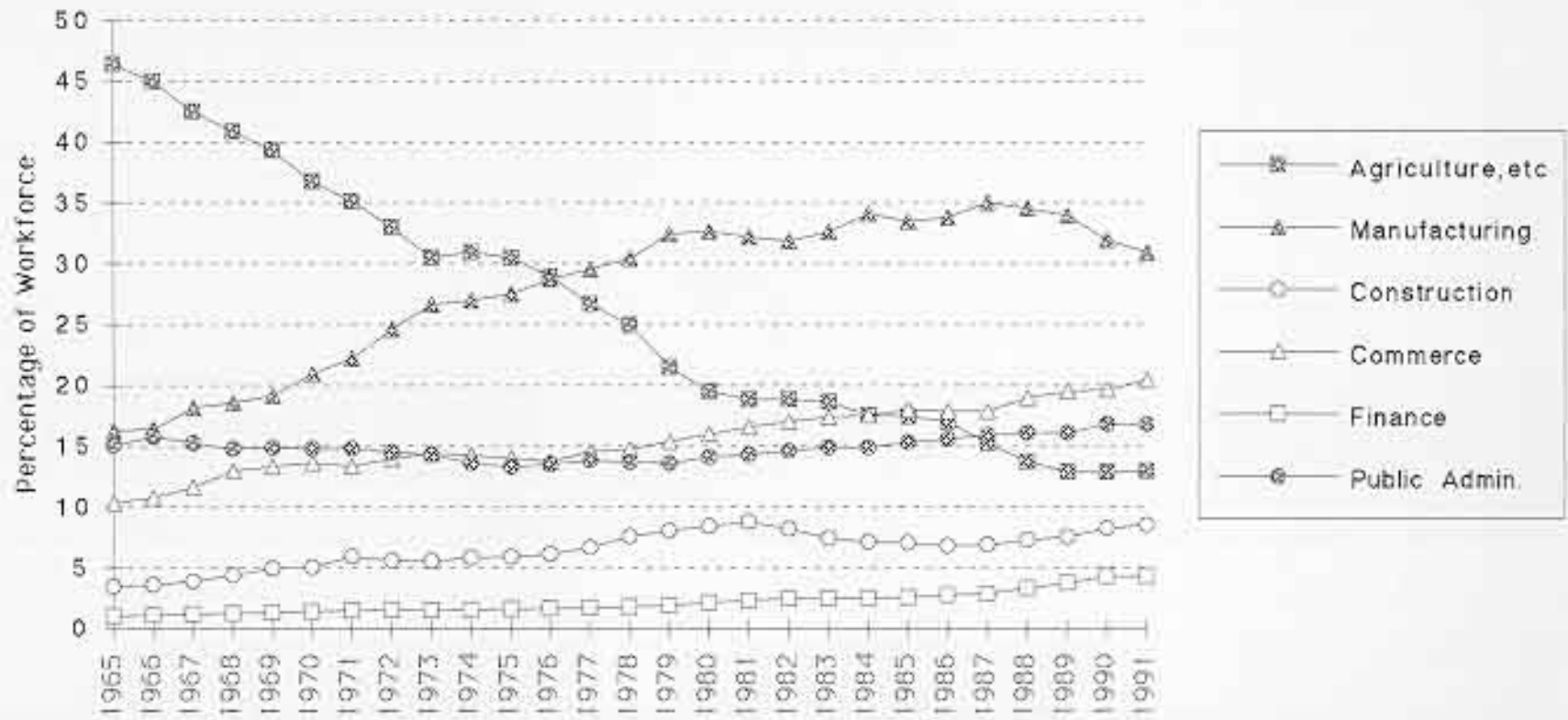
Three Types of Regional Planning.

Regional planning can be divided into three major groups: interregional, interlocal, and locational planning. Interregional planning includes national planning and is concerned with population, welfare, production, investment, consumption, and the setting of priorities for development of economic and social sectors. Interlocal planning focuses on the same sectors as interregional planning but in a smaller scale. Interlocal planning works within a given areal unit and uses different methods to implement its regional plan. Interlocal planning units rationalize the needs of the areal unit in coordination with the goals of the national development effort. Locational planning represents the locational pattern of activity as supported by sectoral planning institutions. The observations of Antoni Kuklinski offer us further clarification:

"Interregional and Interlocal Planning is really very weak without the cooperation and support of the sectoral agencies, institutions, and enterprises which support the development in sectoral perspective. Each sectoral Planning institution has to make a choice of a given locational pattern of its activity. This choice is based not on overall national criteria but on the criteria of internal sectoral or entrepreneurial efficiency. This choice, however, is very important since the sectoral agencies are more closely related to the investment decision-making bodies than the agencies of Interregional or Interlocal Planning. Locational Planning, the implicit spatial dimension of the planning system, is very often more important than explicit dimension represented by Interregional and Interlocal Planning (Kuklinski 1978)."

The Six Year National Development Plan.

Chart 5: Percentage of Work Force by Sector Over Time

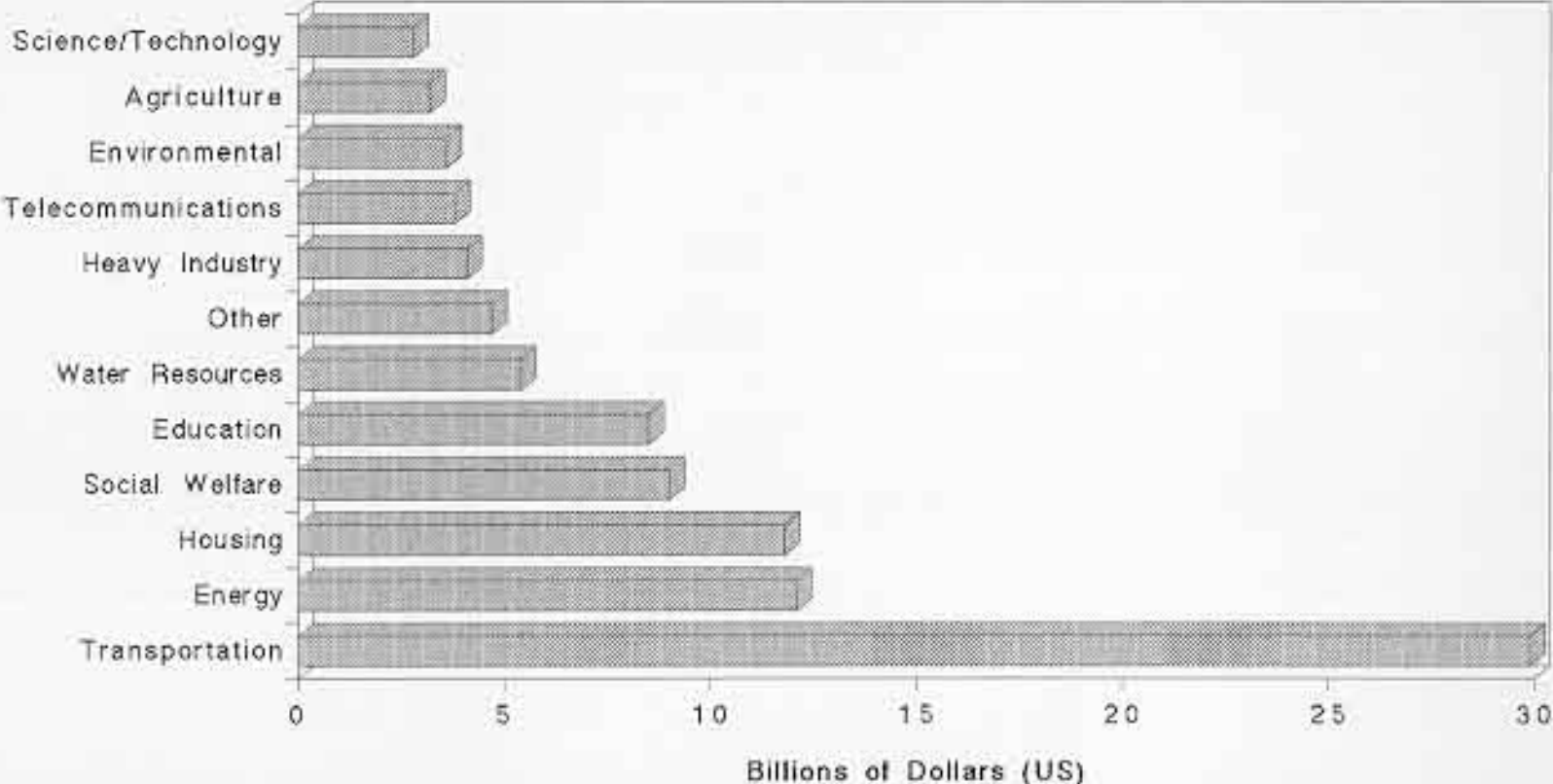


In 1991, then-Premier Hua Pei-tsun presented to the Taiwan cabinet a \$303 billion Six-Year National Development Plan comprised of 779 projects. The goals of the plan are to restructure the economy, stimulate economic growth, decentralize the economy, aid in balancing the location of growth, to become the financial and communications hub of Asia, and make Taiwan a model for the development of China (Baum 1992). In 1990, growth in GDP was 5.2 percent, the lowest rate since 1982. The problems facing Taiwan are seen to be infrastructure problems, high labor costs, environmental degradation, and urban overcrowding that led to a decline in private investment of almost 10 percent in 1990 (Baum 1991). There was also an increase in the out migration of middle-class professionals from the largest cities. Therefore, one of the main features of the plan is to develop 18 regional areas to relieve the congestion and skewed population distribution found in the largest cities, among them Taipei and Kaohsiung. Another stated goal of the plan is to elevate the per capita income currently around \$10,000, to \$14,000 by 1996 and \$20,000 by the year 2000, making Taiwan one of the world's developed economies (Shapiro 1992, Baum 1992).

The plan calls for the development of seven highways (including a second north-south highway), a mass transit system for five cities (including Kaohsiung, Taichung, and Tainan), housing, universities, museums, libraries, hospitals, shopping centers, and a rail link between Taipei and Kaohsiung that reduces the time of travel from four and a half hours to 93 minutes. Energy projects include two 1,000 mega-watt capacity nuclear power plants (to be located on the lightly populated eastern coast) and additional coal-burning power plants that will double coal consumption from its current level (Valeriano 1992, Shapiro 1992). Greater use of liquefied natural gas to replace dependence of imported oil is also a goal of the plan. Other projects include airports, aquariums, oil refineries, pollution control, cellular phone networks, plant upgrades, reservoirs, waste water treatment plants, sewage systems and landfills (Valeriano 1992). Planned expenditures per sector for the Six-Year development plan are illustrated in Chart 6. Transportation, energy and housing make up the three largest expenditure sectors for the development plan. Social welfare, environmental protection and clean-up, and education represent investments in "soft infrastructure" that improves the quality of life or add to GDP growth over the long-term.

The development plan is also designed to meet the people's expectations of better living conditions. The plan coincides with the government's introduction of a universal national health care insurance system in 1994. Medical facilities are being expanded, as part of the plan, and 300,000 to 900,000 units of affordable housing are being built to offset the high cost of real estate in Taiwan (Baum 1992). The Health issue is further supported by the plan's \$14 billion

Chart 6: Planned Expenditures by Sector



earmarked for environmental clean-up and the development of 74 sanitary landfills and 21 waste incinerator plants to be spread across the island (Baum 1992).

There is controversy over how much of the development plan projects are financially feasible or whether they represent little more than the wish list of the government. During the past year, projects have been reviewed by the government of Premier Lien Chan and it is anticipated that the new cabinet will reduce the total expenditure for the plan.

Land Constraints and Development Planning.

Most development planning is measured in monetary units that often hide conflicts and incompatibilities, and particular neglect of the areal and locational aspects of a development plan perpetuates this problem (Fuchs and Street 1980). Most development plans remain sectoral, but give lip service to the need for developing regional policies (Ginsburg 1973). In the case of Taiwan, a spatial examination of the past development plans for the nation can illustrate contradictions within development plans. The 1980 article by Roland Fuchs and John M. Street, Land Constraints and Development Planning in Taiwan, draws attention to the land use issues of development planning in Taiwan. Their work, though 13 years old, is still relevant with respect to the development planning currently undertaken in Taiwan.

The land use patterns of Taiwan should be of little surprise to anyone: irrigated crops, particularly rice are found largely on the plains; various dry land crops, including tea and bananas, are cultivated on the hills and tablelands; forests cover the mountains. As Taiwan's population increased rapidly alongside a shift from agriculture to manufacturing, settlement areas concentrated in the urban centers of the western coastal plain, the area that contains most of the island's level and arable land (Fuchs and Street 1980). In past development plans for the island, the government maintained a basic food self-sufficiency policy while some of the best agricultural land was converted over to urban related use. The food policy and increasing population growth and urbanization led to the intensification of agriculture on the remaining level land and also into marginal areas and slope lands. From 1962 to 1976 more than half of the new agricultural land put into production was slope land and forest land. This happened because, during the same period, the land diverted from agricultural use to urban use totaled 148,000 hectares. Fuchs and Street conclude:

The rapid growth of population, urbanization, and industrialization, together with the intensification of agriculture and associated land use conversions, have already resulted in substantial environmental degradation. The effects of urbanization and

industrialization are particularly evident in sharply increased water and air pollution; urban flooding has increased in the Taipei area as a result of decreased infiltration, increased runoff, and the subsidence caused by a high rate of ground water withdrawal. Agricultural intensification in the plains has resulted in increased water pollution from applications of pesticides and fertilizers. The deforestation resulting from logging and conversions of forests to agriculture has induced landslides and soil erosion, has decreased ground water recharge, and has increased runoff, flooding, and reservoir siltration (Fuchs and Street 1980).

Taiwan's rapid development was achieved under a series of six consecutive four-year development plans, the first beginning in 1953. Regional planning was initiated in 1960, comprehensive development planning started in 1970, and a Regional Planning Law was enacted in 1974 to promote rational urbanization. However, the development planning in Taiwan has focused primarily on sectoral development. This is caused by several reasons, one of which is that "many of Taiwan's administrative arrangements lack full statutory basis, and many policy areas lack detailed legislation for example, urban development (Winckler 1988)." A 20-year comprehensive development plan for the period 1976 to 1996 is a clear example of the little attention given to the land use and location implications of development planning in Taiwan. The following list of goals and strategies are noted: 1) a rapid rate of economic growth; 2) accommodation of rapid population increase to 22.3 million by 1996; 3) maintaining the farm lands required to sustain self-sufficiency in the production and supply of staple foods through preservation of prime agricultural lands; 4) expansion of the role of manufacturing in the nation's economy; 5) "rational" population distribution and the decreasing of overpopulation in the largest cities; 6) balanced regional growth and the furtherance of greater income distribution equality; 7) improving the urban environment and increasing the housing space by 20 percent; 8) improvements in the transportation systems across the island; 9) development of water resources to meet urban, industrial, agricultural and other demands; 10) further development of the coastal zones for ports, industry and fishing, tourism and recreation; 11) and environmental protection of the land, air, and water (Fuchs and Street 1980).

While the above goals and strategies of development appear sound when examined singularly, they contradict each other when examined in the aggregate. The general concept in the plan was that additional land to be used for urban-industrial, agricultural and transportation purposes would come from the conversion of marginal lands and forested mountain terrain. The environmental costs of such a land use conversion had apparently not been thoroughly examined

and properly considered by the planning authorities, perhaps due to a preoccupation with economic development, which can be measured in monetary units.

A closer examination of the contradictions existing in past Taiwanese national development planning should be considered by government officials as they revise the current Six-Year plan. For example, the goals of continued economic development and manufacturing expansion conflicted with the goals of preserving farm land, environmental protection and balanced regional development. This occurred because the expansion of manufacturing occurred near the largest cities, on land prime for agricultural use. The best agricultural lands lay in and around the cities because these cities started as agricultural trading posts centuries ago and people worked the land that returned the greatest yield. Transportation systems also required the conversion of some agricultural land to other non-agricultural uses. The reduction of prime agricultural land results in the conversion of forest land and marginal lands. However, the land use swap does not occur on a hectare by hectare basis. Depending on the terrain, it may take several hectares of hillside to produce the yield that can be obtained from one hectare of prime flat land. This led to soil erosion and degradation of the delicate sub-tropical forest ecosystem of Taiwan, contrary to the goal of watershed development. Increases in manufacturing and industry also lead to more air and water pollution. Concerning locational strategy and industrial growth, Fuchs and Street (1980) observed:

If rates of economic growth are to be maximized, industry, rather than being evenly disbursed or channeled into less industrialized planning regions, will continue to develop in existing centers, such as the Taipei and Kaohsiung metropolitan areas, which of all cities have the best existing infrastructure and offer agglomeration and scale economies. Such concentrations, however, would exacerbate environmental problems and accelerate the loss of prime agricultural land.

Post-war Japanese development planning took the same path in Japan under the National Income Doubling Plan of 1961. That plan "sought to raise the level of the Japanese economy on the premise that trends such as concentration of industrial development around Tokyo Bay and the Inland Sea were positive (Shimokobe 1981)."

Concerning the latest development plan, the goal of spreading the population across Taiwan in a "rational" development approach is contradictory with the goals of sustaining a high rate of economic growth (for reasons mentioned above), as well as the goal of preserving valuable prime

agricultural land. Low-density decentralization of the population across the island will consume more agricultural land than would high density development within the existing urban centers. Providing infrastructure to low-density urban sprawl is also more costly and inefficient. Multiple uses of the coastal areas is another goal that contradicts itself because port facilities, recreation, industry and tourism will find it difficult to share the same area. In addition, upslope agricultural development will lead to greater sedimentation along the shore.

Some alternatives that would reduce the conflicts between the stated goals include the stocking of staple food items, instead of locally grown food self-sufficiency policy, to prevent large-scale environmental degradation of the slope lands. Also, the intensification of agriculture in the low-lands would assist the food issue, while forestry and recreation are used as means to preserve the mountains. The marginal lands, reclaimed tidal lands, are mostly used for agriculture and livestock production, for which they are poorly suited. Urban and industrial uses might be the more appropriate use of these lands. The issue of supporting balanced regional growth sounds nice to the ear, but the issue should be examined for differences in resource and factor endowments between the developed area and the "lagging" area. The question here should be "do the benefits of balanced regional growth offset the obvious economic costs?" As mentioned above, higher density urban development can preserve valuable agricultural land, while the costs of spreading the population around the island can be tallied in money spent and land area forever consumed. In the case of a highly populated island like Taiwan, higher density land uses in urban areas is a critical consideration for the land use issues involved with national development planning. In essence, planners must work for the optimal distribution of land use, and lead the way in developing methods for measuring the costs and benefits of alternative land uses (Fuchs and Street 1980).

Transition Theory: Population Dynamics.

Due to the limited amount of usable land on Taiwan, I have focused on the population to land issues that confront the residents of the island. A closer examination of demographic transition theory can explain the population dynamics on the island and where the population transition may lead in the future. According to Drake's Transition Theory, the initial point of population dynamics is where both birth and death rates are high and relatively equal to each other. Here, rates of change in population growth or decline are quite low, barring large-scale natural or manmade disaster. As the transition progresses, death rates drop due to rapid improvement in the overall health of the population, yet birth rates remain high. In the case of Taiwan, the overall health of the population on the island was improved due to improvements in public hygiene, education, and sanitation infrastructure at the direction of the Japanese colonial

power. The transition theory progresses and, in time, birth rates gradually decline to a rate nearly equal to the death rate. In essence, the rates of change for a particular transition begin in relative stability, then go through a period of rapid change in rate of growth, followed by relative stability once again. The final stage of stability may be a successful transition or an unsuccessful one. The time lag between the decline in death rate and the latter decline in birth rate can be influenced, according to Drake, by government intervention in the form of public policy initiatives. The observations of Paul Kuznets, in his 1988 article, An East Asian Model of Economic Development: Japan, Taiwan, and South Korea, further describe the demographic transition in Taiwan:

The [population] slowdown is a product of decline in already low (crude) death rates that is more than offset by larger declines in (crude) birth rates. These declines, in turn, have been associated with better sanitation, public health services, and medical care in the case of death rates, and for birth rates, with successful population planning programs and, with development, the increasing advantages of small family size. While population deceleration is not an unmixed blessing, since lower population growth limits market-scale economies and labor-supply expansion, deceleration not only favors growth of per capita incomes but should also provide benefits from slower urbanization, lesser demands on infrastructure, and rising labor productivity, which are likely to more than offset the costs of slowdown (Kuznets 1988).

Projecting the growth in population for Taiwan, a logistic curve was used to best illustrate a fit for the population transition. Using the actual data for the years 1966 to 1991, and an upper limit of 26 million people, the curve fit indicates that the upper limit of the curve should be reached near the middle part of the next century. While the logistic curve should represent an S-shape on the graph, stability then rapid change then stability again, the actual curve did not fully illustrate the initial stages of relative stability (Chart 7).

A number of population projections for Taiwan have been made and are intended to aid in examining several population scenarios possible in future years (Chart 8). The projections into the future are made to the year 2021, one of which is the official Taiwanese government projections and four other projections made by the author. The four projections I have supplied here include linear, exponential, logarithmic, and logistic curves, based on the actual population data for Taiwan up to the year 1991. The linear curve illustrates a continuation of the population increase to 1991, and would result in a total population of roughly 29 million people by the year

Chart 7: Projected Population in Taiwan Using 26 Million as Limit

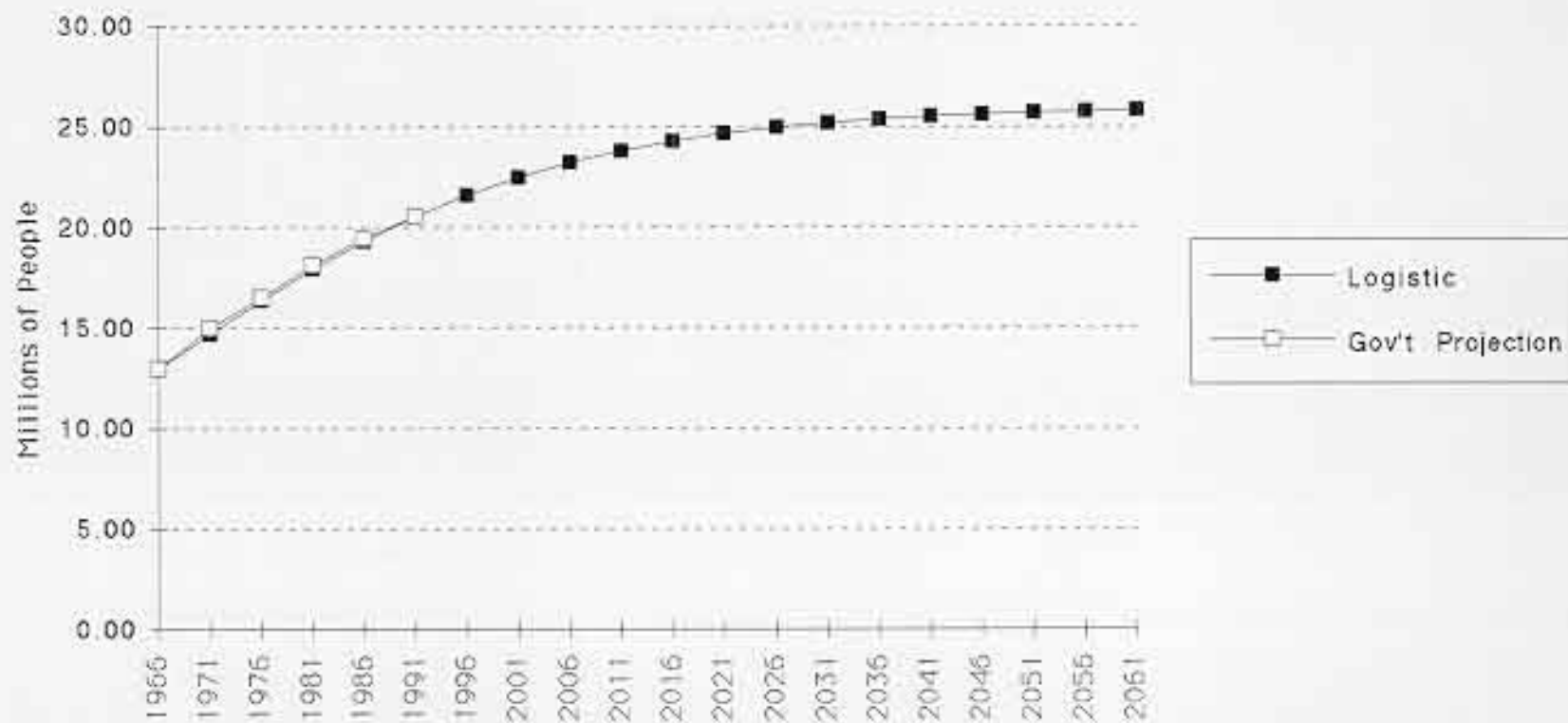
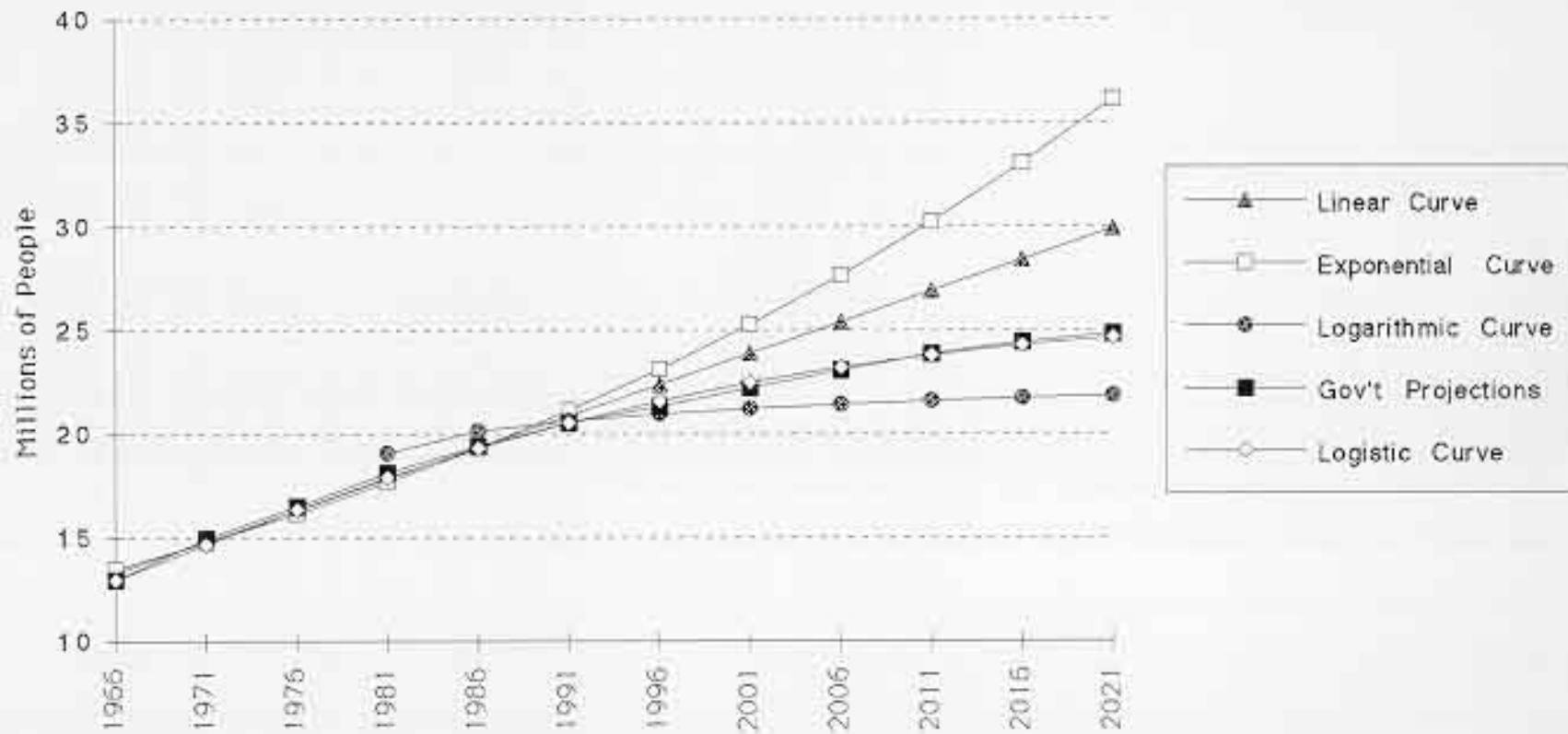


Chart 8: Population Projections for Taiwan



2021. The exponential curve indicates a building of the population every year resulting in an increasingly larger population building upon itself exponentially. The exponential model projects a total population of roughly 36 million people by the year 2021. The logarithmic curve is the inverse of the exponential curve and projects a total population of roughly 23 million people by the year 2021. This decrease in the rate of population growth, in theory, would derive from population induced factors developing and then driving the population growth rate downward. The logistic curve projects the population of Taiwan, using a 26 million population limit. The logistic model indicated the population would rise until the middle part of the 21st century and then level out. The logistic curve most closely matched the population projection of the government of Taiwan.

The issue of land use in Taiwan is in large part reflected in the amount of land used for agricultural production. The total amount of land used for agricultural production has not changes much in the past 30 years. While paddy agriculture has declined a little, dry land agriculture has increased and replaced paddy usage by nearly an equal hectare for hectare swap (Chart 9). While I had hoped to locate land usage statistics in greater detail, the decrease of paddy field agriculture may represent that land transferred for industrial and urban uses. Also, the increase in dry land agriculture may represent the increase in agricultural production that has moved into the low mountains. The environmental degradation that arises due to agriculture being undertaken in the mountains includes soil erosion, pollution from pesticides, increased sedimentation in the rivers and along the coastline, and streams polluted by human activity in areas lacking proper waste treatment and refuse collection. Today, Taiwan imports roughly fifty percent of its food supply, obviously indicating that the domestic agricultural sector makes up the other fifty percent (Zich 1993). I believe that it may be in the interest of the Taiwanese people to import a greater percentage of its food supply and to investigate methods to enhance agricultural productivity of land in non-mountain areas. Such measures would help preserve the fragile mountain lands and help avoid negative by-products of further agricultural activity in the mountains. These issues should be explored in greater detail before any radical policy change is advocated.

The population-environment transitions facing Taiwan today are, in many ways very different from those face 30 or more years ago. The people of Taiwan are relatively affluent today and are greater consumers of high priced items. At the same time, the new affluence has brought about a social change: the recognized value of the small family. The choice of a smaller family is partially responsible for the decrease in the annual population growth rate (Chart 10). The sharp rise in annual population increase percentage during the year 1969 is probably attributable to

Chart 9: Area of Cultivated Land

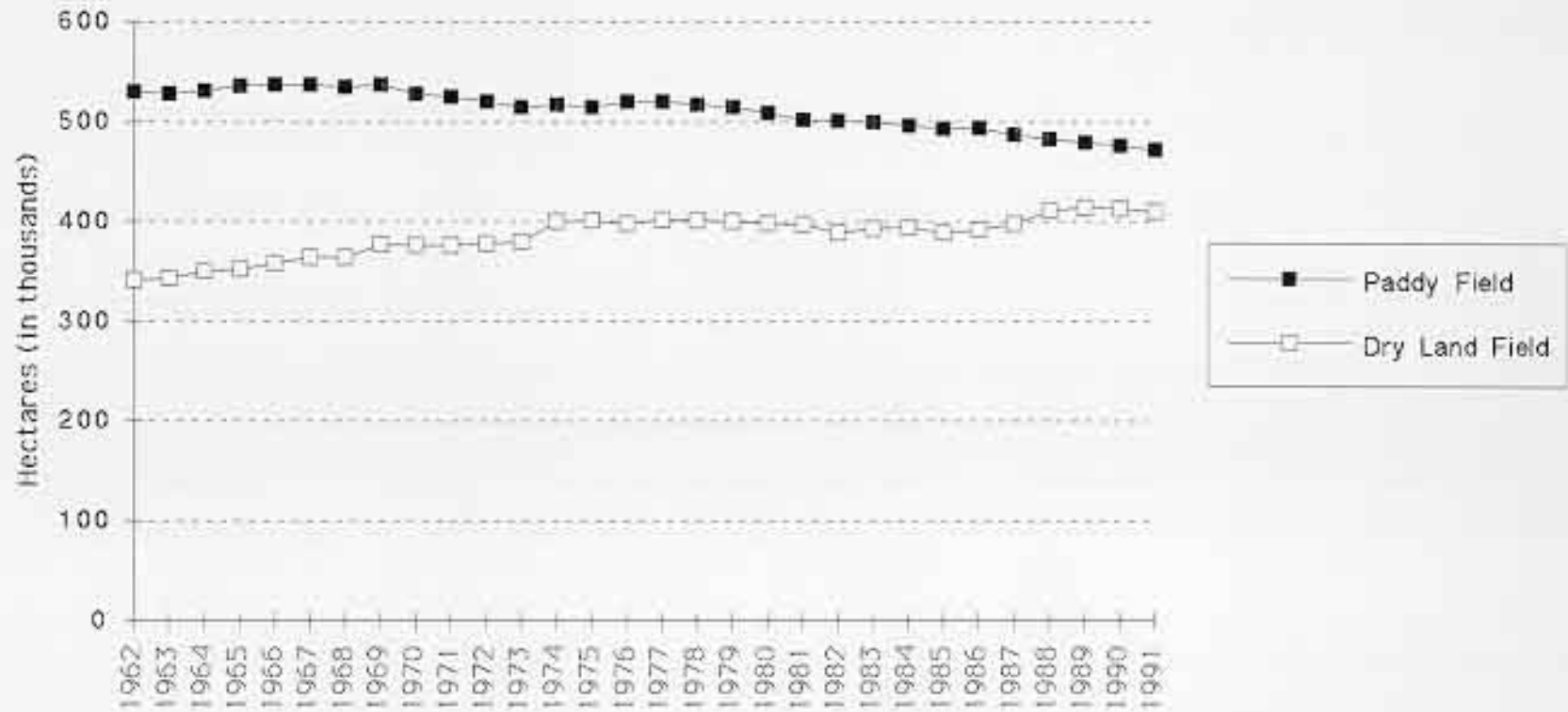
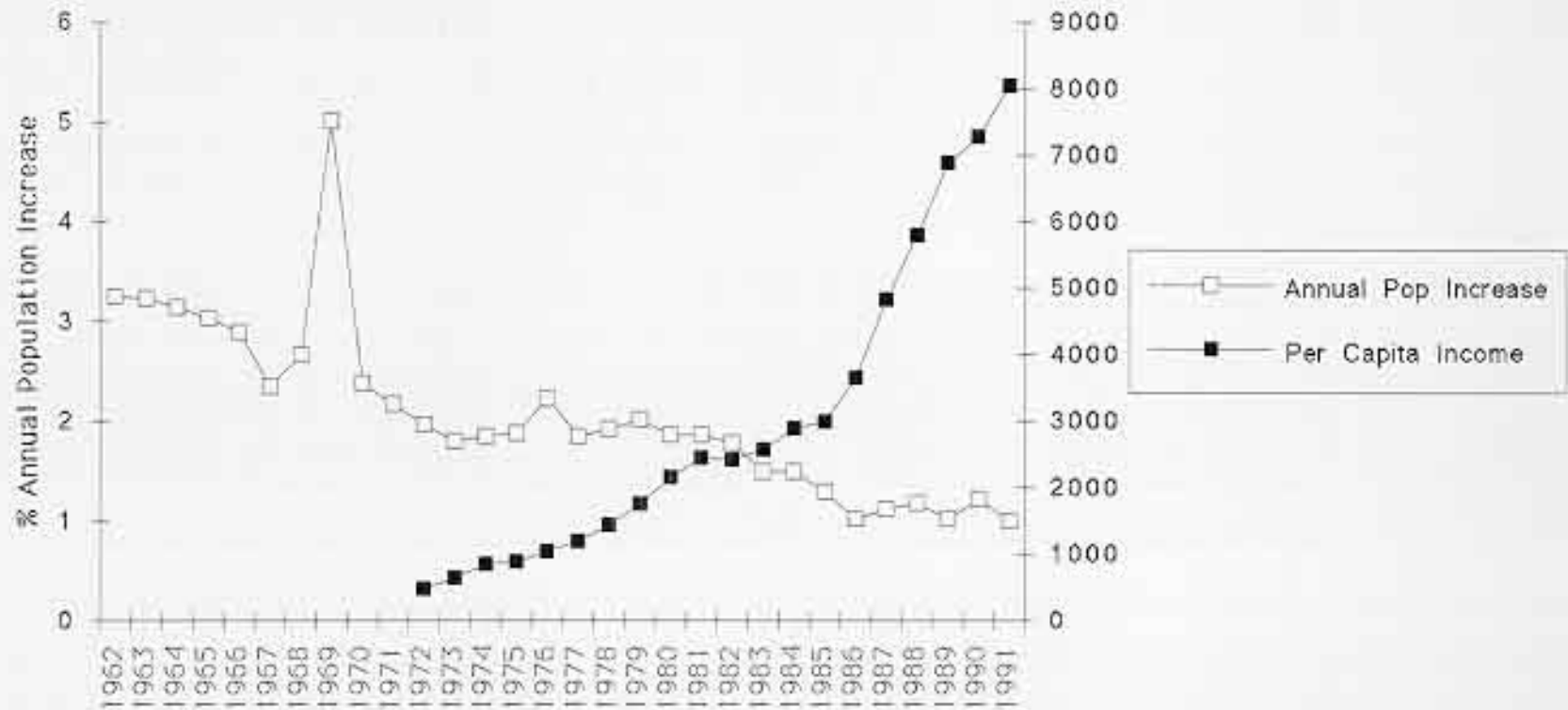


Chart 10: Annual Population Increase vs. Per Capita Income



erroneous data collected by the government, but was included here nonetheless. The decline in family size has accompanied the rise in per capita income (Chart 11). The decline in family size from roughly five and a half to under four persons per household for a total population of over 20 million informs us that the demand for housing has increased dramatically. The development of new housing could be performed by building higher density housing in the urban areas, or lower-density housing in the urban periphery, or in the development of new growth poles (new towns). Each of these scenarios has obvious land use implications. The new affluence of the Taiwanese people has also led to the greater ownership of motor vehicles (Chart 12). In 1962, there were roughly 10,000 cars on Taiwan. Today, there are almost three million motor vehicles on the island, with an additional ten million motor scooters and motorcycles (Zich 1993). The air pollution over the urban areas of the island has become almost as infamous as the smog in Los Angeles, California. The air quality problem in Taiwan is derived from the affluence attained by the people of Taiwan: more income results in more motor vehicles that results in more air pollution.

The national development planning in Taiwan should take into account the affluence of the people and direct national investment into measures and programs aimed at curbing the negative by-products of economic development and the rise in per capita income. Not only has the consumer habits of the people changed during the past 30 years, but the development of the economy has shifted to a point where Taiwan is now positioned to exert a new competitive advantage in the global market place. These and other policy issues are briefly addressed in the remaining sections of this paper.

Policy Issues.

The spatial issue of where agricultural and urban development take place is important to the long-range prosperity and environmental preservation of Taiwan. The policy of the government may best be served by promoting the intensified use of the existing agricultural, urban, and industrial lands. Several considerations are presented here that take account of the economic prosperity of the people, the limited amount of usable land, the rate of population growth, Taiwan's competitive advantage, and the quality of life on the island.

The decrease in the rate of annual population growth has benefited the overall prosperity of the people and further decreases should be promoted by the government. Maintaining a manageable total population size on the island will enhance the success of further economic development while avoiding gross environmental degradation. The recognized advantages of a smaller family size evolved from the equity in income distribution; wealth derived from the

Chart 11: Household Size vs. Per Capita Income

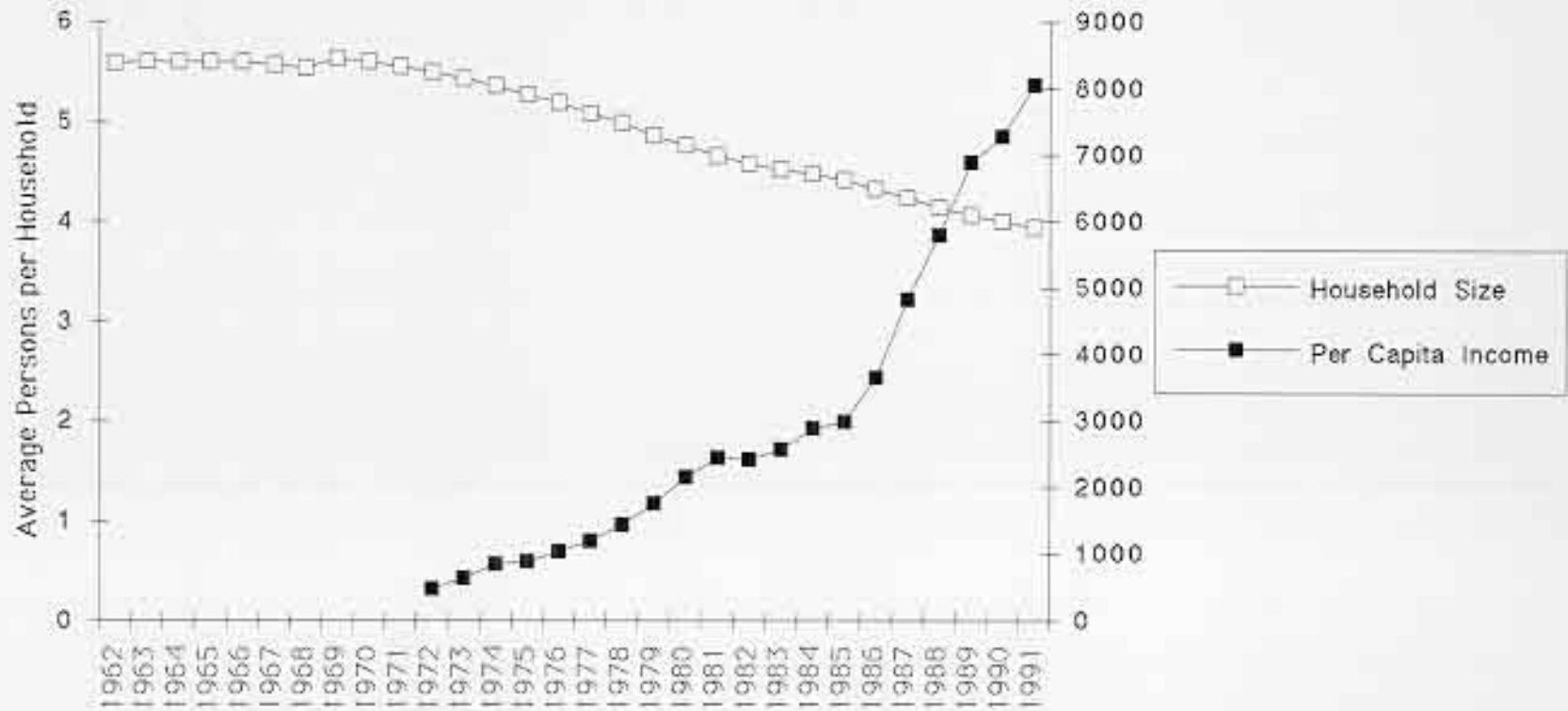
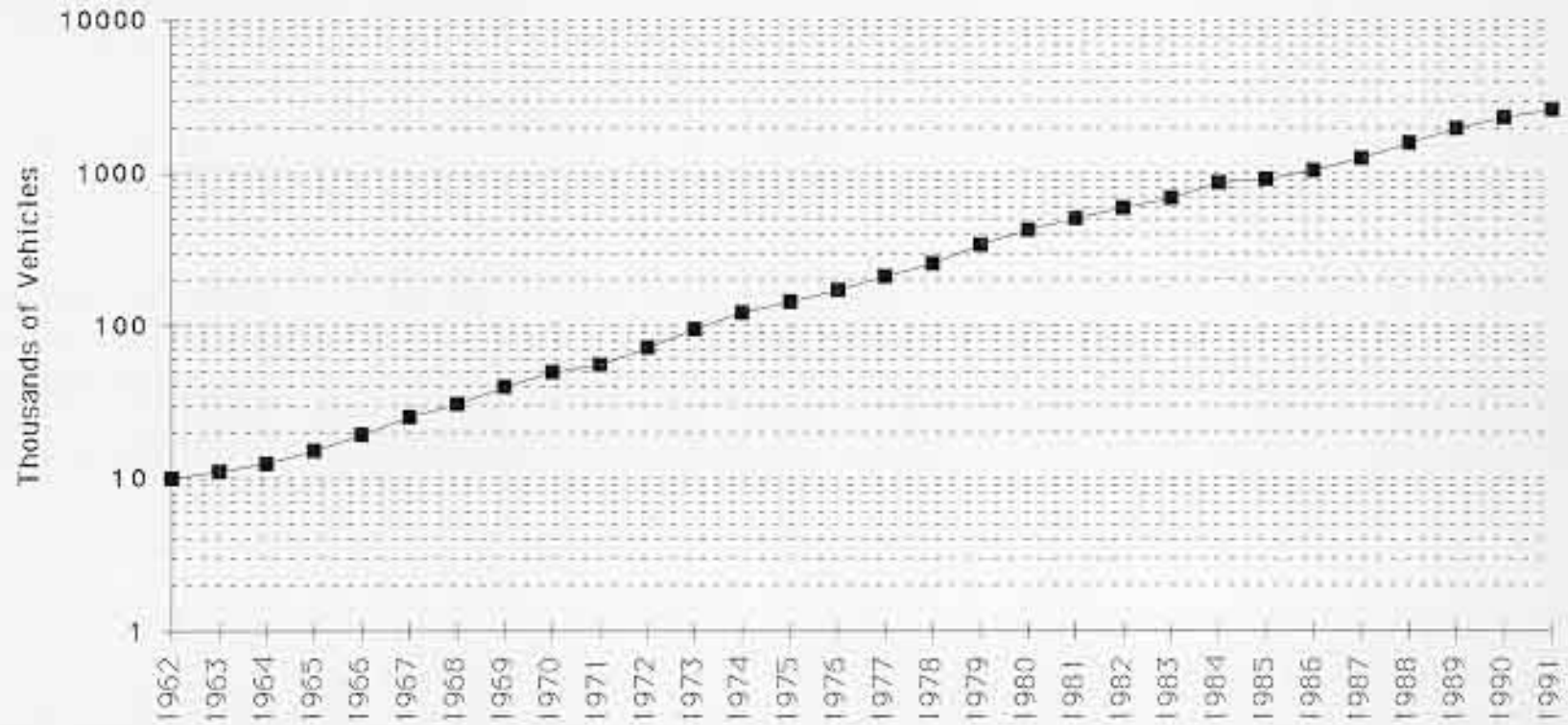


Chart 12: Passenger Cars



industrial development policies of the past. Continued equality of income distribution should aid in keeping the annual population growth rate from rising above its current level.

With a low population growth rate, there will be less of a demand on increasing agricultural output and further encroachment of agricultural development into the mountain lands. In addition, national investment in housing, transportation, environmental clean-up, and less polluting industries would further the efficient and environmentally sound development of Taiwan and improve the quality of life for the residents of the existing urban areas. By avoiding the unwise use of land, costly infrastructure development of the urban periphery and greater environmental damage can be avoided. Instead, direct investment in making the urban areas a more pleasant place to live would slow the spillover development of the urban periphery and the development of new urban areas on existing agricultural lands. Affordable high-density housing, inexpensive and efficient urban transportation systems, and the enforcement of air pollution regulations on both vehicle owners and industry would go a long way to improving the current urban quality of life. In other words, it is my opinion that the government transfer planned expenditures away from investment in non-urban areas in favor of investment in the existing urban areas. Otherwise, emigration out of the urban areas would require the government to possibly spend greater sums on developing larger spatial areas of low-density urban sprawl and aiding in the permanent conversion of more agricultural land to non-agricultural use.

Future industrialization on Taiwan should focus on high value-added industries and other high-technology enterprise, and away from the heavy polluting, metal-bending, smoke stack industries common in nations that are at the earliest stages of industrialization. Therefore, it is important that the national development plan of Taiwan consider the competitive advantage of the island as it exists today. According to Raymond Vernon's theory of the product cycle (Clark 1989):

New products and technological innovations are most likely to occur in the most advanced economies that are marked by high incomes and capital-intensive production. Once a new product proves itself in such a market, though, its production becomes more standardized, leading to lower costs and marketability in less wealthy economies. As a result, as the product moves from "new" to "maturing" to "standardized," its center of production is diffused from the innovative country to other developed states to developing nations, which even begin exporting back to the "center" as the product cycle comes to an end.

Considering the various sectors that may receive national development funding from this Six-Year plan (see chart 6), the transportation, housing, environmental, and education sectors could be the beginning steps toward improving the quality of life for the Taiwanese people. The transportation improvements focus on both motor vehicle infrastructure as well as mass transit systems. The mass transit systems will help cut down on the pollutants released into the atmosphere over the larger cities of the island. Mass transit within the cities will reduce sprawled urban and industrial development at the periphery of the city and beyond. The enforcement of environmental laws on the island, monitoring efforts and tougher regulations should go a long way toward beginning to clean up after forty years of virtually unchecked industrial pollution.

The nation has progressed from an agricultural society to an industrial society, and the per capita income has soared. Urban and industrial land use has increased and pushed agriculture off of some of the flat lands and into the mountains. As mentioned earlier, environmental degradation is swift as more people, roads, pesticides, and waste cluster in the mountains. Perhaps the government should consider boosting the food imports from 50 percent to 60 or 70 percent, rather than permitting agriculture to move into the mountains. The country is wealthy enough to afford prices of food that are a little higher and the threat of a blockade from the People's Republic of China appears remote. Hence, the staple food self-sufficiency programs of decades past appears to be outdated. Also, the containment of urban sprawl will aid in reducing the costs of providing expensive infrastructure to the citizens of the nation. Water systems, housing, mass transportation, energy, and other infrastructure can be supplied with higher quality, enhanced reliability, lower costs, and with better equality when confined mostly to the existing urbanized areas. Only gradual and planned urban development beyond the existing boundaries should be permitted. Such a policy will help enhance the quality of life in the cities, reduce the consumption of large amounts of agricultural land by urban and industrial interests, and aid in improving the environment by reducing the rate of new environmental degradation to pristine areas and to permit more thorough environmental regulation enforcement within concentrated areas.

Finally, the spatial issues of national development planning are rarely considered by decision-makers or are considered without any serious implementation measures. Densely populated nations, like Taiwan, should make the most efficient use of their existing urban, agricultural, and other lands. The population growth rate continues to decline, making the controlled development of the city and the urban periphery feasible in addition to spatially correct. Although the total population on the island appears to be leveling, the affluence of the people has increased so much that they are consuming more and polluting more per person than they did just 20 and 30 years ago. The government has succeeded in bringing down the rate of

population growth but now must turn to instituting policies that make efficient use of resources, encouraging recycling, and providing incentives that will aid in cleaning the air, water, and land.

Conclusion.

Many national development plans have tended to ignore the development of the city as a key development ingredient. There has been a bias against cities, a bias that favors lower density development and a sizable agricultural segment. However, in the words of Norton Ginsburg, "To overlook the potential advantages of large numbers of people living in relatively small areas and being able to produce if mobilized effectively, would be sheer folly. Even so, the bias against cities, and particularly the large city, is marked in most development thinking (Ginsburg 1973)." He goes on to address the dualism issue by stating, "There is little evidence to counter the proposition that it is in cities, and especially larger ones, that the forces of modernization for socializing alienated elements and for education and training, are most numerous and most economical. All this speaks for massive investment in cities, even in countries where most of the population lives elsewhere (Ginsburg 1973)." The intensified use of land in and around Taiwan's cities and less emphasis on domestic agricultural production are key requirements for Taiwan to improve its environmental status and enhance the quality of life.

Taiwan simply is in short supply of flat, usable land and is home to a population of more than 20 million people on that land. The physical and human landscape existing on Taiwan forces policy makers to seriously consider a parsimonious use of the inhabited land areas. The margin for error in future development planning on the island is small, and investment in making existing urban areas more livable may be a wiser policy than creating new growth poles, or permitting vast areas of land to be developed under conditions of low-density suburbanization or other inefficient land usage. A country that considers spending over \$300 billion on a national development plan has the resources to greatly enhance the living conditions for the people living in its largest cities. In addition, the amount of land used for agricultural production is too much considering the post-agricultural comparative advantage of Taiwan. Since the nation currently imports fifty percent of its food, the government should consider increasing those imports to perhaps 60 to 70 percent rather than see agriculture continue to move into the rugged mountains.

The Taiwanese national development experience over the past several decades has been led by government intervention in the form of economic policy initiatives, land reform, population planning, and other measures. The continued success of development in Taiwan will continue to be led by such government intervention in the future. The demographic transition facing Taiwan today indicates that high birth rates have dropped and will someday equal the existing low death

rates. Until such a time, it is in the interest of the Taiwanese government to continue its policies that facilitate a successful transition toward lower population growth on the island. In the words of Drake, "whether a society passes through the transition into a satisfactory state is determined by many factors, largely defined, and often remediable by human intervention. It should be the purpose of public policy to formulate, develop and implement these positive interventions (Drake 1991)." Closer partnership between the national development planning teams and the locational/sectoral agencies may be the best road to dealing with the transitions ongoing in Taiwan.

Finally, The spatial issues presented here pertain to the nation of Taiwan. Their applicability to other nations is not intended. The recommendations made here are founded on the Taiwanese government's foremost goal of rapid growth of GDP. Other development literature suggests that "the criterion for locational policy within the regional planning context is best defined as the achievement of given levels of living standards for populations at minimum national costs. This involves trading-off part of national economic pay-offs for social and political gains (Teriba and Kayode 1978)." The social and political situation in Taiwan being what they are, it appears that the government of Taiwan has recognized the need for modest investment in those sectors that do not return large gains to total GDP (e.g., housing and environmental protection). Nonetheless, these investments constitute the framework for continued growth, enhanced quality of life, and preparedness to take the necessary action to ensure the successful passage through the many population-environment transitions facing the island and its people.

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CAPITAL AND BUREAUCRATIC TRANSITION DYNAMIC IN MEXICO

JUAN CARLOS CERVANTES

The relationship between trade and public and environmental health is presently not well understood. Generalizations based on limited and broad studies can be and have been made about this relationship. Unfortunately neither of the two approaches contribute to sound policy formulation for dealing with the conflict between international trade and environmental concern. Free trade, in the modern world context of global market expansion and free competition among economies whose strength lies in their comparative advantage; economic efficiency; productivity and growth, as a pattern is relatively new and with clear benefits; the environmental consequences, however, are not so clear. It is often argued that free trade produces resources that allow a country to pay for environmental clean up. This, however, misses two other probable outcomes that could result. First, the assumption can not be made that resources stemming from free trade will necessarily be used for environmental clean up; nor can one ignore the added pollution due to an increase in trade, which decreases the marginal benefits gained. There are studies that assert a direct positive relationship between environmental remediation and economic and technological growth. It is true that free trade could force countries to adopt more efficient and so called cleaner technologies which would entail a relative reduction in pollution output, but this efficiency could also serve to hasten the degradation of the natural environment. The United States is a good example of an open economy where most markets are open, but openness encourages increased consumption of those goods available in the open market, regardless of any existence of environmental safeguards or not. Canada is a case in point. Ever since it liberated its timber market, when it embarked on the free trade agreement with the United States, it has intensified its logging industry.

We must be careful not to assume that economic scale and growth or openness is an assurance of ability or willingness to care for the environment, for the most open and largest economies are the biggest contributors of pollution.

Protected markets, on the other hand, also have their negative environmental

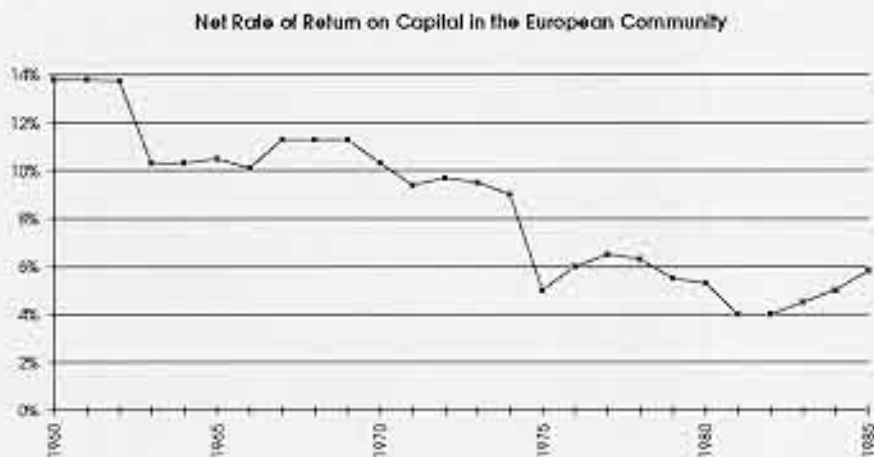
implications. Prime examples are the inefficient factories of Eastern Europe and the once heavily protected industrial sectors of Latin America. Even protected markets in the richest countries such as the agricultural industry in the United States manifest unnecessary environmental costs due to subsidies and other import restrictions. Subsidies reduce the cost of synthetic inputs to agriculture, thus creating incentives to intensify pesticide use, fabricated fertilizers, irrigation systems, mechanical tillage. At the same time, these protectionist barriers may encourage the farm industry to intensify production through the above means or by bringing unsuitable land into production. The environmental consequences of agricultural intensification are far reaching, they extend from the pollution of the air and water systems; degradation of soils; damage to wildlife; fisheries; and to natural ecosystems; these policies could ultimately lead to an ironic dependence on foreign agricultural products do to the eventual resistance of pests to pesticides, thus decreasing productivity. Clearly, a methodology to accommodate the two concerns is needed in the formulation of policy.

While the tension between environmental concern and trade has become more acute in the present and recent past, the debate about whether the internationalization of trade and capital as a means for economic development has succumb to unquestionable praise for the expansion and liberalization of trade. More trade, more government retraction from economic matters, more capital mobility, and more markets are the axioms for today's world problems. Little attention, however, has been paid to the relationship between freer trade and environmental affects, and the social and political phenomenon underpinning this transition. For the purposes of this paper's discussion, the capital transition will be define here as a phenomenon that exhorts the international production system to expand global production; liberalize capital; trade; and diminish the role of the public sector. These are viewed from the vantage point that these developments lack concern for their potentially destructive environmental and social effects.

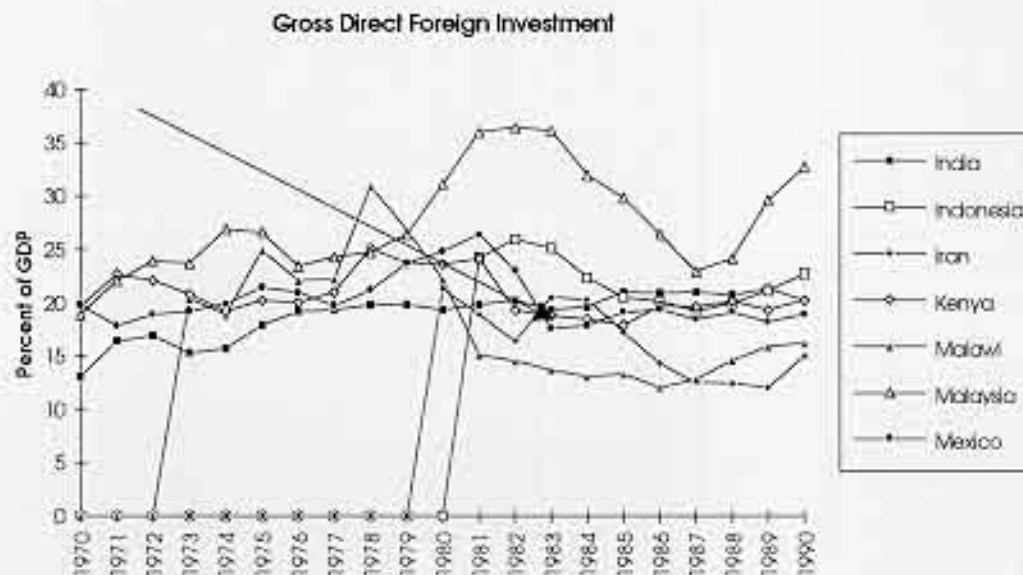
On a global scale, capital mobility is the underlying factor driving the internationalization of trade and political boundaries. With national governments unable to dictate the direction of capital investment, capital seeks the higher returns in international financial markets rather than on investments in domestic industrial activities. The undeniable precept of capital's purpose is to extract high returns, but the relevance of contemporary governments' inability to direct domestic capital for investment is that it represents a transition from the post World War II growth era when governments imposed policies to direct investment, regulate trade, and maintain capital from going abroad. The role of the state in economic matters was to moderate the fluctuating cycles of the markets by spending to create economic stimulus during slumps and direct fiscal and monetary

policies to affect money supply during inflationary periods. Judging from the unprecedented world economic growth from 1946 to the early 1970s, it is apparent that conditions were acceptable to capital. Profits and markets grew sufficiently at the home economies to warrant state intervention. As a consequence of these developments, the standard of living for industrialized countries rose and labor's demands for higher wages increased. The rise in labor costs have to be compensated by efficiencies in other areas of the productive sector or net returns on investments will diminish with time. Productivity increases alongside with wages keeps net profits up. One of the successes of the Japanese economy is that it invested in the productivity of its industry rather on labor input cost reductions, thus lessening the need for cheap labor abroad. The U.S., on the other hand, did not follow this path to increase productivity. Instead it sought cheap labor abroad. The sixties decade, therefore, is a critical period in the evolution of the present global economic system because it represents a time when labor became active and increased social pressure forced governments to increase social benefits. As the welfare state increased so did taxation on corporations and so did the reluctance of capital to invest in an environment of decreasing net profits. Figure one illustrates the decline of net profits in the industrialize countries of Europe since the sixties.

Capital is national as far as it is based in a particular nation but as it seeks to assert its right to invest where ever it is most profitable, it frees itself from any national responsibility. It is important to recognize that capital is not generated from a vacuum but rather from direct government policies and concessions, as well as national resources. In this regard, capital owes a duty to the home country and its citizens.



The present international nature of capital reflects capital's assertion that it should be free to invest wherever it extracts the highest returns without regard for ethical and national considerations. Presently, the process of capital mobility is much greater than in the sixties when many corporations shifted production to developing countries. This realization of capital mobility came about through the process of integrating the financial sector to the international scene. The pattern took definite shape during the seventies, at which point investors were unimpeded by state policies from financial transactions in foreign markets. One of the manifestations of this capital sovereignty, evident during the seventies, was the increased activity in foreign lending (figure 2). This development is in part responsible for Mexico's huge foreign debt and its subsequent austerity measures, which caused tremendous hardship for the Mexican population, and capital flight from poorer economies. Regarding this dynamic of capital mobility, a theoretical development of transition theory offers a framework useful to its analysis.



THEORETICAL FRAMEWORK

The theoretical rubric under which the capital transition falls is coined by Drake as a means transition. This transition is defined as one of human institutions; to the extent that this framework models the trajectory of an institution at transition, it can be argued that predictions can be articulated. The transition at hand is that of the capital institution from a condition of regulation to liberalization. Although the transition is occurring on a global scale, this study deals with the presence of this phenomenon regionally.

Specifically, it deals with its impact on Mexico.

According to the theory of transition, institutional forces exert influence on its own structure to become more centralized and powerful. This naturally leads to an egocentric mission which is, by definition, asymmetrically opposed to any external indifferent to any external greater good. In the context of a capital transition, the three determinants of trajectory in transition theory are evident in the evolution of the capital mobility: First, the present rate of change in the internationalization of markets is unprecedented in the history of capitalism, this is largely due to recent developments in communication technology; second, the magnitude of change is global in nature with differing consequences throughout regions; lastly, the temporal aspect of this transition is identifiable within a relatively short period of time.

There are certainly other world and regional sectors which are undergoing transition changes, while at the same time experiencing the effect of the capital transition. Mexico is now at a crossroads in its history for it is experiencing various transitions at once, the most critical of which is the capital transition.

TRAJECTORY OF CHANGE

This is a critical point for Mexico as well as the international community to see Mexico complete this transition smoothly. Perhaps no other transition is more salient for Mexico's reaction to a changing world climate than this one. Mexico's response to similar external capital pressures during the Porfiriato Period (1876-1911), culminated with the first modern civil war in the world, the Mexican revolution of 1910.

The Porfirio Diaz's regime was captivated, as well as the rest of Latin America, by the fervor of economic liberalism which was so prominent during the latter part of the nineteenth century. In Mexico, intellectuals and politicians who subscribed to these doctrines of Positivist philosophy were called *cientificos*. Not surprisingly, Diaz's state apparatus was composed of *cientifico* technocrats who wanted to bring Mexico into the international limelight by inviting foreign capital as a means to develop the country's infrastructure. Although the level of economic growth achieved by the Porfirio regime was impressive, it came at a great social cost. The government's concessions to foreign capital, which came to dominate the country's productive resources, created a development model that benefited only the wealthy and foreign capitalists while the poor saw their average purchasing power drop in 1910 to one quarter the level of 1810. This unequal economic progress bred the discontent which fueled the revolution of 1910.

This historical account bears some resemblance to the present day events of neoclassical liberalization. Mexico again, after decades of foreign suspicion, is at a

critical point similar to the period before the Mexican Revolution. The disparities between rich and poor are widening and the middle sector is once again seeing opportunities being monopolized by the big industrial and financial conglomerates. Unless a path is laid out that offers opportunities to direct capital investment in socially meaningful ways, without jeopardizing national sovereignty and public and environmental health, future social unrest is fateful.

This option to regulate investment, however, is presently tenuous. As a class of transitions, the means transitions encompass all human institutions, and public policy necessarily stems from such institutions. Presently, Mexico is undergoing a political transformation from a strong one-party rule government to a more (at least rhetorically) open system. Transition theory predicts that in the process of this transformation, key sectors of the bureaucracy exert unproportional influence in favor of their mission. Depending on their self interest, the nature and mission of the eventual policy outcome will reflect the special interests of the new bureaucracy. Free trade for Mexico is a point in case: With the greater salience of all the ills, from the major transitions affecting Mexico today -the urbanization; demographic; toxic; epidemiological; and agricultural transition, obscuring the economic causes of the recent austerity program, special interests within the Mexican bureaucracy are once again directing political and economic policy toward their own end. Mexico's economic policy has been shaped since 1917 by two competing associations. One is composed of private bankers that have been influential since the Porfiriato period and the second by a coalition of varying interests under a corporatist system similar to ruling party's structure. The latter coalition consists of labor syndicates, peasants and government officials benefiting from government control of economic policy. These two influential associations have divergent interests and thus compete for dominance in economic policy formulation. The former group espouses the ideals of neoclassical economics while the latter has nationalist views and bureaucratic self interest. Not surprisingly, the banker's coalition has been the most influential in Mexico's economic policy, since its influence has coincided with the presence of foreign credits (figure 3).



Aside from the multinationals with manufacturing establishments in Mexico, the real beneficiaries of this financial integration to international markets were Mexico's private bankers. There are many reasons for this but the most cited factor is the protectionist nature of the economy. Mexico's international integration gave the Mexican bankers the freedom to purchase foreign short-term investments at the expense of long term domestic industrial investments and the multinationals the benefits of a protected domestic market. This factor in the Mexican economy hampered the development of a competitive domestic industry.

Lacking foreign competition and supported by government subsidies, the Mexican industrial sector had no pressing need to promote investment in improving labor productivity. Hence, Mexico's subsequent economic troubles stemmed from its inability to compete on the world market. The government was concerned mainly with developing the industrial sector by protecting its fledgling industries; but, at the same time, the policy suited the interests of the bankers whose money was freed for investment in the more lucrative foreign financial markets.

The political transition, if the theory of means transitions models the trajectory of the bureaucratic transition accurately, seems to indicate that centralization of the bureaucracy is directing Mexico's financial interests toward the lucrative international financial markets. What this indicates is a political transition toward power centralization

in the private interest coalition and away from the state. Most would argue that the political transition in Mexico is toward a pluralist democratic system. However, as previously mentioned, the salience of the austerity measures endured by the Mexican people, during the country's worse economic troubles, has obscured the fact that private interests, pursuing precisely the terms of unregulated activity in financial matters, is responsible for many of the problems. Ironically, the present political transformation toward an open economy (and an "open political system") is largely the efforts of Mexican capital, the financial sector.

In the Seventies, at the urging of private bankers, the Mexican government pursued a policy of international operation of Mexican banks. The strategy called for the merger of Mexican capital institutions which gave official recognition to huge financial conglomerates. The effect of this move was the further centralization of resources in a small and powerful oligopoly. The centralization of financial resources in the banker's alliance, assured them a monoposomy on cheap foreign credit which they then turned into huge profits for themselves.

Once these conditions were created, the government could only attract domestic investment and avoid capital flight through incentives rather than regulation. The government responded by raising interest rates which contrasted with low interest rates in other currencies. The result was high returns on short-term financial speculation; since financial speculators could go abroad and borrow at low interest rates then deposit it in Mexican banks on short term in domestic currency, then reconvert it to Dollars, huge profits were made at the expense of domestic reserves.

In short, the government's efforts to strengthen Mexico's place in the international scene was turned into an opportunistic venture by and for Mexico's financial elite. The incentives created by the government were misused by the financial sector to further concentrate wealth in their hands and stifle domestic competitive potential. Not surprisingly, the wealth was used for ostentatious consumption and capital flight. Table 1 illustrates that the private sector, between 1977-1981 increased its consumption of consumer goods and foreign assets. This increase in consumer goods indicates a luxury consumption by Mexican consumers.

TABLE I
Public and Private Sector
Imports

	1977	1978	1979	1980	Annual 1981 Growth	% of total import growth	
Total							
Private	64	63	66	63	65	50	65
Public	36	37	34	37	35	89	35
Consumer							
Private	78	80	84	49	58	66	8
Public	22	20	16	51	42	198	6
Capital							
Private	62	66	66	71	72	47	23
Public	38	34	34	29	28	32	8

The present political transition, on the surface, is not easily discernible as a means bureaucratic transition consistent with the theory of institutional transitions. If anything, it appears to contradict it. This, however, has to do with the institution that one examines. On the surface, Mexico's move toward pluralism seems to support the views of those who claim that the infusion of foreign capital and investment is correlated with an aperture of the political system. Mexico is said to be prime for an onslaught of foreign capital now that it is becoming politically less centralized and open to foreign competition. We must not forget that capital seeks high returns on investment and not to democratize nations. If Mexico is prime for foreign investment it is because of the centralization of power in the hands of the financial elite. The apparent aperture of the political system is a response by the financial coalition to strip power from the nationalist inclinations of the Partido Revolucionario Institucional (PRI). The government has been vilified by the financial sector ever since the bank nationalization of the Portillo's administration in the early eighties. As Maxfield has pointed out, the two agents have divergent interests in Mexican economic policy. The government seeks to regulate investment for industrial development while the financial sector seeks utter autonomy.

Given the financial strength of the latter group, it is probable that key members of the PRI have been persuaded of the government's potential isolation from international

financial funds. This qualitative observation can be substantiated by the increasing presence of so called *tecnicos*, who subscribe to neoclassical ideals of economics, in high government posts. These *tecnicos* are professionals trained in economics and public administration, usually in foreign universities. The parallels of the present politico system in Mexico to the structure of the political machinery during the Porfiriato period are tempting for making comparisons. The power transition within Mexico's ruling system certainly spells out a different agenda for political and economic emphasis; quite expectedly, the deregulation of foreign and domestic capital and the integration of Mexico into an international market is the logical next step. Viewing Mexico's experience with its bureaucratic transition and the international finance system in retrospect, it does not seem clear that the present capital transition will be moderated with the necessary macroeconomic policies to prevent a further polarization between national priorities and financial interests or between rich and poor.

THE CASE FOR FREE TRADE

The push for free trade is viewed by many as the only feasible solution to global economic stagnation. Others view it as a threat to national and economic sovereignty. Even among proponents of free trade no one unifying reason for their support can be discerned. Part of the reason is that free trade agreements have been instituted under various political and economic scenarios. Most countries have instituted trade relationships with neighbors and allies that complement their economies. There are numerous examples in South America, Asia, Europe, the Middle East, and even Africa. The currently proposed North American Free Trade Agreement (NAFTA) is just the latest formal agreement in which the United States is taking part. The United States already has a free trade agreement with Canada and Israel. Mexico too has agreements with the Central American economies to the South and Chile. Those agreements differ, however, from an agreement with the United States because they complement each other's economies in product differentiation not division of labor.

The virtues of free trade have taken a new prophetic zeal. It is unquestionably asserted that the quest of increasing the expansion of trade through liberalization will improve the lot of poor countries, its citizens, and the world. The problem is, however, that this assertion ignores the one important fact about free trade and Latin America, that free trade has been tried before and it fail to alleviate the problems that current free traders claim it will assuage. The argument for free trade from the vantage point of the North (the first world countries) is that it is the modernizing element of unproductive countries, the one element that brought Europe and the United States to the pinnacle of world hegemony,

and the only means by which poor societies can improve their lot.

The presence of free trade as an economic policy in Latin America can be traced from the 1800s to the onset of the Great Depression. Latin America's experience with free trade came as response to the nationalist and anti colonialist sentiments of the early nineteenth century. As a way to free itself from the mercantilist policies of Spain and Portugal, Latin America was quick to join the emerging free trade economies outside the Spanish and Portuguese empires. At the onset, free trade served the function of solidifying the region's independence but it soon proved detrimental for the region's industrial development. Much of the impediment of national industry had to do with the fluctuating values of primary exports on which the region depended. Despite all that can be said, the region's relationship with the rest of the free trade world was one of dependence and unequal terms.

Latin America's final disenchantment with free trade, however, culminated with the Great Depression. The event marked the end of the region's confidence in the export market of primary goods and the international capitalist system. This historical incident singled out the beginning of a political revolution in the region that produced a more aspiring political structure to deal with national economic matters. Hence, economic development policies post World War II emphasized the well known Import Substitution Model. Today the region's espousal of free trade and liberalization policies is reflective of the fundamental transformation in institutional composition of political power. Again a resemblance to the Positivist Liberalism of the North South struggle in the late nineteenth century can be made with regards to the neoclassical ideals of today's capital.

The inadequacy of free trade as a development model for Latin America can be generalized from looking at Mexico's worsening terms of trade since its trade with the U.S. began to liberalize, starting in the early eighties and up to the present. The increased trade activity in the eighties between the two countries was due to the rapid expansion of the maquiladora industry; judging from Mexico's worsening terms of trade, it is evident that Mexico's trade relationship with the United States is built on unequal if not exploitative terms. Figure 5 shows the gradual decline of Mexico's terms of trade from the period of 1981 to 1991. Since the maquiladora industry has become Mexico's second largest foreign currency earner and because Mexico is only exporting labor services through this sector rather than products, Mexico must continually devalue its labor costs to maintain competitiveness. In other words, for Mexico to buy a given stream of exports, it must increase its payment in labor. This contrasts greatly with the Asian tigers which have manage to increase the in value added of their export products and at the same time increasing their technological sophistication. This trade relationship for Mexico does not

constitute a sustainable economic development but it does serve the function of increasing profits for domestic as well as foreign bankers with assets in the maquiladora industry.

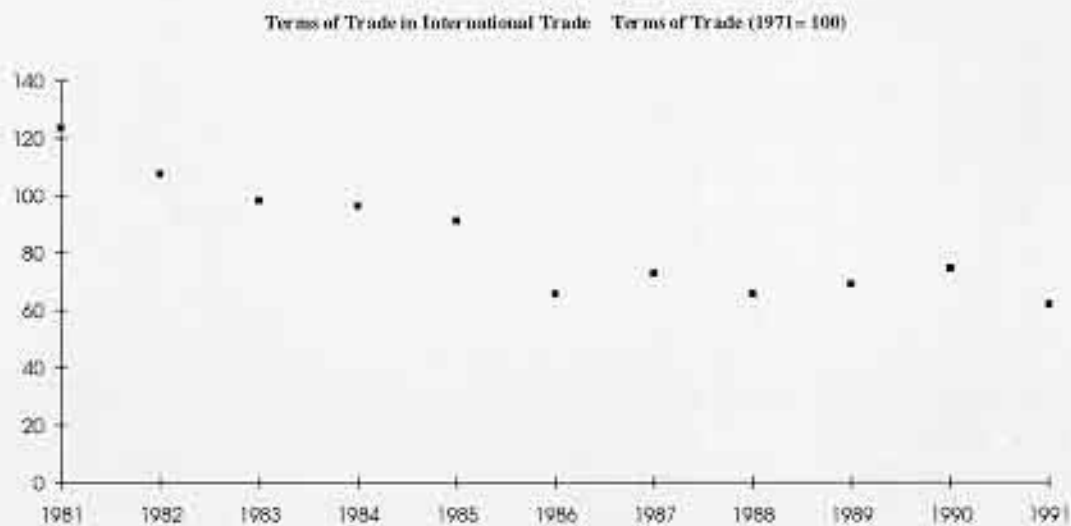


Figure 5. Source: Banco de Mexico Informe Anual, 1991

The uniqueness of the NAFTA is that no previous free trade pact extends membership to partners in different development stages. NAFTA will include Mexico, Canada and the United States. Mexico comes to the bargaining table with a radically different level of economic, political and entrepreneurial development from the other two

partners. Mexico's experience with semi-restricted trade only extends as far back as the early eighties. Prior to this period Mexico had pursued an economic model which by its nature invited heavy government involvement. With the exception of the financial sector in the seventies, the Mexican government, since 1945, sought to develop Mexico's economic potential through what is known as the Import Substitution Industrialization Model. Mexican industry was heavily protected from outside competition under this model. In addition, subsidies were allocated to industries the government felt were crucial to Mexican sovereignty and national capital interests. By the late 70s it became obvious that the Import Substitution Model had failed to develop a competitive industrial base. As previously mentioned, the financial crises brought upon by the government's desire to compete globally in the financial sector left the country with a shortage of domestic savings and a fiscal deficit. To fill the gap, Mexico resorted to foreign borrowing to finance domestic spending which led to the crisis of the 80s.

This salient moment in Mexico's history is the crucial point at which the bureaucratic transition in the political system first becomes evident. Table 2 and Figure 6 demonstrate this bureaucratic transition graphically. Because subsequent to this economic failure, the Mexican government began to liberalize the economy at great domestic and social costs. This sudden liberalization saw a big increase in the number of maquiladora manufacturing plants open shop in the U.S.-Mexico border region. In spite of the fact that the border region had been a free trade enclave since 1965, it did not attract the same level of investment to the region as did the relaxation of foreign investment. Companies were now able to have 100% ownership of their plants and a guaranteed 20% of the Mexican market for goods for which no Mexican equivalent was available. The push for free trade on the Mexican side is really a desire for a guaranteed access or preferential treatment to the all three countries' financial markets rather than in long term investments in small and medium size industries. Furthermore, a NAFTA will secure foreign speculative capital in Mexico's financial market by guaranteeing the safety of all capital with official government sanctions. A free trade deal with the United States, in its most optimistic projection for Mexico's smaller industries, will simply make the U.S. less protectionist toward Mexican goods. This is not a big concession for the smaller manufacturers given the two factors affecting this Mexican sector, unequal access to capital and a flood of cheaper mass produced products from the United States.

Number of State Owned Enterprises December 1982- May 1992

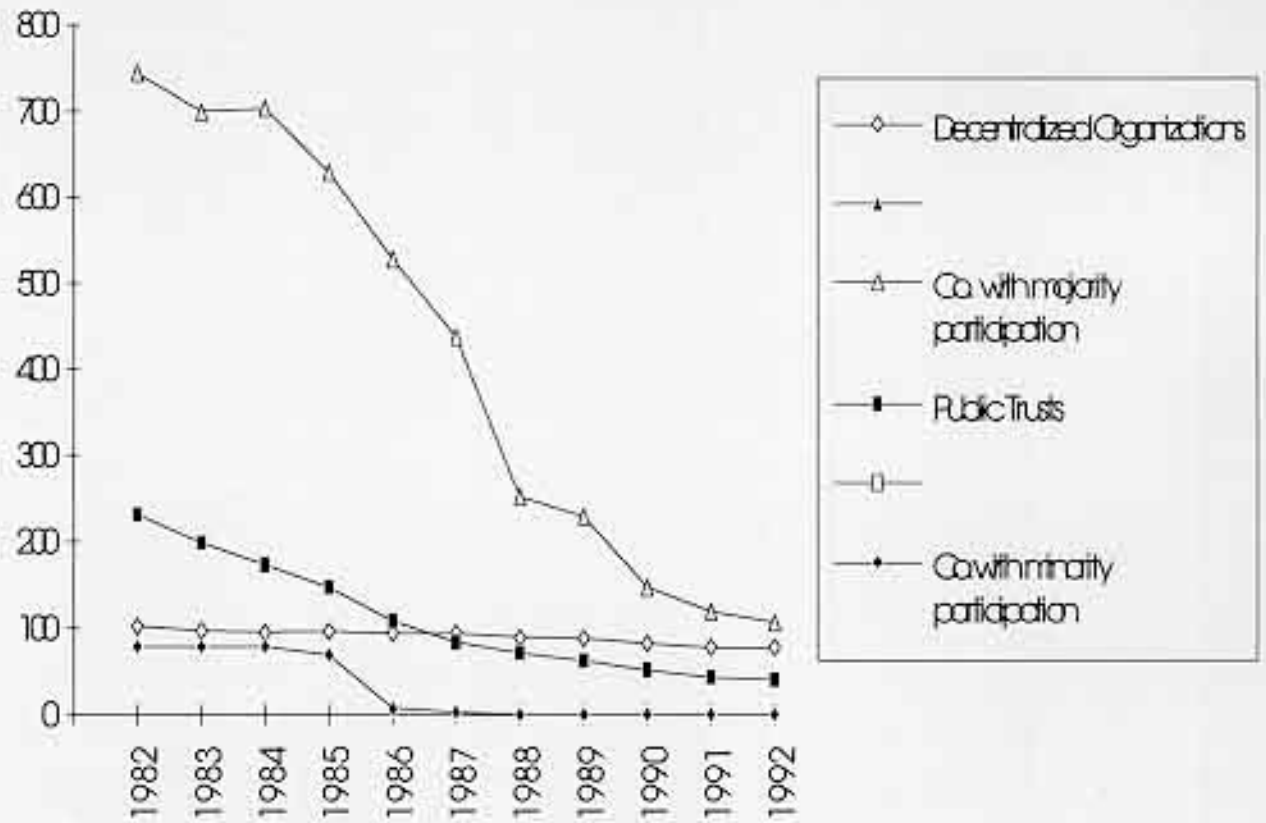


Figure 6 Source: OECD number country reports, 1992

Table 2
ADJUSTMENT POLICIES 1983-1990

	1983	1984	1985	1986	1987	1988	1989
Fiscal Stance							
Increase in primary financial Balance							
Financing of the Deficit by :							
Central Bank							
Commercial Banks							
Bonds (at market rate)							
Real Exchange rate rising							
Debt Rescheduling							
Privatisation of Public Enterprises							
Structural Policies							
Trade Liberalization							
Tax reform							
Financial Liberalization							
Income Policies							

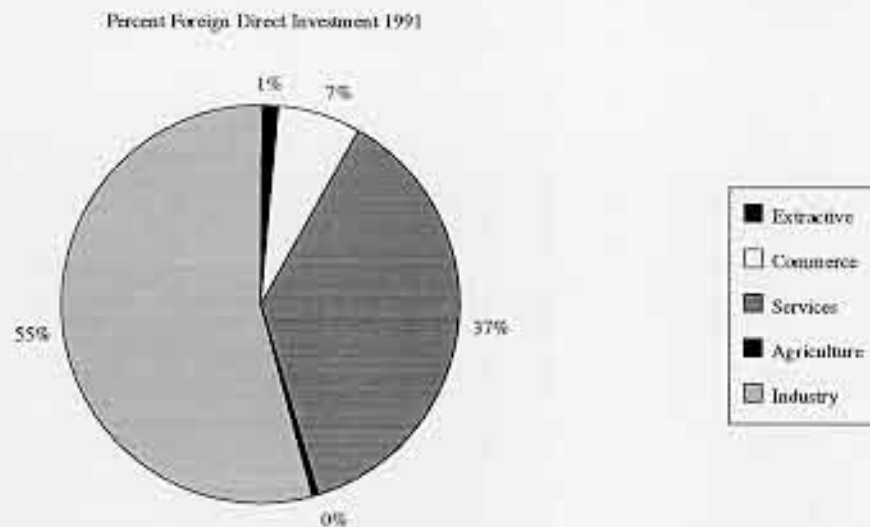
THE BUREAUCRATIC TRANSITION

As previously mentioned, the Mexican government began to play a very active role in the national economy after the Great Depression. In particular after 1940, the government's role in industry intensified. It provided many direct and indirect subsidies to its nascent industries through credits, infrastructure and protection from foreign competition. In 1973 it extended its active role in the economy by adopting legislation to control foreign investment. The legislation placed limits on the amount of foreign capital that could go into activities it reserved for itself and the percentage of foreign ownership in other areas. With the onset of the economic crises in 1982, and at the insistence by the IMF, World Bank, and private banks, Mexico embarked on a new economic strategy.

Trade and economic liberalization would now be the new doctrine that would

reduce Mexico's inflation and increase the competitiveness of Mexican industry. The attraction of foreign capital was to be the pillar of the new economic strategy. In essence, diminishing the state's direct role in the economy was to be supplanted by domestic and foreign capital.

Paralleling the withdrawal of the state from many areas of the economy, was the government's encouragement of export manufacturing. Because the national industry was in no position to compete internationally, due to its lack of capital for modernizing and other macroeconomic impediments, recourse to foreign capital became the new doctrine of economic policy. With the goal of raising foreign investment, Salinas government repealed laws that had barred foreigners from more than 49 percent ownership for all industries. He also eliminated the requirement of foreign companies to receive permission before taking over Mexican companies, and maquiladoras no longer needed official authorization for their establishment. These developments of government retraction enlarged the private sector (domestic conglomerates) and also encouraged the export of manufactured goods. Exports rose from 14 percent of total value in 1982 to 49 percent in 1989. Furthermore, the private sector's role in exports also increased (table 3). Coincidentally, the amount of foreign investment also increased (table 3). The majority of this investment, however, has gone into manufacturing for export. Figure 8 illustrates this point.



Given the exclusive access to capital by the big private sector in Mexico (financial and industrial conglomerates), they and Trans National Corporations are the only ones able to finance the industrial conversion to be internationally competitive. Not surprisingly, the beneficiaries of these privatization activities are the huge Mexican conglomerates and TNCs, which have replaced the vacuum left by the state's retraction. Small to medium enterprises have basically been left out of the benefits of the export oriented economic model.

Table 3

	Trade and Investment Private Sector % Total Exports	Foreign Direct Investment (Millions \$)
1982	13.7	1658
1983	19.8	461
1984	22.1	391
1985	21.7	491
1986	41.1	1522
1987	44.5	3248
1988	50.3	2595
1989	48.5	2500

Source: Salinas. Segundo Informe de Gobierno (1990), Mexico

THE MAQUILADORA INDUSTRY

The birth of the in-bond industry (maquiladoras) began in the 1950s in Puerto Rico as part of an industrialization program for the island. The Puerto Rican case, however, differed from the maquiladoras located in Mexico, the Caribbean, and Asia in that Puerto Rico is a commonwealth of the United States and is subject to U.S. minimum wages. Thus, Puerto Rico did not offer the competitive advantage of low wages typical of the in-bond industry in the other parts of the world.

Mexico's first maquiladoras were established in the Ciudad Juarez region in 1965. These original plants were mostly garment sweat shops. Today the industry is dominated by electronic plants and component subsectors. As of 1990, 1697 maquiladoras are in operation on the northern border of the United States. The distribution of these by state is as follows:

- 797 in Baja California Norte
- 133 in Sonora
- 370 in Chihuahua

109 in Coahuila

75 in Nuevo Leon

213 in Tamaulipas

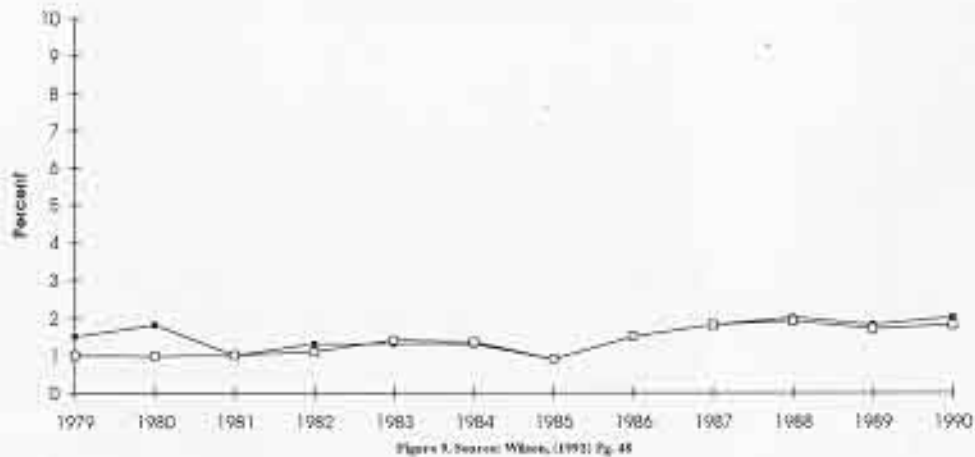
The majority of the products produced are assembled, products such as electronic circuits, for radios, televisions, toys and automotive parts. Not all the plants do assembly value added production, some actually transform products along with assembling. The point is that the product specialization of these plants and their proliferation contrasts sharply with the industry's initial function of an export-oriented regional development model. As already mentioned, the industry has become an essential element of Mexico's new national development plan. However, it is a development strategy in a climate of neoclassical ideology in which labor has no active voice except what the market dictates to it as a commodity. Table 4 shows that returns (wages, salaries, and benefits) as a percent of value added have declined since 1981.

TABLE 4
Declining Benefits of Maquiladora Employees
Labor Costs % Value Added

1975	61
1976	64
1977	60
1978	58
1979	59
1980	61
1981	60
1982	53
1983	47
1984	52
1985	52
1986	45
1987	46
1988	49
1989	51
1990	51

The changing global economy is no doubt manifested in these maquiladora industrial sectors. Their search for higher profits has shifted production to low wage countries whose only comparative advantage is to be poor. For Mexico, this strategy was to aid it in developing the internal input networks to the maquiladora industry that the Asian Tigers were able to accomplish; but the overall use of domestic inputs has not done so well. Figure 9 shows the limited use of Mexican inputs in maquiladora production which unambiguously translates into a manufacturing strategy dependent on foreign inputs of technology, capital, and raw materials, and on an external market; incapable of stimulating a diversified internal industry.

Maquiladora Use of Mexican Inputs, 1979-1990



As incentives, these maquiladoras are generously rewarded by the government to import raw materials and machinery for the purpose of exporting; since these maquiladora industries are a strategy of cost reduction, the government subsidies have to be in the form of infrastructure expenditure. Table 5 illustrates the success the incentives have had in attracting plants to the region. Within a decade, the presence of the industry has been substantial. Because making these plants pay for the investment in infrastructure would be self defeating. The problem with this type of government support is that it comes in the form of roads and industrial support, good for transport and maquiladoras, but not in basic services for the burgeoning urban centers. According to Gonzalez-Arechiga and Barajas, these plants have not compensated the local authorities their share of the infrastructure costs due to the in-migration stimulated by their presence.

Table 5

Maquiladorization of border region		
	1981	1991
Northern Region		
Baja Ca.	16598	102805
Sonora	39863	78181
Chihuahua	71573	223463
Nuevo Leon	76269	134816
Tamaulipas	201687	244085
Aguascalientes	49680	131122
	18500	35705
Total	474170	950177

The further promotion of this type of industrial activity under the auspices of free trade (NAFTA), given the circumstances alluded to above, suggests grave prospects for the environmental and public health of the border region. In particular, the plants established during the eighties had little operating restrictions placed on them due to the priority given them by the government as a viable economic strategy. NAFTA may in fact alleviate some of the environmental problems but it seems doubtful in that the border region will be no more open than under NAFTA; and to say that big business pushed for a NAFTA only to have the environmental play rules changed on them seems not plausible.

Many laws do exist in Mexico to control the ravages of toxic waste produced by the maquiladora industry. The maquiladora decree for the operation and development of such industry, for example, is straightforward about the regulation of waste disposal. It states that all waste generated from hazardous materials imported into Mexico as part of the manufacturing process must be returned to the country of origin. The record on compliance, however, is not very good. The EPA, claims that no more than 20 companies operating in 1987 out of more than 1200 exported their hazardous wastes back to the United States.

Clearly there are environmental and health risks associated with the operation of these type of plants. The risks come not only from the operation of the maquiladoras but also from the differing safety and health standards used in the maquiladoras as opposed to

the standards used in the home plants.

There are many areas which one could direct attention to in order to gauge the public and environmental health risks as a result of the rise of maquiladora industries along the U.S. border region. The public and environmental health risks are due to many factors associated with the function of these industries. The presence of hazardous chemicals, the conditions of the work endured by employees, poor planning for major catastrophes and the underfunding of the enforcing agencies. But since little data exists that shows an unambiguous negative causal effect of these plant operations to the workers, and the potentially negative impacts to the industry if workers became informed of the risks, one can only infer very qualitatively that a reciprocal relationship exists.

As a closing remark, and to stimulate curiosity, it is provocative to look at a couple indicators of general well being in the border region. The following figures are for the state of Sonora, which is on the Northwest corner of the mainland of Mexico. This state is a recent host to the maquiladora industries. The health indicators are for the areas of the state known as the central border area and the northern border (see the map broken down by regions), these areas have consistently had the highest mortality rates in the last few years, table 6 shows the general mortality rates for this region; Figure 10 shows a decreasing trend in infant mortality rate, but the border region's rate, where the maquiladora concentration has taken place, exceeds the mean for the state. A causal relationship?

Table 6

General Mortality Rates in the Border			
	1985	1986	1987
Center Border	6.1	5.2	5.9
Northern Border	5.4	5.2	5.2
State Rate	4.8	4.6	4.5



Sonora

Center Border

Northern Border

Sierra Alta

Infant Mortality Rates in Sonora's Border Regions and Sierra Alta

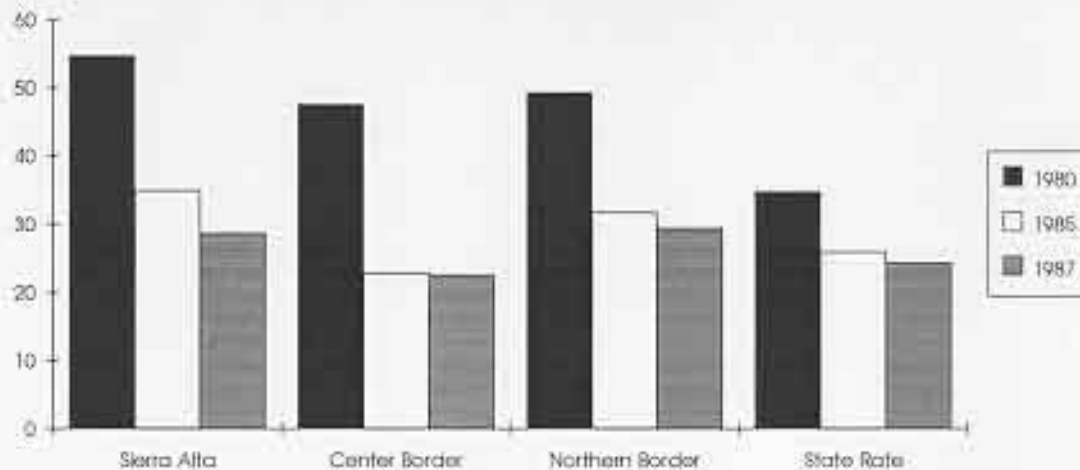


Figure 10. Source: Statistics from the Government of the State of Sonora

POLICIES

The policies being proposed here are not new but need reemphasis. They are of two components; one deals with policies the Mexican government can pursue to develop the long-term competitiveness of the Mexican industrial sector; while the second one is concerned with the long term protection of the natural ecosystems along the United States and Mexico border. The objectives would be to:

*Develop an economic development strategy that promotes an integrated industrial network.

For this to happen, Mexico has to take direct involvement in the way foreign investment is allocated.

-Mexico has to reduce the level of disparity between the big conglomerates and the medium and small industries. To do this, the government has to facilitate access to capital for the smaller industries. This will allow this sector to modernize in order to compete internationally.

-Resources have to be directed toward education, training and acquisition of technology in order for the country to develop native technology

-Reduce specialization by reducing reliance on the export development model.

*Implement existing environmental laws.

For Mexico this means an increase in the number of technical experts for the Mexican border environment.

- Provide technical assistance for Mexico through U.S. technical units.
- Increase the funding for Mexico's EPA equivalent agency (SEDESOL) for their border area operational budget.
- Create an enforcement strategy with the cooperation on both sides of the border.
- Build the enforcement capacity of both sides of the border.
- Do cooperative training visits to facilities on both sides of the border.
- Do workshops and exchanging of personnel and information for both sides of border.
- Develop a database on the waste sites and the movement of hazardous waste.
- Do more and more cooperation.

*Develop new enterprises to reduce pollution.

This goal would be implemented by increasing waste water treatment on the Mexican side.

- Expand existing facilities to accommodate present and future residents.
- Improve waste water treatment systems.
- Construct waste water collection and treatment plants in the densely populated regions of Mexico,
- and improving industrial waste water treatments.
- Monitor and identify end of pipe waste.
- protect water supplies.
- Inventory and monitor water sources, quality and treatment processes.
- Prioritize drinking water protection.

Initiate industrial source controls to reduce air, water and land pollution.

- Collect data on toxic releases from industrial facilities in Ciudad Juarez and Tijuana.
- Target enforcement actions and pollution prevention programs in Ciudad Juarez and Tijuana.

Improve the disposal of solid and hazardous wastes

- Finance equipment for landfills or construction in all the Mexican border cities with large populations.
- Improve detection and reporting of illegal transboundary shipments of hazardous wastes.

CONCLUSIONS

The dynamic between the relationship of trade and environmental and public health has become an important consideration for policy makers concerned with the diverse affairs of statehood. The present transition of capital overtaking state bureaucracies all over the world illustrates the need to be critical about our understanding of this phenomenon. As political boundaries become defined by patterns of economic activity,

public institutions become less a means of moderating injustices brought upon by the invisible hand of the market system and more a vehicle of power and wealth concentration. The internationalization of capital works to destabilize the power structure of political institutions. Unable to allocate investments to areas that are more consistent with national priorities, states are helpless to resist exploitative terms of trade. The inevitable result is a polarization of the world between rich and poor.

Transition theory helps to gauge phenomenon and its trajectory within a population environment dynamic. It is an attempt to understand the event at present in order to make predictions about it. From examining the regional impact of a particular transition, generalizations can be made to the outside world. Mexico is a case in point, for it is in its initial stage of the capital transition. The country has undertaken policies that have transformed the political bureaucracy and its place within the global economic sphere. These changes have come in a relatively short period of time; the events driving these changes have launched the country into a volatile rank in the community of international capital. Unless the country takes direct steps to guide its economic development, it risks a constant place in the periphery of the global economic domain.

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⁰See Nancy Birdsall and David Wheeler, "Openness Reduces Industrial Pollution in Latin America: The Missing Pollution Heaven Effect". Paper prepared for the World Bank Symposium International Trade and Environment, Washington D.C., November 21-22, 1991.

⁰Ibid., Pg. 32

⁰Ibid., 32

⁰This notion of Mexican economic policy as a competing struggle between coalition forces differs from traditional arguments which see the state and private interests as complementary to each other rather than with differing interests. The latter theory, however, is more instructive of the bureaucratic transition taking place. See Maxfield Silvia, *Governing Capital*. Cornell University Press, 1990. (pg. 10).

The corporatist system is identified with the Mexican ruling party because of its ability to incorporate all of Mexico's special interest groups under one body, the Partido Revolucionario Institucional (PRI), hence an institutional corporation.

⁰Esparza R, Ramiro, et al., *La burguesia Mexicana* (Mexico D.F.: Editorial Nuestro Tiempo, 1978).

⁰Quijano M. Jose. *La Banca: Pasado y Presente.*, Mexico, D.F. : 1983. (PP.195-210).

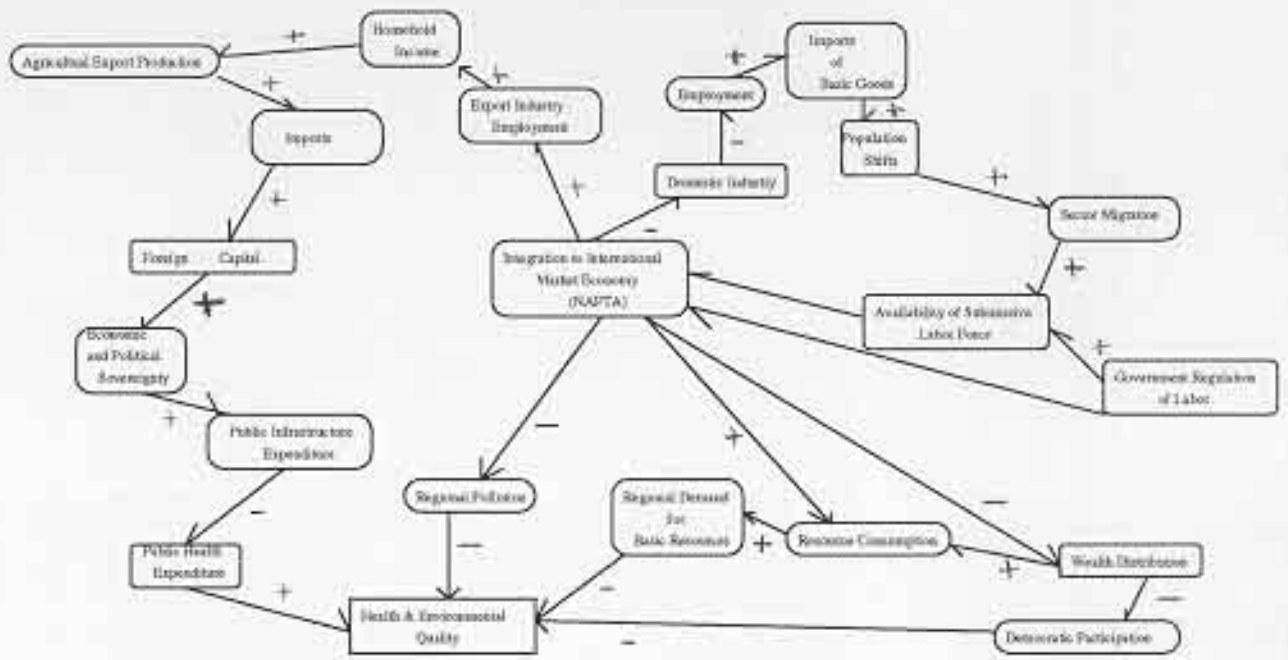
⁰Banco de Mexico, *Indicadores de Moneda y Banca*. Mexico, D.F.: Banco de Mexico, 1975-1982.

⁰See footnote number 4

⁰See Cornelius A. Wayne and Craig I. Ann. *The Mexican Political System in Transition*. Center for U.S.-Mexican Studies, University of California, San Diego. Monograph Series, 35. 1991.

⁰See Gonzalez-Arechiga. B., Barajas., et al. *La industria Maquiladora Mexicana en los Sectores Electronicos y de Autopartes*. Mexico. (1989) P.332

⁰See "The Maquiladora Industries: Hazardous Waste Management." EPA-SEDUE, 1st edition, November 1989.



THE POTENTIAL ROLE OF URBANIZATION IN ACHIEVING GLOBAL SUSTAINABILITY TOWARDS ESTABLISHING AN URBANIZATION TRANSITION MODEL

Bruce Frayne

PART I: GLOBAL SUSTAINABILITY AND URBANIZATION

Paper Overview

This paper sets out to explore the usefulness of developing a model of urbanization to policy makers and planners in developing countries. In so doing, a number of issues are explored. The broadest of these relates to the question of global sustainability. Why is there mounting concern about the future of the world; is this concern real; is it receiving the priority that it should; what are some of the obstacles to achieving a more sustainable future? These questions are touched upon in this introduction. Also of interest is the question of societal development. This refers to the path that a society might take in its transition from one stable state to another. This can be both positive and negative, but to contribute positively to the future development of the world, avoiding large scale catastrophes, such a transition requires certain preconditions and inputs over time and across sectors (Ness, *et al.*, 1993). An argument is constructed around these issues for high levels of urbanization at a global scale as a means of improving the socio-economic status of less developed and developed societies (as the fortunes of both are inextricably linked). This argument assumes that efforts at bringing population growth and industrial growth within the constraints that sustainable development imposes requires the social and economic development of the world's population to levels similar to those already achieved in the developed world. Hence urbanization is key to achieving such an outcome.

Urbanization is also an inter-sectoral phenomenon, involving all aspects of human society and economy. Given the apparent irreversibility of urbanization throughout the world (Potter, 1985), it is therefore even more imperative for the successful evolution of human society at a global scale that investment in the urban sector is sufficient to optimize the transition of all sectors to a desirable and stable equilibrium state. The model developed in this paper is intended to provide a tool for policy makers and planners to better anticipate the urbanization transition as it occurs and to therefore invest appropriately in all sectors by adopting an aggressive proactive stance aimed at achieving a sustainable equilibrium. This could provide an important shift from the characteristic remedial planning and investment that occurs in much of the developing world. It is, however, recognized that many such countries do not have the resources to achieve the goals explicit in the model, and will therefore require greater international assistance. The explicit assumption is that it is in the interests of all peoples and countries of the world for the developing world to urbanize rapidly (which is already happening) and positively (which is less evident) as this is crucial to the cooperation required to implement global policies aimed at achieving a sustainable equilibrium. Therefore it can be argued that coordinated and large-scale investment by the wealthier countries of the world in promoting urban development in less developed regions (particularly in the spheres of health and education) is rational and desirable.

Finally, the demographic sector of the urbanization transition is considered within the context of a developing country. Namibia has been selected for this purpose. This case study is not intended to be comprehensive, but is the first attempt to put one element of the model into effect, and to gauge the potential thereof as a predictive and management tool. Ideally, all sectors outlined by the model should be considered, and integrated to provide the data needed to promote typically discrete sectoral planning activities in the country.

Is the World Really About to Collapse?

The end of the world has been predicted by many different people and institutions throughout much of recorded history. The notion of life being flawed by difficulties and challenges apparently beyond the scope of creative human solution pervades almost every theme of personal drama and history recorded through the annals of time. According to the Bible, Noah and his sons were the first to narrowly escape the destruction of the world by flood, and this provided a warning from God-the-creator to the unrighteous of the world of their precarious physical existence. Promises of destruction by fire and the looming apocalypse described in the book of Revelations were composed more than a millennia ago, and yet still tell of the end of the world for many millions of people across the globe. Living in the Dark Ages, the famous visionary Nostradamus (1503-1566) made many fearful predictions about the course which modern history is supposed to follow. While not proclaiming the end of the world, global war and destruction are all part of his vision. The Renaissance saw the birth of a more scientific era, and social commentators in recent centuries have moved away from the notions of brimstone and fire as their rationale for global demise, and now consider more objective measures of where our civilization might be headed. Perhaps one of the most significant of these was Malthus (1766-1834) who predicted the inevitable collapse of the world by plotting population growth against the ability of a finite resource base to meet the consequent demand for food. The conclusions were obvious and simple: the world does not have sufficient resources to sustain an infinitely expanding population.¹

The literature abounds with micro and macro studies concerning the ability of the world to sustain the increasing pressures which human population and its associated activities place on the natural resource base. Decades ago scientists and planners were predicting disaster after disaster: range lands have been poised on the brink of collapse for half a century in much of rural Africa; toxicity measures of the land, water and atmosphere continue to suggest that our very life blood is being contaminated to the point where we are becoming so diseased that there is no longer any available cure; rain forest destruction and desertification not only destroy thousands of species of fauna and flora not yet understood by humankind, but intensify the struggle for survival of many millions of peasant farmers around the world, exacerbating starvation and needless death. Yet despite these predictions of doom, the world continues to grow and to consume, and each year the international community revises its cries from every political and scientific corner that unless immediate action is taken on this or that key issue, the world faces a non-sustainable future.

This makes it easy, and even tempting, to accept the possibility that humankind will find ways to survive and even to continue to expand and consume that will not necessitate radical changes in either global resource allocation, demographic patterns, or the prevailing unequal modes and rates of consumption. Perhaps technology and political cooperation will advance apace, facilitating a better life for the world's burgeoning population as it evolves. Perhaps technological advancement will place the extra billions of people and billions of tons of waste and garbage on other planets in far away solar systems. Perhaps we will even exploit the resources of other worlds to satiate our own appetites. However, perhaps not.

So who is really correct; the optimists who believe that all will be fine in the end, somehow or other, or the eternal pessimists who preach nothing but environmental and social collapse? The difficulty of taking an informed position in this debate about the future stems in most part from our inability to map out, with any degree of certainty, the world's growth path. If it were possible to know all variables, their interactions with each other, including the human element which is all but non-predictable, and somehow feed all this into a computer simulation model which has yet to be invented, then perhaps we might get close to a prediction of what the future is going to look like, all things being constant.

However, this is clearly impossible². So what are we left with? Well, we are left with an enormous body of evidence, scientific and anecdotal, that the world cannot expect to continue along its present path of growth without at least incurring certain costs which will be of no benefit to the world as a whole, and which will almost certainly have dire negative consequences for large regions of the globe. These include large-scale desertification, particularly in Africa, Asia and South America, continued exponential population growth, global warming, rising toxicity, insufficient potable water, food shortages, growing illiteracy, and rising conflict as competition for scarce resources sharpens. Yet even here it is not possible to accurately quantify these processes, and predicted outcomes vary widely³. In any event, even if some of these factors (and this list is by no means exhaustive) are non-consequential, enough of them are real and have an outcome probability sufficiently high to warrant serious consideration.

Transition Theory

Transition theory suggests that societies move from one stable state to another, although different, state of equilibrium. The move, or transition, from the first state to the second is the change through which society must go as it grows and evolves. Thus as this change happens, it necessarily does so across many different elements of society, and includes changes in demography, epidemiology, deforestation, toxicity, agriculture, energy, urbanization, and many more sectors (Drake, 1991; SNRE, UM, 1992). These changes appear to occur at different scales through time and across space. The timing of these changes relative to each other is crucial to the nature or character of the transition, and will affect the end state reached. Further, the theory argues that for "each transition there is a critical period when society is especially vulnerable. During that period, rates of change are high, societal adaptive capacity is limited, in part, due to this rapid change, and there is a greater likelihood that key relationships in the dynamic become severely unbalanced" (SNRE, UM, 1992: 1).

The importance of a theory such as this for policy formulation and planning activities at a range of scales is that it is conceptually simple, thus providing a *modus operandi* for dealing with what would otherwise be an impossibly complex set of dynamics. By plotting the transitions occurring with any one region or country, it is possible to gain some understanding of what the most vulnerable sectors of the society are within a particular time reference. Also, by using precedence, it is possible to compare the transitions of a given region or country with those of a society which has progressed further within the same sector. Comparative evaluations as suggested here potentially provide valuable information for the society under consideration, and assists policy and resource planners, with the wisdom of the experiences of other countries, to adjust policy and investment with the aim of either emulating a positive example of transition, or avoiding potential problems if possible. Thus this theory provides a potentially powerful planning tool. It is from this perspective that the theory is used in this paper. The conceptual model developed for determining the urbanization transition for a given society is intended for use by public policy and planning agencies in the developing countries of the world in which transitions are occurring simultaneously and rapidly, and thus increasing social vulnerability (see Figure 1, Part II).

PART II: ESTABLISHING AN URBANIZATION TRANSITION MODEL

Urbanization and Transition Theory

Urbanization is one sector within the family of transitions that work concurrently to shape the development path or transition of a particular society from one stable state to another stable state. Similarly, urbanization is itself a multi-sectoral phenomenon, and cuts across a wide range of social and physical service sectors. Also, urbanization has a strong economic dimension to it, involving shifts in the division of labor and modes of economic production. Linked to this transition is an associated change in social norms and behavior, and levels of education and health, which in turn affects demographic structure (Potter, 1985). Thus the process of urbanization is many things, and it is within this characteristic that the potential to accelerate a society's transition from a so-called "traditional" state to a more "modern" state lies. Indeed, many countries of the developed world indicate that a largely urban society achieves a social, political and economic organization which is conducive to promoting or achieving a desirable and sustainable equilibrium state. However, like all transitions in the family of transitions proposed by Drake (1991), this requires particular inputs over time. If key variables such as education and health are inadequate to significantly reduce literacy, promote entrepreneurial activity, and improve life expectancy and general well-being of the population, urbanization may not bring about a desired end state for the particular society in question. Also of importance is the interaction between all sectors and transitions which are occurring over time such as toxicity, deforestation, agriculture, and so forth. Thus the argument for urbanization as a means of reducing population growth rates, improving economic development, moving towards a sustainable use of environmental resources, and achieving a better standard of living for the world's people by moving towards a positive equilibrium state, hinges on the ability of societies to understand the likely products of interactions between key variables affecting that society's aggregate transition, and to use policy to direct investment into the most important areas which optimize the chances of attaining a sustainable equilibrium state.

The demographic dynamic at play in many poor and underdeveloped countries such as Namibia, is one which makes it impossible, given current levels of technology available, for the land to continue to support a rapidly growing and rurally-based population. While the extent of environmental deterioration, particularly of range lands⁴, is difficult to determine and difficult to quantify in economic terms (Cousins, *et al.*, 1988), evidence suggests that the rate of deforestation and desertification in many African, Asian and Latin American countries is such that it represents an unsustainable use of existing resources. Further, such countries are typically experiencing a lag in the education transition, with the result that infant and maternal mortality rates are declining and contributing to the high growth rates. Moreover, the impact of these factors on the transitions of other sectors such as toxicity and agriculture is negative, thus decreasing the chances of improving the standard of living for most of the population once it reaches a state of equilibrium. As suggested by much of the literature on this subject, the likely scenario in a situation such as has been described will be one where population and food production decrease rapidly, with an equilibrium state being reached where both the environment and the human race is adversely affected (Meadows, *et al.*, 1992, Sadik, 1990, Commoner, 1990).

In many rural areas in countries of the developing world, an increasing number of households are becoming poorer. In Namibia, the average (semi-) subsistence farmer in the northern regions has access to land of less than 2ha, whereas a minimum of 3ha is required during years of normal rainfall to produce sufficient grain to feed the household and carry sufficient surplus for planting seed for the next season. Moreover, about 50% of households have no cattle at all as they are unable to meet the costs of acquiring stock, and in many instances are unable to find sufficient pasture on which to graze them. Shifts in political boundaries and unauthorized fencing by more powerful farmers have reduced the range land available.

Further, research suggests that one of the primary reasons for the poor levels of household food security within these communal farming areas is due, in large part, to the lack of draught power. Without access to oxen it is not possible for a farmer to prepare by hand sufficient land (3ha) for cultivation to ensure adequate food supplies for the year. Female headed households are particularly vulnerable in this regard (FAO/IFAD, 1992; Næraa, *et al.*, 1993). As a consequence, land management is now far more opportunistic, and in the absence of any form of cooperative land management system, leads to further denudation of grazing and environmental damage (Behnke & Scoones, 1991). Competition thus increases for land and the poorer and less powerful households are further marginalised, finally being forced, for economic reasons, to migrate to an urban area. For these reasons alone, urbanization is likely to continue for many decades to come in countries with low levels of urbanization and high levels of population growth. Strategies for slowing urban growth are important, but should not be done at the cost of investment in the urban areas. Without significant urban investment the potential offered by urban growth will not be realized, and conditions for poorly educated families with few resources may well be little better than they were in the rural areas.

Furthering the economic argument for urbanization over the maintenance of a largely rural population in countries which have limited resources both for exploitation and investment, and where the environmental resource base is deteriorating with land use pressures precipitated by population growth and inappropriate land management practices, is the fact that concentrating people in urban areas potentially provides an opportunity for economic growth, and ultimately, socio-political development. The rationale is that capital-labor ratios are higher in urban areas (infrastructure and industry) than in rural areas, and consequently, moving labor to the towns raises total factor productivity (that is, production for a given stock of inputs). At the same time, there are economies of scale both in industrial development and, to a much greater extent, the provision of services. Consequently, the investment in urban areas is more effective than in rural areas (Davies, 1993). Urbanization therefore provides increased opportunities for industrial and service infrastructure investment in urban areas, and increases the degree to which people have access to both economic opportunities and social services. Urbanization has the potential to improve the living standards of large numbers of people, thus influencing the demographic transition⁵ of the society to a more stable state, and raising literacy levels, so facilitating the cultural or socio-behavioral transition (Potter, 1985) of the population to a point where widespread interest in the future and cooperation in achieving a desirable future are more possible.

In order to capitalize on such benefits derived initially from improved economies of scale resulting from a process of urbanization, large scale and consistent investment is needed in urban areas that seeks to encourage industrial development (both formal and informal), and invests in service infrastructure. While such a strategy appears to hold little potential for alleviating much of the economic and environmental pressure in the rural areas, it does, as suggested earlier, hold significant potential for improving the medium to long term development prospects of the population as a whole. This is not to suggest that meeting basic needs in the rural areas should be ignored, but rather that rural development *per se* has little potential to raise the standard of living of the population (due to poor economies of scale and environmental pressures), and should thus not be pursued as an alternate to urban growth, or as a means of halting urban growth. Without large scale urban growth, Namibia's population will not be able to continue to sustain its growth within the medium to long term. Urbanization provides a means to overcome this, and to improve the socio-economic development of the population which is in the long term interests of sustainable development and the achievement of a desirable equilibrium state.

The model presented in Figure 1 represents the interaction of the major variables which influence the growth of the primary urban area in a particular region or country. In fact, this model can also be read as the interaction between major variables influencing the transitions of demography, environment, economy

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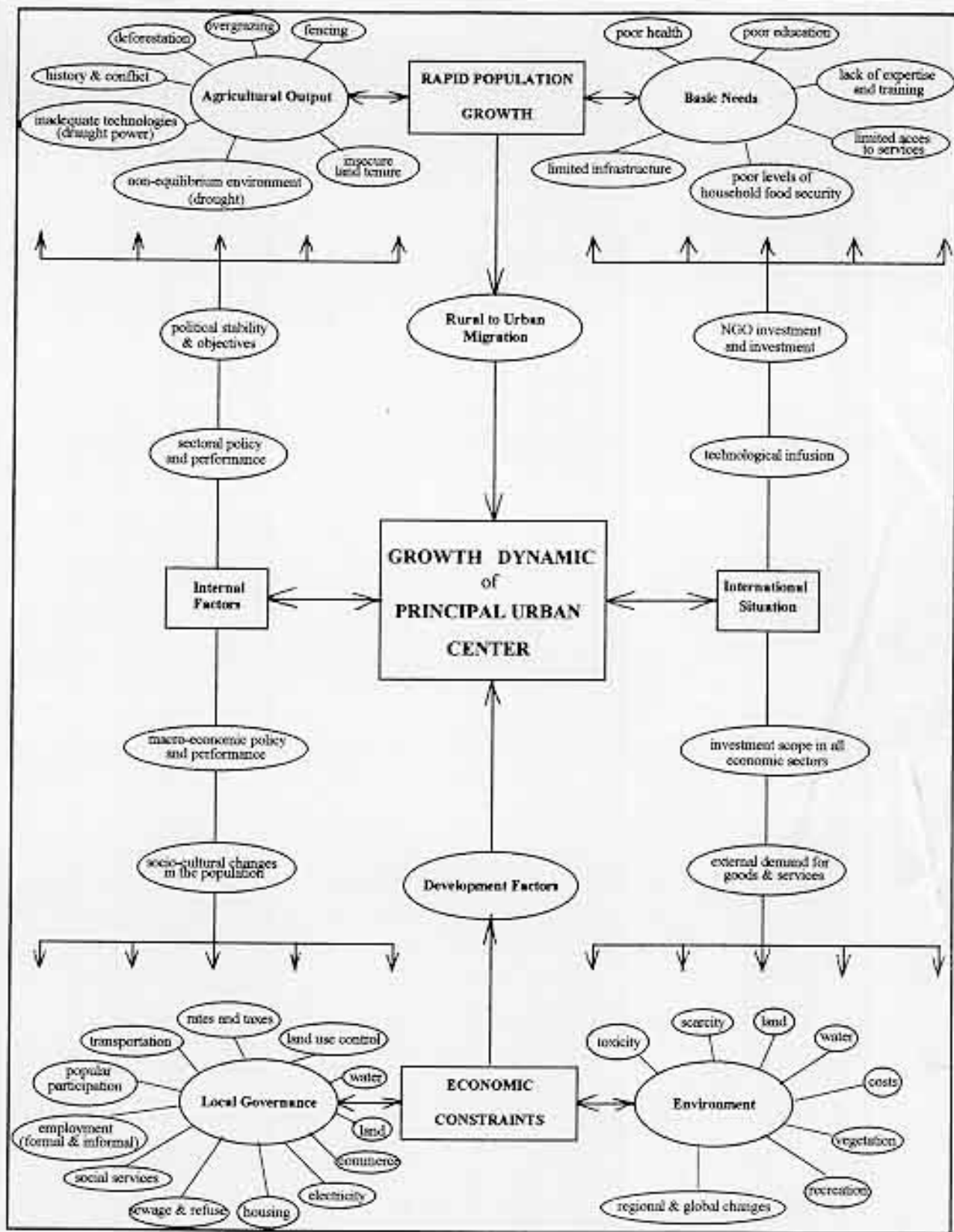


Figure 1. Possible model showing major variables influencing urbanization within a developing country.

on the area of interest to that particular ministry or planning office. Due to the highly interactive nature of and society. It is for reasons of purpose that the model has been constructed to measure or predict growth of the urban center. Ideally, this model would be used by planning agencies across all sectors, receiving information from all other sectors, and thus plotting the likely impact of the variables on all the variables which go to make up the system. However, it is clearly impossible to take data for one time point and use the model to make any kind of long term predictions which are reliable. Thus it is important for the model to be seen as a tool for incremental planning. As data is received and as variables change over time, so the planners and policy makers will need to adjust the conclusions at which they arrive.

Establishing a Comparative Framework as a Method of Analysis

Urbanization is a highly complex phenomenon, and unraveling it sufficiently to provide a useful method of analysis is difficult. The challenge lies in devising a sufficiently simple method of analysis to overcome the unmanageable complexity of the real situation, yet with enough power to integrate key variables influencing urbanization, giving the method an element of predictive power. Ideally, therefore, the method adopted should be comparative, relying on precedent from societies which have already passed through the particular transition under study. This requires both knowledge and judgment on the part of the researcher; knowledge of the history and development of other societies, and judgment in selecting the most appropriate example(s) for matching/comparing purposes.

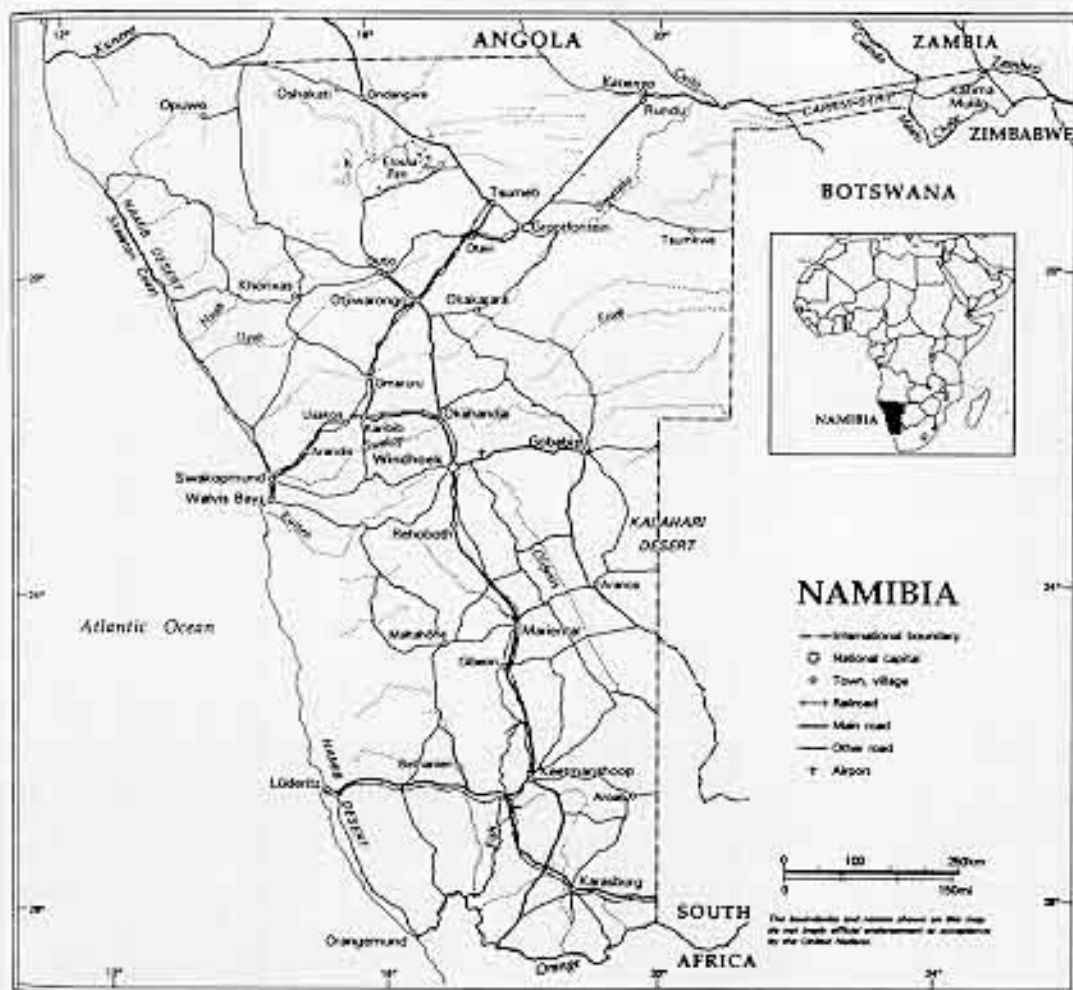
Such a method does not preclude the analysis of the transitional trends within the society under study, and plotting trends on the basis of historical data is an important component of the method. By using precedence in conjunction with historical data, it is possible to at least base the trends developed for various transitions on an approximation of a historical case. Local variations would need to be considered in plotting the curves, as these may alter the transition curve significantly from that provided by the precedential case study. An important element of the method is that it is well suited to an incremental approach where major changes in variables can be incorporated into the data, and new predictive curves plotted. This creates a dynamic interface between policy, research and data.

This method outlined is broad and can be applied equally to all variables/sectors outlined by the model. It also allows for data to be aggregated, and this is useful for developing a measure from precedence which is more general than would otherwise be obtained from only one example. However, time and data constraints have not allowed for the use of a comparative method in the analysis of the possible growth path of the capital city of Namibia, Windhoek (see Part III).

Ideally, population data would be obtained from developed countries with high levels of urbanization, which would then be aggregated. Curves would then be fitted to this data to find the best fit. This function could then be applied to the data for Namibia, and the degree to which they match used as a predictive tool to estimate the likely population at which the city will stabilize.

It follows, too, that developing countries which are significantly further ahead than Namibia in their respective urbanization transitions might also be used in this comparative manner. In order to ensure some validity of such a method, many assumptions would need to be thoroughly investigated and tested. These include total population growths estimates, levels of urbanization, similar and distinct variables between the countries selected as precedent and the case study, and so forth. Thus, while a comparative method provides a good conceptual means of operationalizing the urbanization model, the case study only employs historical data from Namibia.

MAP I
Namibia in Context



Source: UNICEF/NISER (1991)

PART III: URBAN TRANSITION IN NAMIBIA: THE CASE OF THE CAPITAL CITY, WINDHOEK⁶

Country Overview

Namibia presents a model to the world of a smooth and successful United Nations (UN) assisted transition following the implementation of UN Security Council Resolution 435 from a colonial, conflict-ridden state to a peaceful and stable democracy (UNICEF/NISER, 1991). After 23 years of guerrilla war waged by the South West Africa People's Organization (SWAPO) against the South African Government who, for more than half a century, ruled South West Africa⁷ as a colony, negotiations for a settlement which would end the conflict and lead to a withdrawal of South Africa from the country commenced in 1989. The leader of SWAPO, Dr Sam Nujomo, returned to his native country for the first time in decades to assume the role of President of the world's newest independent nation. Independence was achieved on 21 March 1990 after what were considered by the international community as "free and fair" elections in which SWAPO won by a 66% majority. Thus political and popular expectations are high for Namibia, and yet it faces many difficulties and challenges as it tries to forge a new national identity and reduce the inequalities which abound across all sectors of the society (Strand, 1992).

Namibia's income is highly skewed, and is reflected in the population's unequal access to a wide range of social services. A legacy of colonialism, war and *apartheid* policies have resulted in a largely unequal society which "continues to pervade virtually every sphere of social and economic life" (Tapscott, 1992: 1). An indicator of this reality is that the top five percent of the population account for approximately 71% of the gross domestic product (GDP) while the poorest 55% control no more than three percent (United Nations, 1989). Despite the tremendous growth of the civil service which has employed primarily black people since independence, much of this inequality remains defined along ethnic and racial lines. The systematic deprivation of perhaps more than 90% of the country's population from a wide range of basic services such as health and education, and physical infrastructure including electricity, water and land⁸ for nearly three quarters of a century poses tremendous problems for the newly emerging government. Catching up decades of lost opportunity for socio-economic development is not only vastly costly, but has direct negative implications for the future development of the society. Much of Namibia's society therefore has only just begun its transition from an agro-pastoralist and traditional context to a more industrial and urban one. Yet the inequalities which prevail have made the possibility of a smooth and successful transition unsure, and "challenges to overcome inherited structural inequalities and to transform an ethnically fragmented population into a socially more equitable nation, as a consequence, remain formidable" (Tapscott: 1992: 1).

The average annual growth rate for the country is set at about 3.1% (National Housing and Population Census, 1991). Namibia is therefore one of the fastest growing countries in the world. Some comparisons are given in Table 1, and Figure 2 gives a possible projection of the country's total population growth rate to the year 2025. Although the national population is only 1.4 million (National Housing and Population Census, 1991), this growth rate places severe burdens on the country's small economy. Also, nearly 50% of the population is younger than 15 years, and therefore require a large investment by the government in the education and health sectors in order to sustain the current levels of service. Bearing in mind that for the most part it is within this sector of the population that the largest deprivation and poverty is observed, certainly maintaining current levels of service is inadequate to improve the levels of health and education of the population as a whole.

TABLE 1

Population Doubling Times for a Number of Countries in the World (Merrington, 1986)

Country	Population Doubling Time
Kenya	17
Zimbabwe	18
Swaziland	20
Namibia	21
South Africa	23
Mozambique	26
Angola	27
Mexico	27
India	32
Indonesia	32
Columbia	33
United States	100
United Kingdom	630

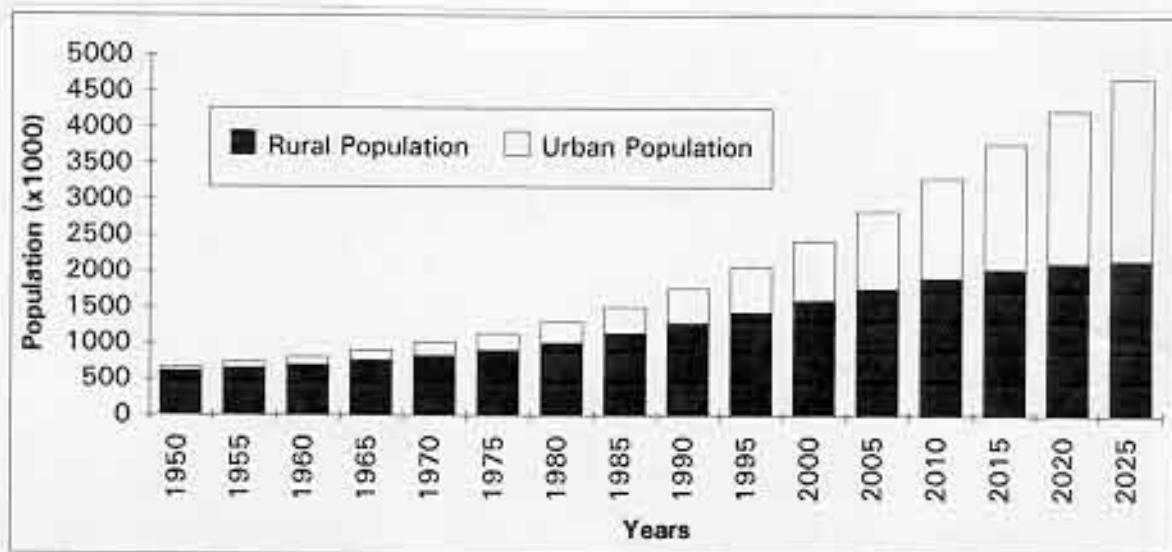


Figure 2. Total Population Growth Projection for Namibia for the period 1950-2025 (World Resources Database, 1993).

However, Namibia already spends comparatively high percentages of its budget on both education and health. Approximately 8.5% of Namibia's GDP is spent on education which is higher than most African countries (World Bank, 1992: 72). This indicates a large inequality in the distribution of educational resources. Similarly, Namibia spends about 4.5% of its GDP on health, which is the same as Japan and generally far more than other countries with similar income levels (World Bank, 1992: 64). One way of addressing this demand is through improved Primary Health Care (PHC), and PHC now provides the mainstay of the Ministry of Health and Social Services' (MoHSS) health care strategy. This shift of resources from a largely curative to a more preventative approach is laudable given the limited resources available for expanding the health sector and the need, particularly in the rural areas, for more accessible and basic health care. Indeed, this program is succeeding in reducing infant mortality rates and raising

levels of immunization across the country. Addressing the shortfalls and demands within the education sector is, however, far more difficult. Thus as strides are made in PHC, continuing the epidemiological transition, and education lags behind, so Namibia faces an increasing demographic problem. The demographic transition theory suggests that under this scenario, Namibia's population is likely to continue to grow rapidly, and that only when education and other programs such as family planning and economic development begin to show returns on investment will the population growth rate begin to decline. This may take many decades.

The mainstay of the economy is provided by agriculture and mining. Although commercial agriculture provides important income for the country and is crucial for ensuring national food security, (semi-) subsistence farming provides the economic base, to a greater or lesser degree, for 70% of the population. Farmers in the more fertile regions of the north and north east are typically engaged in livestock and crop production. In contrast, the more arid regions to the west and south of Namibia are unsuitable for crop farming, and farmers rely only on livestock. Due to their adaptability and hardiness, goats predominate in the arid areas. However, this is leading to environmental damage which, together with periodic droughts, is hampering the farming economy. Over stocking, overgrazing and deforestation are examples of poor land use management in the more productive northern and north eastern areas which is leading to lower per capita rural incomes and greater marginalization of rural households. This situation is central to the unstable levels of household food security experienced throughout most of the communal farming areas in the country (Næraa, *et al.*, 1993). These factors, working together, are spurring poorer rural households to move to urban areas in a bid for economic survival, and contribute to the high levels of rural to urban migration currently experienced (UNICEF/NISER, 1991; Pendleton, 1990; Pendleton, 1991; Frayne, 1992; Tapscott, 1992; and Næraa, 1993).

The manufacturing industry is poorly developed in Namibia, accounting for less than five percent of GDP, and provides little more than five percent of employment by sector (Table 2). With the current growth rate of 3.1%, it can be expected that the potential labor force will grow by at least 15,000 per annum. Further, it is estimated that the Namibian economy will have to grow at a rate of at least 4.5% per annum in order to accommodate this increase, with no absorption of the current population who are unemployed (ILO, 1990).

TABLE 2
Sectoral Contributions to GDP at Factor Cost (%) and Employment by Sector (%) (World Bank, 1990).

Sector	1980	1984	1989	1988
Agriculture & Fishing	11.5	8.0	10.8	19.5
Mining & Quarrying	43.6	35.9	31.7	5.4
Manufacturing	3.9	4.6	4.3	5.1
Electricity & Water	1.8	2.3	2.5	0.7
Construction	3.5	2.8	2.5	6.9
Wholesale & Retail	11.5	12.3	12.7	15.9
Transport & Communication	5.3	5.9	6.5	4.3
Finance, Insurance, Real Estate & Business Services	5.3	5.8	6.0	2.3
Community, Social & Personal Services	1.3	1.9	2.0	19.3
General Government	9.7	17.5	17.9	20.6
Other	2.6	3.0	3.1	-
Total	100.0	100.0	100.0	100.0

Exacerbating this situation is the skewed employment concentration in Namibia. The most recent figures available are from 1988, but this does not detract from their usefulness in providing some quantification of employment concentration. Indeed, it is most probable that this situation has been reinforced in the last five years with the rapid growth of the capital city. Windhoek provided approximately 42% of all formal employment in the country, yet accommodated only 10% of the country's population. By contrast, more than 50% of the population live in the northern regions (Map 2) of the country where only 9% of all formal employment opportunities were located (Department of Economic Affairs, 1988). Again, this situation provides a further draw to the city of Windhoek for impoverished rural communities, thus contributing to the abnormally high urbanization rates experienced in recent years.

Another powerful economic factor influencing rural to urban migration in Namibia is the extreme differentiation between rural and urban incomes. Table 3 gives the results of a survey carried out in 1990, where Katutura is the largest low income township in Windhoek which is typically the destination of rural migrants.

TABLE 3
Reported Per Capita Income Among Survey Households in 1990 (Rand) (UNICEF Namibia, 1990)

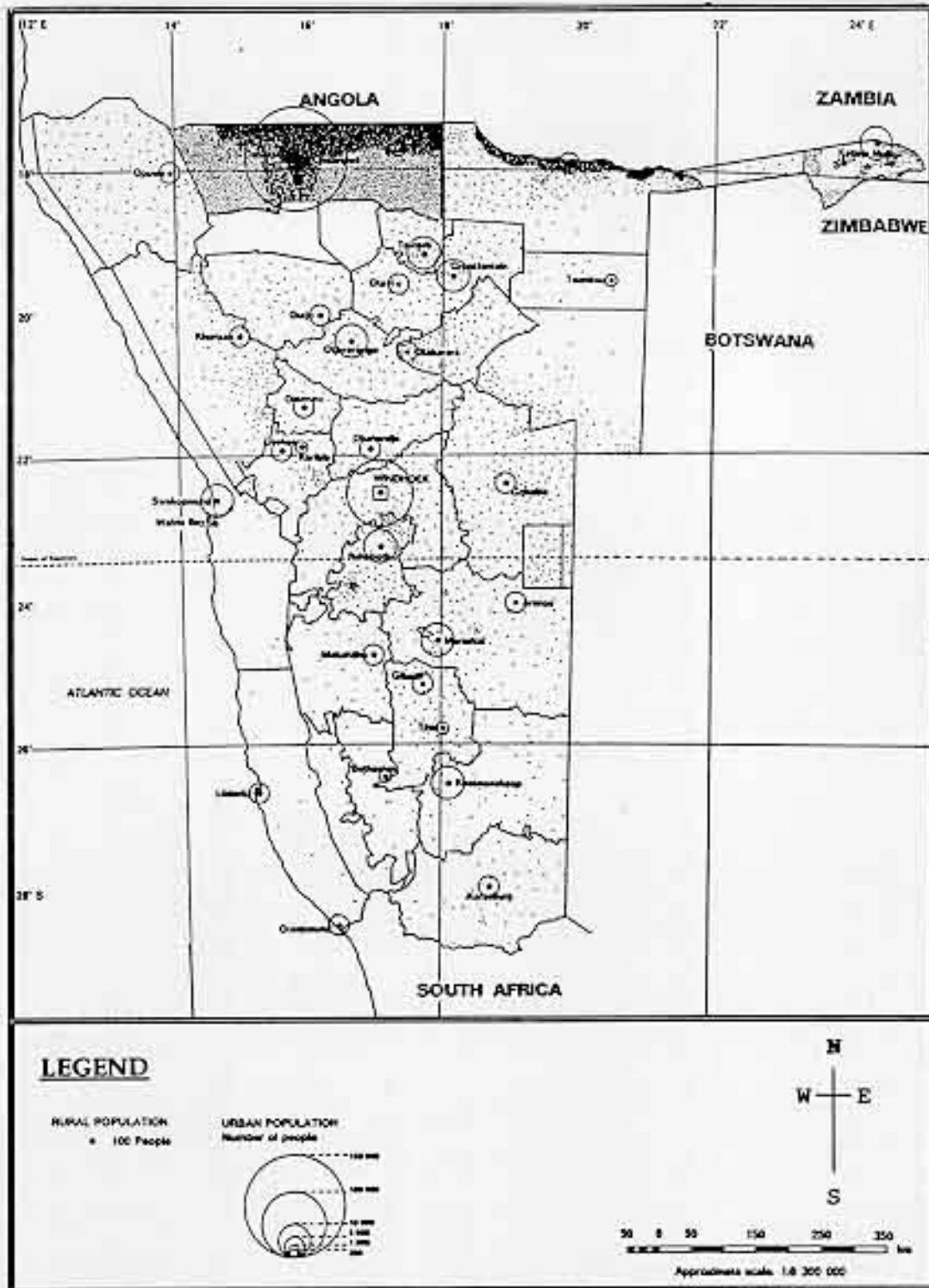
Area	Total
Katutura	R 1 454
Peri-Urban North	R 759
Rural North	R 255

Urbanization Patterns

At approximately 30%, Namibia has one of the lowest levels of urbanization in the world (1991 Census, preliminary results). Yet the rate of urban growth of many of the country's urban centers is high, with populations doubling and tripling in some cases⁹. With an accelerated rate of urbanization in the capital city, Windhoek, over the past three years, it has retained its status of primacy. The city is approximately eight times the size of its nearest urban rival, Swakopmund, and accounts for at least 35% of Namibia's total urban population (Frayne 1992, 13). Within the context of a declining regional economy, it is likely that this situation will be reinforced over the coming years. Indeed, research carried out by the Namibian Institute for Social and Economic Research (NISER)¹⁰ at the University of Namibia and the Windhoek Municipality confirms that migration from the rural areas to the capital is high and has sustained an urbanization rate of between 8% and 12% per annum for the past three years. At this rate the population of the city is growing exponentially, and doubling and tripling times are very low indeed. Assuming the highest rate recorded of 12%, the population will double in only 5.8 years, and will triple in 9.16 years. Assuming a more modest rate of urbanization of five percent per annum, the population will double in 14 years and triple in 22 years. Either scenario presents a demanding planning challenge.

The potential demand on a wide range of resources is large, and probably beyond the capacity of the local government structures to absorb. With an average growth of a little below five percent in the manufacturing sector in the city over the past three years, it is clear that unemployment will continue to rise. Current estimates place the unemployment rate at approximately 40%. However, the most recent figures available place the unemployment figure at 38% in 1991 (Pendleton, 1991). This is eight percent higher than the 1990 estimate made by the Windhoek Municipality. Thus as the population continues to grow exponentially over the next decades, the demand for services such as power, sewage, water, housing, education and health will increase accordingly, yet with unemployment as high as it is and growing

MAP 2
Population Distribution



Source: van der Merwe (1983)

simultaneously, the per capita revenues of the city are set to decrease. Thus questions of how best to use what resources are available to alleviate many of the mounting pressures on the city's social and physical infrastructure are paramount in forming public policy and planning legislation.

Detailed estimates of the magnitude of the future population growth of the city is masked by the lack of data at a national level which can be used to better estimate the growth which the city is likely to face. The time scale is uncertain, even within as much as half a century, and this uncertainty persists in the absence of no methodology capable of assisting planners to anticipate the growth shape of the dynamic at play. Also, the complexity of the variables affecting this population growth are such that devising a useful, albeit incomplete, model aimed at assisting with long term projections of urban population growth is difficult, although important.

Windhoek: Capital City in Positive Transition or Irreversible Decay?

Based on this situation then, how might planners predict the most probable population growth curve for Windhoek? Ideally, this would be done more comprehensively than suggested here. However, due to time constraints, a number of assumptions have been made in order to make the exercise possible.¹¹ The primary and explicit assumptions made are as follows:

- The population projections made by the World Resources Institute (WRI) and presented on the World Resources Database (WRD) for 1993 are accurate approximations of future trends. This may well not be the case in reality, but in the absence of any better data, it will be used in this exercise.
- Urbanization levels in Namibia will slow and/or stabilize at about 70%. This figure is lower than that for the developed world, but probably more realistically reflects the current land ownership trends and modes of production which are likely to persist to a lesser degree in the long term.
- Urban centers in Namibia will retain their current hierarchy (rank order), and thus Windhoek will remain approximately eight times larger than the next town. Given the existing data, it is impossible to foresee the possible impact of investment outside the capital city on the urban hierarchy.

In order to proceed, it is necessary to determine the likely size that Namibia's population will level off at. As Namibia is only within the second phase of the demographic transition at present, this is likely to be some time well into the next century. However, it is unlikely that the transition will be anywhere near as slow as it was in the developed world due to the rapid infusion of technology and the degree of exposure of the general population to modern ideas and values. Still, based on the middle scenario predictions made by the UNFPA, the world population could stabilize within another 40 years, at around 10 billion (double the present figure). Yet when considering the demographic transition of Africa, it appears that the gap between crude birth rates and crude death rates will still be high, although declining 30 years from now (World Population Prospects, 1990, in Drake, 1992: 6). Assuming the demographic transition approximates a logistic curve with an upper bound of 2 billion, then Africa's population might begin to even out within about 80 years from the present.

In attempting to determine the time frame of Namibia's demographic transition, it is important to bear in mind that Namibia's average annual population growth rate is below the average for sub-Saharan Africa, and that the total fertility rate among women aged 15-44 years is 5.2, which is also lower than all countries with the exception of Botswana (DHS, 1992: 20). This would suggest that Namibia would be slightly ahead of the average in the demographic transition of the continent as a whole.

Figure 3 shows in composite form the relationship between the actual data for the country, the projections made by WRI, and the best-fit exponential and logistic curves to that data. As can be seen, the actual and projected data supplied by WRI is best approximated by an unbounded exponential curve. Figure 4 gives a more detailed picture of the data in relation to the exponential curve with a shorter time span. However, it is unlikely that Namibia's population will grow at an exponential rate as suggested by the projections. Environmental, epidemiological and toxicity factors alone will dampen the curve. Indeed, a population of 35 million in a century from the present as indicated by the exponential projection would require a 50 fold increase in the present population of Namibia. Even if the current growth rate of 3.1% was maintained indefinitely, the population would only increase about 10 fold during the same period.

Moreover, WRI use data that indicates an increase in the annual population growth rate during the last decade of this century, yet it is now known from the results of the latest national census in Namibia that the average annual growth rate has begun to decline. This, together with the *relatively* low total fertility rate, indicate that the exponential curve is unlikely to provide a realistic scenario of total population growth in Namibia, and is thus of little use in deriving a possible future urban population for the country.

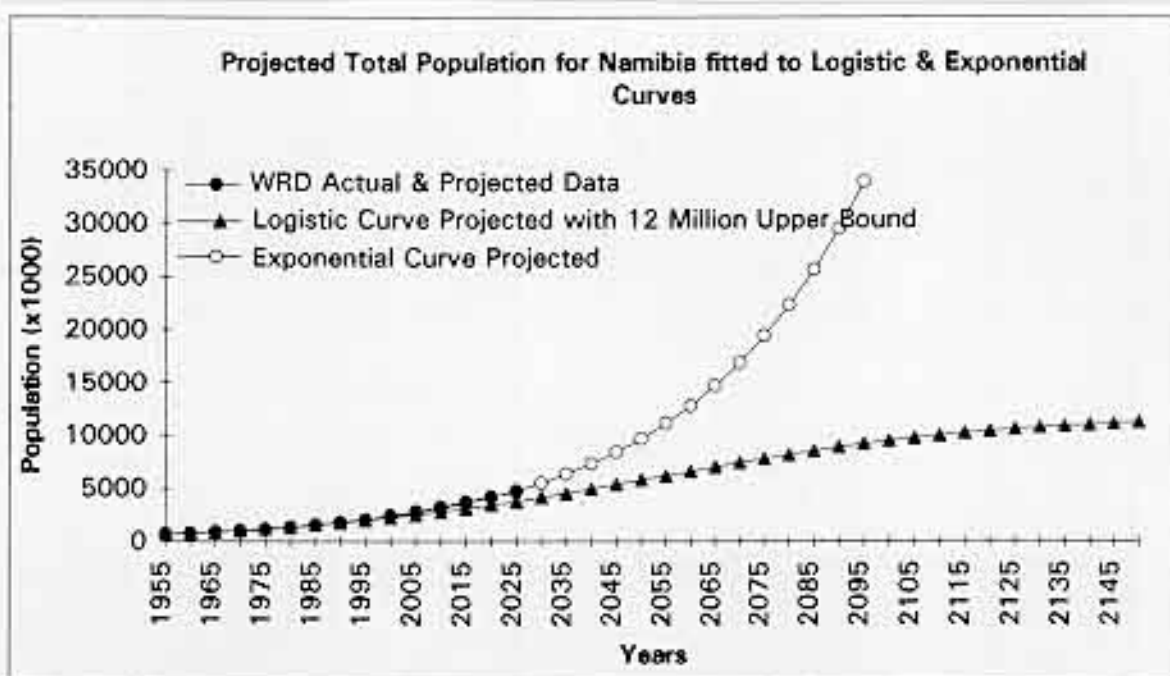


Figure 3.

Figure 5 shows the fit of a logistic curve to the actual data for Namibia's total population and the projection made by WRI. The upper bound of 12 million produces an almost perfect logistic fit to the actual data for the country. Considering that the projection made by WRI is based on a continued rise in the average population growth rate from 1990 until 2000, whereas there is actually a slight decrease apparent from latest the real data available, it is probable that the logistic curve is the more accurate of the projections. Whether or not 12 million is a realistic upper bound will only be known decades from now. This figure might be high, considering the elevated rate of demographic transition in Namibia as public investment continues to target basic health and education needs. However, in the absence of any data to the contrary and the excellent fit between the actual data and the logistic curve, an upper bound of 12 million will be used for the remainder of the exercise.

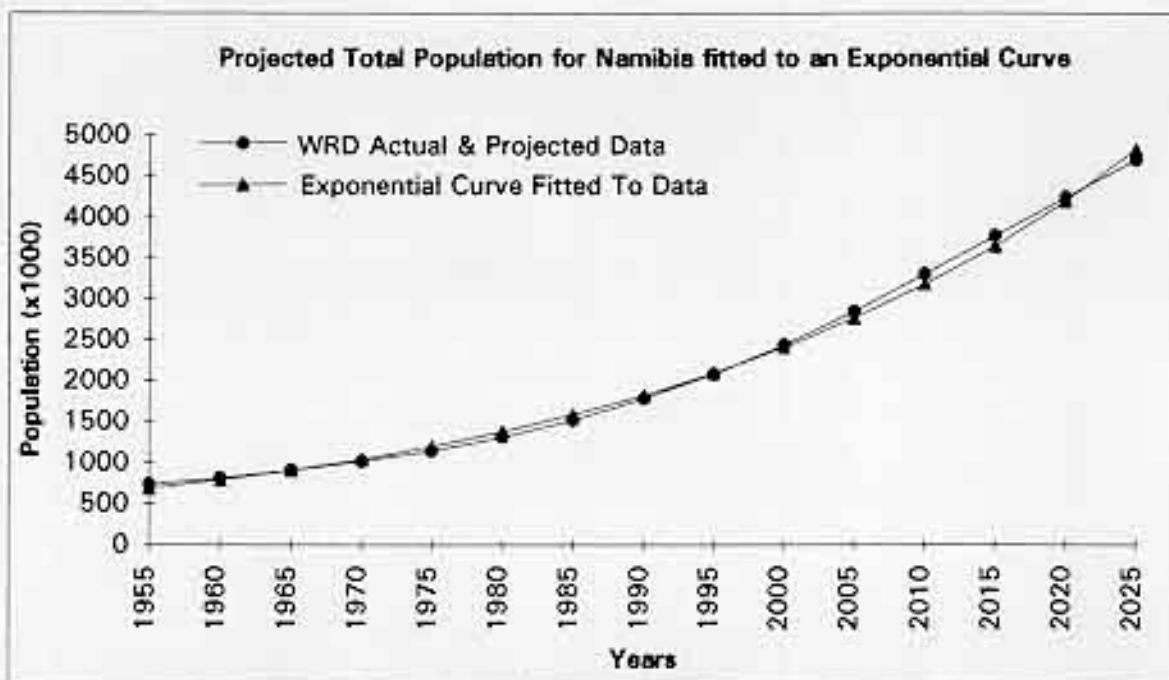


Figure 4.

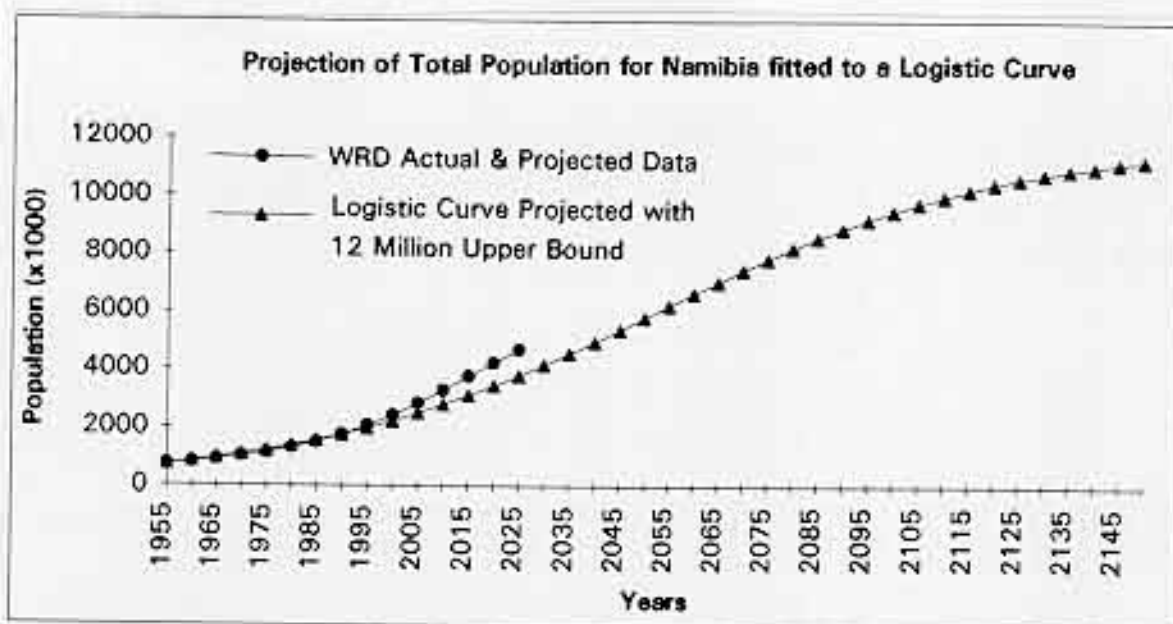


Figure 5.

Estimating a growth scenario for the rural population is important in calculating a possible urban population for the country as a whole, and more specifically, for Windhoek. Figure 6 shows the best-fit logistic curve to the actual data and the projections made by WRI. The logistic curve has an upper bound of 4.5 million. However, it is interesting to note that when projected beyond the year 2025, the logistic curve rises more steeply than the curve produced by WRI. Although projecting out beyond 2025 is of little value with regard to its prediction value, it is interesting in so far as it suggests that the rural population might level off at a value lower than the upper bound of 4.5 million. This would then influence and be influenced by future rates of urbanization and total population growth. These variables are, however, conjecture, and thus reliance on curve-fitting as a method is made for the purposes of this exercise.

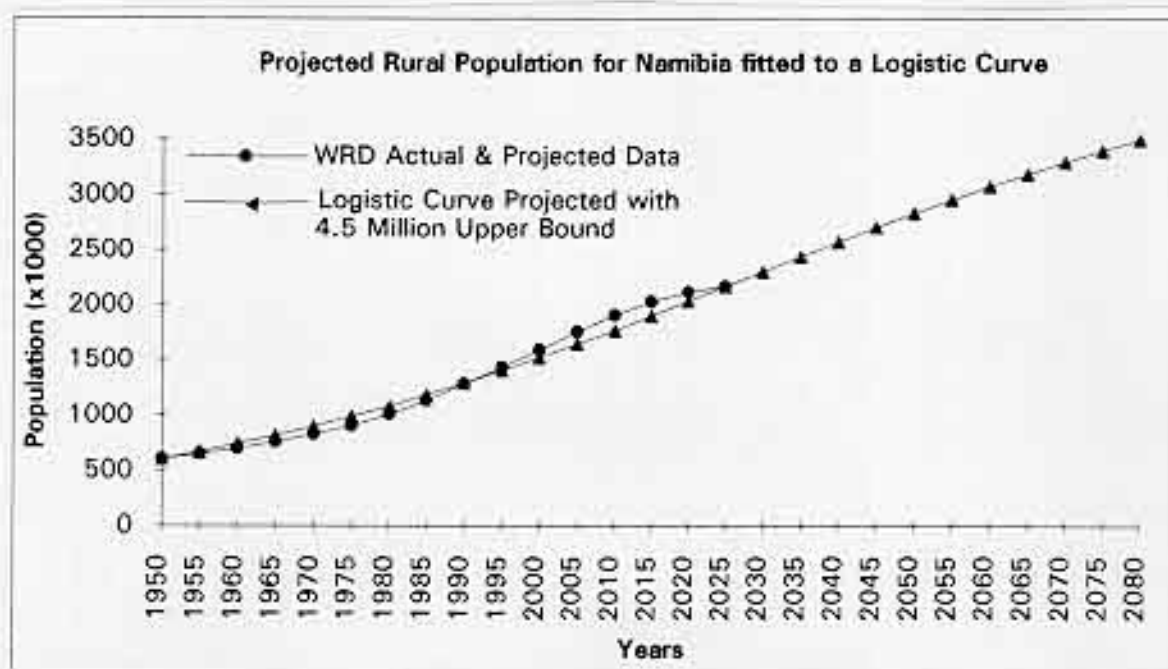


Figure 6.

As a segment of Figure 6 for the period 1950 to 2025, Figure 7 shows the approximate fit between the actual and projected data used by WRI and the logistic curve projected accordingly. Unfortunately it was not possible to find an upper bound that resulted in an exact match of the curve produced by the actual and WRI data, and an upper bound of 4.5 million persisted in providing the best fit. Why a more accurate fit could not be derived lies in the fact that the total population growth rate for Namibia is lower than supposed by WRI, as well as a number of other unknown variables which WRI would have used in determining the decline in the rural population.

Assuming that the urbanization transition stabilizes at 70%, the upper limit of 12 million for the total population of Namibia works well with the upper limit of 4.5 million for the rural population. That is, under the scenario suggested by these projections, the urban population would need to be in the region of 70% of the total population (with a rural population of 30% which would be about 4 million). The urban transition would therefore be complete towards the end of the next century. The most rapid rates of urbanization would be experienced for about the next four decades. In reality, urbanization rates have

increased sharply during the past decade, and are expected to continue well into the next century. Already researchers and planners are warning of the possible consequences of current levels of population growth.

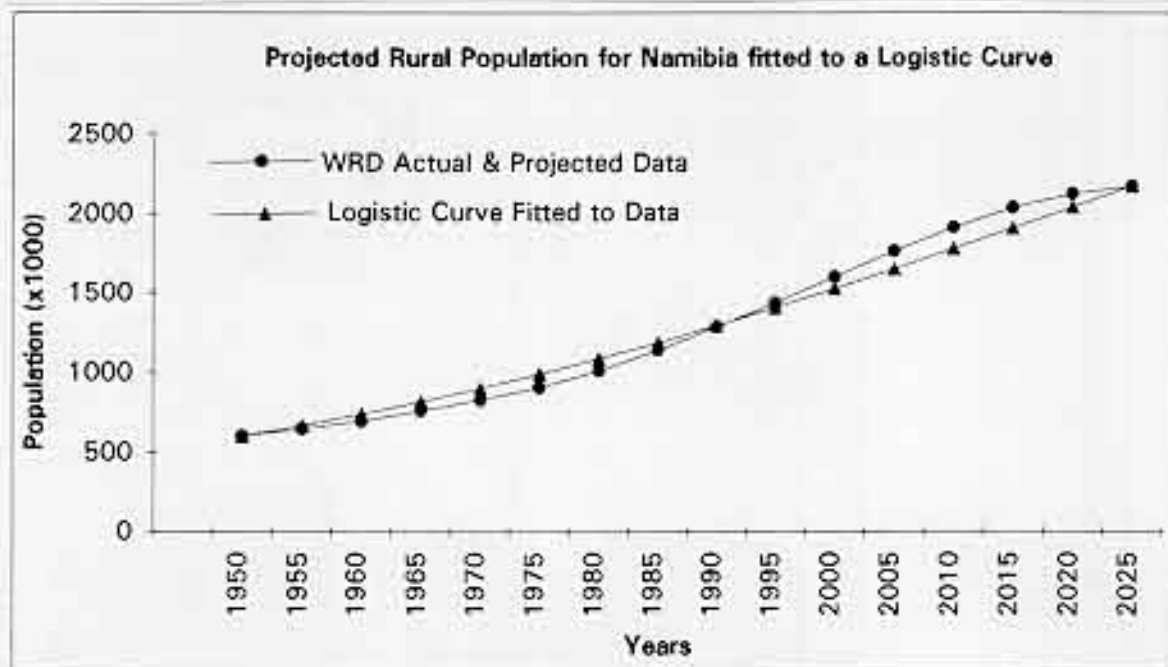


Figure 7.

If the current rank order of urban centers in Namibia persists, then it is possible to suggest that the population of Windhoek will begin to stabilize at approximately 2.5-3 million (35% of total urban population in the latter half of the next century). Even if the total population of the country does not reach 12 million as suggested by this scenario, this figure of 2-3 million does not appear to be unrealistic. While environmental constraints to improved agricultural production may be ameliorated in time with improved technologies and land use management, it is difficult to imagine a rural population as high as 4.5 million in an arid and semi-arid country such as Namibia. Under the prevailing economic conditions in Namibia, which includes a *per capita* decline in the communal farming areas and a decline in the regional economy relative to the capital city and its hinterland, urbanization is likely to focus on Windhoek, and thus increase its primacy.

The question of how realistic this scenario is as a whole is difficult to answer due to the unknown variables which will come into play in future years, as well as the unpredictable interactions which will also occur between all major variables. Thus it is once again important to emphasise that the projections made here should not be used in the raw state in which they are presented here. The argument developed here is intended to be illustrative only.

Implications for Public Policy

The major implications of the above described scenario for Windhoek for public policy will certainly be honed by two overriding factors. The first is the economic context within which the city (and the country) will find itself in as the years progress. The resources available to improve levels of physical and social infrastructure and increase people's access to such services will depend in large part on the prevailing

economic climate. Significant improvements in both formal and informal economic opportunities will help to reduce unemployment and improve affordability. In the absence of some unforeseen economic boost (such as the discovery of oil in Namibia), it appears unlikely that the city will be able to generate the income it requires to meet the growing and projected demand for a wide range of social services, and without a sound tax base used to generate the finances needed to pay for services, it is unlikely that the provision of such will keep pace with population growth.

The second factor is the political imperatives which may prevail in the future. Without the political will to attempt to meet as many demands that a large population will place on the city and its infrastructure, development runs the risk of reinforcing the *status quo*, and thus the interests of a narrowing social and economic elite. This would necessarily be at the expense of the poorer majority of the population.

Policy therefore, will be developed within the parameters established by these two primary factors. Ideally, however, development should be in the interests of the poor majority if the potential benefits of urbanization discussed earlier are to be realized. Appropriate and successful policy measured at the metropolitan scale is also dependent on regional and national policy. There is typically a high degree of interaction between national policy and local urban policy (Rogerson, 1989).

At a national scale, and in order to be consistent with the aims of sustainable development, urban policy should at least be:

- Consistent with broad societal goals. These should be arranged around the concepts of equity and justice, and around the objectives of rapid improvements in social and economic development for the majority of the population. This is seen as imperative as a pre-condition to reducing societal vulnerability as the country moves through the various sectoral transitions.
- Consistent with macro and sectoral planning and development strategies. A failure to understand and exploit the relationship between sectoral planning and investment and urban policy can result in a conflict of interests, and often the failure of urban policy to achieve its goals.

Urban policy at a local, or metropolitan scale, should follow at least the following broad objectives:

- Encourage, through legislation, capital markets and credit schemes, the growth of the formal and informal economic sectors. Where unemployment is rising rapidly, it is imperative for the positive functioning of the city to invest in generating large and small scale entrepreneurial activities, and to thereby make as many employment opportunities as possible available to people.
- Invest heavily in education and health infrastructure. Without a growth concomitant with population increases within at least these two primary service sectors, literacy levels will continue to fall, and the vulnerability of the society as it passes through this urbanization transition will continue to increase.
- Actively control levels of toxicity with the aim of reducing vulnerability as this transition continues to evolve. This would include the strict application of industrial pollution and environmental protection policy and legislation, while also investing in environmentally sound and sustainable methods of providing services such as power, water and sewage. Joint public and private housing ventures may form an important component, especially where more than 60% of the population cannot afford even the most basic formal structures (Merrington, 1990).

The current economic recession and high population growth rates in the country as a whole, suggest that the resources available for large scale urban investment are limited, and are likely to become more so as urbanization continues. Thus prioritizing investment will be important, and public policy should aim to maximize on investments. An approach which recognizes and attempts to deal with the scale of the development challenge which appears to be facing the city is therefore laudable, and planning ought, at least, to ensure no further deterioration of the populations' social and economic status. Once the urbanization transition nears its completion and the country begins to stabilize, the city might then be in a position to build up deficiencies in the system without the massive pressures felt at present (during the transition).

It is important to note that the policy implications outlined here are general in nature, and therefore of limited use to specific planning tasks. In order to develop a more useful and focused set of urban policies for the city of Windhoek, it would be necessary to engage in a detailed sectoral study of the city, its current policies, financial operation, and governance structures and functioning. Also, this would have to be evaluated in terms of achieving the goals stated above, and within the context of the population growth projected for the city. This is clearly beyond a paper of this nature, and thus comments have been limited to broad statements of objective.

Conclusions

This paper represents a very raw beginning to a possible model for plotting urban transitions for the purposes of informing and influencing public policy and consequent investment. Further, this model has been used here in an illustrative fashion, and has not considered the implications of investment outside of the urban sector. Nor has it considered any of the very complex variables influencing population growth and urbanization. It is well known that rural policy affects rates of urbanization and a range of social characteristics, including literacy levels, infant mortality and morbidity, toxicity, entrepreneurship, food production, and so forth. Thus such a model is not complete without the development of a rural component, examining the associated transitions. This is beyond the scope of this paper, but should be carried out, making use of the comparative framework for evaluation established as a method of using the model effectively, in order to better test and refine the model as a means of providing information over time to planners in all sectors. If this idea can be carried forward and made truly usable, then it may have the potential to contribute to the positive evolution of societies to a more sustainable state of equilibrium. If vulnerability can be anticipated and thus reduced through the timeous development of appropriate policy, then countries such as Namibia might be better able to harness its human and physical resources for the benefit of all.

What is clear is that reducing social vulnerability during times of rapid and simultaneous transition of sectors requires not only foresight and research, but resources which are not always available during times of scarcity. Thus international cooperation is seen as crucial to the successful transition of societies which are currently far behind the developed world, and which are undergoing severe social stress. Without the political will to improve the situation of the developing world, the countries of the developed world will face many of the problems currently associated with the developing world, and these will be at a global scale as the world moves through its transition to another state of equilibrium. The various regions of the world are now so interrelated that a bleak future for some will almost certainly mean a bleak future for all. What better reason is needed to rationalize global cooperation and effort?

Endnotes

¹ Malthus is perhaps best known for his *Essay on Population* (1798), in which he argues that the means of life increases arithmetically, whereas population increases geometrically (exponentially), and therefore the latter will always outstrip the former in the absence of, he argues, certain checks and balances such as war, epidemics and famine. This idea received little support from humanists of the time (and indeed, since), and Malthus' notion that sudden reductions in population from time to time were necessary, "struck humanists as the essence of the heartlessly *laissez-faire* attitude to mankind's biggest difficulties" (Craig, 1969, in Dickens, 1854: 321).

² In the Preface to *Beyond the Limits*, the authors say about their first work, *The Limits to Growth* (1972) that "the book was interpreted by many as a prediction of doom, but it was not a prediction at all. It was not about a preordained future. It was about a choice" (Meadows, *et al.*, 1992: xiii). The complexity of the variables which result in any particular outcome are such that prediction is not possible.

³ The first conclusion about the future of the world which appears in *The Limits to Growth* (1972) states that "if the present growth trends in world population, industrialization, pollution, food production, and resource depletion continue unchanged, the limits to growth on this planet will be reached sometime within the next 100 years. The most probable result will be a sudden and uncontrollable decline in both population and industrial capacity" (Meadows, *et al.*, 1992: xiii).

⁴ The assessment and quantification of rangeland destruction is made problematic by the typically non-equilibrium environment in many countries of the developing world (particularly in Africa). In regions where it is not possible to establish static carrying capacities (livestock units per unit of land), it is by definition almost impossible to establish the extent of overgrazing and exploitation of the land along a continuum. Even with no use by man, non-equilibrium environments support large fluctuations of fauna and flora according to natural cycles of drought and rain, and all animal species use the resources available in an opportunistic manner.

⁵ The use of the term demographic transition in this text refers to the classic demographic transition theory which has prevailed for decades as the principal demographic model. However, the theory has recently been challenged by Abernethy in her book *Population Politics: The Choices that Shape Our Future* (1993), in which it is argued that reductions in fertility (birth control) are best motivated by perceptions of limited resources, rather than improved socio-economic status alone.

⁶ It is important to note that the exercise which follows is done merely as an illustration of what might be possible. It is undertaken here as a requirement for SNRE545, University of Michigan, 1993, and thus should not be used for any form of planning or as a reliable and valid source of data. Time constraints make it impossible to provide a more complete and rigorous analysis at present using the techniques of curve fitting.

⁷ Namibia was known as South West Africa prior to independence in 1990.

⁸ According to the recommendations made by the Odendaal Commission of 1964, Namibia was divided into eleven regions defined on the basis of ethnicity. This resulted in the deprivation of land for many peoples in the country, disrupting transhumance patterns and other coping strategies. The consequences of this have been an increase of pressure on environmental resources, per capita declines in communal agricultural output, and further social stratification, both within the regions and across the nation as a whole. This system of "homelands" has been replaced with 13 new regions defined along geographic and economic lines, although it remains impossible to dissipate the ethnic dimensions of such division (Töttemeyer, 1992).

⁹ The regional center of Katima Mulilo in the Caprivi region grew by more than 2000% from 1981-1990, and the capital city, Windhoek, grew by approximately 45% over the same period. Although this is in part explained by certain redefinitions of urban boundaries, these numbers give a realistic impression of the kind of urban growth experienced during the past decade (1981 National Population and Housing Census; 1991 National Population and Housing Census; Frayne 1992).

¹⁰ NISER has recently been dissolved and its functions taken over by the newly formed Social Sciences Division (SSD) of the Multi-Disciplinary Research Centre of the University of Namibia. However, research undertaken and published under the title of NISER is referenced as such.

¹¹ It is important to reiterate that the assumptions made here are inadequate to provide reliable or valid outcomes/conclusions. This is done only as an illustration of the method.

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WETLAND LOSSES AND SHRIMP FISHERIES IN THE REGION OF LAGUNA DE TERMINOS, CAMPECHE, MEXICO - A PROPOSAL

by Iliá E. Hartasánchez H.

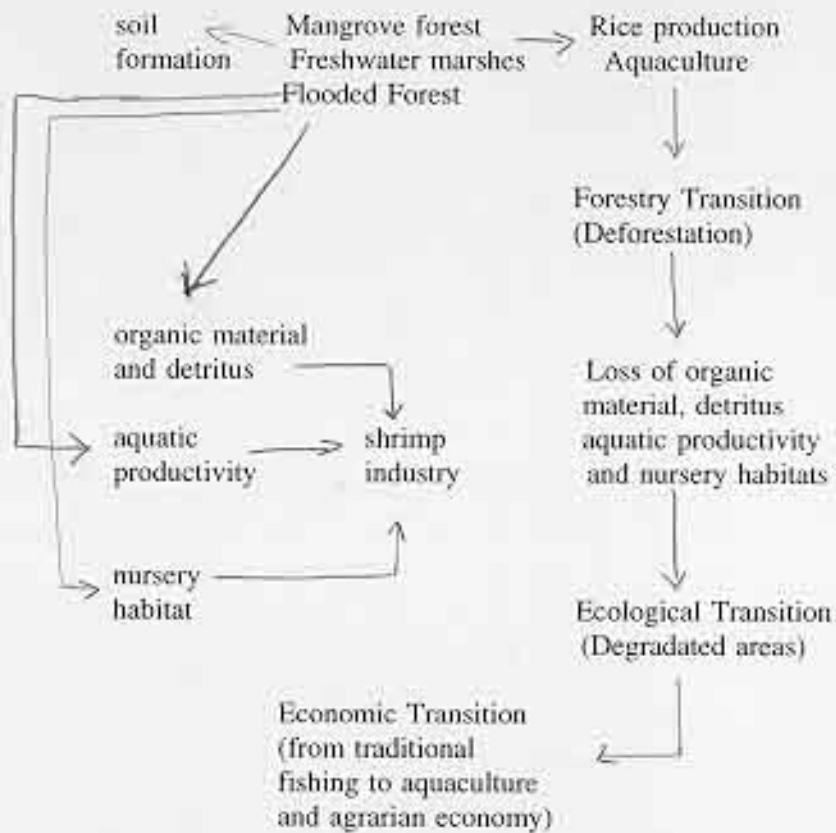
PREFACE

This document is a proposal to investigate the trends of shrimp fisheries and its relationship to wetlands conservation in the region of Laguna de Terminos. The information to be presented has been organized as follows. First, a general background of the area is provided, explaining the ecological and economic importance of the Laguna de Terminos wetland. Second, a delineation of the proposed investigation with an example of the methodology to be employed is described. Third, a description of the proposed research analysis itself. Fourth, a brief explanation of the expected results, possible policy implications and the estimated time required to carry out the investigation is included.

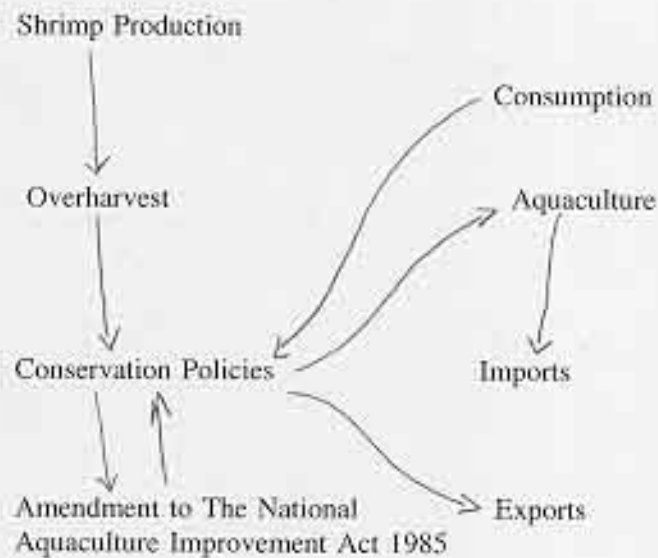
INTRODUCTION

Coastal wetlands act as sediment traps that stabilize coastline, protect against hurricanes and storm surges, serve as nurseries for commercially exploited crustaceans and fishes, and are habitats for other biological resources including waterfowl (Norse, 1993).

The ecological importance of the Laguna de Terminos wetlands is closely related to the economic development of the region. The largest shrimp production of Mexico is caught in this area. The ecological processes of this ecosystem have been studied from different perspectives and the close relation between vegetation and shrimp harvest has been described (Yañez-Arancibia and Day, 1988). Nevertheless, the permanence and conservation of this wetland is threatened by productive activities such as rice production and aquaculture. The objectives of the study proposed are: a) to analyze the trends of shrimp fisheries in the Laguna de Terminos wetlands, b) to analyze the process of wetland loss in that region, c) to understand the relationship between the permanence of wetland areas and fisheries harvest over a period of time and d) to forecast possible trends of conservation and maintenance of shrimp fisheries in accordance to present policies. Fig. 1 shows the diagramatic model of this proposal.



US SHRIMP FISHERY DATA EXAMPLE



BACKGROUND

The wetlands of the Laguna de Terminos to the South of the Gulf of Mexico in the State of Campeche have been of great importance for the local and regional economies.

Commercial shrimp production in the Laguna de Terminos region was initiated at the end of World War II when the United States of America increased the demand for the product (West, 1985). The most intense commercial activity of shrimp production in the region has been developed at Ciudad del Carmen (Fig. 2). During the decade of the 50's Ciudad del Carmen was traditionally a fishing port with a solid infrastructure and a large shrimp fleet. During the early 70's this area was industrially developed due to oil extraction from large deposits located offshore at the Sonda de Campeche and more recently, projects of different productive activities are increasing.

As consequence of this development, both an ecologic and economic transitions are occurring in this region.

Ecological Importance of Laguna de Terminos Wetlands.

The freshwater marshes of this area are part of the large wetland system of Grijalva and Usumacinta that encompass the States of Tabasco and Campeche. This system represent the highest diverse reserve of aquatic plants in Mesoamerica (Lot and Novelo, 1988).

Aquatic vegetation in this area is very important not just because of the large amount of organic material it produces but also because of its fundamental role in the capture, stabilization, and retention of sediments that lead to soil formation (Novelo and Lot, 1988).

Another important source of organic material that increases water productivity in wetland areas is the mangrove forest. Day *et al.* (1982) explain that the amount of litterfall provided by the mangrove forest to the Terminos lagoon is about 15 to 18 ton/ha/year. When this material is transformed in detritus it is transported by rivers from interior lagoons to the Terminos Lagoon and then to the sea (Day *et al.* 1988; Vera-Herrera *et al.* 1988). Day and Yañez-Arancibia (1988) explain that the decomposition and the bacterial enrichment of the organic detritus increase aquatic productivity and nutrient recycling, providing appropriate conditions for the development of aquatic organisms. Related to this Roman (1988) found that mangrove forests in conjunction with aquatic vegetation, constitute an important habitat for the reproduction of different species of shrimps *Penaeidae* in the region.

A similar situation is related to fish communities. Yañez-Arancibia *et al.* (1988) explain that 75% of the dominant species of fish at the Sonda de Campeche depend on the productivity of the Terminos lagoon. Furthermore, the same authors mention that 90% of the marine species with commercial value, develop one phase of their life cycle in shallow waters of the Laguna de Terminos wetlands.

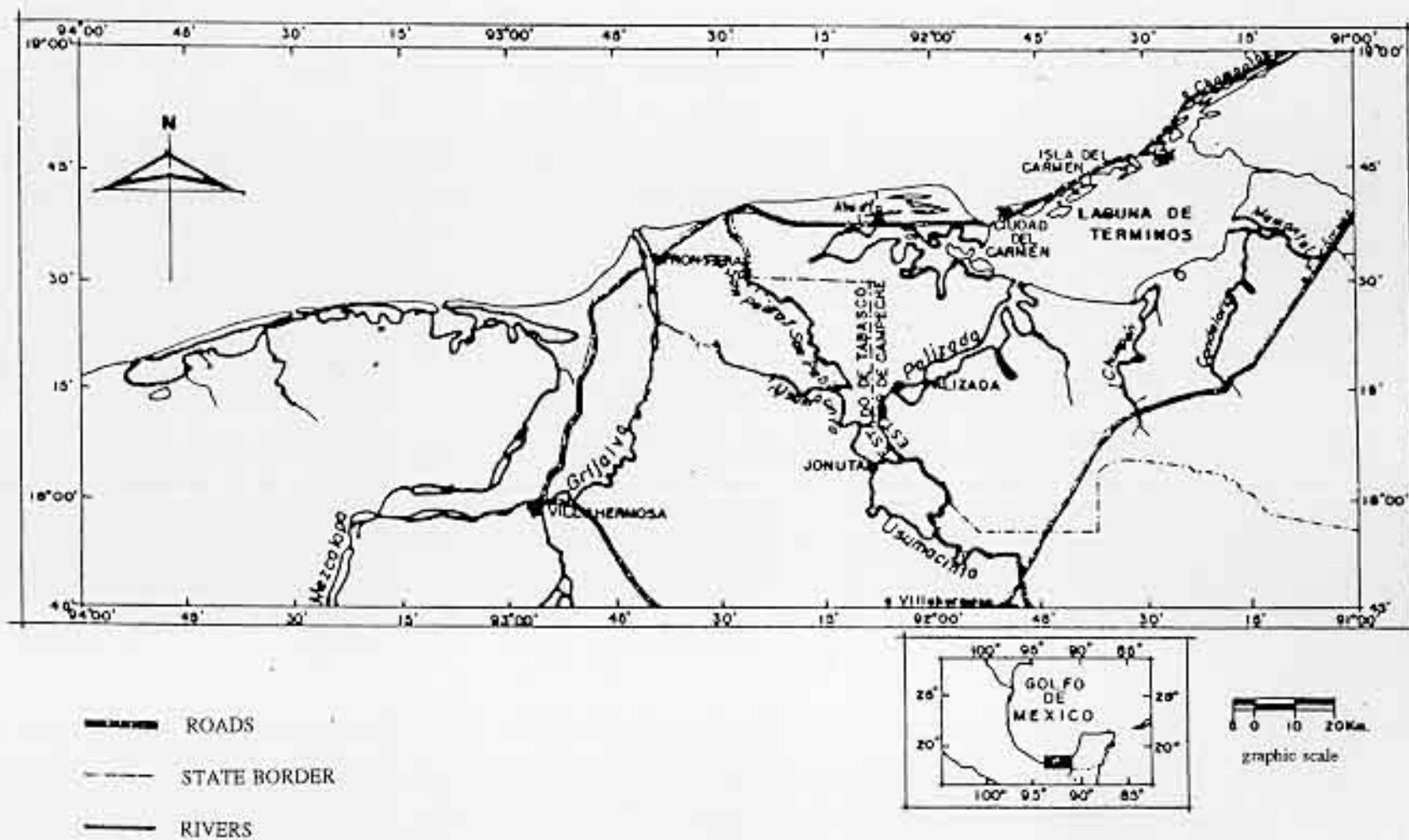


Figure 2. Wetlands of Laguna de Terminos, Campeche, Mexico (source: West et al., 1985).

Economic Importance of the Laguna de Terminos Wetlands

Wetland areas maintain a dynamic and complex ecologic interrelationship between vegetation and aquatic and terrestrial fauna. These relations made possible the development of local and regional economies that are based on fisheries products.

In this region the permanence of the mangrove forest and the freshwater marshes are of critical importance because they provide the organic material that contribute to the increase of productivity of the aquatic environment. More than 50% of the national shrimp production of Mexico is obtained in this area. As a result of intensive fishery activities carried out in this area, 60% of the national shrimp fleet and the 26% of the shrimp freezers of the country are located in this region (Yañez-Arancibia and Aguirre-Leon, 1988).

The ecological and economic importance of the Laguna de Terminos wetlands has been demonstrated. Productive activities which lack of ecological planning, such as rice production and aquaculture, are threatening the conservation of the wetlands and consequently the maintenance of local and regional economies. It is on these transitions that this proposal will focus.

The productive activities mentioned above implies the destruction of natural ecosystems, in addition each one of them has their own ecological implications. Rice production requires the use of fertilizers and pesticides that pollute the environment and could gradually lead to a decrease of production, which would negatively affect the economies. In many cases aquaculture has been a highly profitable activity, but when it is practiced without the appropriate ecological planning, could represent a potential threat for the maintenance of the coastal ecosystems (Olsen and Arriaga, 1989). For example in Ecuador 112,790 ha of mangrove forest were cut to build artificial ponds to produce shrimp. The recruitment of shrimp postlarvae was the base for the success of the project. However, since the mangrove forest was cut, those aquatic organisms which required the mangrove roots for their development were depleted. The destruction of the mangrove forest and those organisms dependent upon mangrove roots caused the production of shrimp to decrease dramatically (Olsen *et al.*, 1989).

In the case of the Laguna de Terminos region, rice production and aquaculture have increased during the last years and could become an important problem for the conservation of the area and the maintenance of the regional economy (Hartasanchez, 1992).

PROPOSED INVESTIGATION

An analysis of the ecological and economic transitions in the region of Laguna de Terminos, Campeche is proposed. According to Drake (1992) transitions imply changes and they can be used to

describe a specific period of time which spans the shift from low to rapid change in the sector and usually a return to relative stability.

In the case of the Laguna de Terminos wetlands, different changes have occurred and it is possible to identify forestry, ecological and economic transitions.

The interrelations between vegetation types and the biological dynamics of the different components of the system lead to the productivity of the area. These processes are fundamental for the sustainable development of the shrimp fisheries as well as other productive activities in the region.

This analysis will be focused on a regional scale. It will use a time series of statistical data on shrimp production from the Research Center of the National Institute of Fisheries based on Ciudad del Carmen. Information on land use and land cover for the region of Laguna de Terminos will be obtained from the Secretary of Agriculture and Hydraulic Resources (SARH) based in Ciudad del Carmen. Population data, as well as data on different economic indicators such as exports, imports, shrimp consumption and commodities will be obtained from the National Institute of Geographic and Statistical Information (INEGI) based in Mexico city.

The data will be fitted to different distributions in order to diminish complexity and to provide a logical interpretation of the real processes. Then a group of forecasts on the future status of the variables to be analyzed will be done.

In order to illustrate the way in which this methodology will be employed to analyze Mexican data, an example of the trends of the shrimp production in USA between 1950 and 1990 is described. In this brief study, variables relating to landing (harvest), imports, exports, total consumption and per capita consumption are considered.

USA shrimp fisheries. An example of the methodology to be utilized.

Time series data from 1950 to 1990 on landings, imports, exports, total consumption and per capita consumption were analyzed. A curve fitting analysis was done to diminish complexity and to provide a logical interpretation of the real processes. To fit landing data an exponential distribution was used; for imports, exports and total consumption the logarithmic model was applied. Finally, forecasts for some variables were done.

Results

Fig. 3 shows the trend of the population growth over 40 years. It is possible to observe a gradual increase. The forecasting of this trend towards the year 2000 does not show an important change but a stable growth.

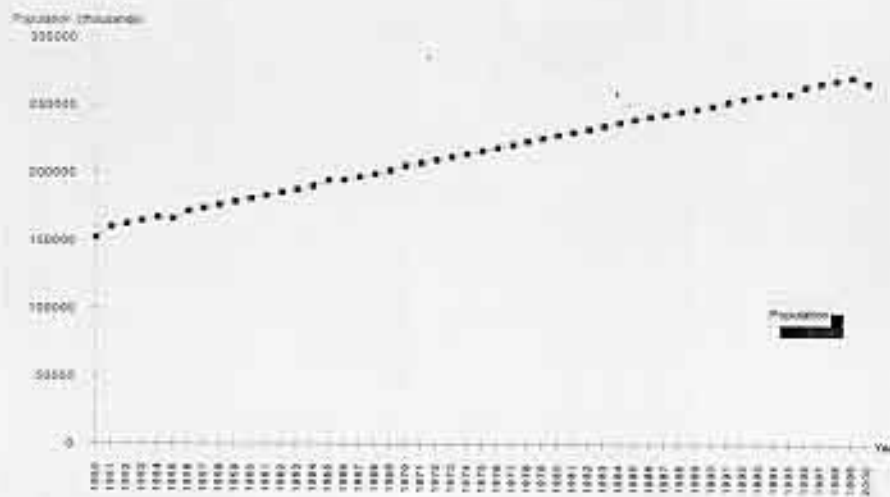


Figura 3. Population growth over 40 years (1955-2000).

Regarding the shrimp market behavior in the USA, Fig. 4 shows that the general pattern of landings over 40 years remains low in relation to the imports. A sharp difference between these trends occurred during the decade of the 80's. Imports increased during this period while landings dropped and remained lower.

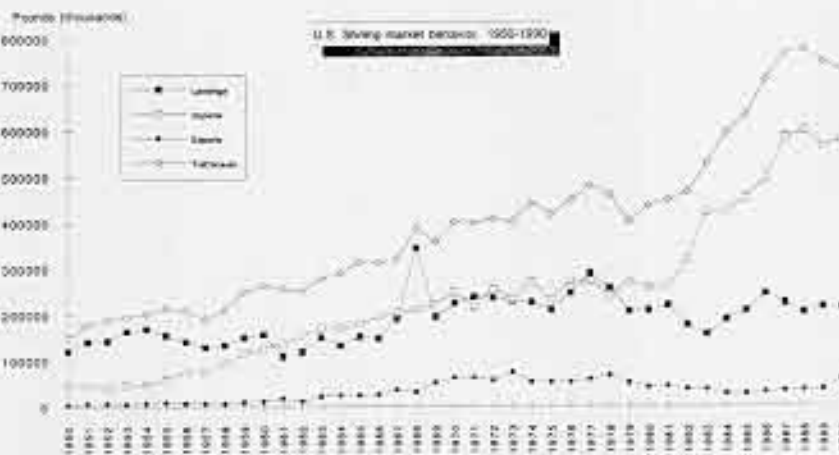


Figura 4. U.S. market behaviour between 1950-1990.

The total consumption of shrimp in the USA has remained high in relation to the general trends of landings and imports, and a similar pattern can be observed in Fig. 4 for the per capita consumption. Nevertheless it is possible to observe some variations. For example, between 1962 and 1967, the total consumption continued to increase although landings were lower. A similar and more conspicuous pattern happened during the 80's. On the other hand the import trend presents an increase starting from 1956 to the late 70's. Then, during the decade of the 80's a sharp increase can be observed.

In relation to the exports, a clear, low trend in comparison with the concepts above, has predominated.

The curve fitting model employed for landing data did not describe clearly the trend of that distribution (Fig 5), perhaps due to the variability of the data, a different distribution should be used.

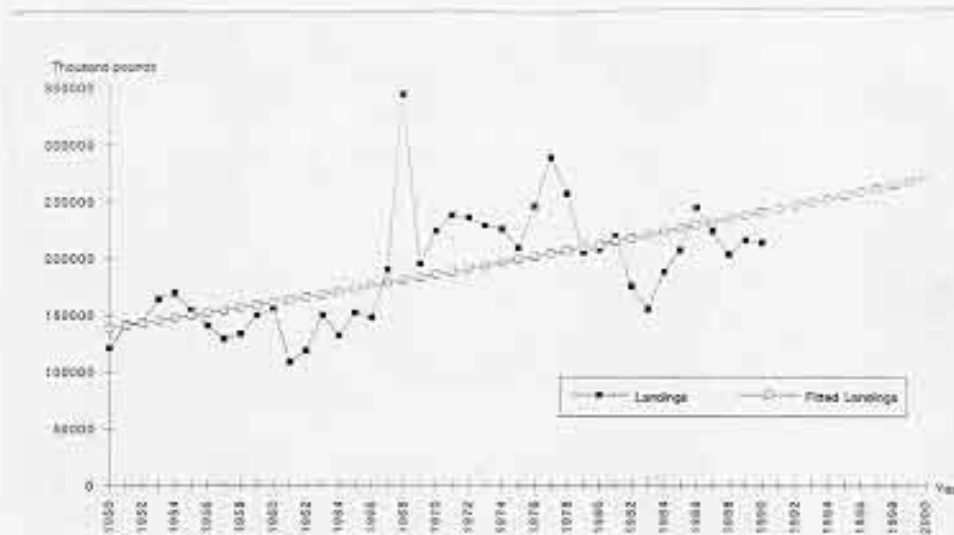


Figura 5. Exponential curve fitting for landing data.

In relation to import data, it seems that the logarithmic model was appropriate to describe the tendency of this aspect (Fig. 6). The actual data patterns show during the early years, exponential growth with an apparent tendency to remain exponential. It might be possible that in forecasting for a longer period of time, the distribution would reach an inflection point which would more clearly fit a logistic distribution.

Export data definitely could not be fit to a exponential or logarithmic distribution (Fig. 7). In general, looking at the overall trends of landings, imports and total consumption during the last 40 years it is possible to find conspicuous changes during the decade of the 80's.

There are some explanations for these patterns. During the 80's, a decrease in landings occurred because the United States catch of its mainstay fisheries had approached or exceeded their maximum biological limits (NMFS, 1988). As consequence, sea food imports from aquaculture increased and this

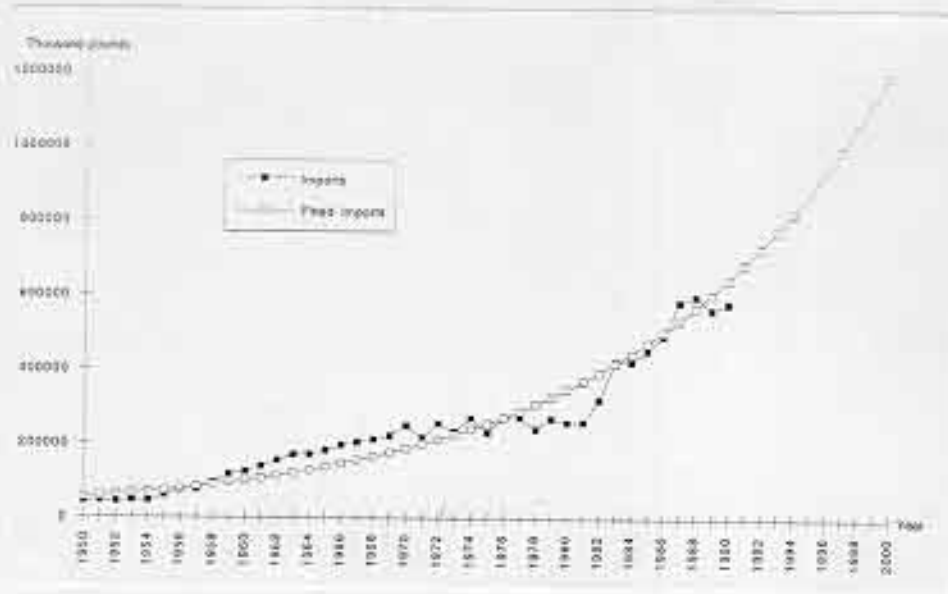


Figure 6. Logarithmic curve fitting for imports data.

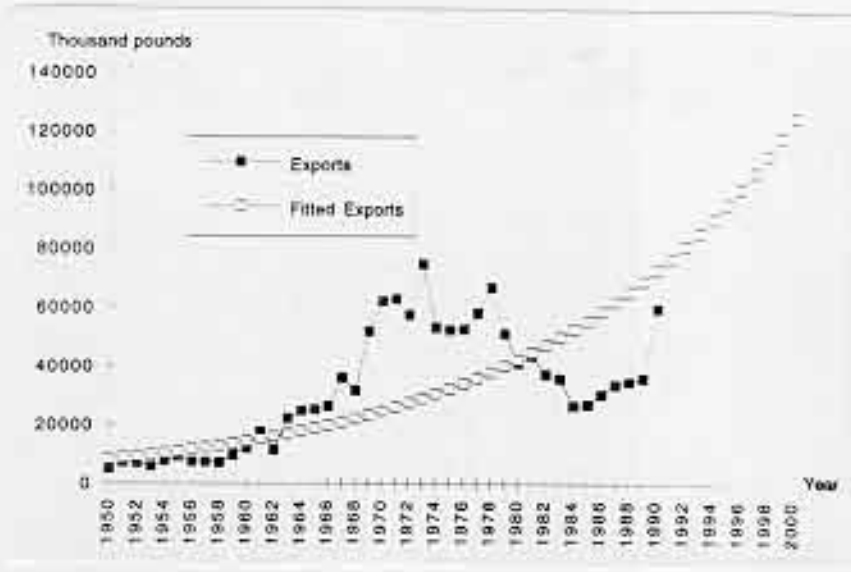


Figure 7. Exponential curve fitting for exports.

satisfied the raise in fish consumption (Fig. 8). The same report explained that imported shrimp in 1986 accounted for 67% of the total U.S. supply. These imports were mainly from sources in Central and South

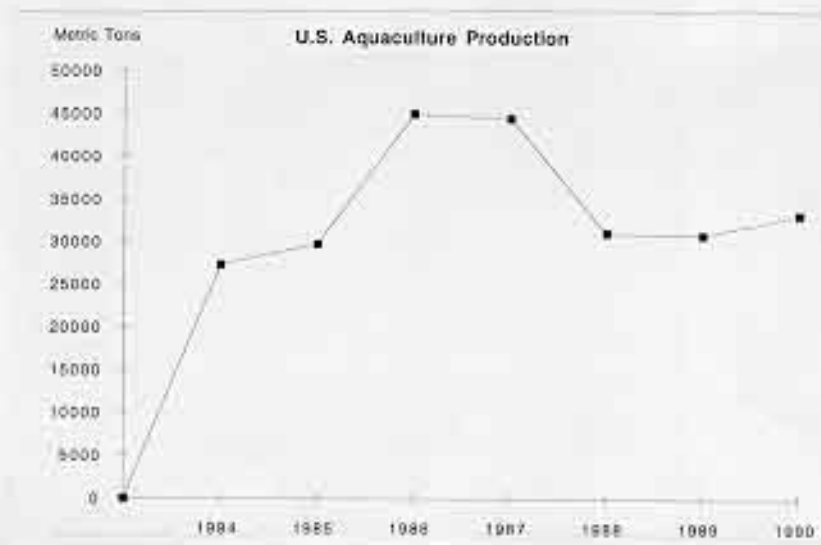


Figure 8. Aquaculture production in United States between 1984-1990.

America. Indeed, the National Marine Fisheries Services explains that between 1980 and 1986, U.S. per capita consumption increased almost 15% and that the objective of the National Aquaculture Improvement Act of 1985 was to stimulate the development of domestic aquaculture to replenish depleted fisheries (NMFS, 1988).

Another different but related explanation could be the status of price changes for shrimp. Vondruzka (1991) explained that through the late 1970's, price trends had fluctuated mostly upwards. Since the late 1970's, price trends have fluctuated mostly downward because supplies of shrimp have grown faster than demand in the world market. This situation made the acquisition and consumption of shrimp easier.

This relationship between price and demand could represent an economic transition that reflects an ecological change due to the increase of aquaculture production. For example, wetlands are important nursery areas for shrimps which require the microhabitat that coastal vegetation provide to develop one part of their life cycle. When natural conditions are altered, an impact on recruitment of postlarvae occurs. Dahl (1990) did an analysis on wetlands losses in the United States and found that 53% of the original wetlands from 1780's to 1980's have been lost.

Finally, as consequence of this shrimp market behaviour, the U.S. Government encouraged the development of the aquaculture and decided to coordinate and implement an effective National Aquaculture Policy.

PROPOSED ANALYSIS EXTENDING BEYOND THE SUBMITTED RESEARCH.

The proposed research for the Laguna de Terminos wetlands will apply data from the region following the approach explained in the previous section. Beyond that effort, additional analysis will be made in order to provide analytical criteria to the Mexican Government and private organizations concerned with the formulation of alternative policies for the conservation of the wetlands.

The ecological and economic importance of the Laguna de Terminos wetlands are linked and will determine the conservation of the area. As Drake (1992) explain explicit recognition must be given to the interconnectedness among sectors and across scales. In the case of the Laguna de Terminos wetlands, this interconnectedness is evident and requires the analysis of three different transitions: forestry, ecological and economic.

Forestry Transition

This transition is explained in terms of deforestation processes. It has been suggested that this transition could be a mirror of the agricultural transition as land was cleared to extend cultivation (Drake, 1992). For this reason it will be analyzed by looking at two economic activities: rice production and aquaculture.

Rice production to the South of the Laguna de Terminos wetland has been developed to a point where large areas of mangroves and marshes are threatened. In this case, the transition starts with slashing, burning, and plowing the land during the dry season. The next phase includes a second plowing during the wet season in order to remove all remanent weeds. This practice leaches the minerals and nutrients out of the soil and eventually causes a decrease in rice production. As a result, to improve production, fertilizers are used to reestablish a nutrient balance in the soil and pesticides are used to control weed growth. Consequences of this practice are the loss of soil quality and the runoff of toxic chemicals that pollute rivers and lagoons. The final outcome of these processes is an imbalance in the economy of the local society.

Aquaculture production has also led to the forestry transition at the Laguna de Terminos wetlands. In this case, the transition starts with the cutting down of mangrove trees and the drainage of freshwater marshes. The following step is to built and operate ponds where shrimp will be produced. Once this has been accomplished, the phase of collection of large quantities of shrimp postlarvae is initiated. However,

to sustainably maintain this activity the obtention of postlarvae is essential and this will depend on the habitat available (mangrove roots). The cutting down of the mangrove forest results in a loss of nursery areas of different organisms and it represents the loss of the main source of organic material to the Terminos lagoon and the sea. This situation represent a threat to the maintenace of the economy of the area.

Ecological Transition

This transition could be the mirror of the forestry and agricultural transitions since biological interrelations have been altered to develop economic activities.

This transition is explained by the transformation of natural resources into degraded areas. This transformation could induce a decrease of productivity in those areas and may not support human population needs, causing not just economic but social problems.

At this point, the timing of transitions become critical. As Drake (1992) explains, since transitions relate to one another they affect societal vulnerability and this creates additional problems.

In the case of the Laguna de Terminos wetlands, the transition starts when human activities transform mangroves and flooded forests as well as freshwater marshes into rice fields or aquaculture areas. The loss of these ecosystems has important implications on different ecological aspects of the area. The mangrove forest and freshwater marshes represent the most important sources of organic material to the coastal zone, generating a high productive environment. Due to this condition a high diversity of aquatic organisms are found in the Terminos lagoon. Furthermore, these ecosystems also represent a fundamental habitat for a high diversity of wildlife. Besides its biodiversity importance, mangrove forests play a major role in the soil formation process and form an excelent natural coastal barrier against hurricanes or other similar events.

In relation to the timing of transitions, it is evident that an overlap of transitions are taking place. When the forestry transition occurs an ecological transition is initiated. As Drake (1992) point out, the timing of transitions will be influenced by public policy.

Economic Transition

The implications of the transitions explained above could lead to very important changes in the economic development of the region. These transitions will reduce the dependance on traditional fishing methods in the region by developing an aquaculture industry and creating an agrarian economy based on rice and cattle.

Economic indicators of this transition include general economic levels of market growth, production quotas, income, and increases in goods and services for the region.

EXPECTED RESULTS

This research is expected to obtain a clear understanding about the transitions that are involved in the productive system of the Laguna de Terminos wetlands. Identification of trends and key relationships, critical periods, rates and magnitude of changes and factors that lead to those changes are also expected.

POSSIBLE POLICY IMPLICATIONS

Several policy implications could be expected. First, redefinition of regulations related to the exploitation of the natural resources in the area. Second, a regional and local prioritization of the financial support given to productive projects. Third, recognition of the importance of creating policies regarding coastal communities in those areas. Fourth, redefinition of strategies of production taking into account the ecological processes that support the economy of the region. Fifth, reinforcement of conservation laws to protect wetlands in coastal areas.

In conclusion, the use of transitions, as Drake (1992) explains, facilitate the historical links of change with historical policies providing criteria for decision-makers in the short term.

ESTIMATED TIME REQUIRED TO CARRY OUT THE INVESTIGATION

To carry out this study 6 months it will be necessary to gather the data required for the analysis: fisheries, rice production, aquaculture production, wetland area lost, economic indicators.

Data analysis and elaboration of the final report will require approximately 8 months.

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A HISTORICAL APPROACH TO THE AGRICULTURAL TRANSITIONS IN COSTA RICA AND ITS IMPACT ON THE ENVIRONMENT: FROM THE COLONIAL SUBSISTENCE ECONOMY TO THE 1990s AGROEXPORT DEVELOPMENT MODEL

Roy Rojas Montero

I. INTRODUCTION

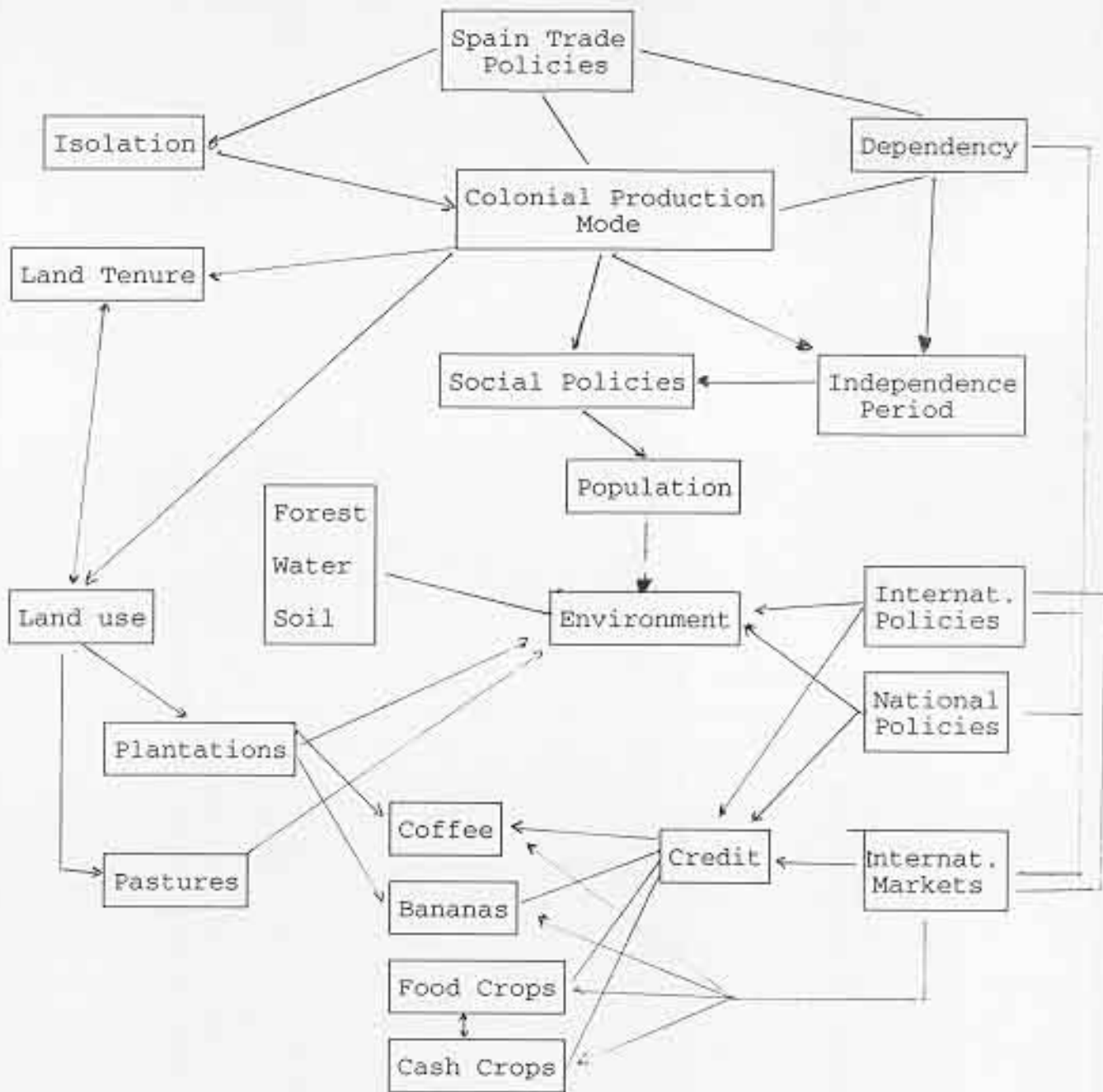
Costa Rica is the second smallest country in Central America. It has a population of about 3 million people who, in a great majority live in urban or semi-urban areas. The economy of the country has historically depended upon the agriculture though nowadays there is an incipient and weak industrial development. In fact, since very early in the independence period the country became a cash-crop exporter, relying on two or three basic monocultures, from which coffee and bananas have been the most important. This traditional dependence on only two export products has rendered the country highly vulnerable to the fluctuations in the international markets and the periodical crisis in the world economy.

The introduction of coffee and its success as an export crop in the 1830s, operated profound economic and social changes in the young independent Republic and marked the first agricultural transition in the modern history of Costa Rica: From a colonial subsistence economy Costa Rica soon developed an agrarian capitalist structure which inserted the country within the global trade panorama.

The expansion of coffee contributed to the ongoing process of deforestation initiated early in the colonial era with the increase of pasture areas for cattle production. Nevertheless, other process such as centrifugal migration furthered by the gradual concentration of land in the most fertile agricultural areas in the central highlands, led to the colonization of new zones which were rapidly deforested and put under either, cultivation or pastures. The introduction of bananas at the end of the XVIII century exerted even more pressure over the national forests.

The monoculture-dependent economy signaled Costa Rica's life until the mid XIX century, when a new economic model was implemented in order to industrialize the country and overcome its dependence on the highly variable world market conditions. The adoption of this model only resulted in a higher dependence and led the country to indebtment and to a general economic crisis since the basic economic structural problems -land tenure, wealth distribution- were never addressed. This crisis exploded in the 1980s thus compelling the governments to re-orient the economic strategy of the nation, in a great extent under the pressure on the International Banks and Financial Agencies who required the country to serve its external debt. A non-traditional crop export model was adopted to respond to the new situation, a model basically oriented to the production of high-value cash crops. This situation marked what apparently is another transition

Schematic Model



in the country's agricultural history, and not only in terms of production or revenue income but also in terms of the deep changes in state's structure and policies it has implied.

In this paper, I am going to try to describe this transitions from a historical perspective and as far as possible, I will attempt an empirical interpretation of their possible meanings. The work of Anderson (1992) on the Forestry Transition in Costa Rica, somehow overlaps in its general thematic with the current paper, since, as Drake states (1991), the forestry transition has been largely the mirror image of agricultural transition. Therefore, I will try to concentrate on the agricultural transitions and its possible relationships with the population transitions.

II. AN OVERVIEW OF PRE-COLUMBIAN COSTA RICA

Except for some small patches of antropical savannas and cultivated lands, when the Spanish arrived to America, the current territory of Costa Rica was a land of dense ancient tropical forests covering coastal lowlands and highland valleys alike, which contained tens of thousands of exotic plant and animal species (Faber, 1992). During the several millennia of the precolumbian era, Costa Rica was inhabited by Amerindians, which created a niche in the tropical forest ecosystem, making their living from a shifting agriculture, using simple agricultural techniques. Hunting, fishing and gathering were complementary activities for sustenance (Hall, 1984).

PRECOLUMBIAN ECONOMY

There was no specialized commercial agriculture comparable to the one practiced by Europeans. Systems of permanent cropping or annual rotation and fallowing occurred in some localized areas, particularly along the more moist and fertile river bottoms. But most Indian plots were generally abandoned as yields declined after two or three years, due to the declining soil fertility and invasion by weeds. As a result, extensive areas of forests were cleared by Indian villagers to grow their crops, but allowed to recuperate as secondary forests later on (Faber, 1992). It is not clear to the archaeologists how and when the transition from gathering to agriculture was achieved in Costa Rica since there is no evidence of primary plant domestication but probably agricultural techniques diffused from the Mesoamerican and the Andean regions.

Nicoya, a historical region in the current province of Guanacaste (Northwest Costa Rica) has been long considered by the archaeologists as the Southernmost margin of the Mesoamerican-culture area. This cultural area was characterized by the preponderance of grain crops (beans and com) as well as cacao cultivation, the existence of Mexican-influenced religious practices and political structures, and the use of languages of the main Mesoamerican stocks (Edelman, 1992). In fact, the groups which occupied this area combined the production of com and beans with squash, which big leaves protected the soil against evaporation and erosion. Being part of the Dry

Tropical Forest ecosystem, this area presented more favorable conditions for human settling and for agriculture. This fact explained for the existence of the larger populations the Spanish found at their arrival, in relation to the very humid central highlands and the lowlands in the South and the Atlantic regions of Costa Rica. These territories were predominately dominated by groups under Southern-culture influence. These societies generally had tuber-based productive systems that supported only scarce populations with less complex forms of societal organization. Most of the crops planted were native from the Tropical Wet Forest of the Northern part of South America and included cassava (*Manihot esculenta*) and peñibaye (*Gutierrezia utilis* Oerst.); the fruit of a tropical palm. Cacao, introduced from South America also, was widely cultivated but, unlikely the Mesoamerican area where it was used for exchange, in the South-influenced areas it was used mainly for ceremonial purposes. Corn was also known by this cultures but it is presumed that it represented a secondary crop since environmental conditions of the Humid Tropics made its storage difficult.

Nevertheless, and in spite of the general uniformity of the native cultures in central and southern Costa Rica, archaeological research is providing evidence of gradual changes in economic activities, political and social organization and population density over time. The increase in the number and size of archaeological sites between 1000 b. C. and 1500 a. C. suggests a slow raise in the population in the long run, though it is likely that big fluctuations occurred in the short term. In some areas the population might have reached a temporary boom some few centuries before the arrival of the Spanish conquerors.

III. THE CONQUEST AND COLONIZATION OF COSTA RICA

As in the rest of the continent, the arrival of the Spanish conquerors to Costa Rica represented the beginning of five centuries of "old world" imperialism, or as Eduardo Galeano -an acknowledged Latin-American historian- termed it "the pillage of a continent" (Faber, 1992). The overall process of the conquest not only led to the cultural and physical decay of the indigenous peoples -many of which were driven almost to extinction- but also represented the destruction of the sustainable modes of production through which -for millennia- they related with Nature. As the rest of the European imperialists, the Spanish regarded the native agricultural systems as primitive and inefficient, thus, fostered a process which some authors have described as *ecological colonialism*: the substitution of the indigenous ecosystem by their own agricultural systems and by land-use patterns suitable only for the Mediterranean areas where they came from, but not for the Humid Tropics (Faber, 1992; Hall, 1984).

According to Faber (1992), ecological imperialism in Central America by the Spanish conquerors assumed three distinct but interrelated dimensions. First, the initial purpose of the Spanish conquest was to extract the region's cultural and natural resources, particularly gold and silver, and enslave Indian labor to harvest this wealth. To appropriate the New World's natural resources, land and labor-power for the Crown, required the military defeat of Indian cultures. The second dimension of ecological imperialism involved the use of ecological-biological weapons, along with conventional ones, as instruments of mass murder and subjugation by the Spanish. In ecological terms, the "old world's " plants, animals and diseases benefited the Spanish as biological allies in their defeat and demoralization of indigenous peoples.

IV. THE POPULATION CATASTROPHE

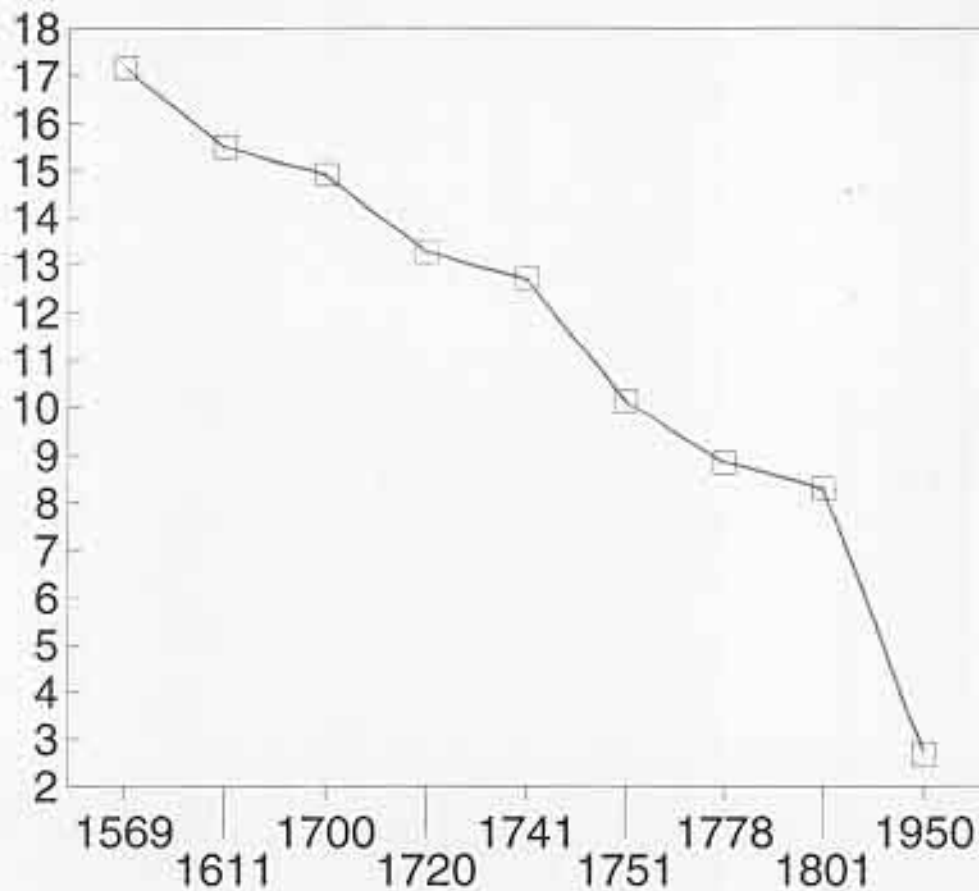
Costa Rica's native population suffered a demographic catastrophe of massive proportions after the contact with the Spanish began. As Hall (1984) points out, native population was one of the most appreciated resources by the Spanish Empire since it was used as the main source of labor to work the crop fields and gold mines. Therefore, slavery was among the most common methods to dominate the Indians. After the Spanish defeated and conquered the Nicoya region (northwest Costa Rica) in 1520 most of the native people was exported to Panama and Peru to work as slave labor in the mines and to help in the conquest of Peru. It is estimated that in this region, the Indian population declined from 62,692 at contact in 1522 to a mere 1,800 sixty years later (Newson, 1982).

In the inland and southern territories, colonial authorities recorded a population of 27,200 by 1520; though, some authors think that the Spanish could have underestimated the real figure by not taking into account the population of those regions out of the scope of Spanish effective control. Therefore 400,000 is considered to be a closer approach to the real a population by the date considered. Figure 1 shows the decline in the native population in the central and southern territories of Costa Rica from 1500 to 1950. In 1569 colonial authorities had recorded 17,000 Indians but only 8,000 were left by 1801, which represent a decline from 98% of the total population to just 16% (Hall, 1984).

High mortality rates due to unknown epidemic diseases combined with the slave trade, over exploitation, racial mixture, acculturation and the disruption of the agricultural production were the main factors contributing to reduce indigenous population to the status of an ethnic minority, which at the beginning of the XIX century made up less than a fifth of the total population. Nowadays, they constitute only 1% of the population (Faber, 1992; Hall, 1984).

During the first 100 years after the discovery of Costa Rica in 1502, the net effect of the Spanish and African immigration on the total population was counteracted by the high mortality rate experienced by the Indians. During the XVII century somehow, this trend was substituted by a slow and fluctuating demographic growth. An average increase of 1% in the XVIII century brought about a population of 52, 591 in 1801 (Hall, 1984)

Figure 1 Decline in native population in Costa Rica (1569-1950)



Hall, 1984

V. COLONIAL ECONOMY

As Hall (1984) points out, native population was one of the most appreciated resources to the Spanish Empire since it was used as the main source of labor to work the crop fields and gold mines. Anyhow, when the Spanish started to colonize the inland territories of the country by 1560, the New Laws from 1542 had proscribed slavery for native people though institutionalized the system of *encomiendas* to incorporate the natives into the colonial system.

Under this system the Crown made grants of Indians for labor service, then it was but a disguised form of slavery since the Indians were virtually constrained to work for the *encomenderos* (encomienda holders) and pay tribute to the Crown (Edelman, 1992; Melendez, 1975).

The destruction of most of the Indian population and the failure to discover significant mineral resources meant that Costa Rica, although increasingly settled in the seventeenth century, was destined to remain "a marginal zone of a secondary region of the colonial system" (Edelman, 1992; Faber, 1984). The absence of these necessary conditions for agricultural plantation production or large-scale mining led to the creation of minifundios (small family farms) of colonial settlers oriented primarily to subsistence production as the foundation of the Costa Rican colonial economy. Shortage of Indian labor power limited economic development to such an extent that not a single large hacienda existed in Costa Rica prior to independence (Faber, 1984).

VI. CATTLE RANCHING IN THE COLONY

The small size of the Indian population was both a cause and an effect of the introduction and spread of livestock after the conquest. Faced with a labor scarcity and few economic possibilities, the logic of an enterprise based on the simple extraction of semiferal animals was attractive to Spanish colonists and their descendants. At the same time, cattle feasted on the Indians' crops, contributing to starvation and exacerbating the initial population decline (Edelman, 1992). On the other hand, while in Europe beef consumption was generalized among the privileged groups, in Latin America it had come to constitute a basic meal for the subordinated sectors of the population since the beginning of the colony.

When beef cattle was introduced into America, it reproduced so fast that in a short time it became a constraint for agricultural production. Nevertheless, in few years its growth rate decayed sensibly due to the gradual depletion of pastures. Despite this, American conditions seemed to be more favorable for cattle production than European's.

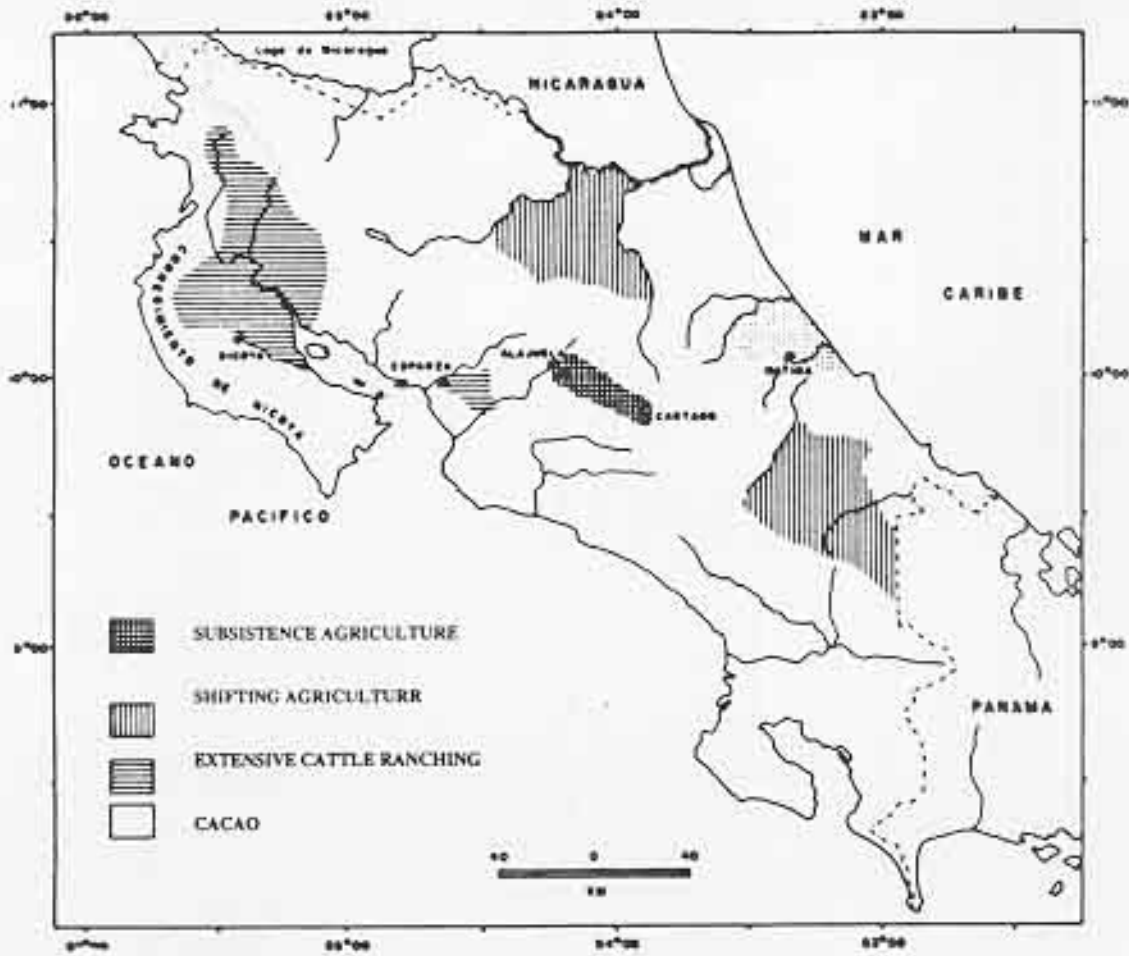
Costa Rica was no exemption. For the small colonial farmer, cattle had a relevant role as a means of production, transportation and feeding. Thus, the biggest exploitation in the Central Valley of Costa Rica were devoted prioritarly to beef cattle production. It was only after the beginning of the coffee expansion when most of the agricultural lands and cattle production were displaced toward the new areas of colonization. (Alvarenga, 1988).

VII SPAIN'S COLONIAL TRADE POLICIES AND THEIR EFFECT ON COSTA RICA'S ECONOMY

As it has already stated, during the whole colonial period Costa Rica remained a marginal zone of a secondary region of the colonial system (Edelman, 1992). Approximately three months were required to travel by horse from Costa Rica to Guatemala, the seat of its colonial government. The effect of such isolation on the population can be appreciated by considering that the bishop in charge of the province, who resided in Nicaragua, was able to pay only eleven visits to the unfortunate territory between 1606 and 1815, the intervals between visits ranging to thirty-three years. Such seclusion kept the inhabitants unaware of social and political trends. This situation was basically exacerbated by the rigid trade control and monopoly exerted by the Crown. Under the Hapsburgs Spain had controlled virtually all trade in and out of its American colonies. The only alternative to trade with Spain was piracy and black-marketing, often by the British and their allies. Some liberalization of the trade occurred in the late XVIII century as a result of the Bourbon reforms and measures taken by the Cortes, or parliament, of Cadiz to eliminate certain taxes on agricultural production and to permit trade between colonies, partly in an effort to suppress contraband commerce.(Cardoso y Perez, 1977) This economic reforms had a greater impact on such provinces as Guatemala and El Salvador, which exported cochineal and indigo dyes, than in Costa Rica which exported little of anything and where they were not sufficient to generate the growth that occurred in other secondary areas of the colonial system. (Edelman and Kenen, 1989; Cardoso y Perez, 1977).

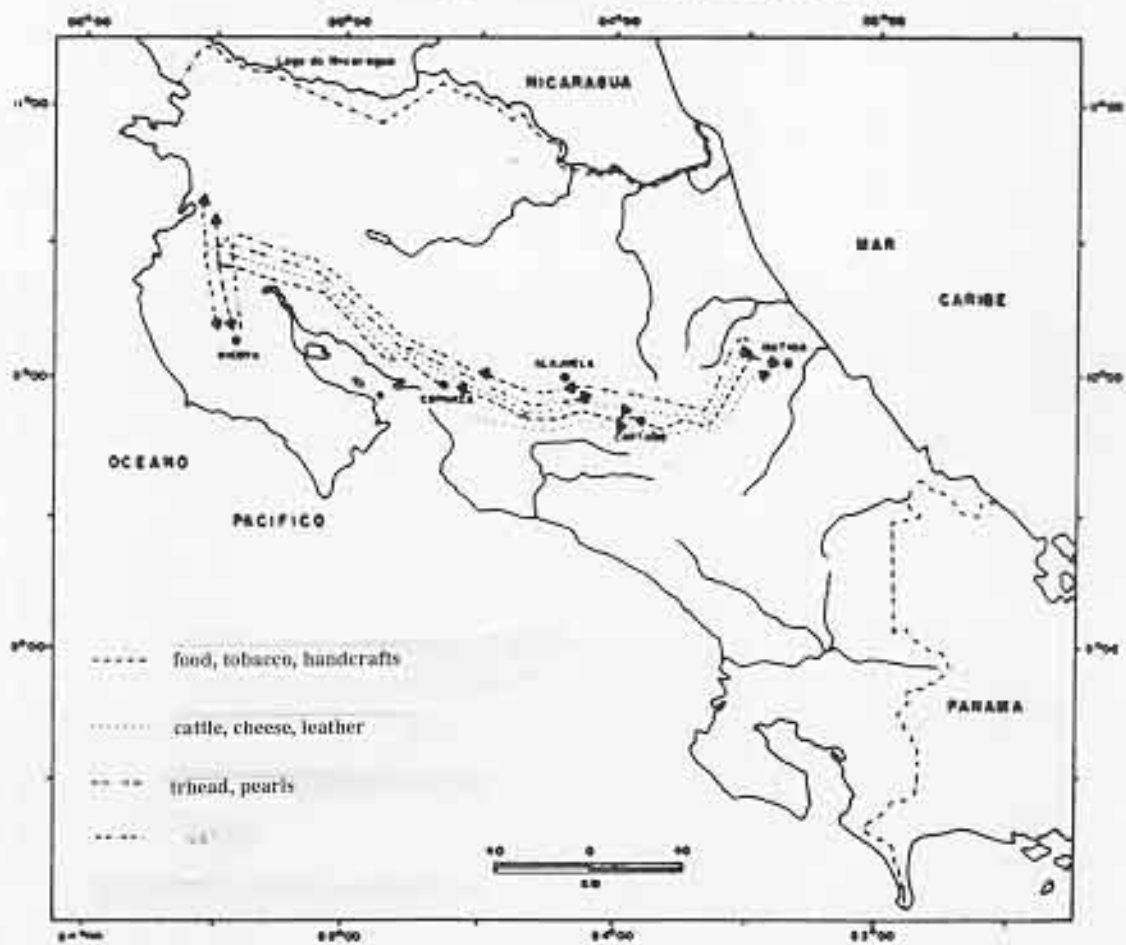
A small cacao boom on the Atlantic coast from about 1650 to 1750 never effectively altered the economic precarious situation of the small colony, which discouraged elite efforts toward aggrandizement, though it did lead to considerable wealth and to importation of African slaves in the local context. By the XVIII century the policies of the Crown and Guatemala had resulted in a complete economic stagnation to the point where even cacao had to be abandoned (Stone,1974). Toward the end of the XVIII century, the introduction of a post of the royal tobacco monopoly in San José greatly stimulated the settlement in the area and assured its preeminence later in the Republican period, though tobacco production was unable to expand and tended to stagnate after independence. Thus, despite this occasional upturns in local prospects, the Costa Rican colonial economic regime was not far beyond subsistence and barter with a few relatively unimportant export activities. With the independence in 1821, the revocation of the remaining provisions for forced commercialization removed an important obstacle to economic growth. Figure 2 shows the geographic economic spaces in Costa Rica during the late colonial period (1750-1821) and Figures 3 shows the routes of interregional trade during the same period.

Figure 2 Economic spaces in the Costa Rica of the late colonial period (1750-1821)



Molina, 1991

Figure 3 Interregional trade in colonial Costa Rica (1750-1821)



Molina, 1991

VIII. THE COLONIAL HERITAGE

The egalitarian image of early independent Costa Rica, which is not a completely false one, was made possible by the general isolation and poverty of the vast majority of the population during much of the colonial period. Despite their best intentions and efforts during the early colonial period, the Spanish conquerors were unable to establish firmly either the landed estates or the servile labor systems that would be characteristic of other, more densely populated areas of Central America. There was simply never enough Indian labor or external demand to permit substantial or sustained export activities of any kind. Thus, several major Spanish colonial economic institutions, such as *encomienda* and *repartimiento*, were short-lived or weak from the beginning, often decaying or disappearing during the XVII century (Edelman, 1992).

IX. THE INDEPENDENCE PERIOD: THE NATIONAL STATE

The construction of the national state in Costa Rica was a gradual process, parallel to the expansion of coffee cultivation. The colonial heritage was limited to an economy based on isolated subsistence activities by a society of peasants and landowning farmers. Although large differences in personal wealth existed, cultural homogeneity and a strong individualist tradition seem to have been the most significant characteristics of the rural petty bourgeoisie (Perez, 1989). With independence in 1821, and to some extent even before, the local elite began to modify the economic structure inherited from colonial times. Clear attempts were made to stimulate export agriculture of diverse types, especially among the wealthy and politically influential. But prior to the massive expansion of coffee cultivation in the 1840s and 1850s, no viable export alternative was found. (Hall, 1984)

The inclusion of Costa Rica within the world economic system as the colony of a merchantile European Empire initiated the long process of underdevelopment which still persists today. However, the early stabilization of the democratic government after the independence and the structural situation of the country as being one of the less developed and unpopulated of Latin America (unaffected by the socio-economic problems of the large Indian communities or ancient slaves populations) allowed Costa Rica to become one of the first countries to establish a neocolonial economy based upon the exportation of one or two primary products (cash-crops) and the importation of a wide variety of manufactured products and raw materials (Cardoso y Perez, 1977). Consequently, coffee and bananas got to replace other export goods and the impact of the agro-export economy on land use and tenure has persisted until recent days.

X. THE COFFEE TRANSITION

Coffee, a subtropical perennial crop rose in the decade of 1830 as the main export product of Costa Rica. It had ample acceptance in Western Europe, particularly England and Germany and for fifty years it was Costa Rica's almost exclusive export product. The volume of exportations was quite fluctuating over the years, reflecting huge variations in the yields, but the trend in the long term since the mid-nineteenth century to the mid-twentieth century was one of gradual increasing in production, achieved basically through an expansion in the planted areas. After 1950, the introduction of new varieties and cultivation techniques led to an intensification in the yields and to an increase in exportations (Hall, 1984).

By the late 1830s coffee exports began to reach important levels in the local context, surpassing the worth of all other exports combined. From 23,000 kg exported to Chile in 1832, coffee exports burgeoned to over 1 million in the 1840s, 4 million in the 1850s, 11 million in the 1870s and 20 million by the end of the century. These exports were overwhelmingly to Great Britain. By the 1880s railroad transportation to the Atlantic port city of Limon permitted greater coffee exports to London. English and other European immigrant merchants played a key role financing the coffee expansion, both through mortgage funds with which to expand operations. These foreign merchants soon became planters and even more important, processors themselves.

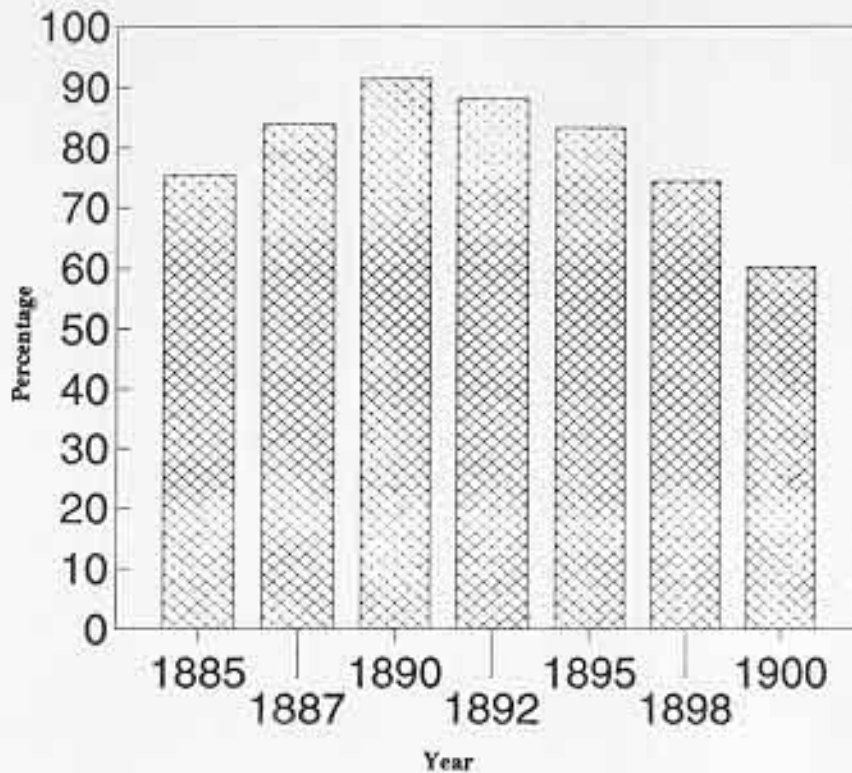
Monocultural dependence upon coffee exports soon followed, as did importation of British goods on a large scale. Coffee regularly accounted for 75 to 95% of all exports by value before the rise of banana exports in the last two decades of the past century. Figure 4 shows the value of coffee exports as a percentage of total exports during the last quarter of the XIX century (Cardoso y Perez , 1977)

Therefore, the adoption of coffee as the base of the economy marked a fundamental dividing line in Costa Rica's economic history: its transition from a subsistence-based frontier agriculture toward an agrarian capitalism. But unlike other Latin American countries, in Costa Rica this process was not characterized by violent conflict, forcible expropriation of peasants, or suppression of migration through monopolization of public lands.

XI. THE INTRODUCTION OF BANANA PLANTATIONS

Though bananas were introduced to Costa Rica since the colonial times, they were first exported commercially in the 1880s. In 1894, Minor Keith (later to become founder of the United Fruit Company in 1899) reached an agreement with the Costa Rican government to complete a national railroad, from San Jose in the Central Valley to Limon along the Atlantic coast. In exchange, Keith received land grants equal to 7% of Costa Rica's national territory, in addition to the land on which the railroad was constructed, as well as large parcels for the building of piers, ports and warehouses.

Figure 4 Value of coffee exports as a percentage of total exports (1885-1900)



Molina, 1991

Banana production started declining after 1913. World War First and the Recession of the 1930s reduced the demand, and therefore, the prices came down. By 1930, the banana enclaves in other Caribbean countries were more profitable than Costa Rica. This led to the temporary disappearing of the banana plantations in the Atlantic coast of Costa Rica. By that time, new plantations had been established in the southern lowlands of the Pacific coast but most of them had to be abandoned as early as 1943 due to the appearance of Mal de Panama, a banana disease. From 1963 to 1973 the planted area declined 50% in this area.

After recurrent crisis, the banana plantation enclaves still play a relevant role in the national economy and contribute in a significant percentage to the national income. Nevertheless, the production is no longer monopolized by Foreign Companies since from the mid-1960s national planters have irrupted into the market (Chinchilla, 1992).

Yet, unlike the nationally owned coffee industry, Costa Rica's banana industry has historically functioned as an export enclave, contributing little to the social development of the country (Faber, 1992).

XII. MONOCULTURES AND THEIR EFFECT ON LAND-TENURE STRUCTURE AND THE ENVIRONMENT

The wish for opening new lands for the production of coffee and bananas was the driving force behind the agricultural colonization after the independence. Thereupon, export monoculture crops have occupied many of the most fertile and accessible lands of the country.(Hall, 1984). Coffee trade grew rapidly over the next three decades after the first shipments were made by 1830, preserving existing minifundios and advancing the formation of new ones into the lush woodlands of the Central Valley surrounding San Jose. In the beginning, the expansion of coffee in a society with many small holders like Costa Rica's meant that income from coffee was more equitably distributed than elsewhere in Central America and that its multiplier effects on other economic sectors, particularly commerce, were considerably more profound (Cardoso y Perez, 1977).

But while coffee brought prosperity to the country's small family farmers, it also unleashed a process of deforestation. As the plantations expanded, they moved up the hillsides, displacing some of the finest forests of the region, first in the areas of rich volcanic soil and subsequently in the adjacent darker alluvial soils as well (Faber, 1992)

Later half of the XIX century the relative equality which had characterized Costa Rican society began to erode as a land concentration process started. With the unhealthy reliance on increased borrowing from British bankers, land holdings became more concentrated as many small farmers went into debt and sold off their farms. Thus, in 1892 for instance, 11.1% of the value of all registered property in Costa Rica changed owners, the vast majority being coffee-growing estates. Between 1883 and 1892, the number of large coffee haciendas increased 20%. Although rural people in Costa Rica remained small landowners, the process of land concentration created a new class of landless wage laborers, and for the first time, the large latifundio existed side by side with the small farmer. Growing landless exacerbated deforestation and habitat destruction, as many displaced farmers cleared public lands on the outer portions of the meseta, often at altitudes too low for coffee production. By the early 1900s, Costa Rica's richly diverse forests of oak, laurel, and myrtle, characteristic of the wetter and warmer highlands of southern Central America, had been extensively degraded (Faber, 1992)

In spite of this, the largest properties in modern Costa Rica are primarily cattle ranches and a smaller number of sugar plantations, neither the most lucrative of tropical enterprises. Most of the banana plantations in the coastal enclaves though are big land holdings, belong to foreign transnationals and therefore, historically have had less effect on the composition and wealth of the country's upper class than if they were owned by nationals. These considerations obviously shaped the capital accumulation possibilities of Costa Rica's landowning class. Moreover, as various studies of the coffee sector show, much of the capital accumulation of the Costa Rican coffee

bourgeoisie was based on control of processing and marketing rather than on direct control of land and production (Perez, 1984).

XIII. THE CATTLE RANCHING EXPANSION

At the beginning of the XIX century, most agricultural land in the Central Valley of Costa Rica, the country's main population concentration area, was in pasture. The spread of coffee cultivation occurred on lands that had previously been used for pastures, sugarcane and food grains. By the late XIX century pastures in meseta farms had generally been reduced to the minimum required for draft animals. As a consequence, cattle and food production were displaced to peripheral areas of the country, such as Guanacaste (northwest Costa Rica) (Molina, 1991). As this process consolidated, coffee exports and the accompanying unprecedented prosperity, fueled a demand for livestock products and oxen for transport in central Costa Rica (Edelman, 1991)

On the other hand, during this period as colonization of new areas occurred, extensive cattle ranching was the only feasible type of land use before the development of modern transport. Cattle ranching had an advantage over agriculture as the product was able to resist the slow and hard transport from the distant haciendas. Leather and cheese were relatively long-lasting high-valued products easy to be transported to distant markets (Hall, 1984).

As Anderson points out, as a consequence of the export diversification import-substitution model prompted by the government in the 1950-1960s, the cattle industry became a major thrust of Costa Rica's agro-export diversification program. The government pumped national and international credits into the cattle activity to support this sector of economic development (Anderson, 1992). Cattle ranchers soon turned their eyes toward new zones for expanding their activity. Thus, between 1963 and 1973 the area devoted to pastures increased in 63%, most of this new areas coming out from forest lands. Today, according to Parsons (1989) 70% of the crop lands in Costa Rica are under pastures. Anderson (1992) remarks the fact that there is a very inefficient level of productivity in the cattle industry in relation to the area it occupies. Therefore, Anderson adds, cattle ranching exhibits the dual problem of economic inefficiency and environmental deterioration.

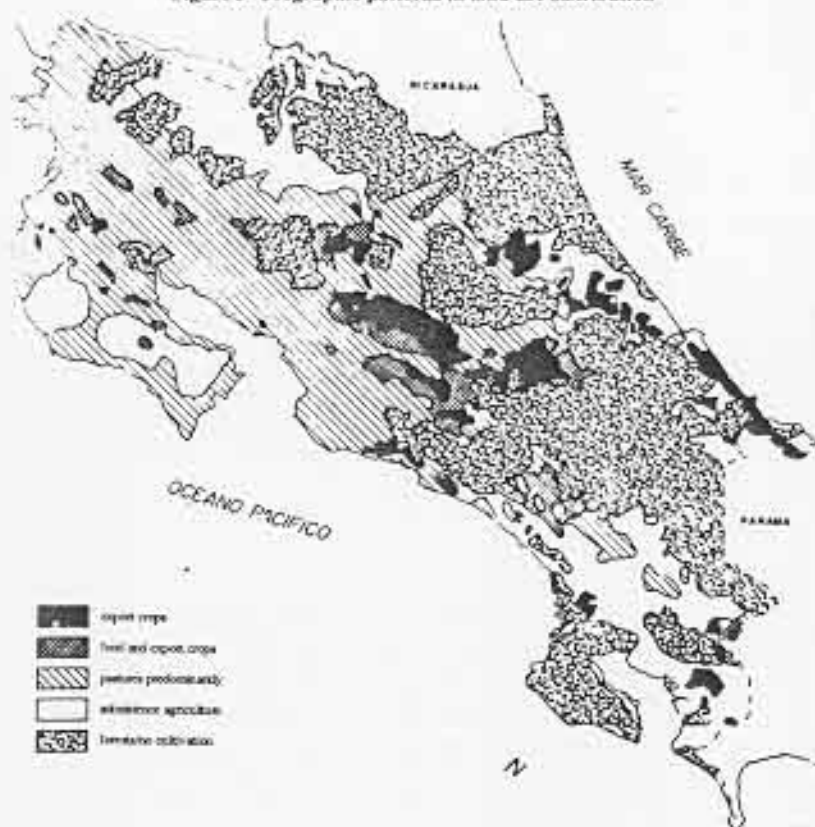
The ecologic impact of cattle expansion in this period has been devastating. Along with the depletion of the forests there come the problems of soil erosion and compaction, nutrient depletion; not say the loses in biodiversity. Table1 shows the trends in land use in Costa Rica from 1950 to 1990. Figure 5 shows geographic patterns in land use distribution, according to Hall (1989).

Table 1 History of the distribution of land use in Costa Rica since 1950

Activity	1950		1977		1985		1991	
	ha	%	ha	%	ha	%	ha	%
Agriculture	508,229	9.97	555,990	10.9	600,000	11.76	700,000	13.73
Cattle	894,455	7.54	2070,400	40.6	2200,000	43.14	2150,000	42.16
Forests	3392,356	66.52	2088,200	40.9	1700,000	33.33	1600,000	31.37
Others	304,960	5.97	385,105	7.5	600,000	11.76	650,000	12.74

Source: Fournier O. L. 1993.

Figure 5 Geographic patterns in land use distribution



Hall, 1984

XIV. POPULATION

At the moment of the independence, Costa Rica had a population of about 65,000. A relatively slow demographic pattern of 1.5% per year persisted up to the first quarter of this century. The population reached the number of 100,000 by 1850 and 250,000 by 1927. Between 1885 and 1930, a high birth rate (approximately 40%) combined with an average death rate of 24%, produced an average demographic rate of about 1.68% per year (Harrison, 1991). During the period of maximum immigration at the turn of the last century, approximately a quarter of the demographic growth was due to the influx of foreign labor. After the first quarter of the XX century, immigration was negligible. In this epoch, however, population entered a period of unprecedented natural growth (Hall, 1984).

Costa Rica's population grew from less than a half million in 1927 to 800,000 in 1950 and 2.4 millions in 1984. The whole process saw dramatic changes in demographic patterns. The overall increase was in the order of 66.9% and the average annual population growth rate was 3.9 percent; one of the highest rates in all of Latin America and the Caribbean.

In the 60's and the 70's birth rates underwent a drop unprecedented in the developing countries. Rural birth rates declined even more than urban ones. Rural urban differentials in many other 'quality of life' indicators (infant mortality, education, literacy, electrification) declined as well, even though rural-urban income differentials increased, demonstrating the role of expanded public services in causing these changes. Between 1963 and 1967 however, this figures dropped to an average annual rate of 3.6%, the result of a significant decline in the birth rate. An ever declining death rate, which stood at 7.4% per thousand in 1966, prevented an even more significant growth rate reduction. The net rate of population increase reached a low of 2.2% per year in the mid-1970's and it has since risen to around 2.5% in the wake of the 80's recession and other changes (Blutstein et al, 1969).

The noteworthy improvements in levels of living and in social conditions definitely contributed to the remarkable decline after 1960 of about 30% in the crude birth rate and 32% in the gross reproduction rate. In fact, general improvements in sanitary and medical facilities in that period led to reductions in infant mortality (Blutstein et al, 1969).

Nevertheless, more complex factors are to account for some of the decline in the Costa Rican birth rate during the 1960s. Among these are:

a) increasing concentration of the population in or near urban areas. (in 1950 33.5% of the population was urban; 34.5% in 1963, and 42.1% in 1973. Significantly, in 1973 and estimated 55% of the total population resided in the Central Valley, the political, social and economical center of the country.

Figure 6 Birth and death crude rates for Costa Rica (1955-2000)

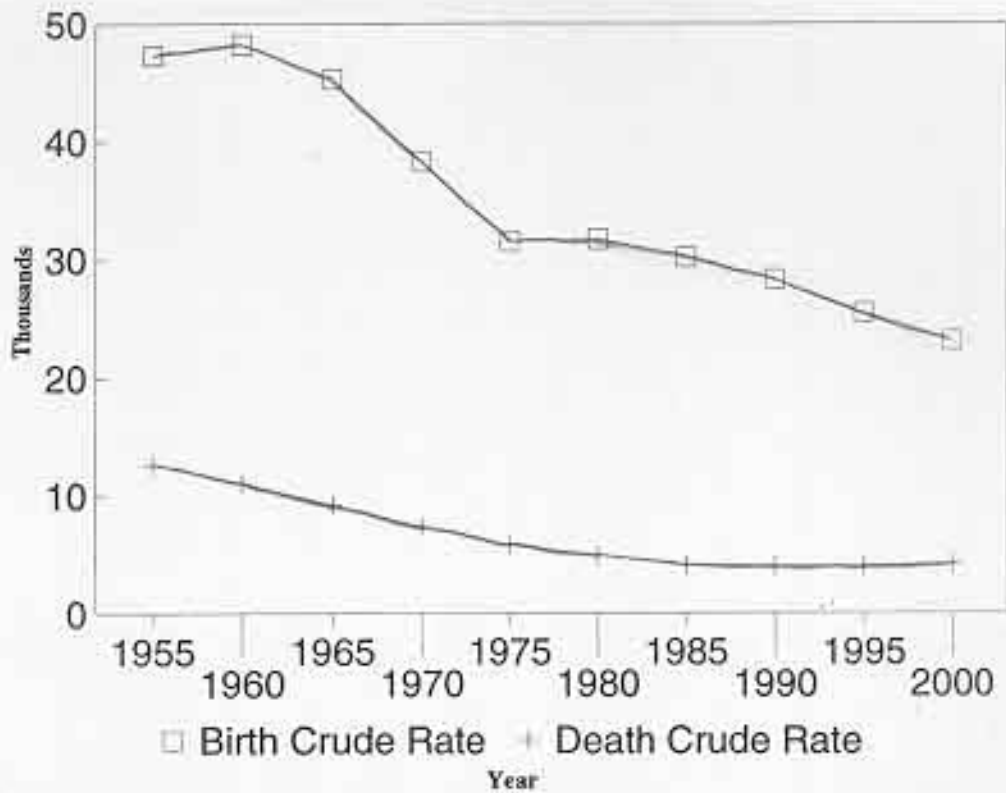
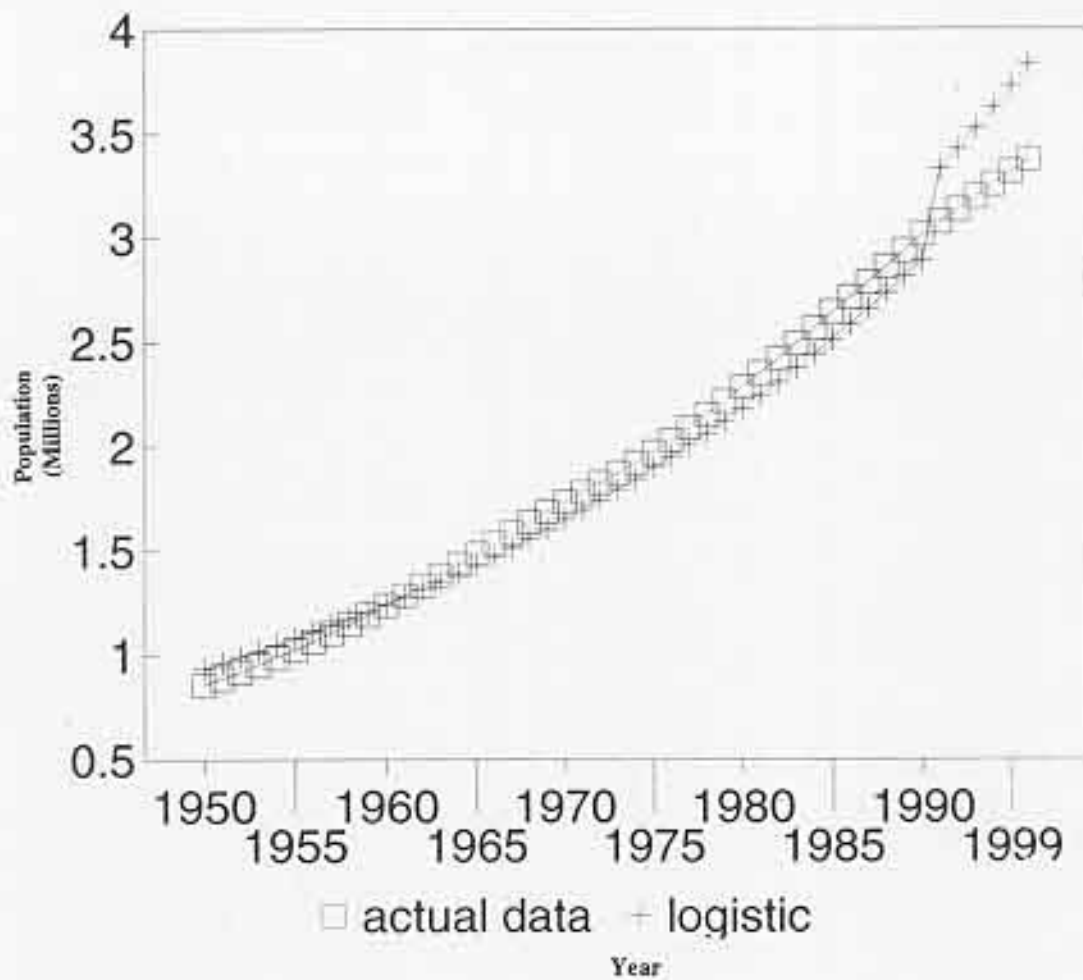


Figure 7 Population growth for Costa Rica and logistic fit (1950-2000)



b) Impressive advances in education.

c) There was a wide diffusion of modern contraceptives, especially in urban areas but also among significant proportions of rural women. The later group may have been influenced by what some observers have regarded as the rather close relationship between urban and rural groups in Costa Rica.

d) The operation of both private and public family planning programmes is thought to have had some effect on fertility, but all observers stress that although these efforts may have contributed to recent declines, the fall in fertility was already well under way before the programmes began to function on a significant scale.

The trends observed in Costa Rica during these years reinforces two different hypotheses relating to demographic development in general: that fertility transitions much more rapid than those of the past are quite possible in other parts of Latin America and the developing world, and that levels and patterns of consumption, education and other facets of modernization are more important pre-conditions for such transitions than urbanization per se, or than public family planning measures, although the latter can no doubt speed up the transition once it is under way (United Nations).

At present there are indications that the incipient "demographic transition" of the 1960's and 1970's will continue. (Harrison, 1991). Figure 6 shows the trends in birth and death rates from 1950 projected to the year 2,000. Figure 7 shows the increase in the total population from 1950 projected to the year 2,000. This figure also shows the logistic fit to the population growth curve in the same period.

XV. IMMIGRATION

After the independence, the former Spanish colonies opened themselves to the foreigner immigration. Costa Rica whose population in 1824 was 65, 393 unsuccessfully tried to emulate other barely populated American countries. But, since most of the new colonizers should have to settle in isolated, undeveloped regions with dense tropical forests, Costa Rica became much less attractive to them as compared to the temperate areas in North and South America, where railroads were opening vast areas to colonization. Europeans arrived after the independence were never more than 1% of the population. Most of them were merchants, adventurers or independent teachers and in the term of one or two generations integrated to the social and political life of the country. The only Europeans who immigrated to Costa Rica primarily as laborers were Italians.

brought to the country to participate in the construction of the railway during 1880. They also, got assimilated very easily to the Costa Rican society. The biggest wave of immigration in the Republican period was the influx of black people from the Antilles who settled in the Caribbean lowlands.

They arrived under the status of temporary immigrants, expecting to get back to their home countries once their contracts with the railroad construction company finished. Nevertheless most of them stayed permanently in the country and became laborers in the banana plantations. As Table 2 shows, the proportion of foreigners in the total population reached a maximum of nearly 10% in 1927. By 1973 it had declined to 2%.

Table 2
Foreigners in the population (1864-1973),
(Hall, 1984)

YEAR	TOTAL POP.	FOREIGNERS	% OF TOTAL POP.
1864	120.499	2.653	2.20
1883	182.073	4.556	2.50
1892	243.205	6.289	2.59
1927	471.524	44.320	9.40
1950	870.875	34.821	4.00
1963	1.336.274	30.128	2.25
1973	1.871.780	34.857	1.86

XVI. COSTA RICA IN THE XX CENTURY

During the first half of the XX century the Costa Rica's economic panorama changed little if at all. In 1950 coffee and bananas, two commodity crops, still dominated the country's exports, generating 90% of the total foreign exchange earnings (Faber, 1992). Although the prices for these exports improved immediately after World War II, they suffered relative price declines by the mid-1950s, revealing the country's economic vulnerability. It was then, when new governmental policies started to be implemented in accordance with an overall regional plan which involved all of Central America. This new policies were devised to allow the country adopt an import-substitution export diversification development model were somehow backed by the Alliance for Progress Program sponsored by the U. S. government.

Thus, during the years since 1960 Costa Rica and the other Central American countries experienced considerable industrial development, with the main beneficiaries being the local capitalists (Weeks, 1985). As Lizano (1979) points out the social costs of industrialization were extremely high, not only with respect to prices and employment, but also because due to the methods of financing Costa Rica took the path of offering financial incentives to industrial

enterprises. The result was adjustments to the tax system that, in effect made all taxpayers pay the industrialist's taxes.

It was in this context which the Common Central American Market (CACM) was created as the mechanism to integrate and reinforce the small economies of the region through promoting industrialization and finding solutions to the problems arising from the old export-led growth mode (Lizano, 1979). The creation of the (CACM) led to 7 to 9% increases in industrial output. One of the main effects of the CACM was to induce multinationals to stop exporting certain manufactures to Central America and to produce these within the region (Wees, 1982). On the other hand, the adherence of Costa Rica to the CACM made the country to become more fully integrated into the world economy as supplier of cheap agricultural commodities and raw materials. By the mid-1970s, cotton, beef, sugar, coffee and bananas constituted between 82 to 85% of all trade outside the region and over 60% of export earnings.

According to Faber (1992), in Central America, neither backward linkages -industries that produce commodities (producer goods or inputs) necessary for the production of agricultural products and raw materials- nor forward linkages -industries that process agricultural products and raw materials into another commodity form - have been developed in the processing of the primary commodities produced by the capitalist export sector. Thus the region is sectorally disarticulated, despite the creation of the CACM and the development of some import-substitution industrialization (domestic manufacture goods that were previously imported), and despite more recent neo-liberal trade policies under the Caribbean Basin Initiative. As a result, the capitalist export sector remains highly dependent on imported capital goods and highly vulnerable to trade and credit fluctuations in the international market.

XVII. THE CRISIS OF THE 1980s

Beginning in 1977 when the gross domestic product (GDP) rose by 8.9%, the rate of growth began to fall drastically. By 1980 growth had slowed to 0.8%. The trend continued, and in 1981, for the first time in several decades, production fell, in absolute terms, on the order of 4.6%. The imbalance in the Costa Rican economic system is fundamentally seen in three areas: decreased production, trade imbalances, and the budget deficit. These imbalances have brought maladies that, until very recently, were relatively unknown in Costa Rica: inflation, unemployment, and devaluation. These problems, in turn, affect the distribution of income and wealth, and provide the motive for application of policies that also modify the distribution structure (Villasuso, 1983)

The problems presented by the foreign-oriented sector of the Costa Rican economy, though multiple and complex, can be summed up under two broad categories: deficit in the trade balance and the large foreign debt. The trade deficit has been an endemic problem. Since the mid-1950s, the figures indicate that the value of imports far outweighs that of exports. In 1970, for instance, exports represented 23% of GDP. By 1980 this figure had grown to 30%. Nevertheless, in this same period, imports increased from 25% to 40% of GDP. The commercial deficit, for its part, rose from 40% of exports in 1970, to almost 60% in 1980.

The two mechanisms used to finance the trade deficit have been foreign investment and foreign debt -the latter unquestionably the most important in recent years. The public-sector foreign debt rose from less than \$900 million in 1978 to more than \$2.7 billion in 1982. Loan conditions became more stringent. Payment terms were shortened, interest rates rose, and debt service increased at an exaggerated rate, reaching approximately 35% of the value of all exports. In 1980, both the trade deficit and the debt reached a crisis level (Villasuso, 1983).

XVIII. THE AGRICULTURAL SECTOR IN THE CONTEXT OF THE CRISIS

THE NEW AGRICULTURAL TRANSITION

In the light of the general economic crisis that bumped up in the 1980s the new governments -in a great extent pushed by the pressure of the external debt and the requirements for payment from the International Banks- engaged in Structural Adjustment Policies, fostered mainly by the IMF and the World Bank. Thus, a new orientation in the development model was adopted though it was still based on the already existing cash-crop export-oriented model. New economic policies would rather promote alternative non-traditional high-value products and an expansion towards non-traditional markets. Nonetheless, traditional export-products were also reinforced (Chinchilla, 1992). As a consequence of these policies, during the last seven years traditional export products were boosted to increase both in area and productivity (coffee, bananas, sugarcane, beef cattle); food crops production for the internal market decreased or stagnated; non-traditional export-oriented products grew, both in terms of volume exported as well as in the number of different activities developed: pineapple, oranges, tropical fruits, ornamental plants, oil palm. All these activities characterized by high technical requirements are still showing an ample productive expansion (Chinchilla, 1992). Figure 8 shows the increase in the participation of non-traditional export crops in relation to traditional export crops, expressed as a percentage of total exports. Figure 9 shows the increase in the volume of exports (in MT) of non-traditional crops from 1984 through 1990. Figure 10 shows the trends followed by two of the main non-traditional export commodities (ornamental plants and pineapples) from 1984 to 1991. Finally, figure 11

shows the recent transition in the production experimented by non-traditional export crops in the decade of the 1980s up to date. This Figure also shows the exponential fit for this curve.

Figures 8, 9, 10 and 11 all clearly show the dramatic increase undergone by non-traditional export crops since the beginning of the 1980s. In Figure 8 is possible to observe how non-traditional crops even surpassed traditional crops in 1990 in terms of participation in the total national exports. Figure 9 shows the magnitude of this increase in terms of volume exported. Figure 10 shows the same trend for two specific non-traditional export crops.

Though production of non-traditional export crops seems to have had an exponential growth in the period considered according to Figure 11, the prediction of possible future trends remains a risky task, since in the future it might be affected by the ever fluctuating conditions in the international market. The current economic recession affecting the world may determine an eventual decline in the observed trend. Also, the ever increasing competition among developing countries to dominate the market of non-traditionals is a very important factor to be taken into account. Anyhow an interesting element of the current agricultural transition going on in Costa Rica, is that seemingly it is not occurring through an expansion on new virgin areas but through an expansion on prior pasture and food-crop lands. This seems to be a direct consequence of the economic policies which have promoted and incentivated the production of non-traditional export crops in detriment of food-crops and even beef cattle production. Another important element is that this transition is coming about through an intensification in the use of production resources such as Drake (1991) asserts will be the future tendency in agricultural transitions.

XIX. THE CONSEQUENCES OF NEW POLICIES

The orientation of agricultural development in Costa Rica since the end of the Second World War has been toward large-scale "agribusiness", which has meant production for export. Any successful development strategy for the country would have to have this emphasis to a degree, regardless of the political and ideological motivations of the governments involved. In the nearest future, the demand for manufactures in Costa Rica must be met in part by imports, particularly the demand for capital equipment. These imports must be paid for by exports, and there is little prospect for significant manufacture exports. Thus, agroexports will continue to play a vital role in any rational national development strategy. However, the emphasis upon large-scale production for export has not been implemented rationally, but in a way such that production for export has been at the expense of and perhaps caused the absolute decline of the peasant sector and self-sufficiency in food production (Weeks, 1985).

Figure 8 Participation of traditional and non-traditional export crops in the economy (%)

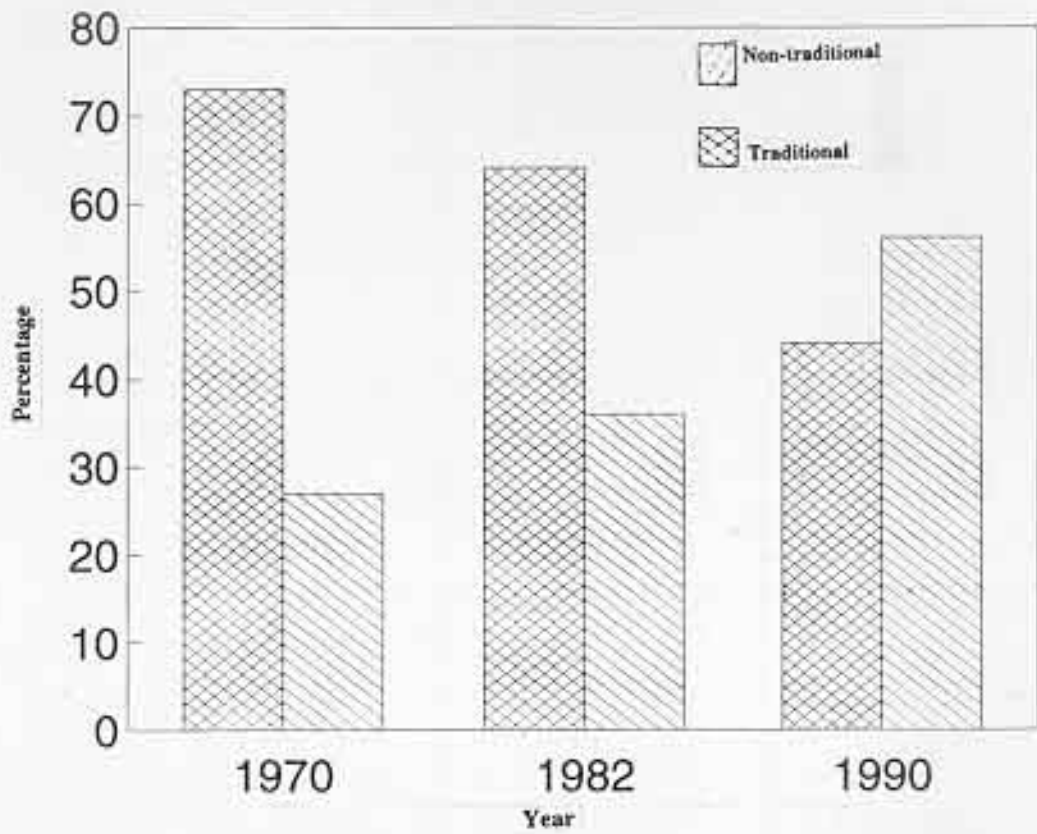
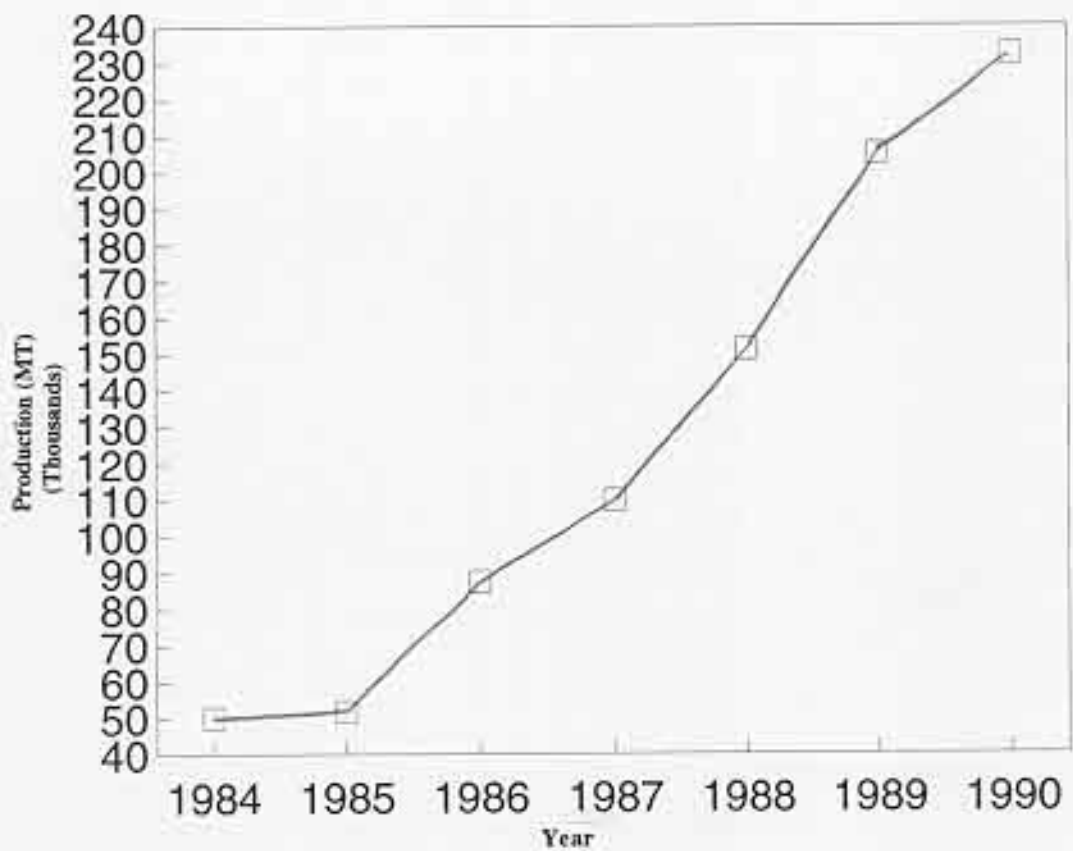


Figure 9 Increase in volume of non-traditional crops



CONCLUSIONS AND RECOMMENDATIONS

Suffocated by an unprecedented economic crisis partly product of an enormous external debt but also as consequence of a generalized international political and economic instability, Costa Rica embarked itself after 1980 in a new economic project looking forward to increasing the national incomes in hard currency. Thus, the promotion of non-traditional high value export crops prompted the country into what is apparently a new agricultural transition, preceded in importance only by the introduction of coffee as the main export product in the last century. Conceived as an strategy to get fast money to serve the external debt, this policy has ironically only increased the country's debt, since new loans from the World Bank and other International Agencies and Banks have come into the country to support this economic program. In the short term the most evident consequence of this policies will be probably what Weeks (1985) has already pointed out before in this paper. That is, a decline in the peasant sector and in self-sufficiency in food production, consequently increasing the country's dependence on the external markets controlled almost exclusively by First World countries. The non-traditional export promotion policies represent just a variation of the agroexport model adopted by the country since its independence. Therefore, dependency is implicit to it. It means the perpetuation of the country's role in the international economic stage as a neo-colonial commodity and raw material exporter.

Though the results of this economic policy are insofar spectacular, future trends are hard to predict, given the volatility in the international scene. Besides it is also clear that the benefits derived from the application of this strategy have been absorbed in a great extent by the power economic groups controlling the local means of production. Alternatives? No easy answers seem to be at the reach of hand. What is important anyway, is that the country must look for a development model which explicitly takes into consideration the well being of the whole population. Whatever the model chosen, it must necessarily be carried out on a sustainable development basis if the country is to continue depending on its natural resources.

WHAT HAS THE URBANIZATION TRANSITION MEANT FOR WOMEN'S LIVES IN INDIA?

Kameshwari Pothukuchi

Introduction

Urbanization has taken many forms in India. Historically, cities have served, and continue to serve administrative, extractive (ports), diffusion, manufacturing, cultural and congregative functions. Nonetheless, urbanization in India, as in other parts of the world, has ushered in essential changes in the social organization and structure of production, reproduction and control. In cities, work is characterized by the emergence of predominantly non-agricultural occupations; occupational specialization; bureaucratic work and administrative structures; the increasing use of inanimate energy sources especially in productive activities; and modes of delivery of basic services and resources for survival in impersonal, professional and business relationships. Urban behavioral and social attributes typify internal locus of control, greater diversity, and the accompanying cosmopolitanism and secularism. Urban life and living generally involves greater acceptance of innovations and change; a changed conceptualization of time; modern institutions; and the specialization and separation of the spatial aspects of daily life. Additionally, as in other developing cities, urbanization in India has also meant increasing dualism--or the presence of huge inequities and polarization--in its key attributes. Dualism, both internal, and with reference to the surrounding hinterland have been the symptoms of urbanization and underdevelopment in India. Ironically, this dualism continues to be reinforced by development policy that continues to favor cities.

Development policy has all too often, and for a variety of reasons--often having to do with political expedience, focused on cities at the cost of rural development. Public and private investments in the industrial and the service sectors as well as investments in social infrastructure usually mean a better quality of life -- access to jobs, health services, water, transportation. Thus cities have become magnets for people from the countryside, and in the continuing lack of attention to rural infrastructure and social welfare, urban to rural migration has continued unabated over the last several decades. Urbanization has grown from accommodating 17 percent of the total population in 1950 to now supporting nearly 29 percent of the population. Between 1981 and 1991, 12 cities have been added to the list of "million-plus" city category -- which now boasts of 23 names, including the urban areas of Bombay, New Delhi and Calcutta. Contrast this with the period 1971 to 1981, when only 3 new cities were added to the category. Estimates put India's *urban* population in 2025 at around 700 million, the same as the entire nation's population in 1981. What does this development mean for India's people, particularly her women?

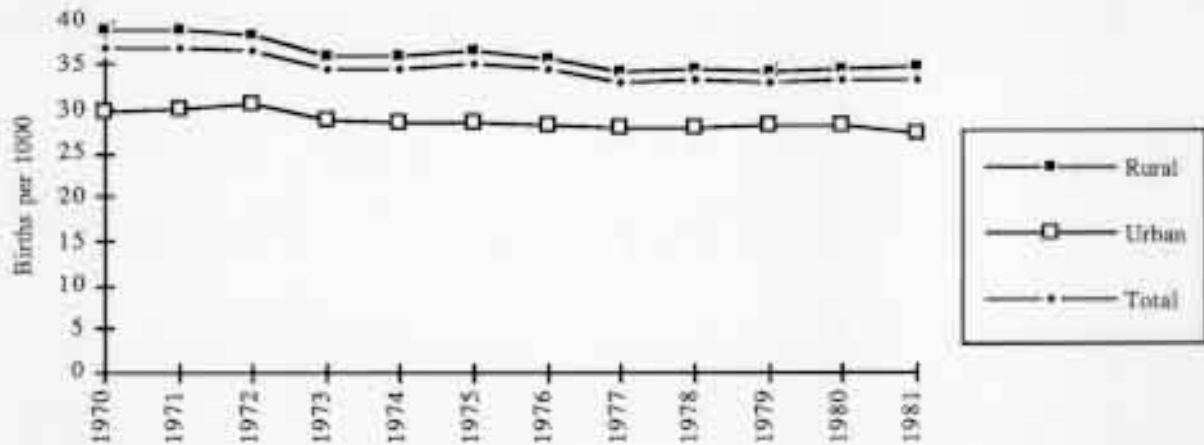
Basic indicators of welfare

In terms of basic demographic indicators such as crude birth and death rates and infant mortality rates, urban India is a much happier place. FIGURES 1a, 1b, and 1c provide data for these indicators for the period 1970 to 1981. Both birth, as well as death rates are lower in cities by a high margin. Urban infant mortality is on an average nearly half that of rural areas. To be sure, even the urban rates do not equal those in developed countries, they do, however, constitute an improvement over the statistics for rural areas. Interestingly, over the 9 years of data for infant mortality in FIGURE 1a, on the whole, *rural* infant mortality has shown no substantial decline, while the urban figures show a steady downward trend. These statistics, do need to be read, however, with caution as they do not show long term trends.

FIGURE 1d shows also a higher incidence of rural poverty for both periods for which the data is shown--1977/78 and 1984/85, the rate of decline seems to be equal in both, urban and rural areas. These social and economic indicators provide some evidence for the fact that on the whole, the quality of urban life is an improvement over that in rural areas. It would seem that both men and women would gain from urban residence. The important questions however, are: are the gains equal in all sectors and all regions? What are the comparative trends for women in urban areas versus those for rural women? How do

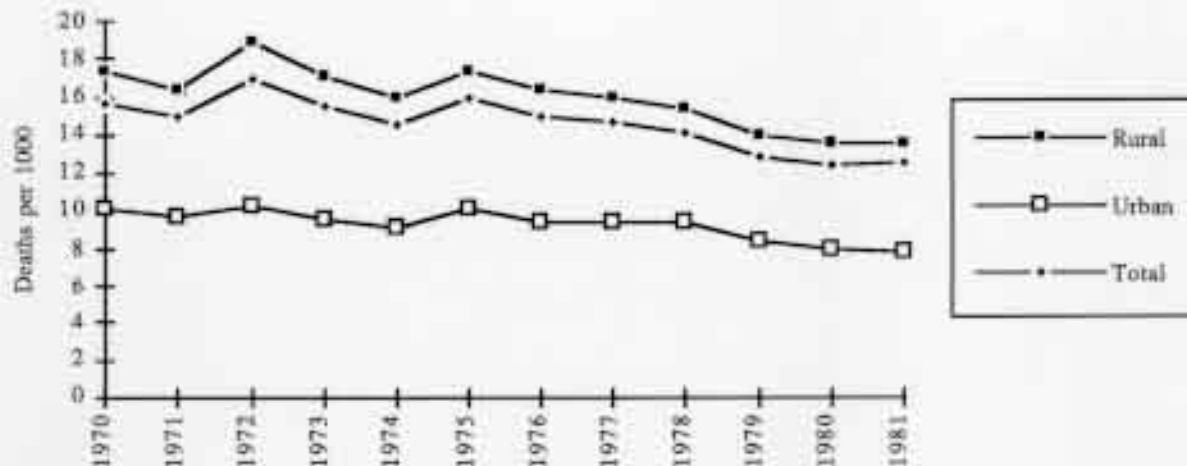
specific gains and losses play out along gender dimensions? And with what consequences, particularly for women? What are some causes of these effects especially on women, and how do they occur? Finally, what are the policy implications of the answers to the above questions – for women's development and for social and national development? This paper begins to address some of these issues.

FIGURE 1a: CRUDE BIRTH RATE, 1970-1981



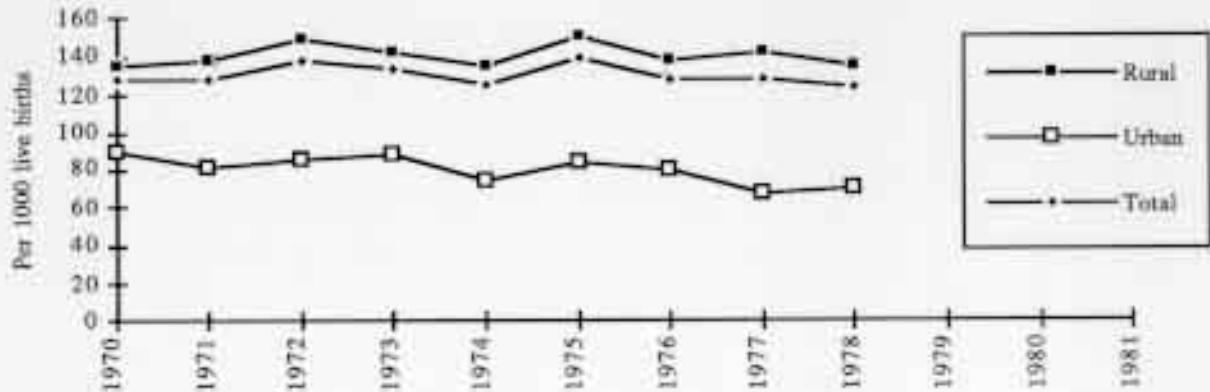
Source: World Bank 1991.

FIGURE 1b: CRUDE DEATH RATE, 1970-1981



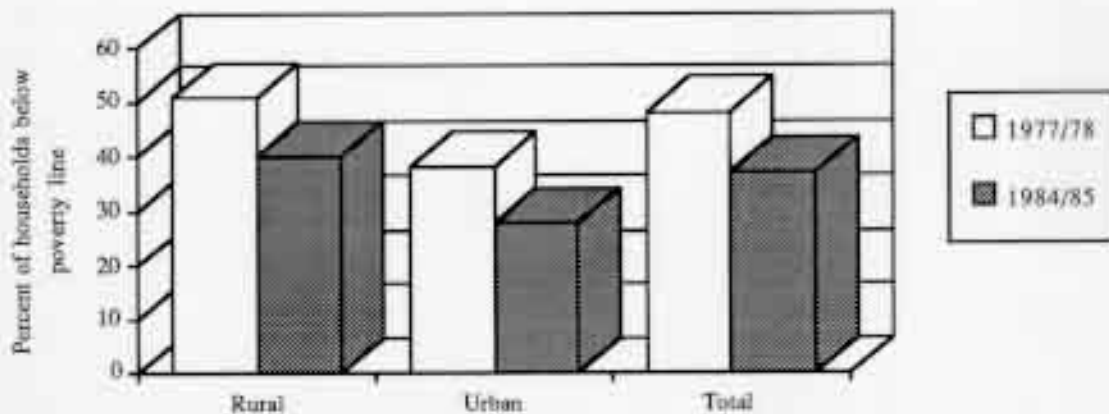
Source: World Bank 1991.

FIGURE 1c: INFANT MORTALITY RATE, 1970-78



Source: World Bank 1991.

FIGURE 1d: INCIDENCE OF POVERTY, 1977/78 AND 1984/85



Source: World Bank 1991.

Women's access to resources and services necessary for survival

In general, women's access to services and resources is closely tied, in India, to gender. Women's existence and roles are associated with the home and its maintenance while men have socially acknowledged rights to economic and political power, defined in the society as necessarily external to the home. As a result, government policy aimed at improving the lot of women has viewed them largely as passive beneficiaries of social services and antipoverty programs (Boserup 1970, Tinker and Bramsen 1976; Mies 1982, World Bank 1989); in other words, as targets for development 'outputs'. Indian women's access to goods and services, to productive assets and factor markets (including the right to sell their own labor) is contingent in a way that men's is not. Women's links with the 'outside' are mediated by male relatives. The extent to which households are able to limit contact between their female members and the outside spheres -- most explicitly through female seclusion -- is traditionally one of the most important criteria for establishing social rank.

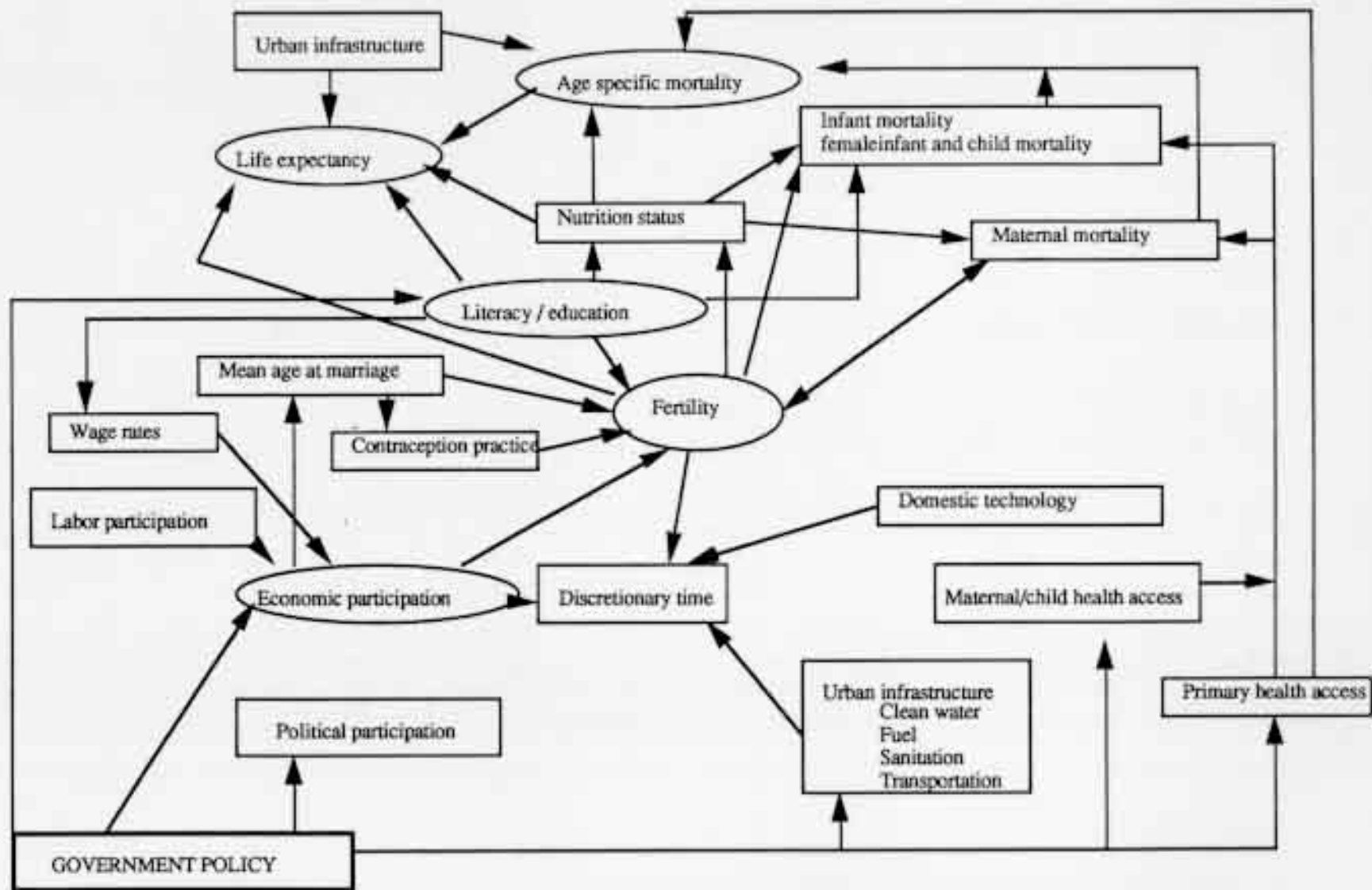


FIGURE 2 :FACTORS AFFECTING WOMEN'S LIVES

The urban effects on women's lives

Given the above background into traditional gender structures and the attributes of urbanization, it appears that diverse mechanisms exist through which urbanization affects women's lives—positively or negatively. How might urbanization cause (or precede in time) some of these general effects?

First, urbanization fosters changes in social, cultural and cognitive structures to make them less rigid, less dependent on tradition, and more receptive to change and diversity. As discussed in the introduction, work becomes more impersonal; the social relations of work, more professional and impersonal; occupations involve increasing specialization and depend on innovations and use is made of increasingly complex technology and organization. Individuals, in their reduced dependence on natural forces, and in their dependence on human ingenuity in their use of technology in work come to develop an internal locus of control and a belief in human agency and capacity to change. Diversity fosters cosmopolitanism and an acceptance of differences among people that is difficult to obtain in the countryside. Cities are centers of higher education, development of art and culture and scientific enterprise. Urban social relations provide a social and a political environment where gender relations can be questioned and where traditional gender relations appear less of a 'given'. "Urbanism" itself is characterized as a way of life.

Second, urbanization implies spatial changes -- different patterns of spatial organization of work, of distribution of resources and in the organization of settlements and other land-uses. Survival in the subsistence-level rural farm meant that all the functions of survival -- production, reproduction and consumption -- were all spatially concentrated and socially located in the extended family. Urbanization, especially with the development of the industrial and service sector has resulted in the spatial separation of the spheres of production and reproduction, along with the spaces men and women are associated with. These developments have negative as well as positive consequences for women (Turshen and Holcomb 1993). Settlements are large and dense, and basic services such as sanitation and water supply become critical for survival. These are usually provided in close proximity to the settlements constituting huge savings in women's time. On the other hand, however, dense settlements may also mean that natural resources -- such as wood, or dung for fuel -- which were readily available at little cost in rural areas are now unavailable; instead, women may have to concentrate on wage-earning activities to increase their paying capacity in an increasingly monetized environment of resource- and service-transfer. Enough evidence exists to show that women are disadvantaged in relation to men in the cash economy.

Third, development policy itself has continued to foster urbanization; in the urge to mimic western patterns of industrial growth, India had poured much of its development resources in the engines of growth -- cities. Investments were also made in urban infrastructure -- water, sanitation, transportation, education and health -- for functional as well as political reasons. These resources and services are nonetheless, not only more available in cities per capita, but also more accessible in spatial terms. Further, the cultural changes associated with urbanization mean that women will be more likely to use them, and have the social 'permission' to their use. Therefore, effectively, women are closer to having equal access to social welfare inputs in cities than they are in villages, and this may be due both to the greater physical availability of these services and the greater social permission for their use.

A fourth hypothesis for the urban effect on women's lives has to do with the relative value of children in urban and rural areas, particularly that of girls (studies indicate urban/rural and sex-differentials in other regions of the world -- see Aghajanian 1988, for instance). Traditionally--and rural areas show a greater hold of tradition--daughters in most parts of India are seen as burdens whose net cost is greater than the benefits they may provide to the household. This happens in two ways -- through huge dowries that have to be paid in daughters' marriages and by the fact that daughters are seen as belonging to their marital homes after marriage. Secondly, sons are traditionally expected to support their parents in their old age. Education of daughters is not only considered a waste, but traditional notions of sexual propriety and gender segregation make parents reluctant to send their daughters to school, especially after the onset of puberty. Girls thus have a higher immediate value as domestic help while investments are made on boys with a view to the future. Girls and women eat last and least; they have less access and social 'permission' to avail of health care; they are socialized to be stoic and uncomplaining. Chronic malnutrition and low access to primary and maternal health care results in low-weight babies, high infant mortality and high fertility.

In urban areas, greater access to domestic technology and lower subsistence activity lower the need for more hands, and actually increase the cost-benefit ratios of bringing up children. Further, economic contributions to the family are best facilitated through participation in the cash-economy rather than in the subsistence sector. The value of education in increasing opportunities for urban employment is therefore recognized. Poor women's need to work outside the home for cash and fewer extended families may also mean that there is less help with child care, and a lower incentive to have more children. Thus female children are not as critical in domestic and subsistence activities as they are in rural areas. Further, greater care and attention are provided children in smaller families to ensure their survival. The higher availability of services, and the lowered rigidity of traditional structures and relations provide a context where girls can avail of education, health care and other services.

The four hypothetical mechanisms for change are not unrelated, these categories are described for analytic purposes. These mechanisms also interact with each other and act to reinforce or mitigate their effects. For instance, access to education has the potential to help women challenge oppressive gender structures and bring about cultural change – resulting in a synergistic interaction of education and the urban environment in general. Higher investments in human resource development are also reflected in higher wages: this has the potential to change the dominant view of women as dependents only.

It is worthwhile here to also mention at least one other perspective in contrast to the 'modernization' perspective described above, which posits a rationalization of social relationships which results in gains for women through the dissolution of traditional structures. In this contrasting perspective, urbanization, at least in its western flavor, overlays capitalist relations over an explicitly patriarchal social structure with consequences that do not bode well for women. They run the risk of becoming marginalized and exploited in labor markets that are sex-segregated and where women's wages are extremely low, and working conditions poor (Brydon and Chant 1989; Buvinic, Lycette and McGreevey 1986). This perspective rejects the 'redeeming' effect of top-down education on grounds that these are yet another means of social control, and are reinforced through the use of sexist syllabus, patriarchal relations at school and work, and inadequate questioning into gender structures.

Further, the authors of the exploitation theory posit that no amount of investment in human capital would, in the absence of other mechanisms (like affirmative action), reduce the disincentives for capitalist firms to maintain the gender segregation of the labor market, to keep women's wages low, and to assure themselves a reserve labor force that they can call upon at their convenience. Thus, in this perspective, urbanization does not constitute purely benefits for women, women lose traditional entitlements before they gain a foothold in the new urban social environment. Here, women bear, and internalize the cost of urban growth and economic progress. Another, related perspective also holds that urbanization signifies a loosening hold of tradition *only* on men. Women continue to be pressured to be the upholders of the culture and be solely responsible for its maintenance (Turshen and Holcomb 1993).

Important indicators of women's quality of life.

Having discussed some ways in which urbanization may affect women's lives, we need to see if these effects do, in fact, exist, and if so, to what degree, and how? That said, what should one measure to judge the impact of external forces on the lives of individuals or members of a group, and how does one measure these impacts? Social scientists studying 'quality of life' issues have been grappling with these problems; there is much that is yet unknown, especially as it relates to the measurement of change in, and its meaning for, women's lives. Some theoretical work exists that identifies several indicators that are important in evaluating the quality of women's lives, some of which are borrowed from the general work on quality-of-life (Buvinic, Lycette and McGreevey 1983). Demographic indicators traditionally used are sex ratios, age-specific mortality rates, life expectancy statistics, all of which can be measured quantitatively without much quarrel over concepts (although the concepts themselves may be complex and often, very confusing).

Trickier concepts that provide insights into women's lives are their health and nutritional status; their levels of economic, social and political participation and effectiveness; women's control over resources and over their own labor, sexuality and fertility; and amounts of discretionary time women have available. Some of these concepts are not only difficult to operationalize and measure, they are also

politically contentious because, in their attempt to define and to make connections between different things, they expose structural inequities and relate women's lower position to tangible aspects of social organization and resource-distribution. These conceptualizations challenge essential gender ideologies as arising from some "natural law", and provide the seeds for their transformation. All of this is understandably threatening to groups that benefit from the current patriarchal organization of society.

This paper will therefore study as many of the categories discussed above, as possible, to compare the lives of urban and rural women and their male counterparts. FIGURE 2, a schematic diagram, draws connections between several important aspects of women's lives, as well as to government policy. Several concepts – such as fertility, life-expectancy, literacy have multiple connections to each other. These concepts will therefore be addressed here to the extent that data is available for this exercise.

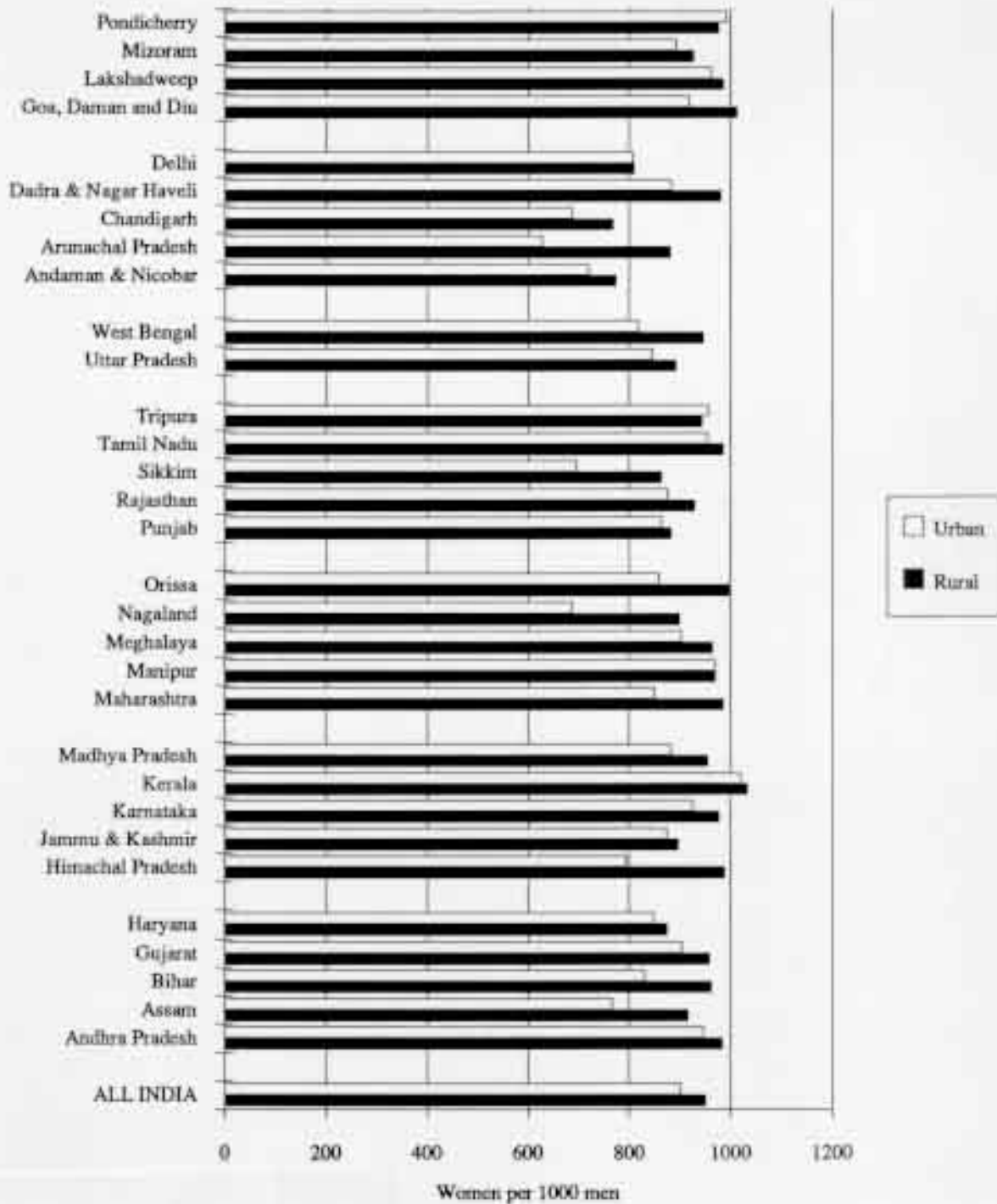
A note on the data used in this paper: only quantitative information from censuses, government and international agency reports and information derived from academic research is used where relevant. Few qualitative studies exist that look closely at the comparative aspects of urban and rural women's lives. It is also important to remember that gender and urban-rural are not the only dimensions of inequity in India. One of the more inegalitarian societies in the world, India shows inequities along a variety of dimensions – age, caste, income, marital status, region, religion, etc.. Broad quantitative studies may or may not take into account all these different dimensions; however, comparative statistics provide us with some aggregate measures that, while concealing much, do tell us something about people's lives in general. They provide us with a basis for gross comparison. Since both the groups that are being compared are female, I hope that the gender biases inherent in the original data will be controlled for, to some extent.

Another caveat relating to the use of data in this paper is that it does not provide any critique of the operationalizations of the concepts, nor close examination into the measurement of the data itself. Women's labor participation rates, for instance, show significant increases when the definition of their labor included categories of work not previously considered for measurement – such as fetching water and fuelwood, or tutoring children (See World Bank 1991). A recurring problem when studying women is that measurements themselves are biased, reflecting the general societal biases against them. When women are devalued, their work is devalued too, and much of their lives are invisible to public accounting exercises. Is work only that which is paid? Is work that is done in groups while socializing not work? I have taken census figures and other information as given, and this is not without problems in terms of shedding light on women's lives. Further, for the categories in which urban-rural comparisons are being made for women's lives, not all involve data from the same period. Not only are more recent data needed, we also need data over longer periods to make reasonable inferences about trends.

Female mortality and life expectancy

A glance at sex ratios in the last several decades shows that women's position in the nation as a whole is not only worse compared with several nations in the West but also with other developing countries in Africa and South East Asia. Further, it is showing a downward trend – a broad indicator that national 'progress' has not reflected in fairer sex ratios, and in fact has resulted in some worsening of the position of women. Nationally, sex-ratio from the 1991 census was 918 (women per 1000 men). FIGURE 3 shows sex ratios for rural and urban areas, disaggregated by state, for 1981. In 1981, the all India sex ratios for urban and rural areas were 902 and 951 respectively. Rural-urban differentials in sex ratios are however, confounded with rural to urban migration, which is predominantly male. Data has not been available that would allow disaggregation of urban sex-ratios by native and migrant status of sub-populations. Age-specific mortality or death rates provide a better indicator of women's status along the urban/rural dimension. According to the table, the states of Kerala and the erstwhile Union Territories of Goa, Daman and Diu had highest sex-ratios, while states of Nagaland, Jammu and Kashmir, Punjab, Rajasthan, Uttar Pradesh, Mizoram, Andaman and Nicobar, and Arunachal Pradesh have on average, lower sex ratios than the national average.

FIGURE 3: SEX RATIOS, BY RURAL AND URBAN, 1981



Source: Census of India, 1981.

FIGURE 4 shows sex-ratios of age specific death-rates disaggregated by rural/urban residence. More women die than men in the same age-cohort in rural areas than in urban. The rural-urban ratio of death rates for females in the age group 0-4 is 2.03, while that for males is 1.96. In the age groups 15-49 years, which straddle the reproductive years, the rural female death rates are also higher than their urban counterparts. The deviation from the general trend for the cohort 5 to 9 years may be a result of lower rural reporting.

FIGURE 4: RATIOS OF AGE-SPECIFIC DEATH RATES, ALL INDIA, 1984

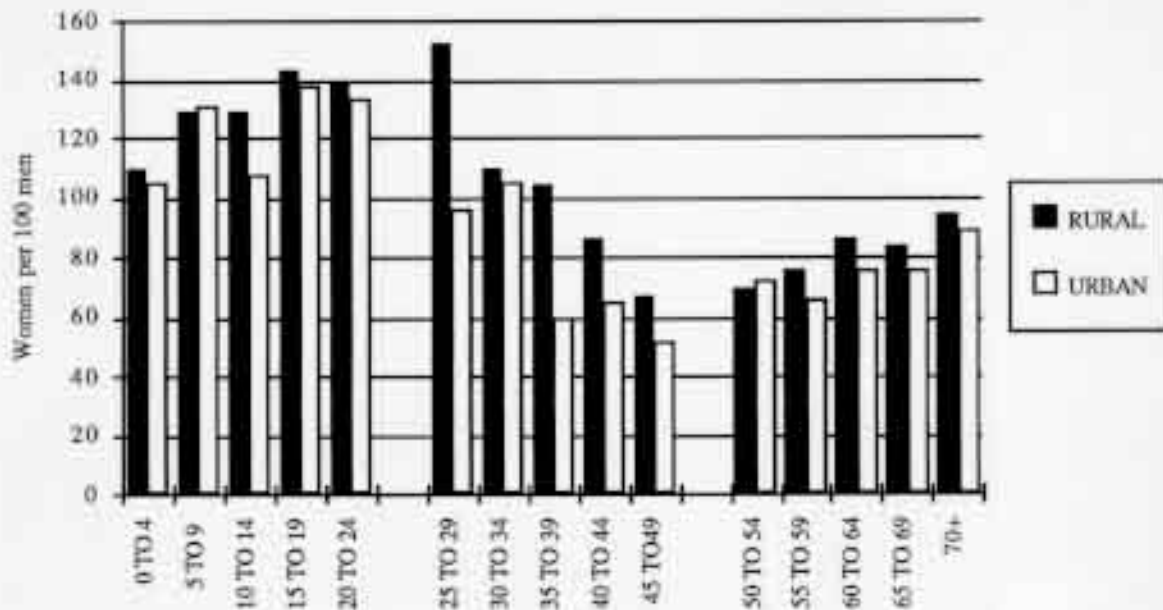
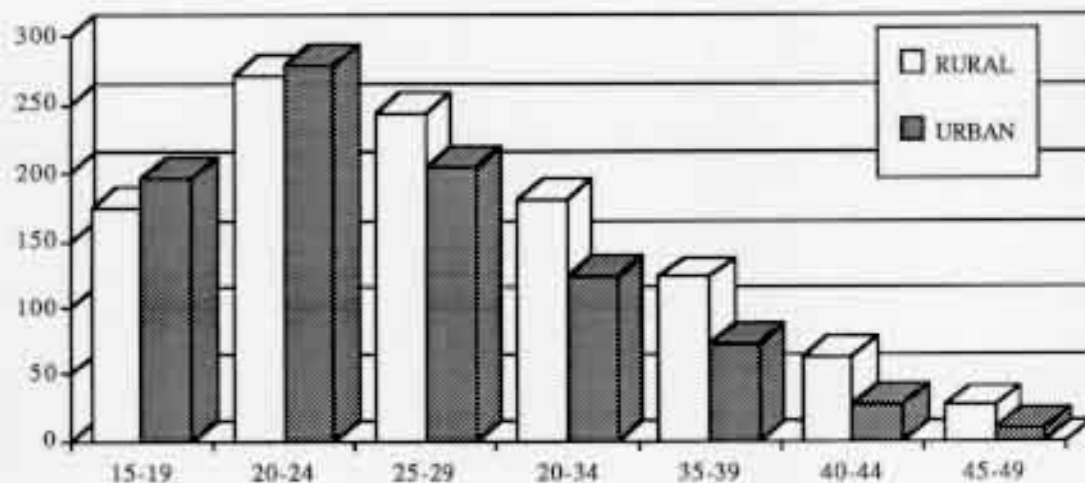


FIGURE 5: AGE SPECIFIC MARITAL FERTILITY RATES, 1978



Source: (FIGURES 4 AND 5) World Bank 1991.

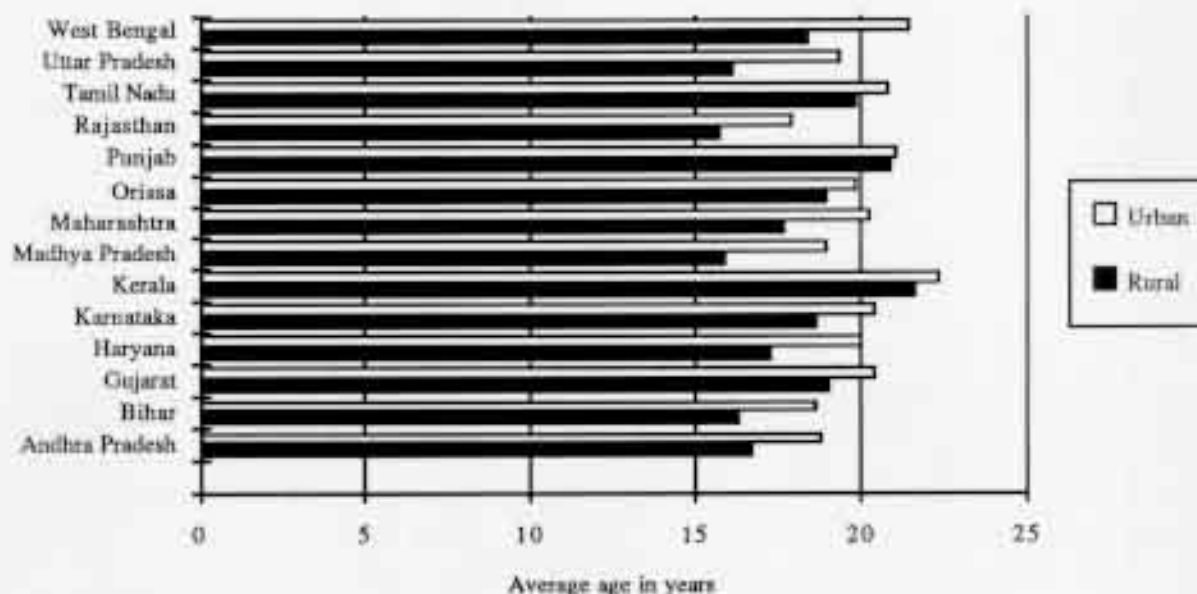
Urban and rural differentials in fertility

FIGURE 5 – age specific marital fertility rates for 1978 – also shows differences along the urban-rural categories. However, these are split differently. For age groups, 15-19 and 20-24, urban fertility rates were higher, at 197 and 278 respectively, compared with 175 and 271 for rural areas. However, for older age groups, rural fertility rates are higher and to a greater degree than in urban areas. While it is difficult to draw inferences from this data given the lack of other information, these differentials do indicate a higher total fertility rate in rural, as compared with urban areas. What could explain the higher fertility rates for the urban lower age groups? Higher numbers of rural stillbirths? Lower rural birth-reporting? Higher birth registration in urban areas and therefore better data quality? Definitive inferences are difficult without additional information.

Urban and rural differentials in mean age at marriage

The hold of traditional ideology with respect to women in rural areas, the lower access to literacy and education among women in rural areas, and the higher net cost of female children to families may combine to lower the mean age at marriage there. FIGURE 6 shows the age at marriage for males and females in different states, broken down by urban and rural areas, for 1981. Rajasthan, Uttar Pradesh, Bihar, Madhya Pradesh and Andhra Pradesh show mean ages of marriage for women that, for rural areas, are lower than the minimum established by law. These are also states that show unfavorable sex-ratios. Striking however, is that for all the states without exception, the mean age of marriage is higher for urban areas than rural.

FIGURE 6: AGE OF MARRIAGE FOR WOMEN IN SELECTED STATES, 1981

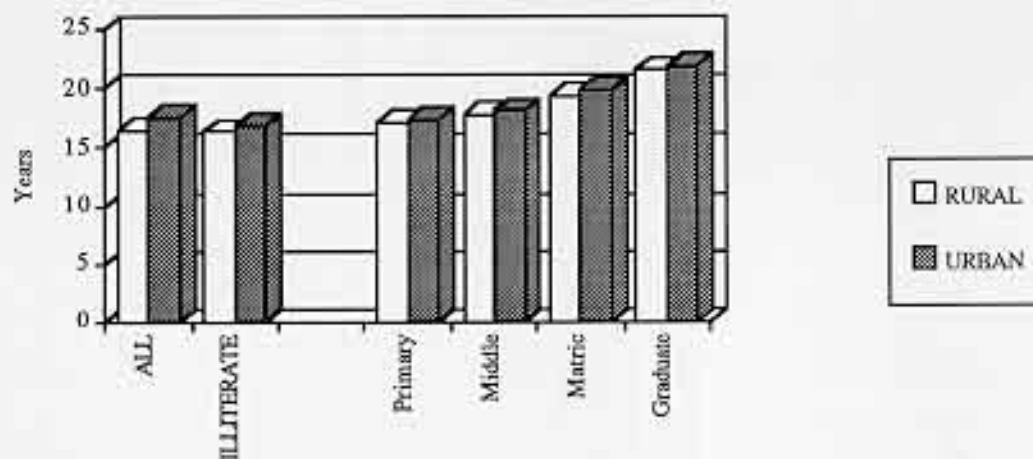


Source: Census of India, 1981, Series 1, Part II-Special
(Report and Tables based on 5 Percent Sample Data)

Women's education and their age at marriage are positively correlated. See FIGURE 7. Regardless of level of education, urban-rural differentials favor urban women more in terms of delaying marriage. In India, the woman's age at marriage has a great influence on total fertility and infant mortality levels as well as child and maternal health status. Premarital sexual activity and premarital pregnancy are strongly sanctioned in the culture, and newly married women are under great pressure to prove their fertility. FIGURE 8 shows that female education is implicated in infant mortality reductions, regardless

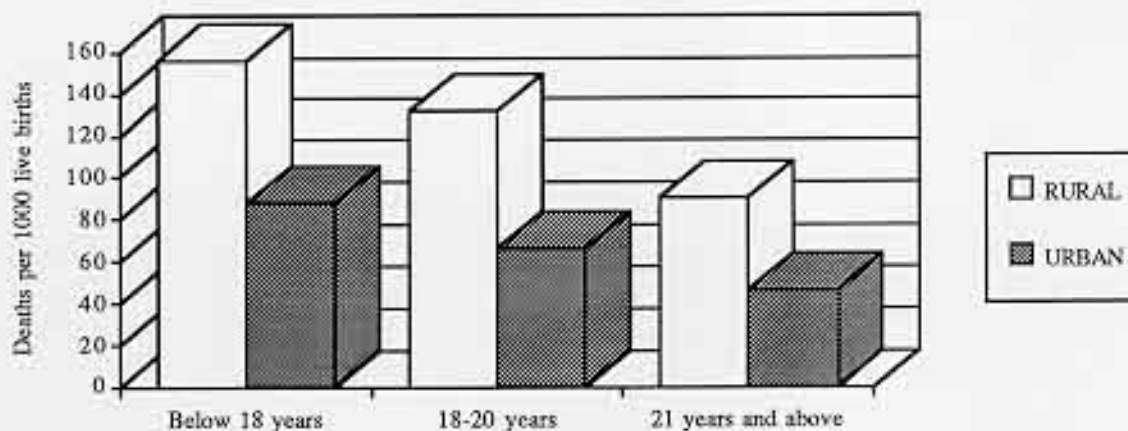
of urban or rural location. It also shows that urban infant mortality, while negatively correlated--as might be expected--with age of marriage, is much lower than rural infant mortality.

FIGURE 7: MEAN FEMALE-AGE AT MARRIAGE BY EDUCATION LEVEL, 1981



Source: World Bank 1991.

FIGURE 8: INFANT MORTALITY RATES BY MOTHER'S AGE AT MARRIAGE, 1979



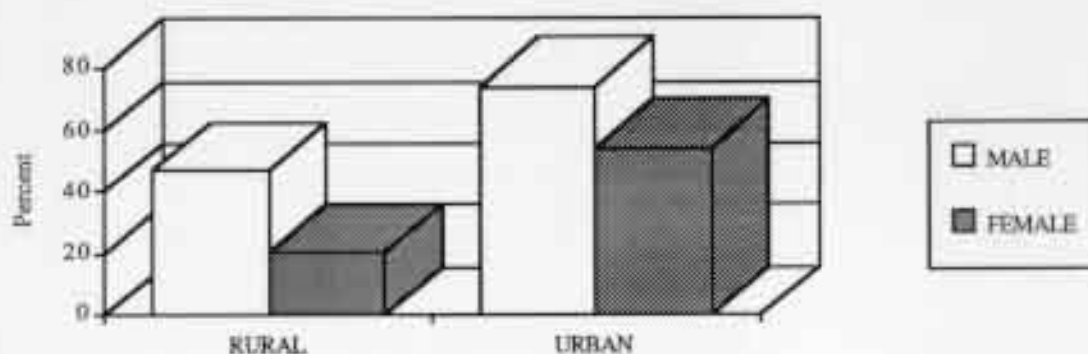
Source: World Bank 1991.

Urban-rural differentials in female literacy

FIGURE 9 shows, predictably, that female literacy is higher in urban areas than in rural. However, what is interesting is that the gains through urbanization are greater in degree to women than to men. For instance, the effective rural female and male literacy rates are 20.7 and 46.7 percent respectively. For urban areas, these are 54.4 and 74.0 percent respectively -- a gain of 34.3 percentage points for women versus 27.3 percentage points for men. Women and men are more likely to have equal access in cities than in rural areas, where women's access to resources and services is traditionally

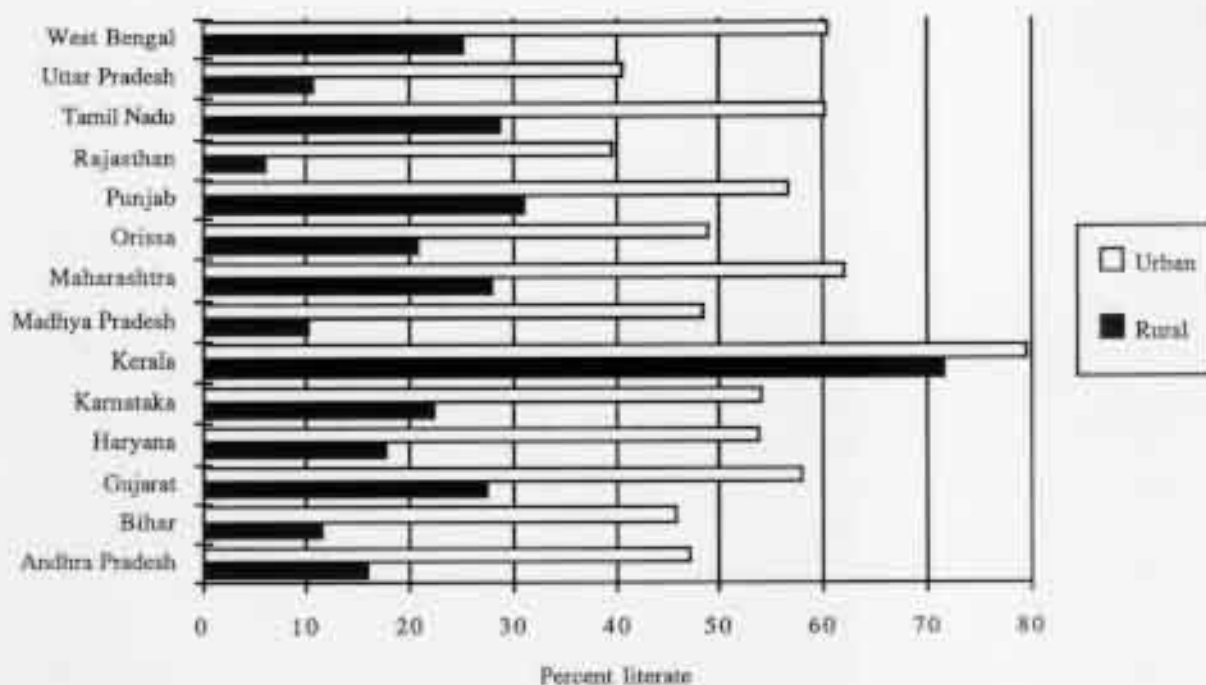
restricted. FIGURE 10 shows how Rajasthan, Uttar Pradesh and Madhya Pradesh are yet again identified in the gross inequities their women, especially in rural areas face in attaining literacy.

FIGURE 9: EFFECTIVE LITERACY RATES BY URBAN/RURAL AND GENDER, 1981



Source: World Bank 1991.

FIGURE 10: FEMALE LITERACY RATES IN DIFFERENT STATES, BY URBAN/RURAL, 1981



Source: Census of India, 1981.

TABLES 1 (rural) and 2 (urban), following, provide two points in time (1961 and 1981) to enable us to assess changes in educational status of male and female workers. However, we find that while gains for men in rural areas have been greater in the two intervening decades, in urban areas, it is women who

have made more progress in the reduction of illiteracy. The reduction in illiteracy in the *urban*, male worker population was only 8.2 percentage points, whereas, women saw a whopping (relatively speaking!) 24.5 percent decrease in illiteracy.

TABLE 1: EDUCATIONAL STATUS OF RURAL WORKERS, BY GENDER, 1961 AND 1981
(Percent)

EDUCATIONAL LEVELS	1961		1981	
	MALES	FEMALES	MALES	FEMALES
Illiterate	69.5	95.6	57.7	88.2
Literate (Without ed. level)	21	3.2	10.9	3.9
Primary	8.1	1.1	15.6	4.8
Middle	-	-	8	1.6
Matric and above	(1.4)	(0.1)	(7.8)	(1.5)
Matric or Higher Secondary	-	-	6.4	1
Non-technical, diploma, cert.	-	-	0.1	-
Technical Diploma or cert.	-	-	0.2	0.2
Graduate and above	-	-	1.1	0.3
	(100)	(100)	(100)	(100)

Note: The educational category as "middle" given separately is applicable only to 1981 figures whereas for the 1961 it is included in the category of "primary". Classification of educational level in 1961 is made only up to "Matriculation and above" whereas that of 1981 is up to "Graduate and above" and is in the table. The figures in 1981 column against the educational category of "Matriculation and above" are given to facilitate comparison. These figures represent the sum of all educational categories, commencing from "Matric or Higher secondary" to "Graduate and above."

TABLE 2: EDUCATIONAL STATUS OF URBAN WORKERS, BY GENDER, 1961 AND 1981
(Percent)

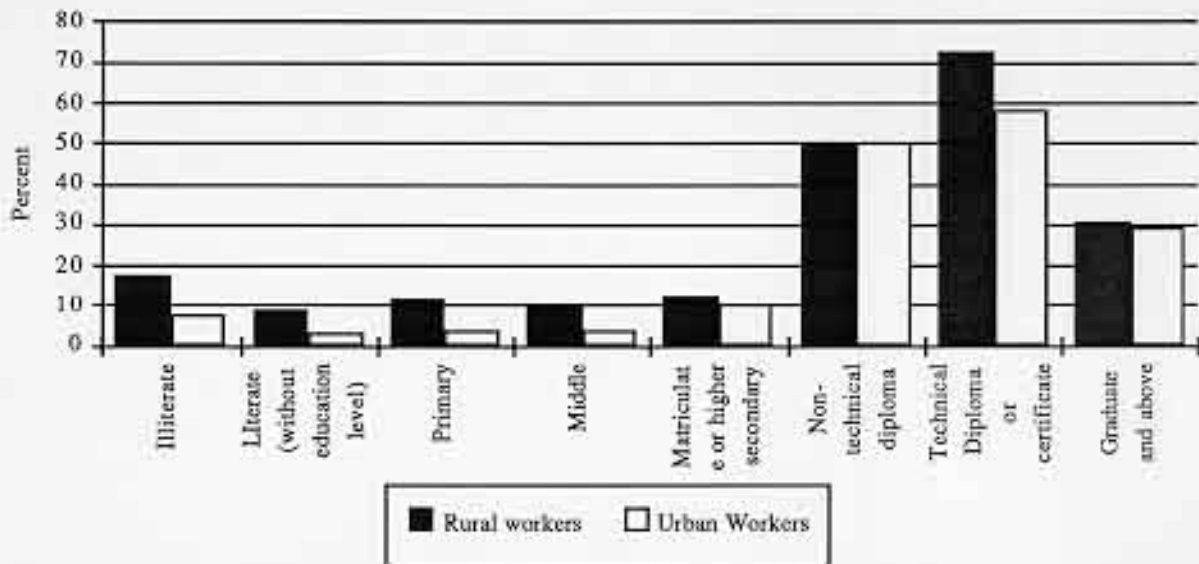
EDUCATIONAL LEVELS	1961		1981	
	MALES	FEMALES	MALES	FEMALES
Illiterate	35.2	81.1	27	56.6
Literate (Without ed. level)	30.2	8	8.5	5.3
Primary	19.8	5.2	17.5	7.6
Middle	-	-	-	-
Matric or Higher Secondary	10.4	3.5	22.3	13.2
Non-technical, diploma, cert.	0.4	0.2	0.1	0.3
Technical Diploma or cert.	0.3	0.1	1	1.4
Graduate and above	3.7	1.9	9.3	11
	(100)	(100)	(100)	(100)

Note: Middle School percentages for 1961 are included in primary.

Source: Tables 1 and 2 were based on data in World Bank 1991.

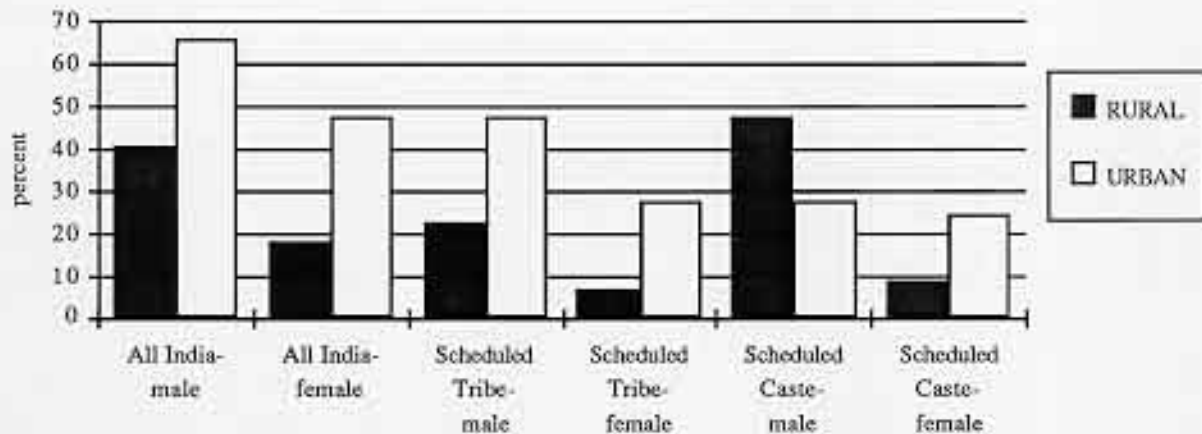
FIGURE 11 shows the workforce participation of urban and rural female workers by educational achievement. Interestingly, a higher proportion of rural women in all categories of education participate in the work force. This may be due to the higher demand for female labor in rural areas than in urban areas, as well as the highly competitive and gender-segregated urban occupational structure.

FIGURE 11: WORK FORCE PARTICIPATION OF URBAN AND RURAL WOMEN, BY EDUCATIONAL ATTAINMENT, 1981



Note: Work force participation rate for all rural female workers is 16 percent, and for all urban female workers, it is 7.3 percent.
Source: Census of India, 1981.

FIGURE 12: SCHEDULED CASTE AND SCHEDULED TRIBE LITERACY RATES BY GENDER, 1981



Source: Census of India, 1981

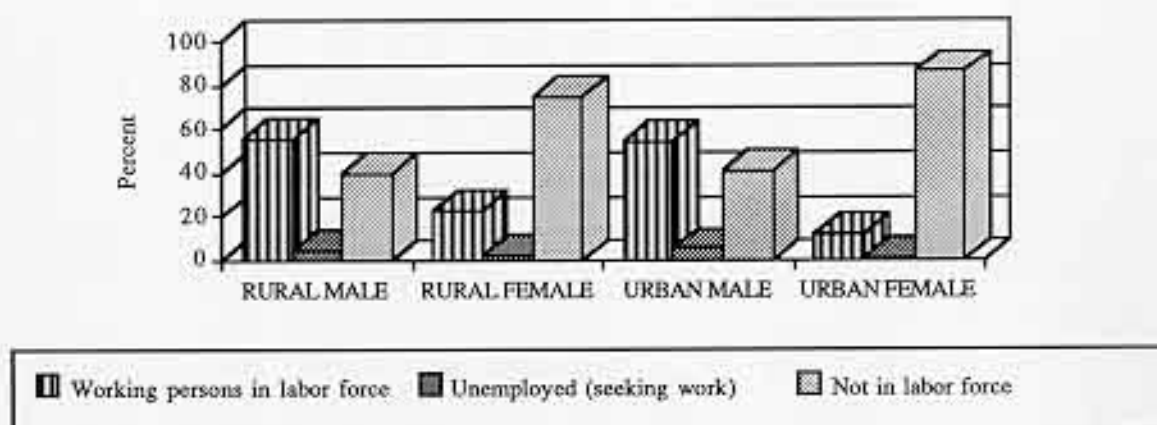
However, as mentioned earlier in the paper, not only are access rates lower among men and women of traditionally underprivileged groups, the gender and the rural-urban differences are sharper among groups like the scheduled castes and the scheduled tribes. For the latter group, rural and urban literacy-rates for women are at 6.8 and 27.3 respectively. The all-India rural and urban *male* literacy rates for scheduled tribes are 40.8 and 65.8 respectively. FIGURE 12 provides more details on this. It is

difficult to explain how and why *rural* scheduled-caste male literacy levels are higher than the urban levels.

Urban-rural differentials in work participation.

On a national level, female employment rates in 1983 were 22.91 percent for rural and 12.16 percent for urban areas (not incorporating expanded definitions of women's work-- See World Bank 1991). For the period of January to December 1983, the National Sample Survey recorded 55.86 percent of the rural male population (5 years and above) as participating in the labor force; that number is not substantially higher for the urban male labor participation at 53.8. Interestingly however, a comparison between urban and rural women's labor participation shows that about half as many urban women participate in the labor force as rural women. See FIGURE 13.

FIGURE 13: DISTRIBUTION OF PERSONS OF AGE 5 AND ABOVE BY CURRENT DAILY ACTIVITY, JAN TO DEC 1983



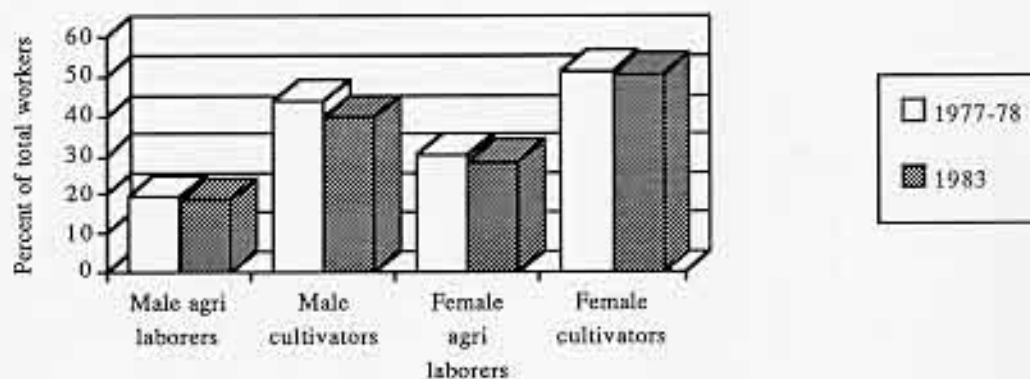
Source: World Bank 1991

According to this figure, urban women not only show lower labor force participation rates than their rural counterparts, but also that this is not because of high unemployment in these categories. 74.83 percent of rural women 86.34 percent of urban women (over the age of 5) were not in the labor force. The levels of male and female *adult* (or for persons above the age of 16) unemployment for the same period are unavailable. FIGURE 16 also provides a breakdown of the job-categories that are populated by rural and urban women. The majority of rural women who were in the labor force worked on their own farm, while the majority of urban women worked as regular salaried employee in a non-farm enterprise or profession (World Bank 1991).

Only one in five rural women (5 years and above) is engaged in wage-work; this is not a very high figure, but is very likely an undercount. Most rural women work in manual agricultural or non-agricultural labor, and at very low wages. Much of this employment arises out of the need for cash and out of extreme poverty, and because there is a demand for cheap, pliant labor for unskilled and repetitive tasks. What is counter-intuitive, however, is the low level of wage-labor participation of urban women. One might expect a higher labor participation from a group that has had more access to human capital resources like education, health care, and other urban infrastructural services. Is it because of how women's work is defined? It is possible that women's low urban work participation is because urban and rural labor markets are different, as are the requirements for participation. Most manufacturing or service jobs require skills beyond basic literacy and numeracy. It is possible that urban women, while showing greater literacy than their rural counterparts, remain disadvantaged in relation to men, in their access to job skills and higher education. We need more information about the kinds of jobs that are available, whether these jobs are traditionally gender-segregated, the kinds of skills that are required, how employers make hiring decisions, and the perceptions and aspirations of urban women themselves.

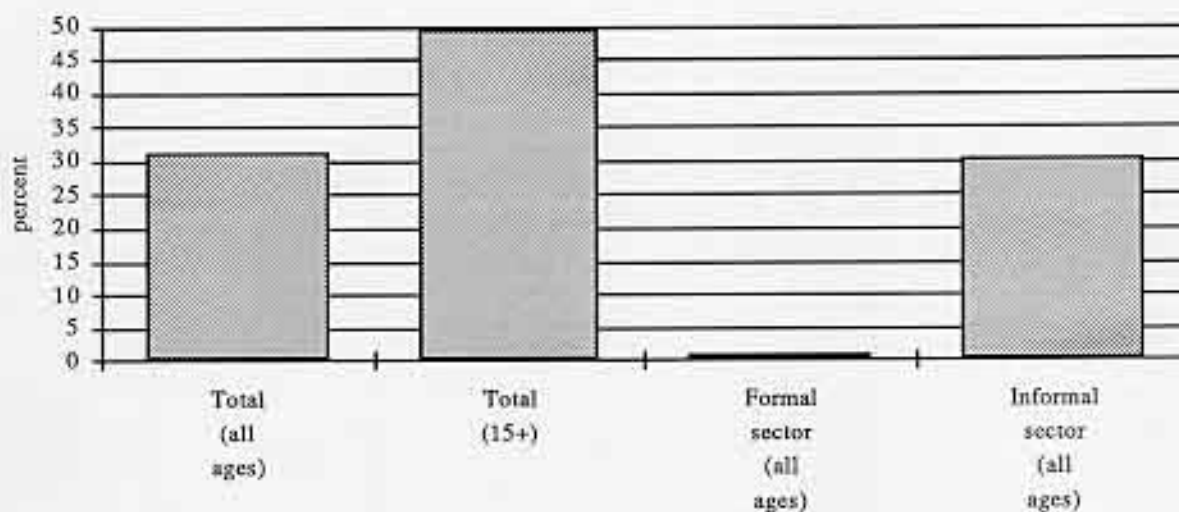
Typically, women's participation in the rural labor force (agricultural and non-agricultural) has been relatively high, when compared with male rural participation or with the levels of labor participation of urban women. FIGURE 14 shows data for 1977/78 and 1983 and the gender differences in the composition of the agricultural labor force. These participation rates have remained relatively stable in the ten-year period that is being compared. While not directly comparable with this information, FIGURE 15 provides data for urban female workforce participation rates in five intermediate-level cities in India. Interestingly, the informal sector is the largest employer of urban women in these cities, providing income to three-tenths of the women. Nationwide, 53 percent of urban and 95 percent of rural female workers are unorganized (World Bank 1991). This has enormous implications for their wage levels, conditions of work, job security and other benefits.

FIGURE 14: COMPOSITION OF AGRICULTURAL LABOR FORCE BY GENDER, 1977-78 and 1983



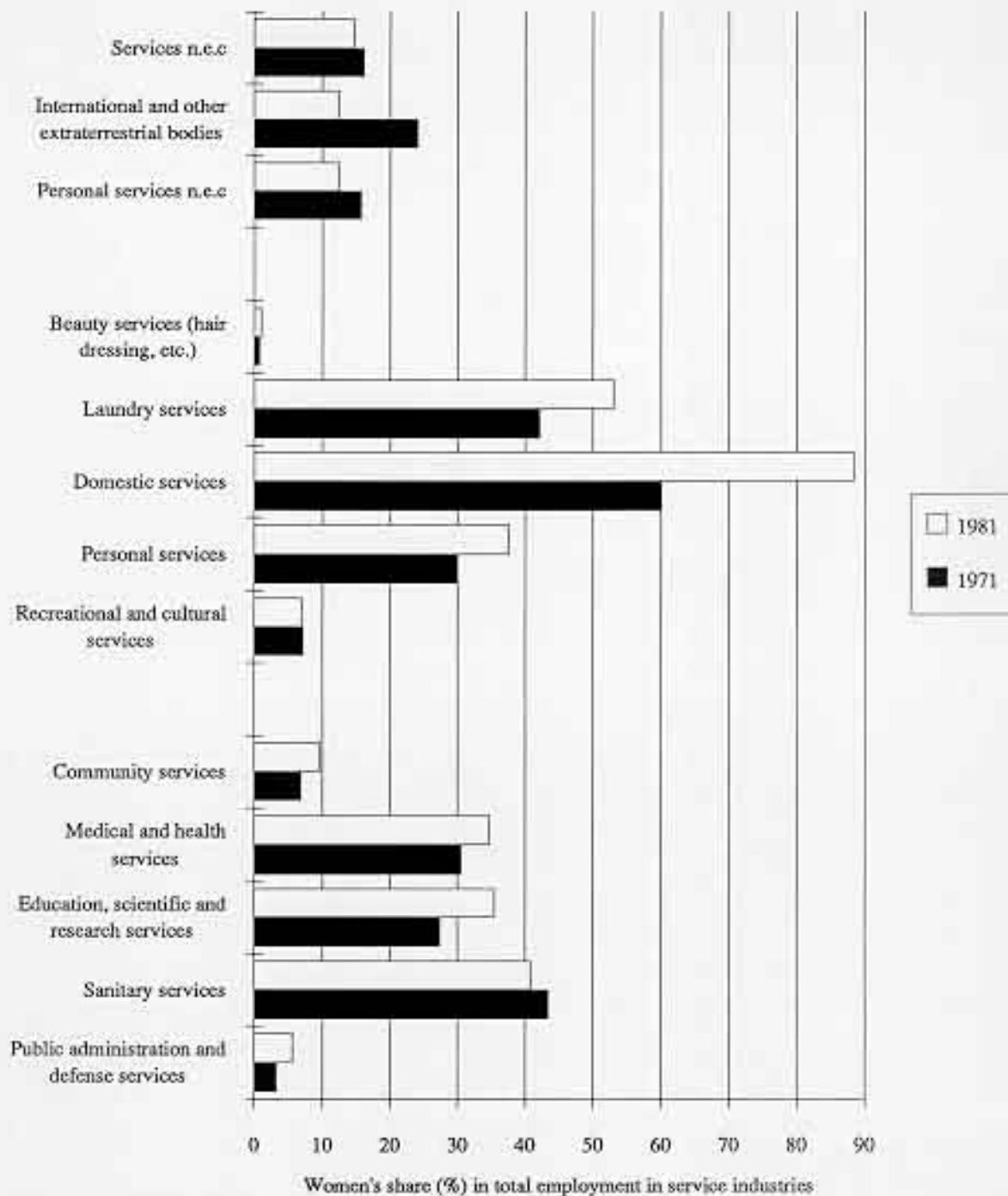
Source: World Bank 1991.

FIGURE 15: URBAN FEMALE WORK-FORCE PARTICIPATION RATES, 1988



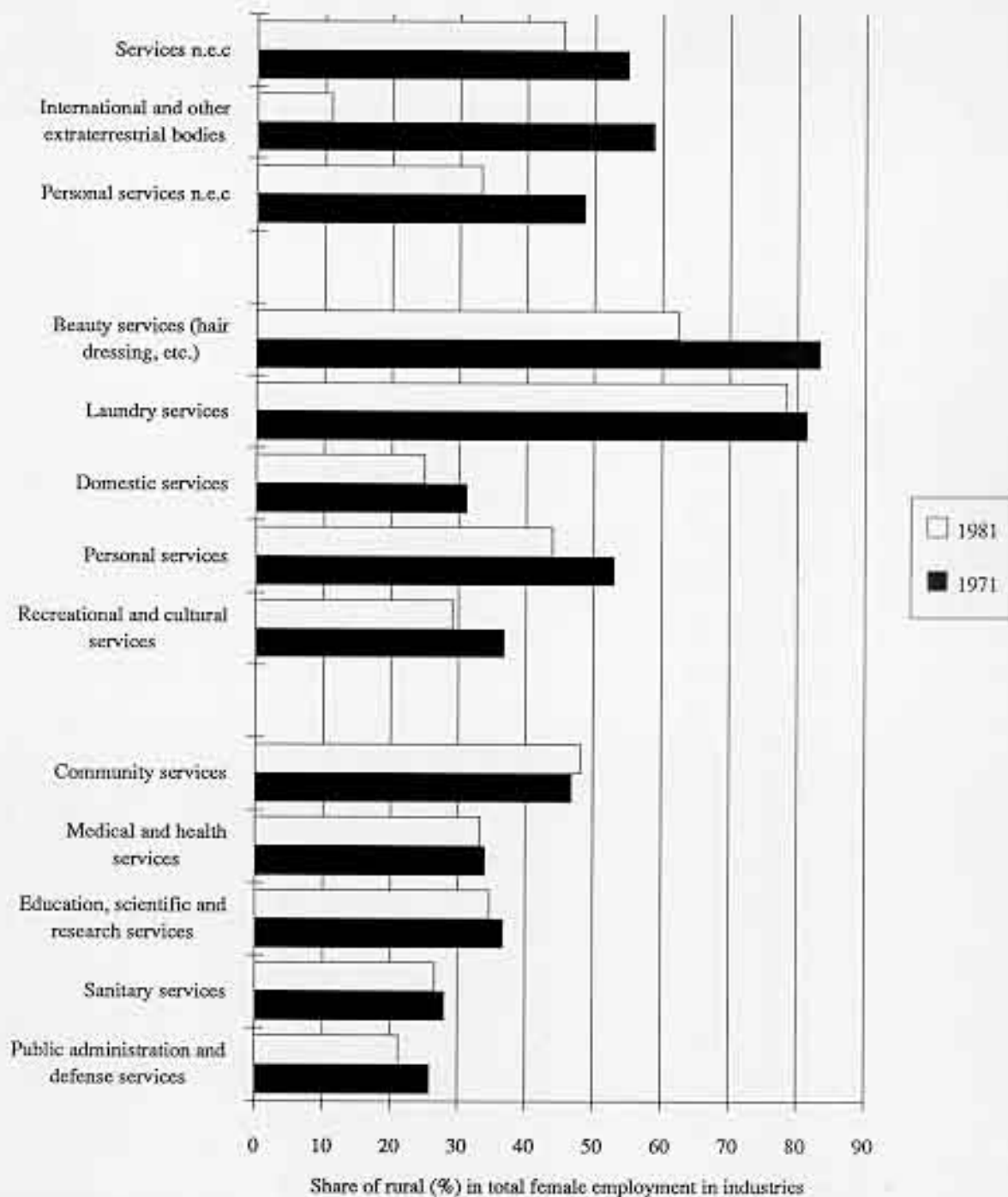
Note: Data is obtained from a 6 city sample (Bangalore, Lucknow, Vishakhapatnam, Faridabad, Trichur, and Puri). Source: NIUA Survey, 1988

FIGURE 17: INDICATORS OF FEMALE EMPLOYMENT IN SERVICE INDUSTRIES (ALL INDIA) 1971 AND 1981



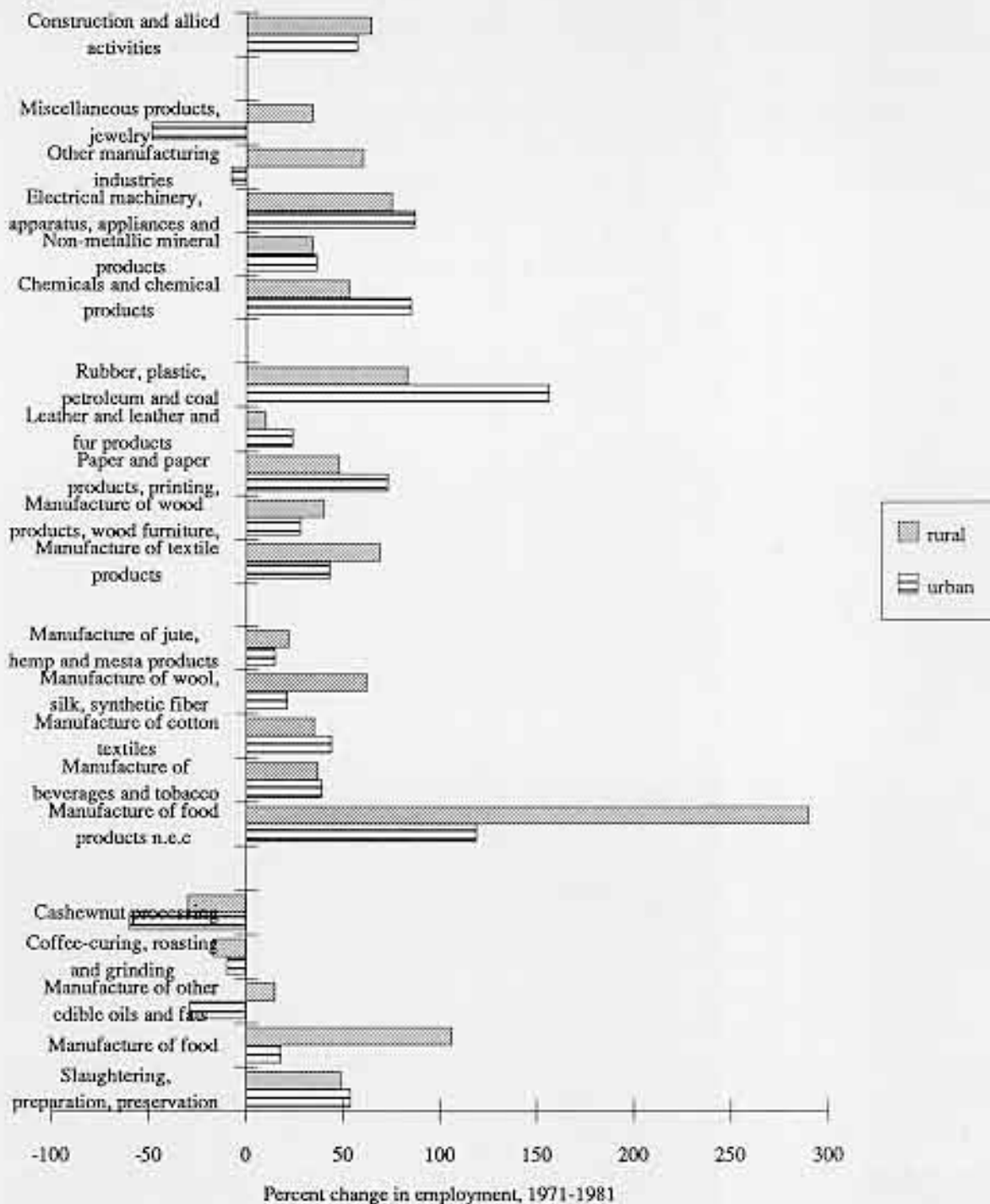
Source: World Bank 1991.

FIGURE 18: SHARE OF RURAL IN FEMALE EMPLOYMENT IN SERVICE INDUSTRIES (ALL INDIA), 1971 AND 1981



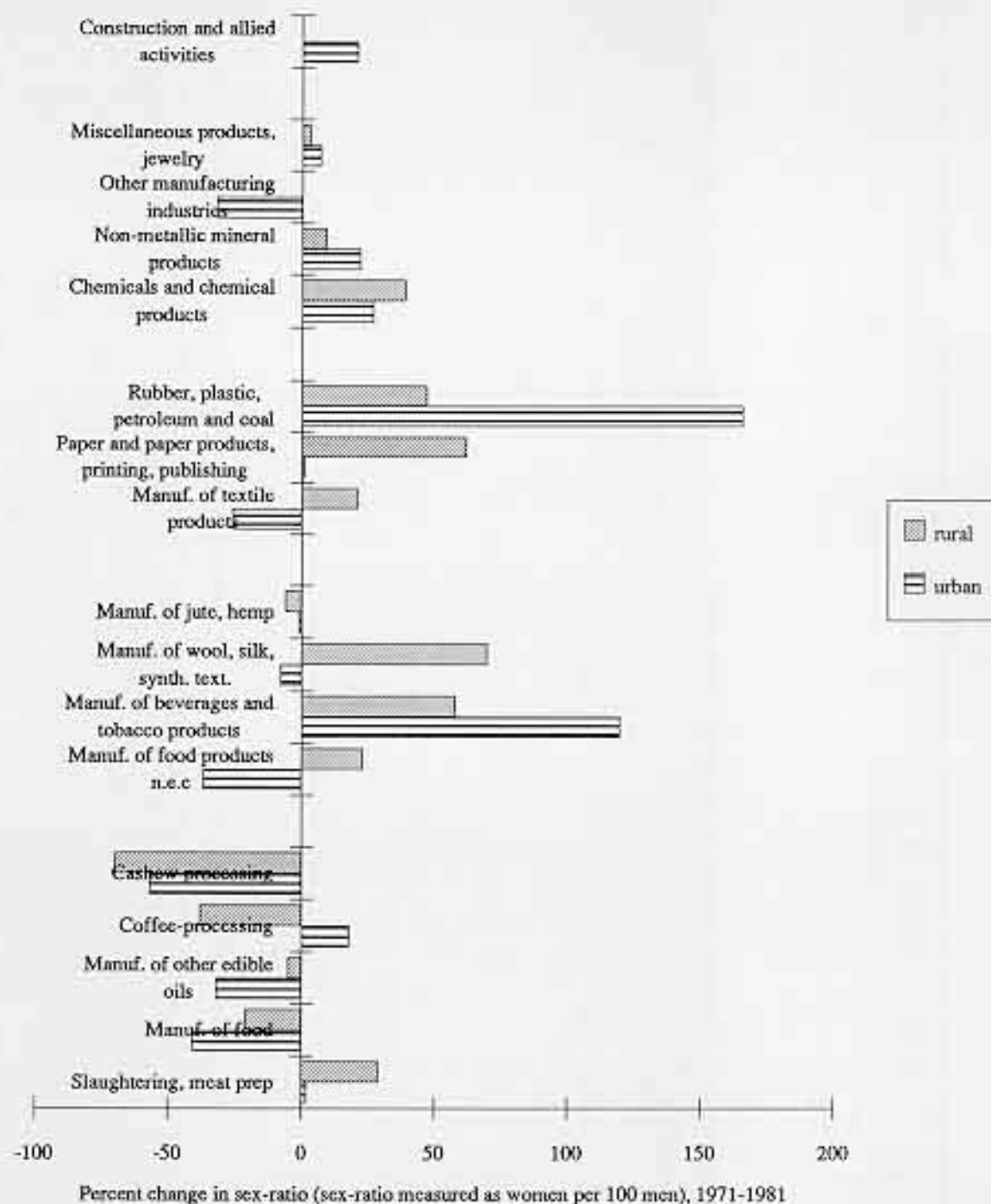
Source: World Bank 1991.

FIGURE 19: EMPLOYMENT IN MANUFACTURING (ALL INDIA), 1971 AND 1981



Note: Comprises Sectors Va (household industry) and Vb (non-household industry)
 Source: World Bank 1991.

FIGURE 20: CHANGE IN SEX-RATIO IN EMPLOYMENT IN MANUFACTURING, 1971-1981



Note: Comprises Sectors Va (household industry) and Vb (non-household industry)
 Source: World Bank 1991.

Within non-agricultural industry groups, women constitute half of all the work force associated with beverage production. The "personal services", "education, scientific and research" and "medical and health" industry groups each employ about one woman for every three men. Detailed statistics (for 1981) are available in FIGURE 16. Women's share of employment in the service industries has fallen nationally. Sex ratios in almost all the service industries listed in the Census of India are increasingly favoring men, except for those that are very clearly female, such as domestic, laundry or personal services. FIGURE 17, also provides some optimistic information for women's relative participation in two specific categories of service industries -- education, scientific and research activities and medical and health services -- where sex ratios have gone up between 1971 and 1981; however, FIGURE 18 provides evidence for the decline in the *rural* share of female employment in the service industry. In other words, while the service industry has grown on many fronts, female share, especially rural female employment in services has fallen. Data was unavailable to determine if the entire growth was due to rising urban female employment in services, rising male employment in services or due to changing definition of the spatial context of the service-industry as urban or rural.

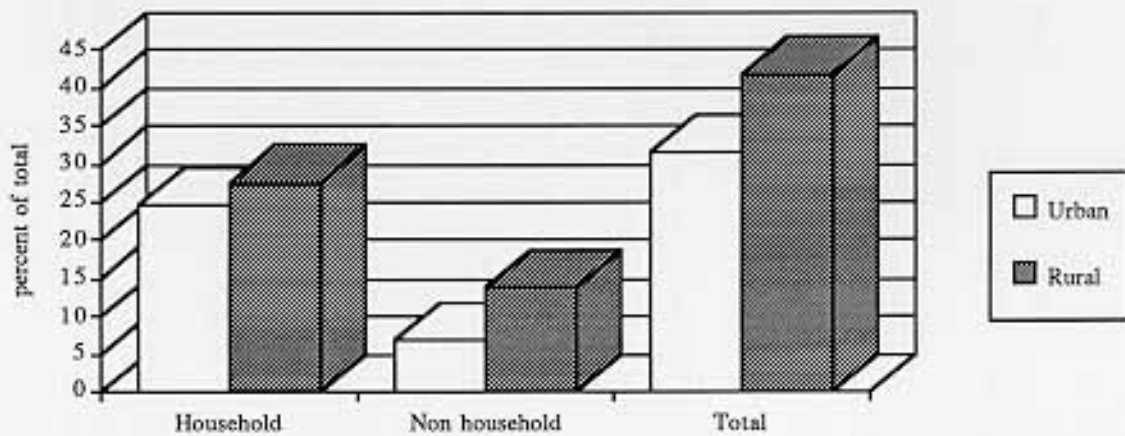
Between 1971 and 1981, several *manufacturing* industries saw huge shifts in their activity (See FIGURES 19 and 20). In the rural areas, four categories -- manufacture of food products; rubber, plastic, petroleum and coal products; paper and paper products and publishing; chemical and chemical products; electrical machinery and appliances -- all saw growths of between 75 and 100 percent over 1971 figures. However, in all of these, only one shows in a substantial increase in the sex-ratio (166 percent) over 1971 figures -- the manufacture of rubber, plastic, petroleum and coal products. This does not tell us what the actual male-female participation rates are; neither does it tell us whether this is a good or a bad development for women, in the absence of other information pertaining to wage rates or total numbers. The turning over of an occupation from male to female has historically meant reduction in wages, and worsening of job conditions.

The chemicals products and the electrical machinery manufacturing industries saw modest increases in their sex ratios at 27 and 18 percent respectively over 1971 figures, while there was a 37 percent *decrease* in sex ratio in the food product manufacturing industry. The only other rural industry that shows increase in the sex ratio is the manufacturing of beverages and tobacco products. This implies that while rural manufacturing is growing, the gender profile of the rural manufacturing workforce is changing to favor men. See FIGURES 19 and 20.

On the other hand, urban industries are employing more women relative to men than in the past, although in some cases, the increases are minimal (FIGURES 19 AND 20). Without any information in the kinds of jobs that women are filling, or their wage rates, or their total numbers, it is difficult to conclude much from these changes. The industries that have a higher sex ratio in 1981 over that in 1971 are wool, silk and synthetic fiber textiles; manufacture of beverages and tobacco products; and paper and paper products, printing and publishing. Ironically, while the food manufacturing industry grew in both, rural and urban areas, it saw a decline in sex ratios for both areas between 1971 and 1981.

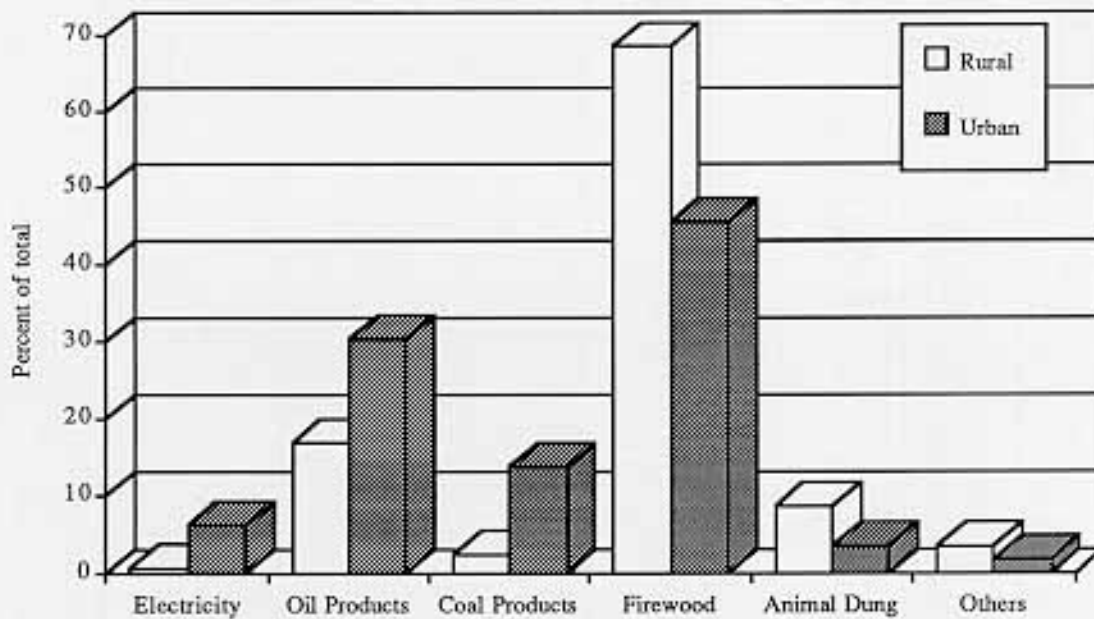
In 1981, roughly a fourth of those employed by household industries were women, versus only a tenth in non-household industry (FIGURE 21). This difference remains regardless of urban or rural location. However, rural non-household industries employ women at higher rates than urban non-household industries. This may happen because of higher gender-segregation of the labor market, higher skills needed for urban non-household industries and the inclusion of industries that traditionally have not employed women, and also may be associated with lower skill requirements in rural non-household industries.

FIGURE 21: SHARE OF FEMALE EMPLOYMENT IN TOTAL EMPLOYMENT IN HOUSEHOLD AND NON-HOUSEHOLD INDUSTRY, 1981



Source: World Bank 1981.

FIGURE 22: ENERGY CONSUMPTION IN HOUSEHOLD SECTOR, 1979



Source: World Bank 1981.

Urban-rural differentials in household energy use.

In rural India, firewood constitutes the largest source of energy for household use. Women and children are largely responsible for collecting fuel; they spend per day, anywhere between 40-50 minutes in abundant areas (Dasgupta and Maiti 1986), to 5 hours in depleted areas (Swaminathan 1984, Agarwal

1985, Nagbrahman and Sambrani 1983). Fuelwood collection can be a big drain on women's time and energy. It also places domestic and child care responsibilities on younger female children. In rural areas, almost all of this is collected or home grown (versus purchased). In urban areas, fuel wood is scarce, and represents a much smaller share of the total energy used in households. Much of the urban fuel has to be purchased in the market. Urbanization has meant that women do not spend many hours gathering fuel; it is difficult to say how much of gain in discretionary time has accrued to urban women as a result. It is possible that poor women have to work longer hours to earn enough cash to pay for basic household needs, including energy, and therefore urbanization has meant a decline in the quality of their lives. TABLE 22 provides a profile of fuel use and its source of supply in urban and rural areas.

Government policy on women

Government policy directly aimed at women considers only their reproductive roles or treats them as victims or targets of welfare. The household is assumed to be the smallest unit of delivery of services or programs. Despite much research on the differentials of resource-distribution and power in household decision-making along dimensions of age and gender, policy-makers assume that benefits within households of programs or policies accrue equally and with similar effects across these dimensions. A further assumption is that the members of the household have similar interests and formulate 'rational' strategies as independent units.

Government intervention in private domains where gender relations are rooted is problematic. Programs that seek to increase access to resources, for example, nutritional supplements for mothers through Integrated Child Health Centers have seen little success. They have failed to consider cultural barriers that prevent the effective use of these supplements. Women are socialized not to eat in public, or before their men-folk, to share their food with their children and other family members. Women's share of food in their households is reduced as a result of these external supplements, with the result that the intervention may often have negative consequences for women. Even where primary education for girls is free, authorities are unable to convince parents of the benefits of female education in the face of their greater immediate value as household help. Huge dowries paid by brides' families continue to provide disincentives to invest in girls' social development at the household level. Laws have not been able to change social practices.

Thus, one sphere where public policy can intervene into the household and change the economic structure and relations of dependency of women, is through changes in the economic environment and by providing greater access to girls and women of development *inputs* (education, health, skills training) rather than treating us as targets of welfare. Changes in the economic environment that can best aid women are those that facilitate access to human capital, skill-training, extension advice, access to factor ownership, technology and raw materials, and to social organization. The most powerful incentives would be policies to alter the incentives and disincentives to families permitting women to sell their labor or take up opportunities for self-employment.

However, this is far more complex than it appears. On the one hand, increasing the controls on firms and markets has not obtained much success. Wage and other labor regulations provide greater incentives for firms to change their modes of operations; instead of hiring, they may contract out piece work, or move toward greater mechanization. This has resulted in the increase in numbers of women and other minorities in the informal sector. On the other hand, decisions in the labor market are power laden and reflect societal gender prejudices. In the absence of other, balancing forces, women can become increasingly disadvantaged in the economic environment -- with segregated, low paying, or boring jobs, low mobility and security and low benefits. Women's education does not bring great rewards relative to men's. In this situation, the government has a responsibility to institute (and enforce) affirmative action programs in its own employment policies and to influence the behavior of firms that it deals with.

Greater access to human capital especially for girls would have to be addressed by increasing not only the availability of literacy and numeracy and other skills but also by making their use of these physically and socially permissible. Making available at least one school in a village, and training employing more female teachers in rural areas would be a step in the right direction. At the same time, popular education about the potential benefits women's education for themselves, their families and for the development of communities needs to be stressed. Low level (that is closer to the field) bureaucrats

and service delivery personnel also need to be trained about the importance of women's access to basic services and resources; all too often decisions made at the local level (and at every other level) reflect only the gender biases of these groups.

At the same time, particularly in rural areas, the value of girls' time to household labor needs to be reduced. Greater physical and economic access to services and resources -- fuel, water supply, fodder and other basic resources need to be provided. Further, women themselves need to be given incentives and rewards to bring themselves out of the vicious cycle of low economic value-- high fertility -- high mortality -- low human resource development -- low economic value. Specifically, given the emphasis on fertility as an organizing principle in cultural relations and structures, fertility-reducing behavior on the part of women and households should be rewarded and compensated. Women should be encouraged in higher education, skills development, wage earning activities.

Conclusion

Urbanization has numerous benefits for women's lives, as well as some indication of some negative trends. Basic demographic indicators of infant mortality, fertility, life-expectancy and literacy show higher levels for urban areas than rural areas. It is possible that these effects occur through different mechanisms. For instance, social and behavioral organization in cities display a lower hold of the traditional rigidity and a reduced sense of fatalism. Greater diversity, changed work relations, increased cosmopolitanism and a higher sense of control are some attributes of city life that allow an acceptance of change and change producing behavior. Higher density, spatial specialization and large numbers necessitate access to services like water, sanitation, transportation, and health. On the other hand, some of these very characteristics encourage additional inputs via public investments into cities, often at the cost of the countryside. This results in a higher availability per capita, of essential services than in rural areas. Combined with the above social and behavioral norms of city life, these have implications for higher and more effective use by women. This access is further made possible by the differences in the relative costs of and benefits accruing to families from children of different sexes. There is thus a synergistic effect that reduces inequalities in women's access to urban resources and services.

Therefore, it is fair to say that while both men and women stand to gain from urbanization, women's gains, at least in some sectors, when compared to rural areas, seem to be greater. At the same time, women's economic participation in cities was found to be low compared with rural areas. The rural manufacturing sector has growth but with simultaneous changes in the gender profile of the manufacturing work force that favor men. While it is difficult to draw definitive conclusions from this, there seems to be an economic trend that may be unfavorable to women. This may have to do with their disadvantaged position with respect to human capital resources, education and job skills; alternately, it may be evidence of gender discrimination in the market derived from the overlaying capitalist structures and relations over an explicitly patriarchal culture. With economic restructuring, and the emphasis on the market, the contours of gender-discrimination in this area may come into sharp focus in the near future. Both these trends signify that some action is needed from governmental, non-governmental, private and community sectors to improve the economic environment for women.

Urbanization constitutes benefits in quality of life for women in relation to rural areas, this does not imply that urbanization should necessarily increase. It does signify an unequal allocation of resources into cities that needs to be redressed, without the loss of quality of life that has been achieved in cities. Resource constraints may not permit the immediate development of infrastructure all of rural India. However, judicious investments in small towns and semi-urban areas, and increasing the efficiency of existing infrastructure may be a short term solution to reducing the polarities between metropolises and villages. At the same time, the training and deployment of female teachers into existing rural schools help increase female enrollment. Women's organization at the rural level, and women's community institutions such as thrift and rotating loans need to be encouraged. More data, recent and in multiple categories also needs to be available to draw surer conclusions. The following policy recommendations arise out of the analysis presented in this paper, necessarily inadequate because of data limitations.

Policy recommendations

To reduce rural fertility, increase rural life-expectancy, and rural and urban economic participation for women, following are some key policy areas suggested by the preceding analysis. These

areas may benefit by intervention from different governmental and non-governmental agencies; further mobilization of women's groups around these issues have also historically resulted in gains for women:

Investments in urban and rural literacy and education for women

- At least one primary school per village or urban unit within walking distance
- At least one female teacher per school
- Skills and job-training facilities, in both urban and rural areas
- Train women teachers in higher education, professional and job-skills training
- Provide public education of parents and community level workers of benefits of female education
- Reduce costs of female school attendance -- free textbooks, uniforms, etc..
- Combine childcare services with schools
- Implement and monitor free meals program for girls
- Monitor literacy/education programs for effectiveness, and evaluate for future planning
- Monitor agencies, programs, schools for gender discrimination in especially rural areas
- Feed-back local data to improve future data quality as well as to inform local planning
- Provide incentives for women village-workers in girls' and women's literacy mobilization

Improve economic environment for women in urban and rural areas

- Encourage community women's thrift institutions and revolving credit operations
- Make credit, resources and other factors of production available on easier terms
- Encourage women's cooperatives -- for credit and for production
- Encourage female participation in extension activities; train women extension workers
- Provide skills-improvement and retraining programs at work site
- Monitor women's economic participation in different sectors, sex-ratios, wage rates, and qualitative aspects of work
- Encourage women's organization for improved and increased access to inputs and markets
- Target employment information to women
- Enforce affirmative action programs for firms contracting with public sector agencies
- Monitor, subsidize and encourage child care facilities, flex-time arrangements, pregnancy and family leave, and other benefits by firms to women
- Enforce existing regulations on benefits to women workers, especially in sectors dominated by women employees

Investments in primary and maternal health and contraception especially in rural areas

- Increase availability and quality of primary and pre-and post natal care
- Provide suitable and free contraception advice and technology
- Provide training to local midwives, education to mothers in basic health care
- Provide financial incentives to lower births and increase birth intervals
- Provide nutritional supplements to mothers, and girls at schools
- Provide nutrition and nutrition needs information
- Encourage and educate the public for the use of health services by women and girls
- Monitor quality of drinking water
- Improve water, sanitation infrastructure
- Monitor women's and girls' health and nutrition status periodically
- Work closely with women's groups and other employment related organizations
- Monitor sex differentials in nutritional status, age-specific mortality and morbidity, selective abortion
- Monitor condition of households headed by women and the status of elderly women

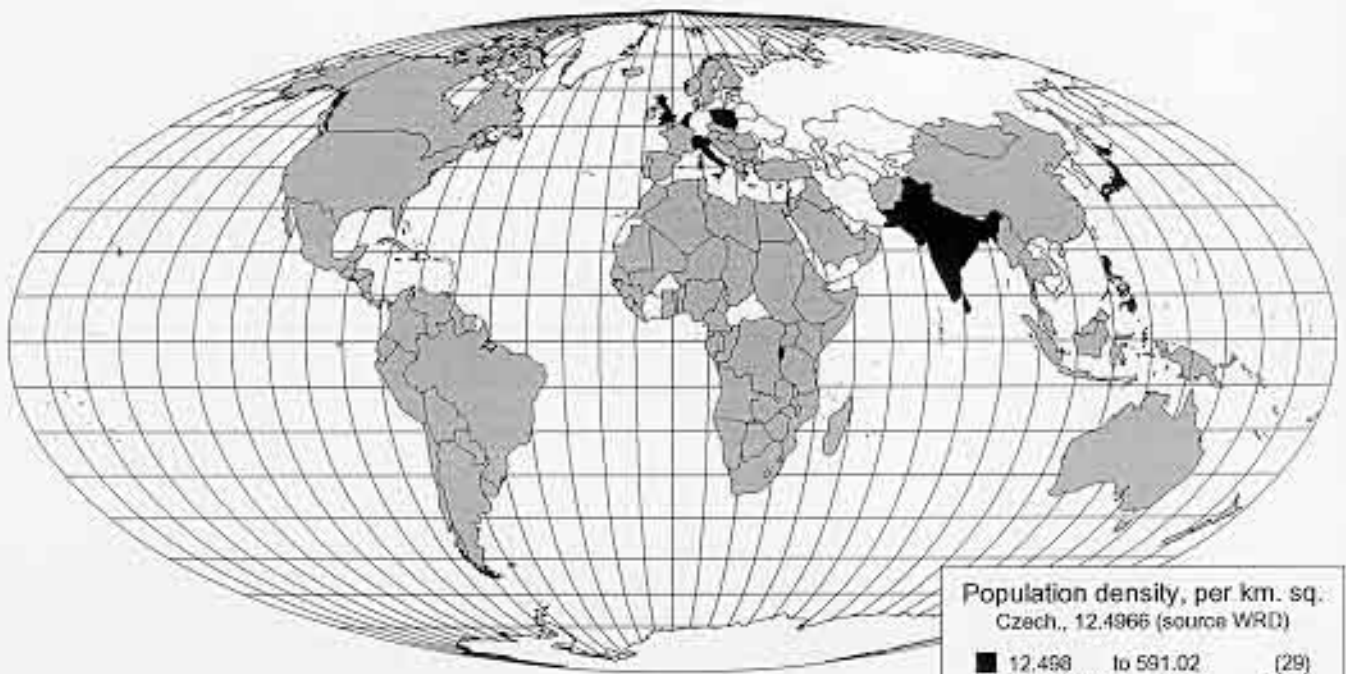
Investments in rural infrastructure

- Make alternative fuels, other purchased goods more accessible to poor women
- Improve safe, drinking water delivery
- Provide safe mechanisms for waste and sewage disposal
- Improve transportation to small towns
- Emphasize rural development of areas discussed above
- Provide incentives for decentralized industrial and manufacturing development
- Support, and improve conditions in rural occupations employing women

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Population density, per km. sq.
Czech., 12.4966 (source WRD)

■	12,498	to 591.02	(29)
■	0.139802	to 12,497	(100)
□	no data or lost in interface		(91)

Scale: 1 in = 6880 mi

THE TOXICITY TRANSITION IN THE CZECH AND SLOVAK REPUBLICS*

Rhonda Ryznar

Population Environment Dynamics and the Toxicity Transition

Human activity creates change in the environment. As societies evolve human activities increase in complexity, range, and frequency. Growth is considered necessary and positive by economists, but rapid growth can create an instability in the population-environment dynamic which makes a society particularly vulnerable to the negative effects of change. These periods of instability and vulnerability occur during transitions that the population and environment pass through until a level of stability returns. Transitions occur within all sectors of population-environment interaction: demography, epidemiology, agriculture, urbanization, toxicity, and others.

In this context toxicity refers to the level of contaminants in the soil, water or atmosphere that are potentially harmful to living organisms. According to Drake, characteristics of the toxicity transition indicate it begins with low levels of production and low levels of toxicity (Ness, Drake, and Brechin 1993). As production and population increase, toxicity increases until the level becomes unacceptable to the general public. This produces a public outcry for pollution abatement and, after an environmentally costly time lag, remediation steps are taken to control the pollution. The toxicity transition tracks environmental pollution that results from a variety of activities and can take place across different sectors of society. Therefore, the toxicity transition is really a composite of many transitions, such as, agriculture, fossil-fuel use, or urbanization.

Though the entire world is suffering through the toxicity transition, smaller areas within the globe indicate variation in the dynamics of the transition. This variation seems to depend on economic ideology, industrial policy, available technology, available resources, and amount of citizen participation in policy making. There is a spatial, as well as temporal, variation in toxicity. This variation creates the appearance of a time lag among transitions. An example of this time lag can be seen in the state of Michigan. Although population counts are dropping in Michigan, industrial production is diminishing, and pollution control laws and devices are in place, nonetheless the list of toxic sites grows annually. This growth may be due to several factors: scientific knowledge has improved our capability to detect pollution, we have grown more aware of what to look for, we have laws that enable us to act upon the problem, and we have active citizen groups of environmental advocates.

There are some population and development experts who see the population dynamic as a confounding factor rather than the driving force behind environmental degradation. According to Shaw, population growth is a proximate, not an ultimate, cause of this problem (Shaw 1989). Shaw admits that inhibiting population growth in less developed countries (LDC's) is an expedient means of preventing further environmental degradation, but the expediency is due to the fact that the ultimate causes of environmental degradation, such as, polluting technologies, affluence, or macro-economic distortions, are resistant to change. Shaw's point of proximate versus ultimate causes is well taken, especially when considering the case of the former Eastern Bloc countries. The population data for these countries show that the overall growth rate has been diminishing for some time, and therefore, its effect on the increase in pollution is negligible. In view of these differing opinions, this paper attempts to examine the toxicity transition as it is occurring in the Czech and Slovak Republics, by

* The new designation of "The Czech and Slovak Republics" is used throughout this paper when referring to the former country of Czechoslovakia. The name "Czechoslovakia" is only used in this document when the data being reported on was gathered prior to the country's separation in 1992 or the information is clearly historical.

discussing the possible forces that gave rise to it and considering its present critical position in relation to future policy decisions.

The Environment in the Czech and Slovak Republics

Central Europe provides an interesting laboratory for the study of population-environment dynamics and the transitions caused by human activities. The Velvet Revolution of 1989 and the subsequent collapse of the Soviet Union tore away the Iron curtain and revealed to a fascinated Western audience the inner workings of the former communist system. Beyond the joy of new found freedoms, however, can be seen a dismaying amount of health threatening pollution brought on by an emphasis on heavy industry and the use of outdated and inefficient technologies.

The Czech and Slovak Republics today rank at the top of the list in environmental degradation in Europe, and the problem is more or less in all regions of the two countries (Dzurova n.d.). Air pollution is the most serious problem mainly because large power plants, industrial sites, and heating plants burn high sulfur content low quality coal and most have no pollution control devices. The sulfur dioxide (SO_2), nitrogen oxides (NO_x), and flue ash emissions rank the Czech and Slovak Republics, both in per capita and per unit of territory, among the top polluters of the world (Dzurova n.d.). The following are figures from an official Czech government publication of 1990 (Vavrousek 1990).

Total SO_2 emissions in Czechoslovakia in tons by year:

1950	1970	1980	1985
900,000	2,450,000	3,100,000	3,150,000

The source breakdown for SO_2 emissions is as follows:

power plants and heating plants,	79%
technological processes,	11%
coal fueled home heating,	7%
and vehicles burning Diesel oil	3%

(Vavrousek 1990).

Since 1985 the amount of SO_2 has remained more or less stable due to milder winters which has reduced the amount of coal being burned for heating. In addition, there has been an increase in the use of atomic energy.

The region of Northern Bohemia in the northwest part of the Czech Lands (see Figure 1 below) is the most industrialized part of the two countries. The industry is dominated by brown coal production, coal burning power plants, and the chemical industry. Annual production of coal in this area is about 70 million tons which is 75% of all the coal production in the Czech and Slovak Republics. About 30 million tons per year are burned in the region by power plants, local heating and steam production for industrial purposes. Most of the chemical plants in this region are very old with some equipment dating from the early 1900's. One company located here, Spolchemie, is known to lose 27 tons of mercury annually. Some plants were located right in the middle of towns, regardless of risk (Paroha n.d.).

This region in Northern Bohemia is in a valley, 60 miles long and 20 miles wide, surrounded by mountains and highlands. In autumn and winter the area is subject to atmospheric inversions and air pollution is particularly severe in urban areas where the source is a combination of home heating and industries. In Most, a city in this region, SO_2 concentrations average $132 \mu\text{g}/\text{m}^3$ annually. The WHO standard, which has been adopted by the Czech and Slovak Republics, is an average of 40 to $60 \mu\text{g}/\text{m}^3$ annually (French 1990). The 24 hour concentration of SO_2 in these periods usually exceeds $500 \mu\text{g}/\text{m}^3$, often is over $1000 \mu\text{g}/\text{m}^3$, with a record of $2700 \mu\text{g}/\text{m}^3$ set in 1982. The combined effect of pollutants from combustion and from the chemical plants is especially worrisome (Paroha n.d.).



Figure 1. The Czech and Slovak Republics, their capital cities and surrounding countries.

Air pollution in other urbanized areas of the Czech and Slovak Republics is also affected by industry, local heating sources and heating plants and are augmented by trucks and automobiles burning low quality gasoline and Diesel oil. Though the absolute number of automobiles is low, pollution production is high (French 1990). In addition to the overall pollution, episodic alarms occur in densely populated areas when the maximum levels of the monitored substances of SO_2 , NO_x and dust are exceeded. In places such as Prague and Bratislava children are often taken from the city to breath air in other less dangerous areas for several weeks out of the year (Dzurova n.d.).

Another consequence of severe air pollution is the health of forests. The forests of the Czech and Slovak Republics are in peril and rank among the most devastated in Europe. In Northern Bohemia all forest stands are dead or dying from the high emission of SO_2 . Overall, 73% of the forests in the Czech and Slovak Republics show some signs of damage (French 1991).

About 70% of the rivers in the Czech and Slovak Republics are badly polluted, with a third of the rivers in Bohemia and half of the rivers in Slovakia unable to support aquatic life (French 1990). Industrial pollution and agricultural runoff including pesticides and fertilizers contribute to the problem. In addition, throughout both countries, only 40% of the waste water is adequately treated. In Bratislava, a city of 435,000 people (United States 1990), just 48% of industrial waste and household sewage is treated before being released into the Danube River.

Half the drinking water that is treated does not comply with national drinking water standards, and these standards have not kept up with modern international standards (Dzurova n.d.). Pregnant women and infants are advised not to drink tap water in many regions due to the high level of nitrates in the water. Yet, adequate supplies of bottled water are not available (French 1990).

Soil is also subjected to contamination from the excessive use of fertilizers, acidification from emissions, and decreasing quality from erosion due to the alteration of the landscape. Heavy metals have also been introduced to the soil and are persistent over long periods of time. This has strongly affected the quality of agricultural production and has contaminated food. Heavy metals and polychlorinated biphenyls (PCBs) in milk, meat and animal fodder are among the greatest problems.

The above is a brief list of some of the environmental problems found in these two countries. Since the 1989 revolution more problems are being discovered on a regular basis, such as, previously unknown toxic waste dumps and oil dumping in now abandoned military installations. This comes as no surprise when, for example, city planners in Prague have not been able to account for 80% of the estimated 40,000 tons of hazardous waste produced in the city annually (French 1990).

Population Dynamics

The population of the Czech and Slovak Republics has continued to grow since World War II. In 1950 the total population of the country was approximately 12,389,000, in 1970 it was about 14,334,000, and in 1990 it totaled around 15,667,000. A population will grow by a certain percentage each year simply because it is driven to reproduce itself out of itself (Meadows 1992). It will increase exponentially when the increase is proportional to what is already there. It is evident from the figures above that the growth rate of the population of the Czech and Slovak Republics is slowly diminishing (see Figure 2).

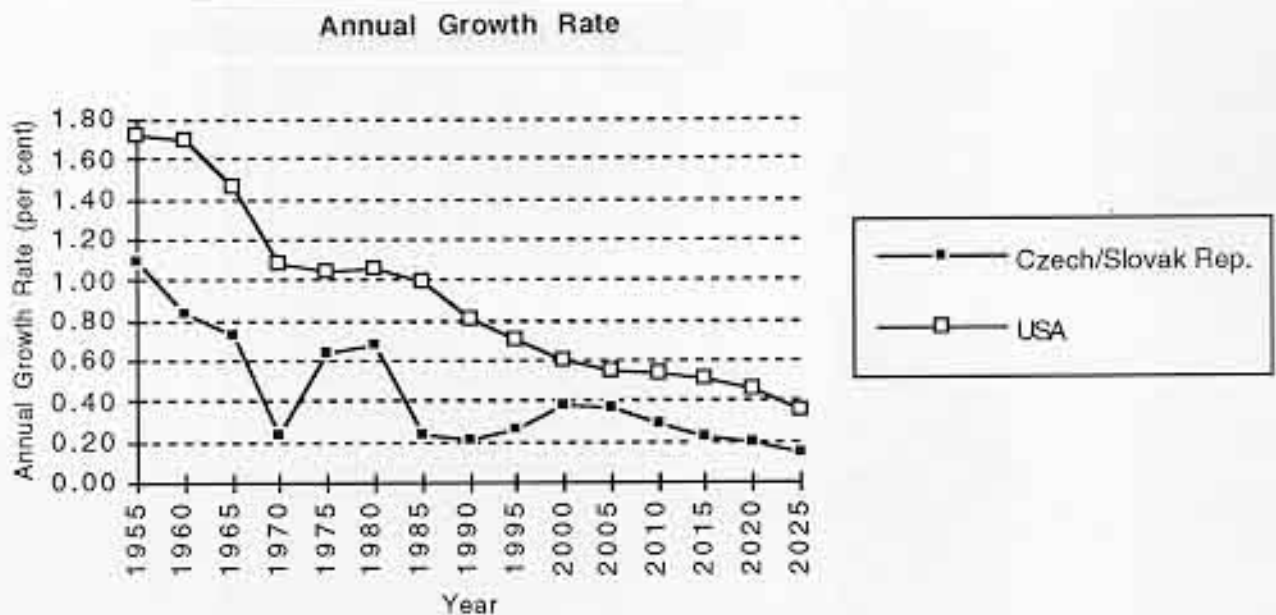
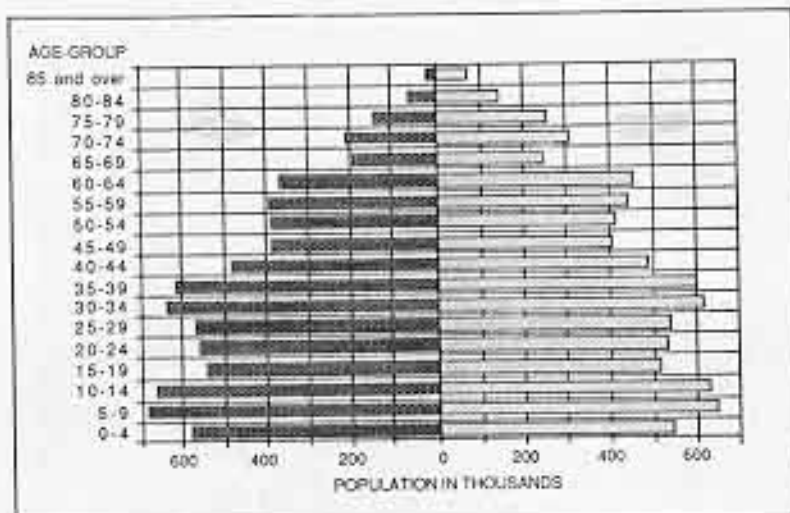


Figure 2. (World Resources Institute 1992)

The population growth rate of the Czech and Slovak Republics is compared to the population growth rate in the United States because both are considered to be highly industrialized countries, have undergone similar transitions since World War II, and the USA numbers provide perhaps a better known frame of reference to the reader. A comparison of the annual growth rates between the USA and the Czech and Slovak Republics in Figure 2 shows that they have a similar overall pattern except for two significant drops on the graph for the Czech and Slovak Republics. This could be due to incorrect data, or some other underlying factor. The two drops in 1970 and 1985 have one significant factor in common. Both were times of severe dissatisfaction with government and economic policies. Though the country came under Soviet communist rule after World War II, in the

1960s economic and political reform were gaining momentum. The reform movement came to an abrupt halt when the Warsaw Pact Tanks invaded Czechoslovakia in August of 1968. Strict economic and political controls were imposed on Czechoslovakia by 1970 and thereafter. Also following the 1968 invasion there was a wave of emigration (United States 1989).

The growth rate appears to have taken up where it left off from 1975 to 1980 and may be the result of a second post-World War II baby boom. As in the United States, the majority of adults in Czechoslovakia were of reproductive age during this time period. The Age-Sex Distribution graph from 1985 for Czechoslovakia, as seen in Figure 3 below, shows that the majority of adults were between the ages of 30 and 34. This means that from 1975 to 1980 they were between the ages of 25 and 30.



Source: Based on information from *Statistické ročenka*, Prague, 1986, 96.

Males

Females

Figure 3. The 1985 AGE-SEX Distribution in Czechoslovakia (United States 1989).

A comparison of the trajectories for the total population of the USA and the Czech and Slovak Republics is shown below in Figure 4. Though the USA has also experienced a second post-World War II baby boom it did not produce the same "blip" in the trajectory as it did in the Czech and Slovak Republics. A look back at the graph for Annual Growth Rate (Figure 2) shows this "blip," but the more smooth decline of growth in the USA has produced a smoother total population trajectory.

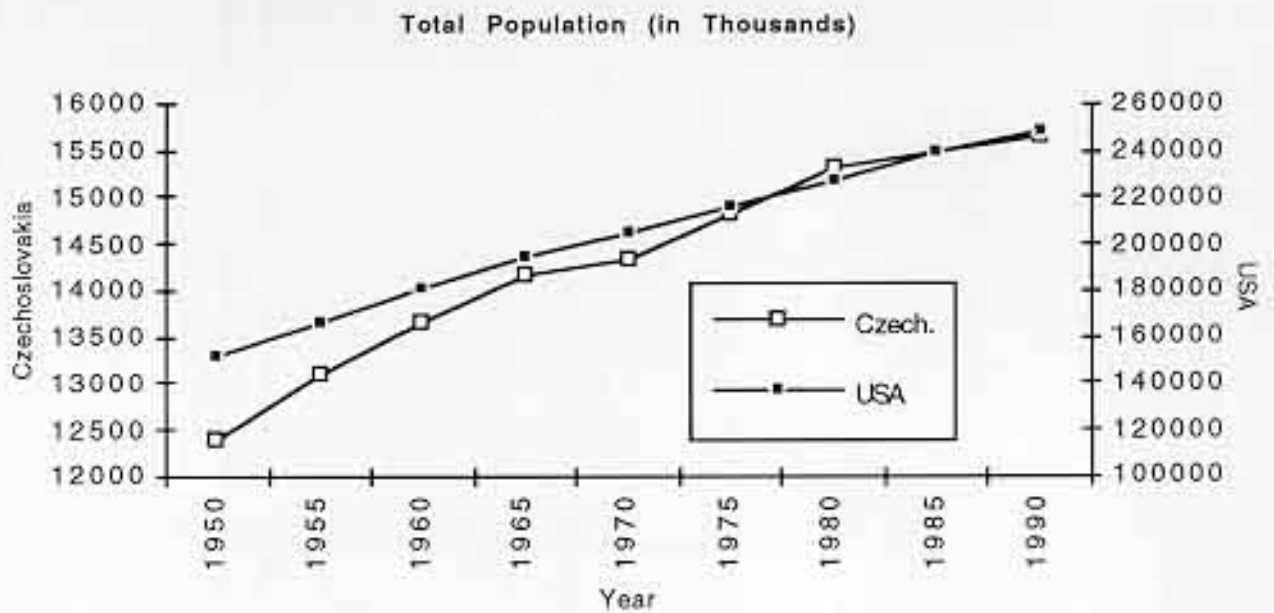


Figure 4. (World Resources Institute 1992).

An understanding of the behavior of populations over time lends itself to future speculation on population growth. Using several common population models one can estimate the future trajectory. The graph below (Figure 5) shows the results of the application of four different models to the population figures found in the World Resources Database (WRD). The four models, including linear, exponential, logistic, and logarithmic, were calculated on the data provided in the WRD up to year 1990 (actual data) and then the trajectories were estimated. The WRD trajectory is plotted with the future estimates WRD provided from their own model (of unknown origin) for time periods beyond 1990.

Projected Population of the Czech and Slovak Republics (in Thousands)

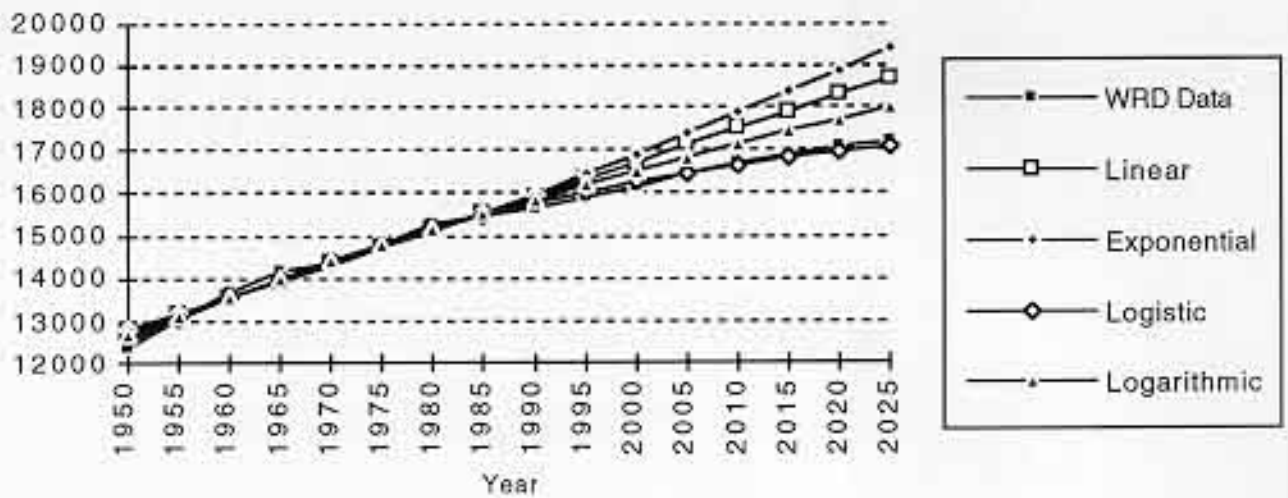


Figure 5. (World Resources Institute 1992).

The logistic curve, produced an R^2 greater than .987, and gave the best fit for the data up to 1990. A look at only the logistic curve in Figure 6 will illustrate the fit. The population limit was set to 18,000,000 in the logistic equation based on an estimation of the direction of the curve in the actual data. A plot of the recalculated Y values shows a gradual approach to the set limit which is barely reached 100 years from now. Given the population data available from the WRD, the logistic curve is the best estimate of the future population trajectory.

Projected Population of the Czech and Slovak Republics Using a Limit of 18000 (in Thousands)

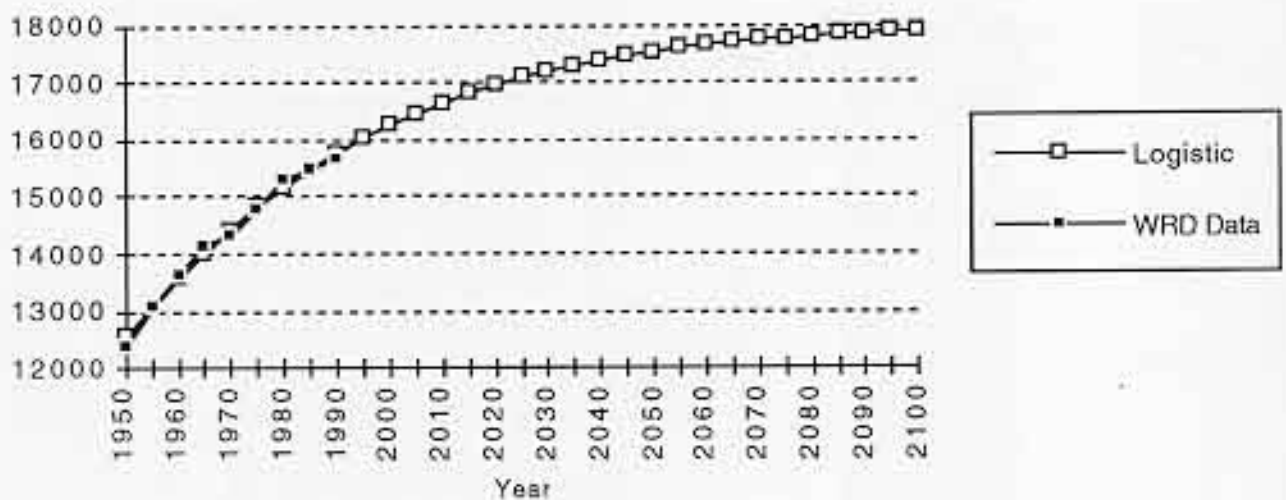


Figure 6. (World Resources Institute 1992).

Populations change over time and these changes are explained by the process known as the demographic transition. The theory behind the demographic transition claims that in the early stages a population has both high birth rates and high death rates that are in relative equilibrium with each other (Ness, Drake, and Brechin 1993). As living standards improve, death rates generally decrease. Then, if the standard of living remains high enough, birth rates will also begin to decrease (Commoner 1990).

The countries of the world today illustrate the pattern of the demographic transition at different stages. The less developed countries have high death and birth rates resulting in a population growth rate of 2 to 3% per year; countries of intermediate development have low death rates and high, yet decreasing birth rates, resulting in a population growth rate of 1 to 4% per year; and the most industrialized nations have low death and low birth rates and slow (<1%) population growth rates (Meadows 1992).

The United States is a highly industrialized country at the late stage of the typical demographic trend and is illustrated by the plot of crude birth and crude death rates below.

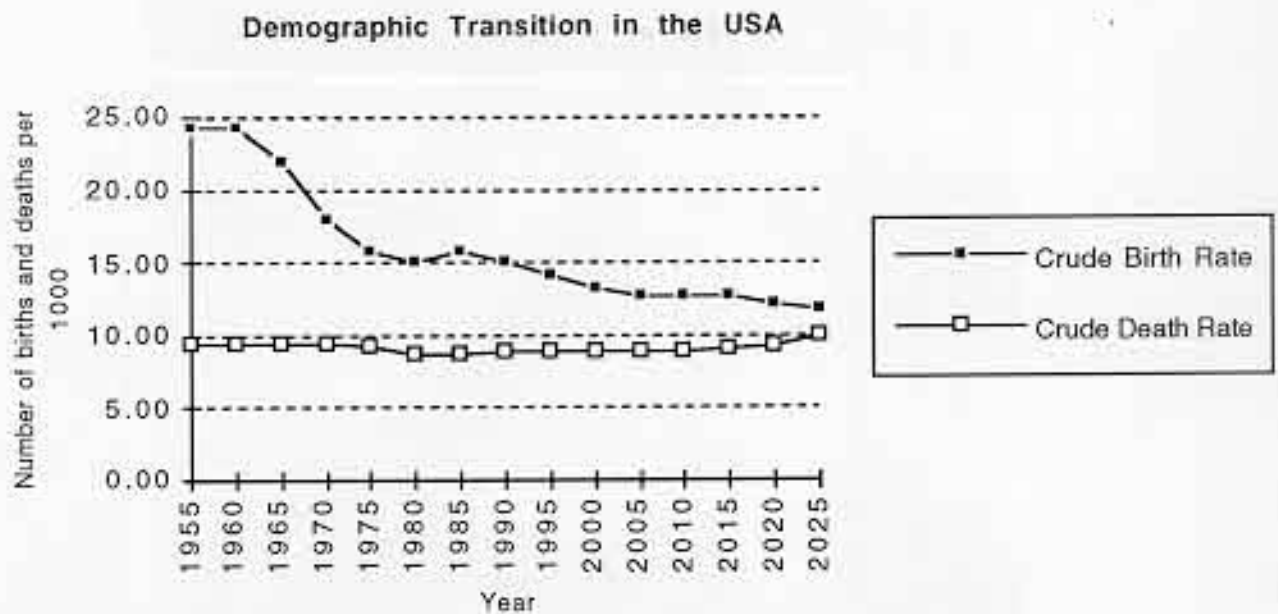


Figure 7. (World Resources Institute 1992).

Eventually the death rate and birth rate will converge and, in some industrialized countries, as birth rates drop below the death rates, the populations will slowly decline. What is most interesting about the former Eastern bloc countries is that they have gone beyond this point. Not only have birth rates dropped below death rates, but death rates have subsequently increased. The birth and death rates of the Czech and Slovak Republics exhibit this pattern as shown below.

Demographic Transition in the Czech and Slovak Republics

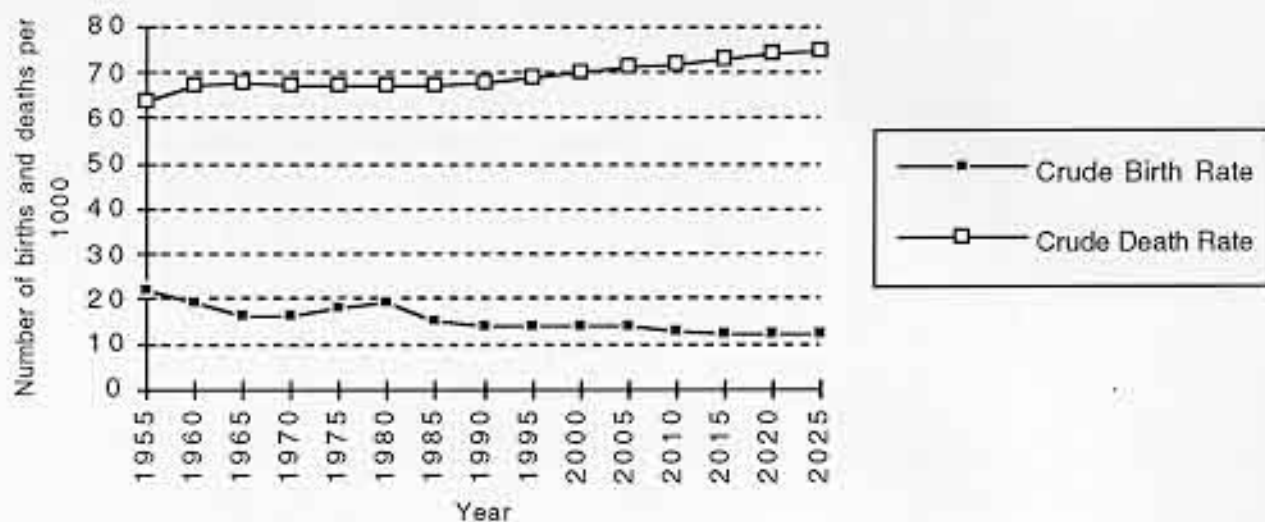


Figure 8. (World Resources Institute 1992).

One of the reasons why the Czech and Slovak Republics may be exhibiting this "flip-flopped" gap between crude birth rates and crude death rates is the current lower life expectancy at birth in the republics. Table 1 is a list of industrialized countries and, among those listed, Czechoslovakia was surpassed only by Poland, Romania and Hungary in having the lowest life expectancy for males at birth in 1988.

TABLE 1

An International Perspective on Life Expectancy

<u>COUNTRY</u>	<u>YEAR</u>	<u>MALES</u>	<u>FEMALES</u>
Japan	1988	75.8	81.9
Sweden	1987	74.2	80.4
Switzerland	1988	74.0	81.1
Netherlands	1987	73.6	80.3
Canada	1987	73.3	80.2
Australia	1987	73.2	79.8
Norway	1987	72.8	79.8
France	1987	72.6	81.1
W. Germany	1988	72.3	79.1
Austria	1988	72.1	78.7
United Kingdom	1988	72.5	78.2
United States	1987	71.6	78.6
Belgium	1986	71.4	78.2
Finland	1987	70.7	78.9
Portugal	1988	70.5	77.7
E. Germany	1988	69.7	76.0
Yugoslavia	1987	68.5	74.3
Bulgaria	1987	68.3	74.6
Czechoslovakia	1988	67.7	75.3
Poland	1988	67.1	75.7
Romania	1984	67.1	72.7
Hungary	1988	66.1	74.2

(Hertzman 1990).

According to Hertzman, until 1965 the age standardized mortality rates for males and females in Czechoslovakia were within Western European norms. After 1965 the mortality rate continued to decrease in the rest of the industrialized world, while in the Eastern Bloc countries, from the mid 1960s to the mid 1980s, it stopped declining for females and began to rise for males. Though causality is difficult to prove, this rise in the mortality rate could be due to human exposure to the high level of toxins found in the Eastern Bloc countries. This phenomenon, coupled with the widespread availability of birth control and abortions, could have led to a low birth rate, a higher than expected death rate, and, a slowly declining growth rate.

Because the environment of the earth has degraded as the population has increased many researchers have concluded that rapid degradation of the environment has been caused by the unrestrained growth of the population. But cases such as that in the Czech and Slovak Republics indicate that the process is more complicated. Commoner states that the environmental impact is not simply due to the rate of population growth. He claims that degradation is a product of changes in the technology of production since World War II (Commoner 1985). Shaw reiterates Commoner's claim and asserts that we concentrate on population control because it is the easiest to affect (Shaw 1989). Both agree that it is a confounding factor to the poverty experienced in many of the less developed countries. High birth rates can continue the cycle of poverty and adversely impact the environment where people depend on its resources directly, for example, where there is a need for more agricultural land. In those cases, though population control may help in the short run, the ultimate cause is unfair economic practices.

Economic and Industrial Policies

In considering the causes of environmental degradation in the Czech and Slovak Republics, Commoner believes that in the Soviet Union it is their use of polluting technologies that were developed in a capitalist society, i.e., technologies designed to maximize profits and dominate the market, coupled with the socialist system's failure to develop the democratic processes "essential to the successful operation of the socialist state" (Commoner 1985). At the same time Soviet society failed to develop socialist technology that could generate the means of production and were designed for the purpose of serving the national interest and the public welfare (Commoner 1985). Early theories of socialism assumed that if the state owned the means of production there would be no reason for the state to contaminate itself and ruin its own wealth. In other words, there would be no motive for pollution. In fact though, factory managers were pressed to commit all of their resources to meeting production quotas.

Czechoslovakia was already a well developed industrial country by the end of World War II. The severe environmental degradation which took place between the 1940s and the 1980s was due in large part to the imposed centrally planned economic policy framework and the State ownership of production means (Czechoslovakia 1991). In a centrally planned economy each industry is subject to policy decisions made by national authorities that determine the short and long-run expansion and contraction of every product group of importance to the national economy. This means directing investment funds, scarce materials, foreign exchange, and even labor, toward priority sectors at the expense of other claims on resources.

Percent of Commerical Energy Used by Sector In the Czech and Slovak Republics (Source: WRD data)

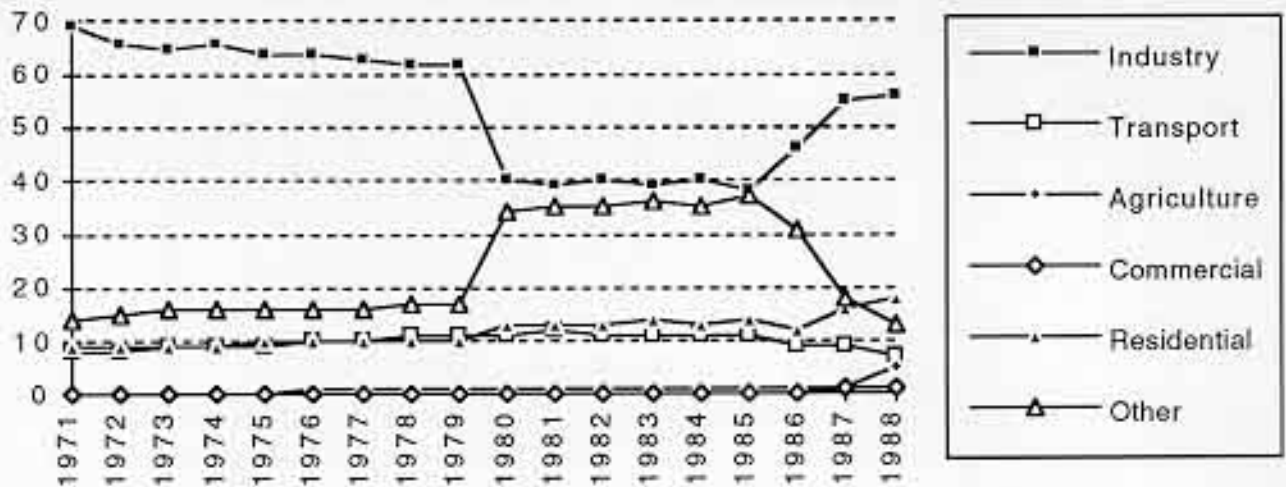


Figure 9. (World Resources Institute 1992).

Figure 9 above shows the percentage of overall consumption of energy by each sector within the Czech and Slovak Republics. It indicates the overall scheme of investment of resources by the large amount of energy consumed by industry and the very small amount of energy consumed by agriculture. The graph also shows a dramatic change in the 1980s. The drop in energy use by industry in the 1980s was probably brought on by the economic recession.

The goal of industrial policy in the countries of Central Europe after World War II was to propel industrialization by emphasizing heavy industry founded upon a strong capability in metallurgy and machine-building already in place (Brada and Montias 1984). Even today, industry still makes up over 50% of the economic base and services make up less than a quarter (French 1990). The emphasis on heavy industry resulted in an intense use of energy, material resources, and water, that was very high by international standards. There was also strong political support for independent, self-reliant economic systems. This political support created a bias in favor of domestic resources, such as, coal (World Resources Institute 1992).

During the 1960's the economy was stalled and many countries in Central Europe experienced the urge for reform. Political reform affected economic reform and a new emphasis emerged toward technologically advanced products that might become intensive growth sources. In Czechoslovakia new research and development (R&D) and investment resources for electronics, precision, and optical instruments were controlled centrally, while responsibility for other less important products was delegated to ministries, associations and enterprises (Brada and Montias 1984). However, after the Russian invasion of Czechoslovakia in 1968 political reform in that country was terminated and Czechoslovakia remained more tightly controlled politically and economically than Hungary or Poland (Brada and Montias 1984). Enterprise autonomy was sharply reduced in 1970 and centralized authority reinstated. Construction activities were controlled centrally and the State Bank was prohibited from financing unauthorized investments. This renewed centralization scheme created disincentives to restructure and in the 1970's poor planning resulted in competition for resources between the Five Year Plans and the "most important structural changes" program (MISC). Czechoslovakia has experienced a shortage of labor and a backlog of construction since that time.

By the 1980's Czechoslovakia entered an economic recession whereby the growth rate for nominal national income (3.9% in 1981) was outpaced by the growth of retail prices, especially meat, foodstuffs, clothing, and some durables. Wholesale prices for fuels, construction materials and other industrial raw materials and agricultural procurements grew at an even faster rate. The standard of living declined with retail prices rising about twice as fast as nominal wages ("Czechoslovakia: The Economy" 1983).

Though the electronic industry grew by 4.8% in 1982 further growth was inhibited by the restriction of trade with Western companies of electronic production and testing equipment. This restriction of trade prevented Czech industries from reaching world standards of quality and reliability ("Czechoslovakia: The Economy" 1983). Czechoslovakia's overall growth rate of productivity declined steadily from 1971 to 1985. The main cause of this decline has been attributed by Rusek to the declining marginal productivity of capital, caused by a fast growing capital-labor ratio and low elasticity of substitution between capital and labor (Rusek 1989). At the present time four-fifths of the trade in the Czech and Slovak Republics is with Russia and the other Central/Eastern European countries (Carter 1990).

Energy Use

One of the most serious concerns for curbing pollution is how to meet energy needs. In Central Europe the primary cause of air pollution is from the burning of lignite, a low energy high sulfur content soft brown coal. Nearly two thirds of the country's energy comes from the burning of brown coal (Carter 1990). Bituminous coal deposits are small and most of the high quality coal is sold to Germany or Austria because it is a marketable item. Soft brown coal, however, is abundant and is used in thermal electricity power stations, generally located in the northwest section of the Czech Lands. This area has been devastated by strip mining and endures some of the worst air pollution in the world. The graph below illustrates the source of CO₂ emissions by fuel type.

Industrial CO₂ Emissions by Fuel Type for the Czech and Slovak Republics (Source: WRD data)

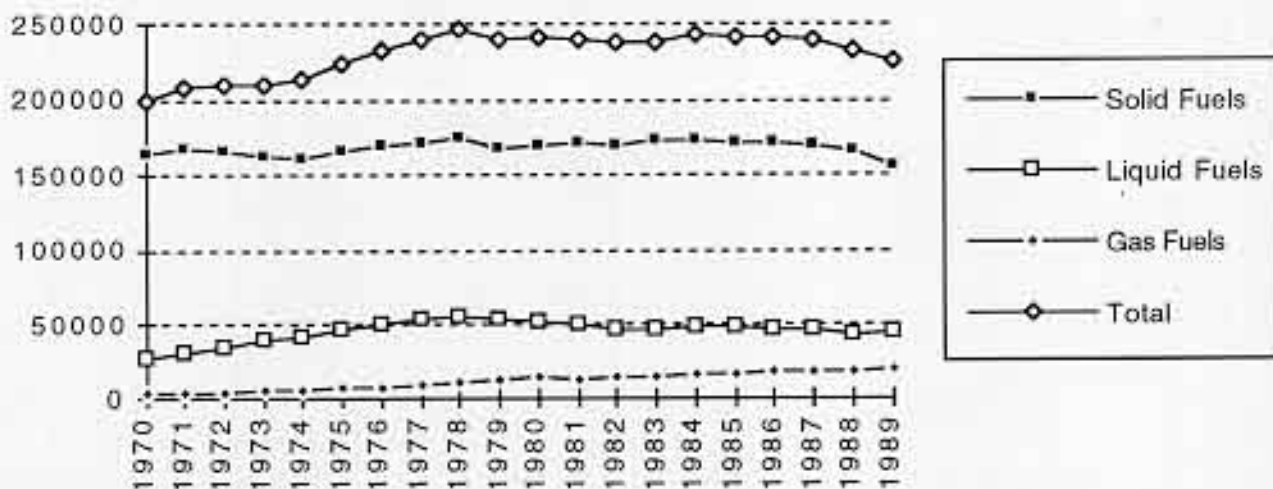


Figure 10. CO₂ Emissions in Thousand Tons.

Czechoslovakia has been dependent on the Soviet Union for much of its oil needs. Oil imports from the Soviet Union were reduced by 10% between 1980 and 1983 though some compensation was gained and natural gas imports were gradually increased by means of a natural gas pipeline crossing the country from the Soviet Union to Western Europe. Since the breakup of the Soviet Union, however, the Czech and Slovak Republics do not want to become dependent on the new

natural gas pipeline. The country suffers serious energy shortfalls and there aren't any easy solutions.

Hydro-electric power is not feasible due to many unsuitable rivers. The need for energy production led Czechoslovakia to enter into an agreement with Hungary and Austria to build a dam on the Danube. Hungarian opposition to this dam grew because of the potential environmental damage it could cause. This controversy was a major impetus in the Green movement in Hungary and the movement played a leading role in events that led up to the Revolution of 1989. Hungary has since decided that they will not participate in the building of the second of the two dams needed for successful operation (to have been located in Hungary just north of Budapest). The first dam, in Slovakia, is now partially constructed and the Austrian financiers are seeking compensation for their \$640 million investment (Land 1992).

An emphasis began in the 1970's on the construction of nuclear power plants in order to supply power for domestic use as well as export to other communist countries and the third world, but construction suffered from labor shortages and delays in construction supplies and was continually behind schedule ("Czechoslovakia: The Economy" 1983). Czechoslovakian nuclear power plants have been constructed using the Soviet designed VVER-440 reactor (Brada and Montias 1984). By 1990 eight plants had been completed and eight plants were still under construction. The nuclear energy program expects to supply 40% of the two countries' electricity by the late 1990's (Carter 1990).

Inefficiencies of Production

A big factor contributing to the high levels of toxicity in the Czech and Slovak Republics is the inefficient use of energy. This can be characterized by energy intensity, i.e., energy consumption per dollar of gross national product. High levels of resource investment per unit of production would typify energy inefficiency. According to the WRD dataset for 1992, in 1989 Czechoslovakia consumed 51 megajoules of commercial energy for every unit of GNP (measured in constant 1987 US dollars). In contrast, the USA in the same year consumed 15 megajoules of commercial energy for every unit of GNP.

Another example of the inefficiencies of production systems which contributes to pollution is in the agricultural sector. Not only are pollutants released by the inefficient use of energy in heavy industry, but by the overuse of fertilizers and pesticides in agriculture. These practices are the primary cause of surface and groundwater nitrate pollution. It is estimated that 80% of the rivers in the Czech and Slovak Republics are polluted by animal waste and agricultural products.

Farms in Czechoslovakia were largely collectivized between 1949 and 1970. Agriculture received lower investment funding than industry and grew quite slowly. Widespread use of fertilizers were relied upon to bolster the agricultural output. This has caused the agricultural sector to undergo its own transition as can be seen in Figure 11 below.

Agricultural Production vs. Fertilizer Use in the Czech and Slovak Republics (Source: WRD data)

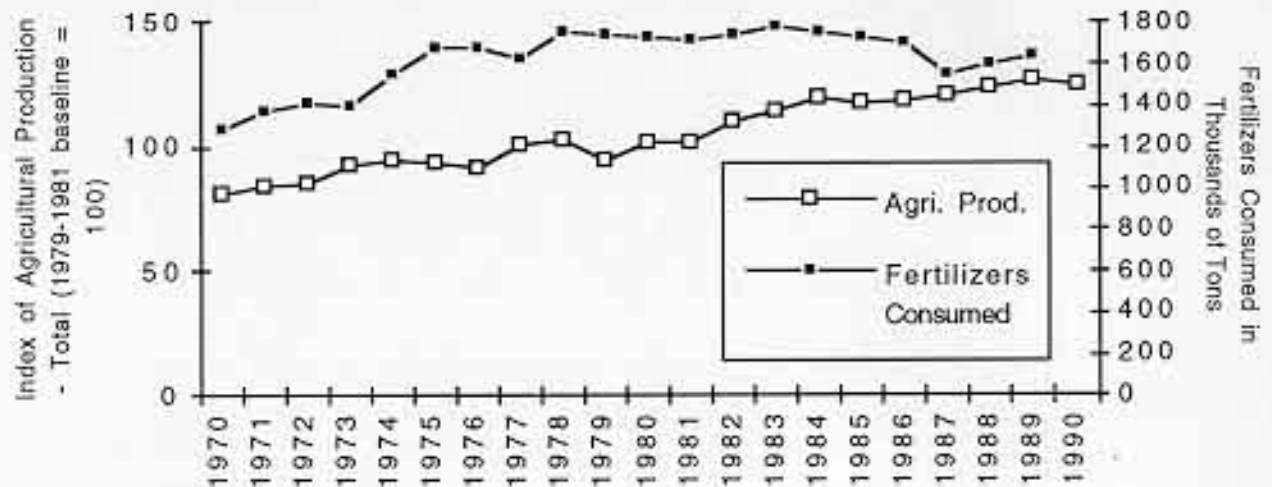


Figure 11. (World Resources Institute 1992).

The theory of agricultural transition has revealed that with time, heavy use of chemicals and fertilizers becomes less efficient, that is, the rate of return on the investment diminishes. Figure 11 shows mixed results in the agricultural sector, however, and can be explained by various changing policies. The graph shows large increases in fertilizer use from 1970 to 1978 and a slow uneven rise in agricultural production during this time period. What is interesting to note in the graph is that in many of the years of increased use of fertilizers there is, in fact, decreased agricultural production and vice versa. Yet, the graph shows that fertilizer use remained steady from 1978 through the early 1980s while agricultural production continued to increase. This can be explained by the efforts of the former communist government to change the agricultural industry.

In order to induce workers to the agricultural sector the government raised the prices of farm products in the 1960s, which gradually increased the incomes of agricultural workers. By the 1970s farm workers' incomes were on a par with that of urban white-collar workers. In the 1960s farm laborers had been predominantly women and older men, but by the 1980s the farm labor force was relatively young and well educated. The improvement of agricultural performance is attributed to this change in the labor force.

Though fertilizer use has declined since the early 1980s, farm production continues to rise. This can be attributed to the fact that in the early 1980s the government introduced measures to encourage private small-scale animal breeding and fruit and vegetable cultivation. The encouragement of private farm production has been that by 1984, 10 percent of meat production, 38 percent of vegetable production, and 64 percent of fruit production was due to these small-scale private producers (United States 1989).

The Toxicity Transition and the Future

Drake's thesis is that the toxicity transition begins with low levels of production and correspondingly low levels of toxicity. Then, as production and population increase, so does the level of toxins in the environment. The toxic level will continue to increase until it reaches a point that is unacceptable to the general public. Then public demand for pollution abatement will set in motion the steps to remediation. The toxic transition can be illustrated by plotting the toxins emitted per unit of production over time. A lack of data to calculate such a variable has led to simulating this transition by the graph in Figure 12.

Total Industrial CO₂ Emissions vs. GNP in the Czech and Slovak Republics

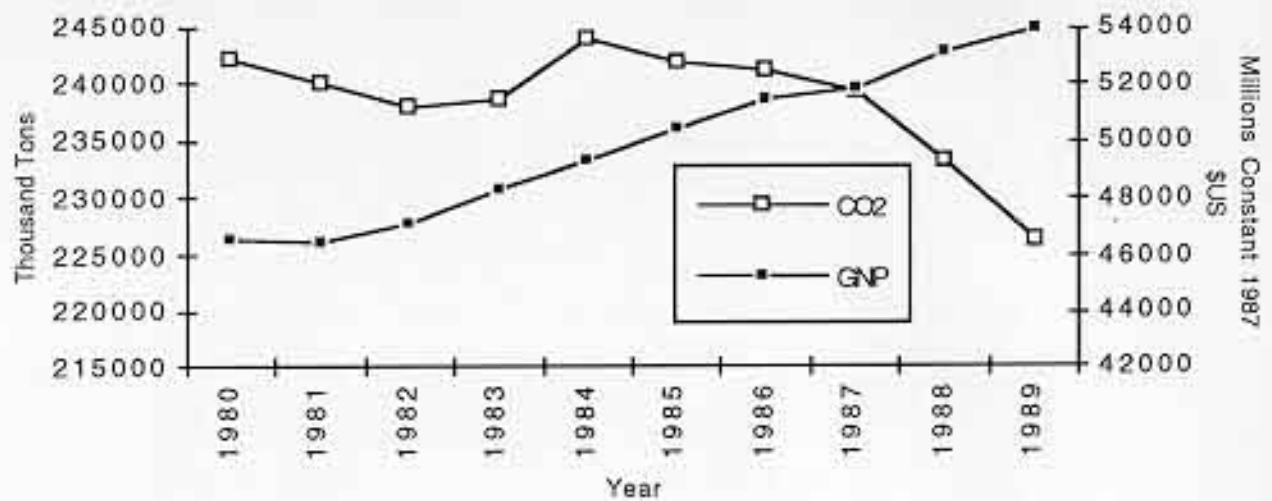


Figure 12. (World Resources Institute 1992).

Unfortunately, there was only data available for 1980 to 1989 and so the true effect of time can not be accomplished. However, it is interesting to see that emissions have been reduced in the last five years and that GNP has steadily risen. The fall of emissions is largely due more to the change in government that brought about some reduced production than to any direct remediation.

If we were to take this graph as any indication of positive change then we might say that the Czech and Slovak Republics has reached a turning point in the transition. This actually may not be so far from the truth if their toxic transition follows Drake's theory. What has been missing so far from the model of this transition is public outcry against the level of toxins leading to remediation. Public objection may have been controlled over the past 45 years, but it was present, nonetheless, and contributed to the collapse of the communist system.

It is well known that citizens in the former Soviet Union were not able to freely express their opinions on such subjects as environmental degradation. Many countries had "conservation" clubs which were allowable because conservation was a less threatening notion than criticizing the lack of pollution controls. As the environmental situation became worse these conservation groups, and later ecology proponents and Green Parties, operated underground and grew into a political force that eventually brought down the communist government. If democracy gains a stronghold in the new governments, and the Czech and Slovak Republics have established a democratic government, then it should bring about positive changes for pollution abatement.

From the end of the Second World War until 1970 many Western countries also faced the same environmental problems that have occurred in the Czech and Slovak Republics. These problems stemmed from the same practices, such as, investment in heavy industry; extensive use of coal as an energy source; overuse of fertilizers in agriculture; dumping garbage and sewage into surface waters; air pollution from vehicle emissions, etc., and some still remain. In the past twenty years, however, there has been some success in curbing the affects of these practices. The success has been attributed largely by economists to three main factors: 1) a significant proportion of the public has come to value environmental quality, and public interest groups have a powerful lobby working toward environmental improvements; 2) competitive pricing of natural resources has led to more conservative use or substitution; and 3) market system efficiency has produced the capital necessary to invest in infrastructure improvements, such as, sewage treatment facilities and pollution control

devices (Czechoslovakia 1991). It is hoped that these three factors will be allowed to develop in the Czech and Slovak Republics.

In addition to the lack of public participation and capitalist market influences affecting environmental health, the Czech and Slovak Republics have several pressing difficulties to overcome as described in this report: a rising death rate; a lack of pollution control devices and enforcement; outdated, inefficient, or non-existent infrastructure; outdated and inefficient technology of production; dependency on low quality non-sustainable energy sources with few acceptable alternatives; economic reliance on heavy industry; and, poor agricultural practices. I might also add the lack of scientific experience in environmental matters and few reliable data sources.

A model was constructed considering all of the factors discussed above that have affected the level of pollution in the Czech and Slovak Republics. This model shows the flow of influence by the direction of the arrows. The feedback loops are designated by (+) or (-) depending on whether the loop reinforces the factor under influence, i.e., causes exponential growth, or diminishes it.

The model shows both the Soviet influence on the economy and the newly emerging Market Economy. It also includes a democratization factor. In reality both the Soviet Policies and the Market Economy, as well as, Democracy can not exist at the same time, except in one sphere of influence, Energy Resources. To test the model you would take away the arrow of influence between Soviet Policies and Market Economy, Democracy, Infrastructure, and Investment, but leave one lower level of influence between Soviet Policies and Energy Resources.

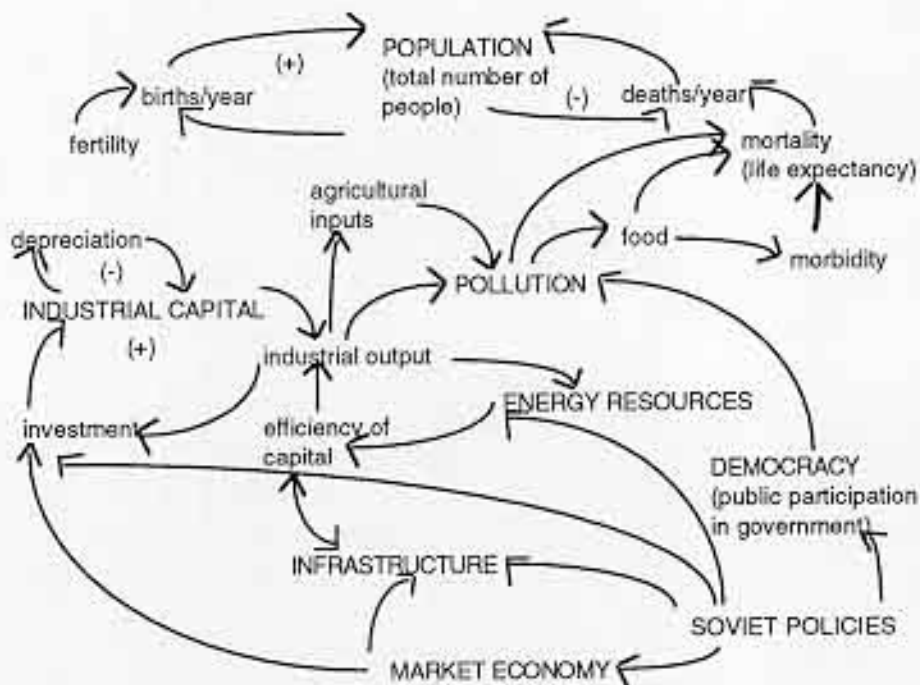


Figure 13. Model of Factors Affecting Toxicity in Czechoslovakia.

If you were to assume that the Market Economy would serve to correct problems of efficiency of capital and resources, would improve the infrastructure and the overall quality of life of citizens, then the most immediate problem that needs to be addressed by policy makers in the Czech and Slovak Republics is the high mortality rates, very likely brought on by the high levels of toxins in the environment.

Using the model and testing a scenario we find that taking out Soviet Policies and inserting Democracy has the following effects. The Infrastructure becomes dependent on the Market Economy. Infrastructure has an effect on Efficiency of Capital, which in turn has an effect on Industrial Output. This would then affect the amount of Pollution emitted. At the same time Democracy would encourage participation of citizens in policy and law making which would also serve to reduce pollution. Reducing Pollution would have an effect on lowering the morbidity and mortality rates. Because this process will take time immediate resources need to be directed toward pollution abatement devices and improved education and health care for Czech and Slovak citizens.

It is estimated that over the next 15 years, the Czech and Slovak Republics will spend about \$23.7 billion on pollution control (French 1991). However, it is important at this time to view the political transition period as an opportunity rather than a overwhelming burden. On the bright side the Czech and Slovak Republics faces fewer problems than some of the other Central European countries. In spite of the vote to split the Czech and Slovak Republics, minority ethnic problems are minimal (Carter 1990). The country's debt is relatively low, at \$5.3 million in 1990 (Carter 1990). Before 1939 it had been a leading industrial nation and this has a good chance for revival. The pre-war shoe industry, Bata, for example is returning to the Czech and Slovak Republics. Other pre-war industries included light engineering and precision instruments. The Czech and Slovak Republics are also in an excellent geographic position as they are at the crossroads between Western and Eastern Europe. This is an opportunity to play a major part as transportation and trade develop throughout the region.

To begin the healing process and stabilize the demographic, toxicity, energy, and economic transitions will require consideration of all factors in a strategic plan. Transformation to a market economy must have built-in prerequisites for pollution abatement and improved technology. The change from an industrial based economy to a services and consumer based economy will increase the production of waste immediately. Recycling efforts need to be initiated immediately to offset the effects of the new consumer society. Also, investors will need to keep the reduction of toxicity a high priority when presented with new opportunities to increase production and profit. The new governments should also consider the imposition of "eco-taxes" designed to penalize polluting industries.

An increase in energy efficiency will most likely occur as energy-hungry industries begin to compete for scarce energy resources. Experience in the West has shown that reducing emissions from automobiles is not sufficient enough to curb air pollution. As standards of living increase in the Czech and Slovak Republics and more cars are introduced to the roads, a concentration on comprehensive transportation policies will have a greater effect on reducing air pollution.

Considering the harmful health effects of pollution in the environment, this time of economic and environmental transformation must also include programs to improve health care and the information available to the general public. There is no reliable historic data on pollution in these countries and research on the amount and type of toxic substances present in the environment is needed. This research, coupled with improved health education would help reduce the effects of pollution related illness and raise life expectancy.

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SCHISTOSOMIASIS IN EGYPT: TRANSITIONS AT WORK

by Suzy Salib

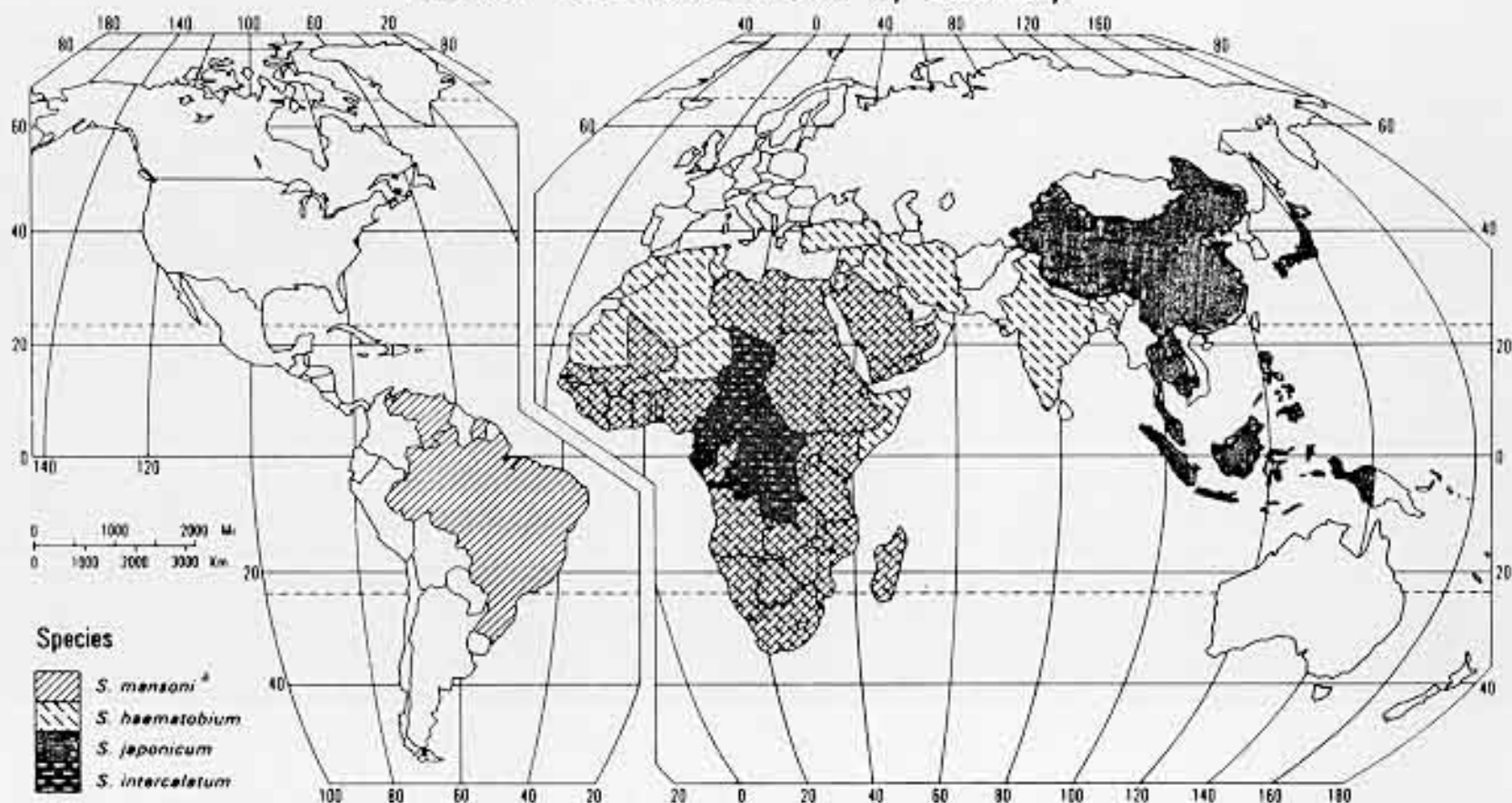
The ancient Egyptian philosopher Herodotus once called the land of Egypt, "the gift of the Nile," and certainly the health and prosperity of Egypt's water resources are instrumental in determining the health and prosperity of its people. For this reason, schistosomiasis (or bilharzia as it is known throughout Africa), a water-borne parasitic disease, is a real national concern. The disease is endemic to almost the whole continent of Africa (Allison 1974), and affects an estimated 200 to 300 million people worldwide (Jordan 1980) in a total of 73 tropical and sub-tropical countries (Weil 1985) (see Fig.1).

The first known cases of schistosomiasis in Egypt date back to the times of the ancient pharaohs. Eggs of *Schistosomiasis mansoni*, one of two forms of the schistosomiasis parasite native to Egypt, have been found in 3000 year-old mummies (Mahmoud 1984). But while the presence of the disease itself is not unique to this century, the astounding rates of infection are, and they currently pose one of the great public health threats facing Egypt. There is a large body of literature which links the extraordinary rates of the disease's transmission to the perennial irrigation schemes which proliferated throughout Egypt, beginning at the turn of the century. In order to understand the need for these irrigation schemes and the subsequent explosion of schistosomiasis, we must look specifically at the demographic, agricultural, urbanization, and epidemiological transitions which had their roots in the early part of the last century, and which are still talking place in Egyptian society today, all in varying stages. Knowledge of these interactions is important because they may aid in predicting future trends in schistosomiasis prevalence, as well as assist in improving current prevention and control methods. The many other countries potentially or currently threatened by schistosomiasis may also draw upon these lessons if they, too, are experiencing the same transitions and are planning similar irrigation projects.

THE NEED FOR A CONCEPTUAL MODEL: TRANSITION THEORY

Biological, demographic, epidemiological, agricultural, and urban variables all play a part in schistosomiasis transmission, but these variables must be seen in light of a conceptual model. To know which variables are responsible for the spread of schistosomiasis is of little value unless we understand how changes in one variable of this disease's transmission may impact upon other variables, and how that, in turn, relates to ultimate disease patterns. Transition theory as posited by Drake (1992) is a useful framework in which to understand the relationships of these variables to each other. Society is made up of multiple sectors, each with its own set of variables and each constantly undergoing change as a result of interactions *within* the sector and interactions *between* sectors. These sectors are often very complex, and include traditionally examined components of society such as demography and epidemiology, as well as agriculture, urbanization, forestry, toxicity, technology, and a host of others. Knowledge of the variables that comprise these sectors, and more importantly, the *rates of change* they experience, are key elements in identifying past patterns of change and interaction, as well as predicting future ones. The timing and rate of change in one sector can very often determine how quickly and to what extent another sector will experience change. In looking at schistosomiasis, we will focus here only on the demographic, agricultural, urbanization, and epidemiological sectors, for they have undergone the most rapid changes in Egypt, and have most directly influenced the schistosomiasis problem. A brief schematization of some of the factors

Human Schistosomiasis by Country



* *S. mansoni* is endemic in the following places in the Caribbean: Antigua, Dominican Republic, Guadeloupe, Martinique, Montserrat, Puerto Rico, St. Lucia, and St. Martin.

Source: Compiled from Table 1 in L.S. Iarotski and A. Davis, *The Schistosomiasis Problem in the World: Results of a WHO Questionnaire Survey*. *Bulletin of the World Health Organization*, Vol. 59, 1981, pp.118-119.

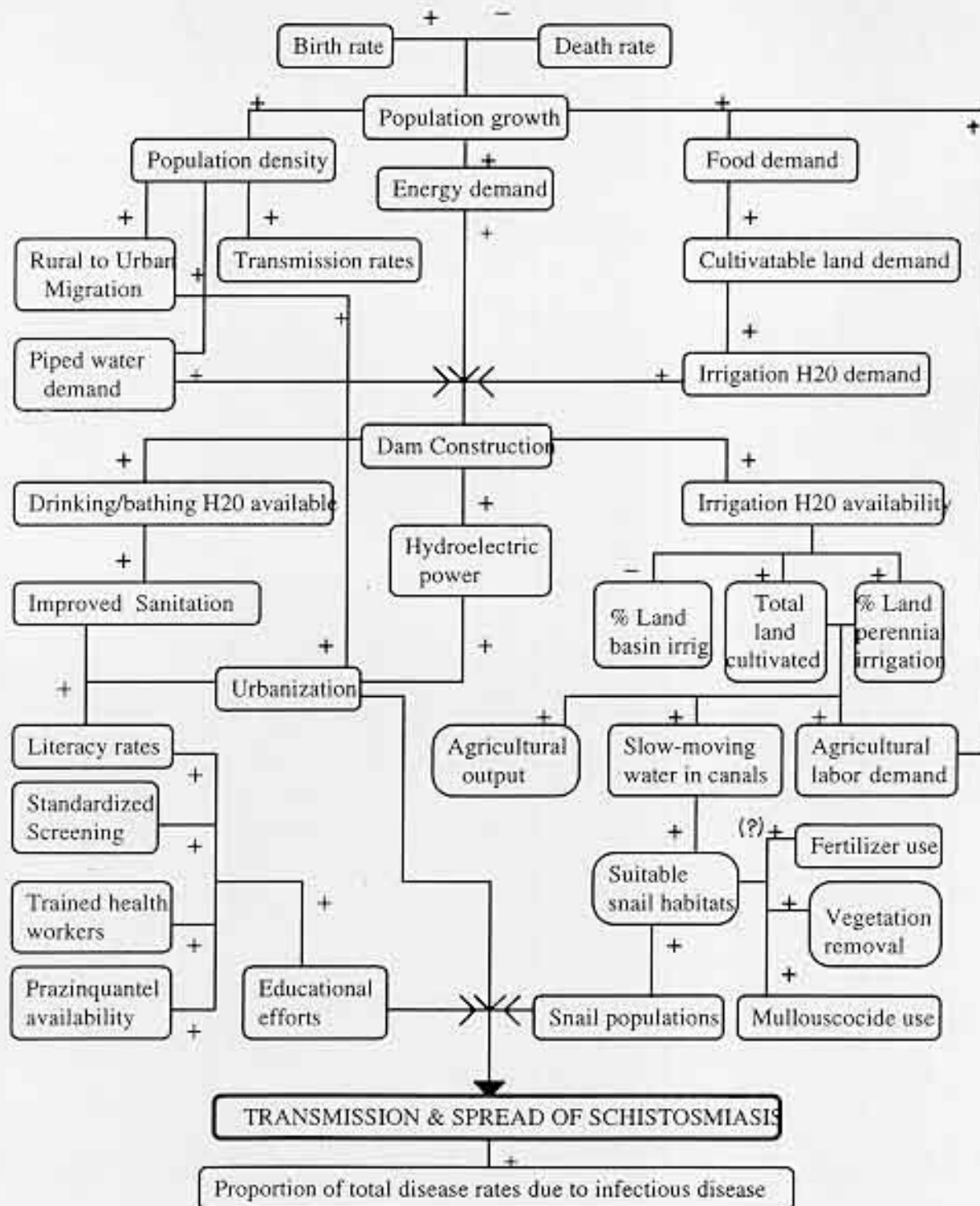
Figure.1: Worldwide distribution of human schistosomiasis by country.

From Weil and Kvale, *Geographical Review*, Vol. 75, 1985 (see references).

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involved in schistosomiasis transmission is helpful in illustrating the complex links between these sectors (see Fig.2). The nature of these interactions and links will constitute the bulk of this paper, and the details will be explained in the context of each transition.

FIGURE.2: SCHEMATIC MODEL OF FACTORS INFLUENCING THE TRANSMISSION OF SCHISTOSOMIASIS



THE BIOLOGY OF SCHISTOSOMIASIS

Yet before evaluating the mechanisms behind the current rates of infection, we must first take a look at the biology of the disease. An understanding of the schistosome life cycle elucidates the necessary conditions and methods for transmission, and how those factors are intimately influenced by changes in the demographic, agricultural, urbanization, and epidemiological sectors of society. In fact, the very combination of these sectoral transitions, as we shall soon see, allowed schistosomiasis to flourish in Egypt.

An infectious disease caused by parasitic worms of the genus *Schistosoma*, Egypt's two native varieties are *Schistosoma haematobium* and *S. mansoni*, while *S. japonicum* is found only in southeast Asia (see Fig.3). Adult parasites live in the blood of mammals, but their life cycle involves a phase of asexual reproduction within a fresh-water snail host (see Fig.4). Adult female schistosomes deposit eggs in the veins surrounding the bladder or intestines of the mammal host. Once the mammal host passes out the eggs through its urine or feces and into the water, the eggs hatch, then locate the appropriate snail host. The newly hatched larvae now asexually reproduce hundreds of times within each snail host. These young parasites burrow out of the host snail tissue and into the water, where they subsequently burrow into the skin of mammals exposed to the water. People expose themselves to infected water most often through activities like swimming, washing, and wading. After the schistosomes burrow into human skin, they migrate to either the bladder or intestines, mate, mature, and lay hundreds of eggs daily, of which those excreted by the human host are only a small fraction. Nevertheless, poor excreta control, mostly by children, is a major link in the schistosomiasis transmission cycle (Gross 1993).

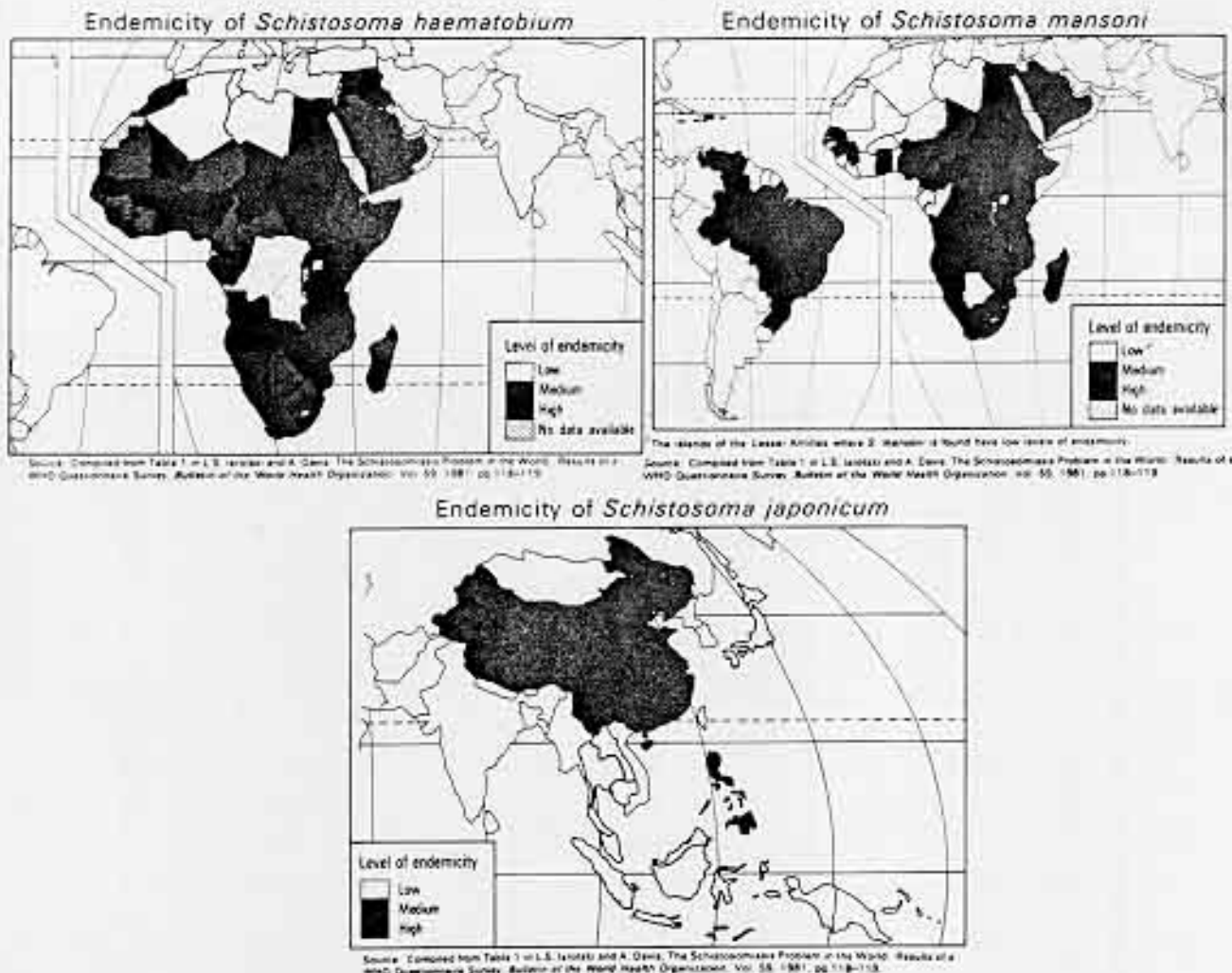


Figure 3: Endemicity patterns for the three major varieties of human schistosomiasis a) *S. haematobium* b) *S. mansoni* and c) *S. japonicum*. From Weil and Kvale, *Geographical Review*, Vol. 75, 1985 (see references).

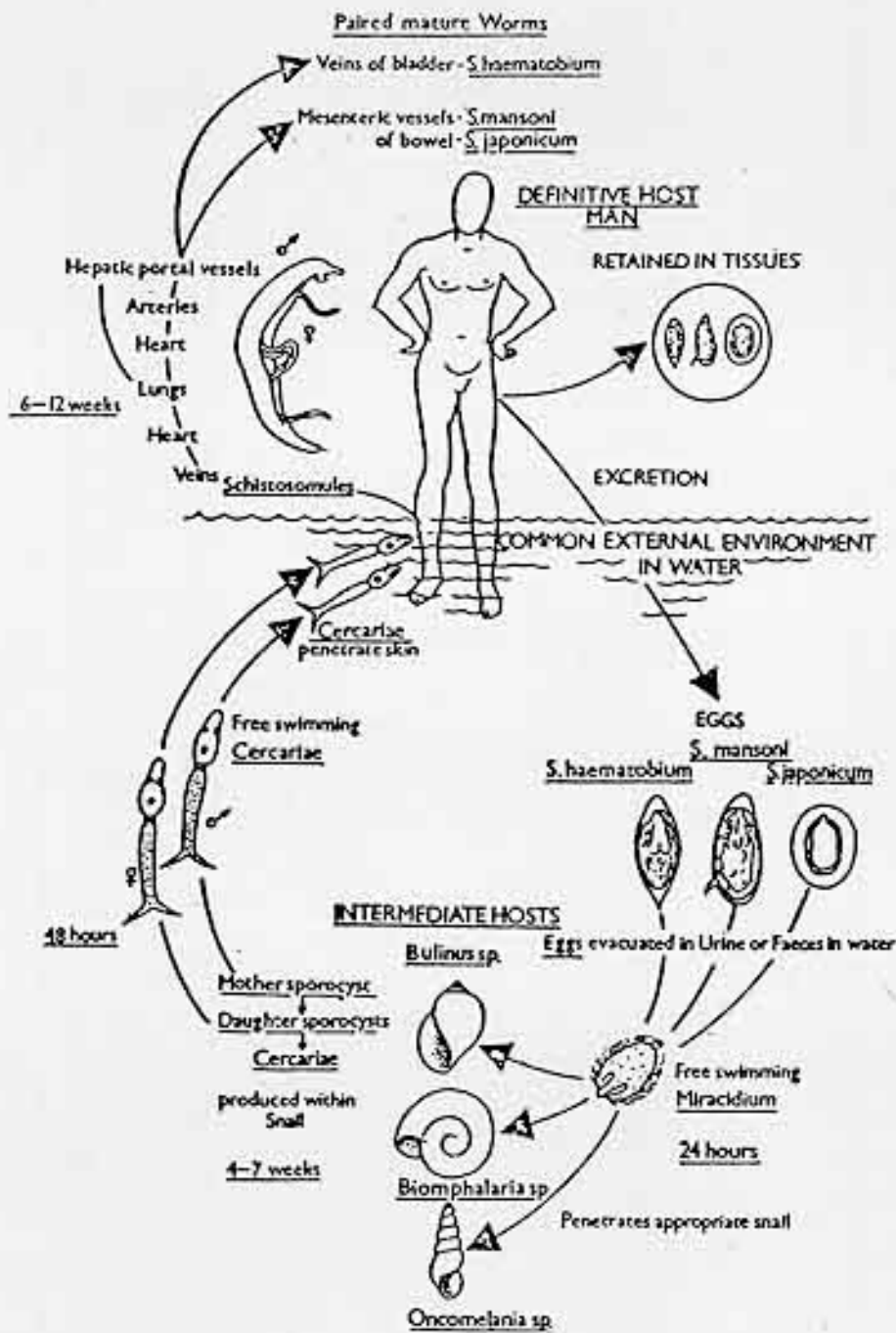


Figure 4: The life cycle of the three major varieties of human schistosomiasis.

From Weil and Kvale, *Geographical Review*, Vol. 75, 1985 (see references).

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The remaining, unexcreted eggs reside in the body and cause the symptoms of schistosomiasis. *S. haematobium* is commonly referred to as urinary schistosomiasis because it dwells in the vesicles surrounding the urinary tract and its most obvious symptom is blood in the urine, but it can also result in bladder or ureter calcification and an increased risk of bladder cancer. *S. mansoni*, which lives in mesenteric veins surrounding the large intestine, also causes blood loss in the stool, enlarged liver and spleen, as well as portal and pulmonary hypertension (WHO 1985). These conditions often manifest themselves in complaints of chronic lethargy and abdominal pain, but fatalities are rare. For this reason the necessity and importance of schistosomiasis relief efforts are occasionally questioned. Yet the symptoms often cause low productivity in rural areas, and while this loss of economic output is difficult to quantify, it certainly exists. But the problems in developing an economic model which accounts for this lost productivity should not halt efforts to curb this disease's prevalence.

Transmission of schistosomiasis is somewhat selective because each schistosome species can only dwell in a single species of intermediate host snail. For instance, *S. haematobium* requires the *Bulinus* family of snails as hosts, while *S. mansoni* needs *Biomphalaria* snails (see Fig.4). Therefore, ecological conditions must be suitable for the specific snail host particular to each schistosome parasite. These conditions include organic material and firm mud substrates with aquatic vegetation. The vegetation serves several purposes: (a) when alive, it increases dissolved oxygen in the water and provides food through green algae encrusting the submerged portion of the plants, and (b) when decaying, it provides food and a surface for laying egg masses (Malek 1962). Massive irrigation projects, made possible by large dams, allow slow-moving water to run through irrigation canals. This slow-moving water encourages the growth of vegetation along the canals, thus providing the necessary and sufficient conditions for snail habitats, and in turn, schistosomiasis transmission (see Fig.2)

THE DEMOGRAPHIC TRANSITION: PATTERNS FROM 1800-PRESENT

Just as schistosomiasis is not a new disease to Egypt, neither is the phenomenon of rapid population growth new. The beginning of the nineteenth century witnessed very minimal population growth and set the initial stage for the subsequently rapid demographic transition. From the years 1800-1830, Egypt experienced an annual population growth equal to that of the annual death rate due to a scarcity and deficiency of food, as well as rampant cases of smallpox and cholera (Panzac 1987). That situation followed the outline of demographic transition theory (Drake 1992), which states that at the beginning of the transition births and deaths are high, but in equilibrium. The middle stage of the transition occurs when those initial conditions are then followed by a marked reduction in the death rate, often due to improved medical care and water sources, and a subsequent rise in population growth rates. This marked reduction in the death rate was evidenced during the period 1840-1860 when Egypt underwent a change from a relatively stagnant population growth rate to a steady and certain one, mainly due to the introduction of vaccinations against smallpox and other plagues. The resulting demographic trend was one of high birth rates, lowered mortality rates, and a rapid increase in population. Looking at the entire century, the population more than doubled (Panzac 1987), beginning at 4.5 million in 1800, 5 million in 1830, 5.4 million in 1848, 8.0 million in 1882, and 9.7 million in 1897 (See Fig.5).

But even despite those rapid rises, they do not compare to subsequent growth rates. The nineteenth century saw the population double in roughly 85 years, but that doubling time steadily decreased as time went on. That is because, within the demographic transition, population growth increases and doubling time decreases as the divergence between birth and death rates widens (Drake 1992). In the early stage of the transition, which occurred in Egypt from 1840-1860, the divergence was determined primarily by the decrease in the death rate, which was a result of massive vaccinations that began at that time. As Egypt moved out of the early and into the middle stage of the transition, the gap continued to widen, as the next doubling took only 50 years, when the population went from 9.7 million to 19 million in the period from 1897 to 1947 (See Fig.5). During this same period, schistosomiasis went from being a minor disease to a

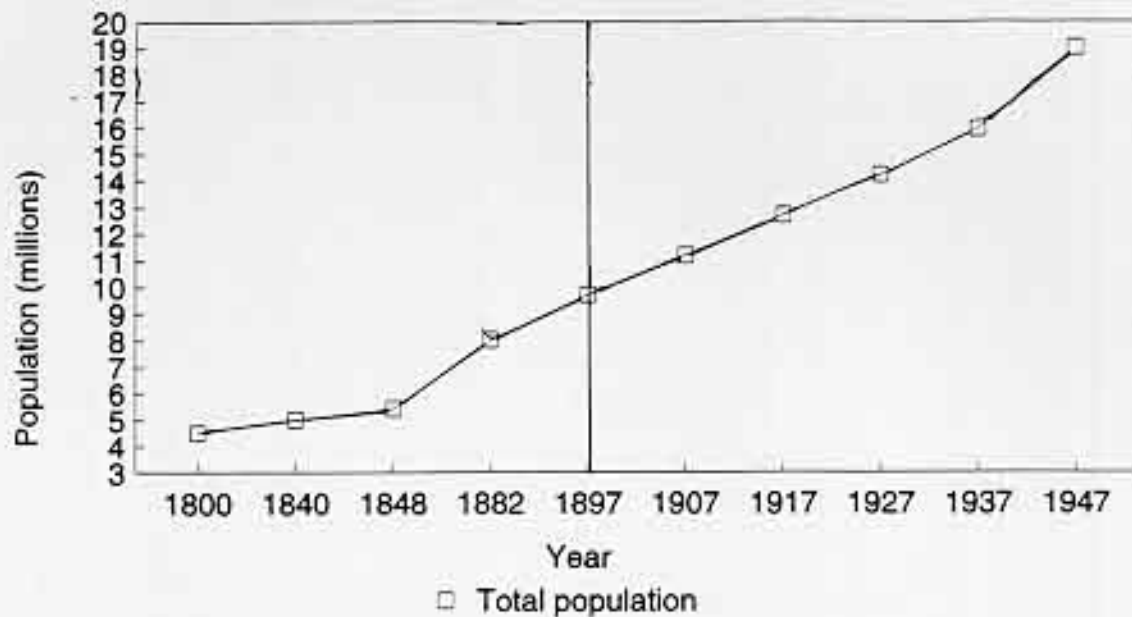


Figure.5: Growth in total population from 1800-1947.

major epidemic, and the dynamic behind this, which involved both the demographic and agricultural sectors, will be discussed along with the agricultural transition..

After World War II, the population again soared for two primary reasons. First, the post-war importation of public health technology, including many pharmaceutical products, significantly decreased death rates. The effect of improved medical technology is evident in looking at the plummet of crude death rates (CDR), which fell 66% in the 40 years after the war (DHS 1988). Second, the decline in births did not keep up with the decline in deaths. With the exception of an initial post-war baby boom, fertility also declined after World War II, but at a much slower rate than mortality. So while the CDR experienced a 66% drop from the 1940s to the 1980s, the CBR fell by only 20% (see Fig.6) in this same time period (DHS 1988).

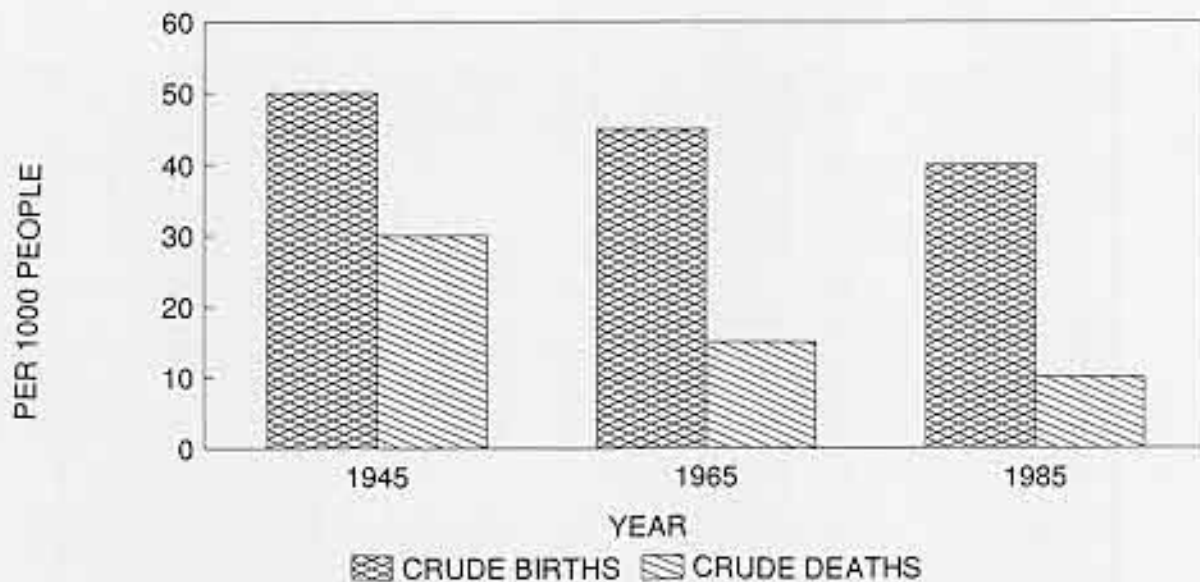


Figure.6: Relative decline in crude birth rates (CBR) and crude death rates (CDR) from the 1940s-1980s.

The failure of birth rates to decline in equal measure to mortality rates led to yet another doubling of the population from 1947 to 1975, leaving the total population at 36 million (Issa 1982). Once again, compared to the previous doubling, the doubling time decreased from 50 years to 28 years. In the following ten years, if the drop in birth rates had not stagnated from 1975-1985, then the gap between crude birth rates and crude death rates might have shrunk more considerably (see Fig.7). The cause of this stagnation is not clear from the available literature. However, because birth rates failed to decline during this decade, population growth rates rose, and only in the last five years have they begun to taper off again (see Fig.8). Overall, then, births jumped relative to deaths, and unlike the second half of the nineteenth century, the second half of the twentieth century has experienced rapid population growth *in spite of overall falling birth rates*. This trend is in line with exponential population growth (see Fig.9), in which the decrease in birth rate is not immediately followed by a decrease in the absolute numbers of people. The time lag between them is due to the fact that even if birth rates are declining, the actual population will increase

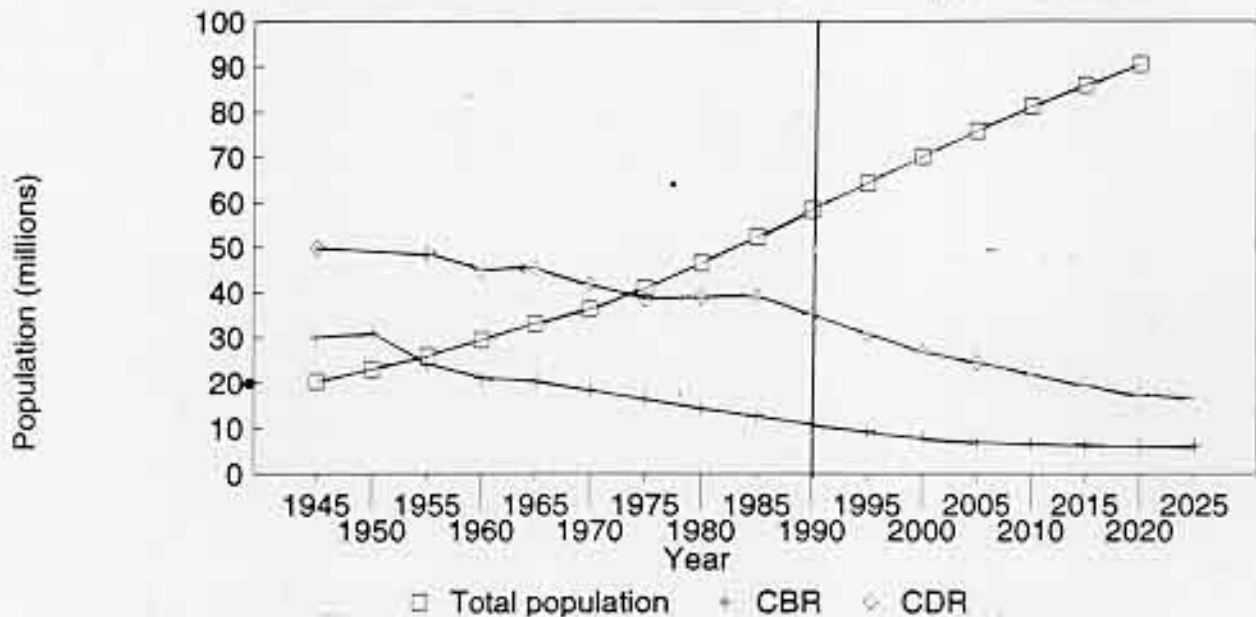


Figure 7: Total births, deaths, and population from 1945-1990, and projected patterns for 1990-2025.

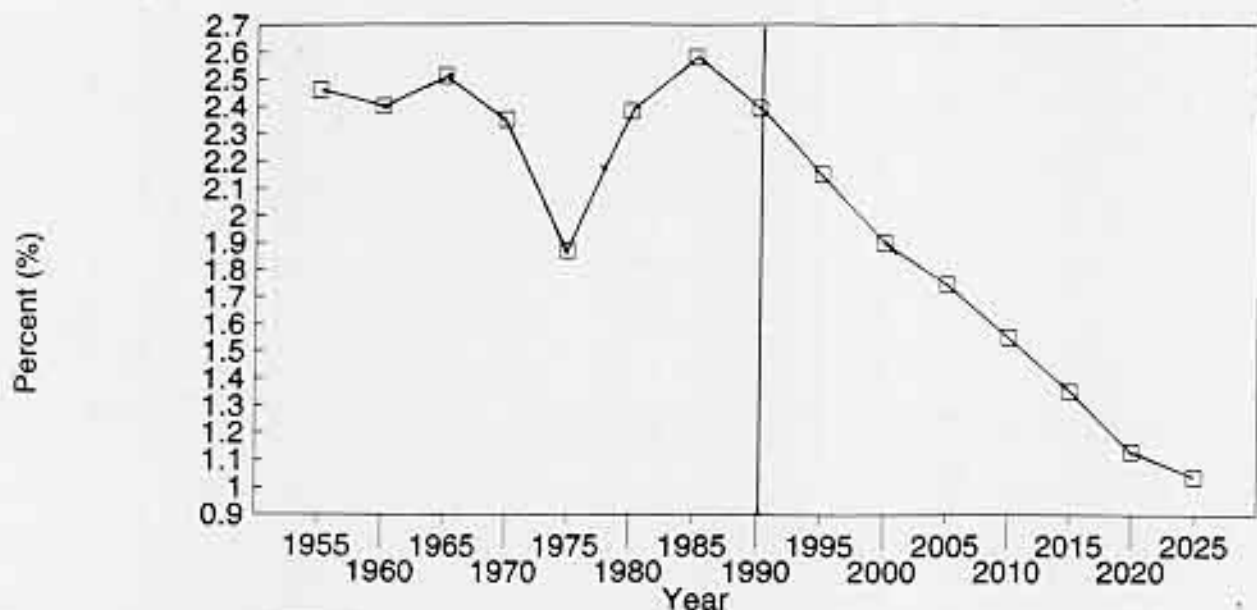


Figure 8: Population growth rates from 1955-1990, and projected patterns for 1990-2025.

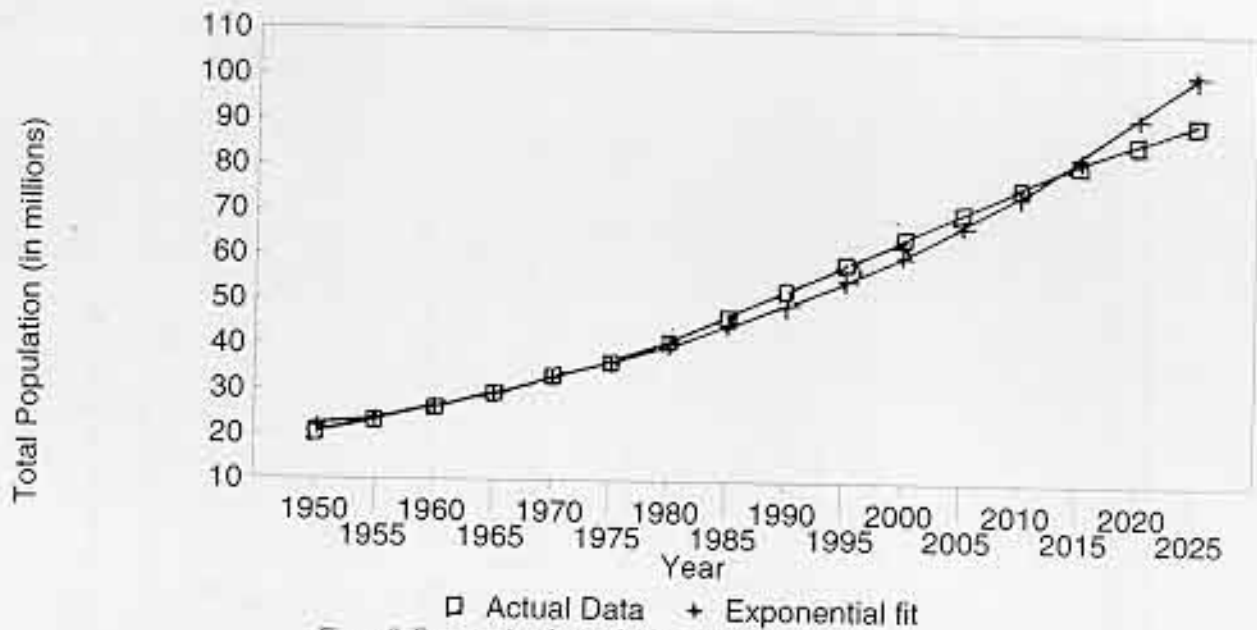


Figure 9: Exponential growth of population.

until decreases in birth rates are great enough to reduce fertility rates to replacement levels. This has yet to happen in Egypt, and consequently, the population stood at 52 million in 1990, half of another doubling complete.

That there has been any decrease in birth rates over the last 35 years in Egypt is due to the availability of contraception methods, which the government began promoting in the mid-1960s with the creation of both the Supreme Council for Family Planning and the Family Planning Board. But even though 96% of women know of both a method and a source of contraception, only 38% are currently using family planning (see Fig. 10), leaving Egypt still in the middle stages of the demographic transition (DHS 1988).

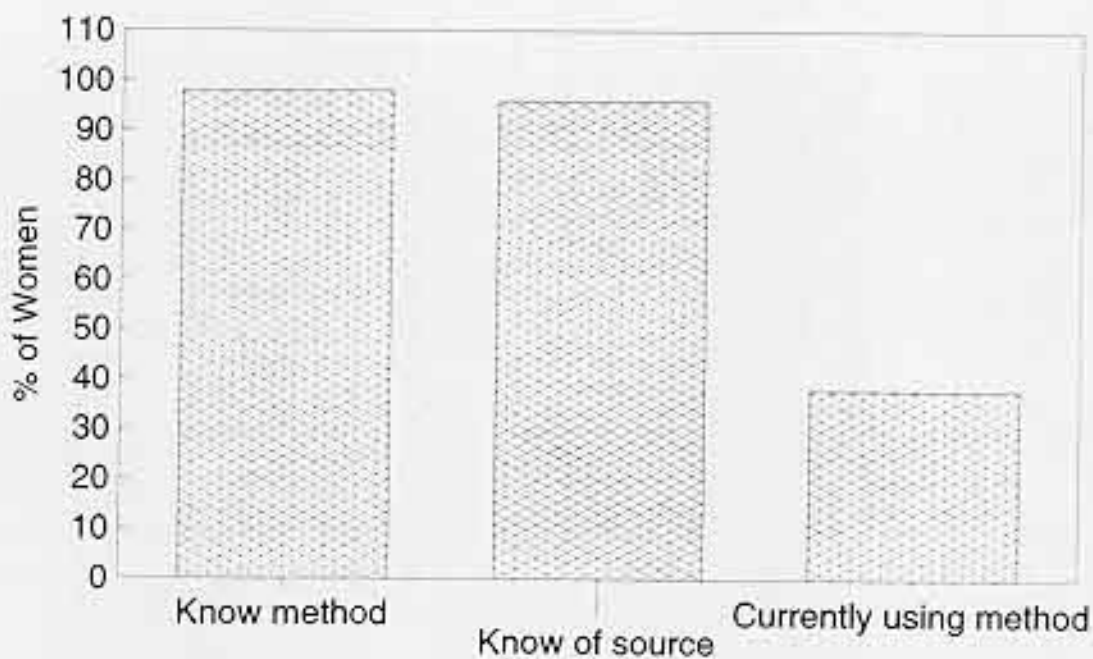


Figure 10: Knowledge and use of family planning among currently married women aged 15-49.

This transition has left Egypt in dire demographic straits, both in terms of population age structure and population density. As of 1990, 39% of Egyptians were under age 14 (World Bank 1993), and if high fertility rates and declining mortality rates continue, this age distribution will remain heavily weighted in favor of the youngest age groups, and may even intensify. Egypt's total population density is only around 50 inhabitants per square km, which seems to be comparable to countries like the United States and Canada, but less than that of Europe and most of southeast Asia (see Fig.11). However, this is quite misleading, because population density in *inhabited areas* is approximately 1300 inhabitants per square km, twice as dense as Singapore and three times as dense as Hong Kong (see Fig.12); this same distortion may be present in other countries like Mexico, which is known to have very crowded urban centers which support a disproportionate share of the population. For Egypt, this huge disparity is a function of the fact that despite a total land area of 1,001,450 square km (World Bank 1993), the population of approximately 55 million people can live only on the 4% of the land that is not desert, which is almost exclusively in the narrow Nile River valley and the northern Delta region (see Fig.13). The implications these facts hold for the transmission of schistosomiasis will be discussed in conjunction with the epidemiological transition.

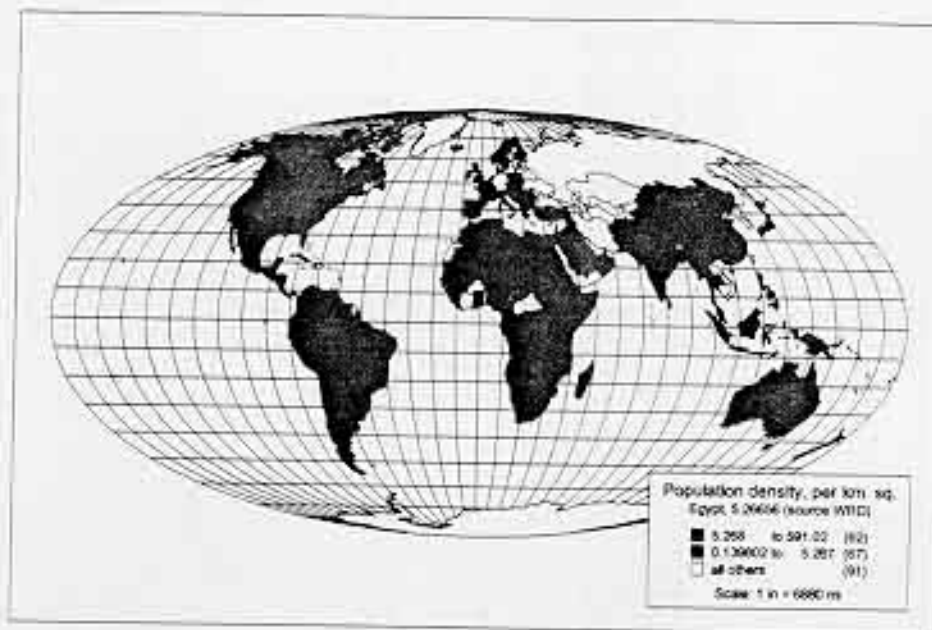


Figure 11: Worldwide population density per km squared.

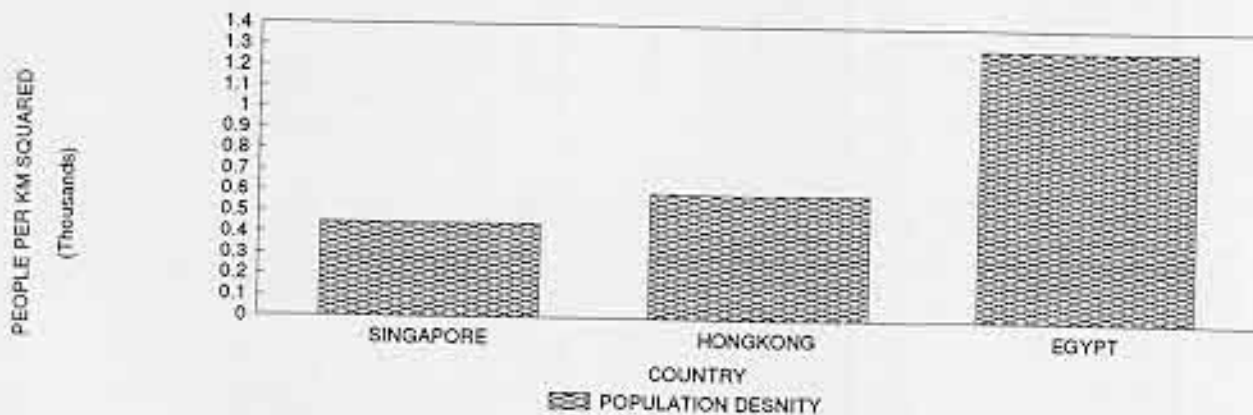


Figure 12: Population densities of Egypt, Hong Kong, and Singapore as of 1990.

THE AGRICULTURAL TRANSITION: RESPONSES TO GROWTH

Just as population growth rates went through transition, so, too, did agricultural practices. In fact, the demographic transition necessitated the agricultural one. The doubling of the Egyptian population from 1800 to 1887 certainly also doubled the demand for food. It was then that pressure was exerted upon the farming class to increase agricultural outputs. Drake (1992) points out that worldwide agricultural output has been able to increase along with population and meet food demands due to 1) the extension of the amount of land under cultivation and 2) the improvement in land productivity. He states that the agricultural transition occurs when the source of greater agricultural output shifts from land extension to improved productivity.

In Egypt, however, it could be argued that the transition occurred in almost the opposite direction. That is to say, its desert climate put it in a unique situation, making it easier to improve upon the productivity of existing farm land, which is known for some of the richest soil in the world, than to bring never-farmed desert into cultivation. Thus, Egypt more or less increased outputs initially through yield improvements, then through expanding the amount of land cultivated. Improvement in land productivity began in the early 1900s as the British, who ruled Egypt at that time, introduced perennial irrigation (by means of irrigation canals) to replace basin irrigation (by means of the annual flood waters of the Nile) in order to boost cotton production for export to England. Land that had supported only one crop per year for the previous five thousand years was now able to support two, and in some cases three, crops per year (Heyneman 1971). Therefore, of the total land under cultivation, the proportion under perennial irrigation increased while that under basin irrigation decreased. These initial perennial irrigation schemes were significantly expanded with the water made available by the construction of the Aswan Low Dam in 1934, and again with more irrigation water supplies due to the building of the Aswan High Dam in the late 1960s.

Due to increased cropping intensity, the subsequent rise in productivity may have met the growing food demands, but it also may have fueled them. Specifically, expansion in the amount of land under year round cultivation translated into a greater need for agricultural labor, especially since only in the last thirty years has mechanization figured into agricultural practices on a large scale. This elevated labor demand may have been satisfied by increasing family size, only serving to reinforce the already burgeoning population growth and food demands. If so, the demographic transition, in which births were quickly outpacing deaths, was amplified by the agricultural one. It is very likely that a positive feed-back loop dominated between these two transitions. This highlights Drake's theory that transitions within sectors, agricultural, demographic or otherwise, do not occur in isolation, but constitute a family of transitions which can serve to maximize or minimize each other.

However, gains in productivity per unit of land by means of greater cropping intensity did not come without a price. Gone was the valuable yearly flooding of the Nile, which brought with it the deposition of tons of organically rich soil. Consequently, Egypt turned to the use of chemical fertilizers to replace these lost nutrients. This practice ushered in a unique dimension of the agricultural transition. Specifically, the source of improved productivity per unit of land cultivated shifted from increasing cropping intensity to increasing use of chemicals and mechanized tools. Data regarding the proliferation of tractor, harvester, and fertilizer use is available beginning in 1970 (see Fig. 14), which was also about the same time at which the Aswan High Dam was completed. Only the number of tractors in use may be leveling off, and that could be due to the greater efficiency of more modern machines, which slows the demands for new ones. Fertilizer use shows no signs of slowing down, however, and harvester use, though not as widespread as tractor use, also appears to be increasing.

With the aid of these tools and fertilizers, Egypt was able to increase its total food production by almost 100% from 1970-1990. At the same time, food production on a per capita basis grew by only 20% (see Fig. 15), and the doubling in total food production did not keep pace with population growth. The low figures in both total food production and per capita food production for the period 1975-1980 are unexplained, but may have been caused by problems with salinity levels of irrigation waters, or some other

unknown climatic or environmental conditions. Thus, persistently high rates of population growth will probably exert even more pressure on farmers to raise agriculture yields even higher, and the continued growth of mechanization and fertilizer use is likely. This will complete the transition from more intense cropping to greater use of chemicals and mechanized tools as the source of improved agricultural productivity. The implications this holds for schistosomiasis transmission rates will be examined in terms of future policy recommendations.

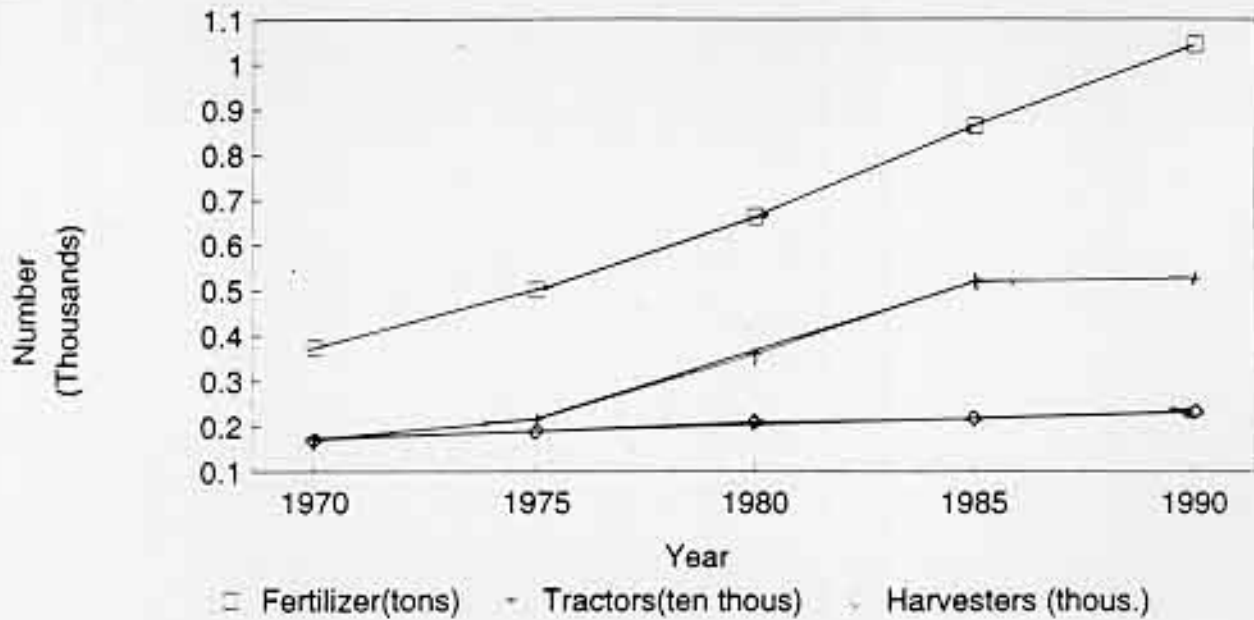


Figure 14: Fertilizer, tractor, and harvester use in Egypt from 1970-1990.

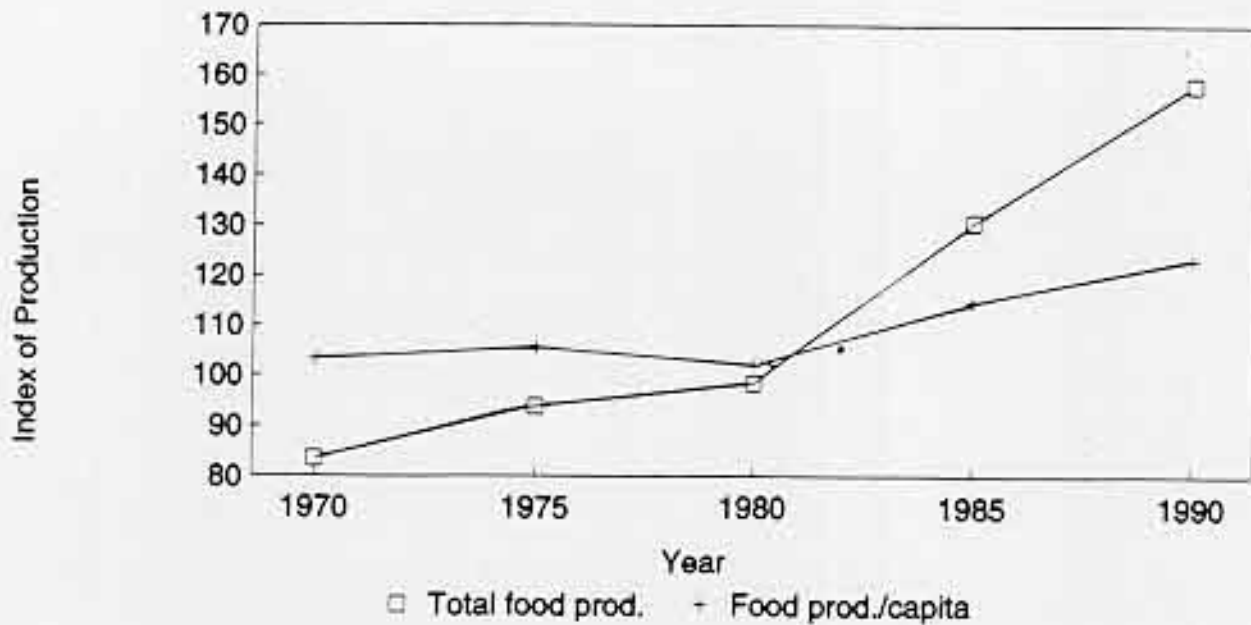


Figure 15: Total food production and per capita food production from 1970-1990.

THE URBANIZATION TRANSITION: SHIFTS IN POPULATION

Almost all internal migration has been in a south to north manner towards Cairo and the Delta regions, with little movement to the east or west (Ibrahim 1980). Surrounded by an inhospitable desert that constrains movement in these directions, the narrow Nile River valley is all that supports the populations of both Upper and Middle Egypt (see Fig.13). As a result, most of the northward migration has been directed primarily toward the urban governorates of Cairo and Alexandria from the rural governorates of Middle and Upper Egypt, with some movement also directed at the eastern coastal governorates of the Suez Canal, Red Sea, and Sinai. This urbanization transition, which is driven by both rural to urban migration and central city population growth (Drake 1992), stems from many push and pull factors.

Push factors are those negative conditions of one's native residence which produce the urge to leave, and pull factors are the attractive conditions that, once the decision to leave has been made, induce movement to a specific locality. Push factors in rural Egypt include increasing population density as a part of the demographic transition, as more and more people inhabit a fixed amount of land. This can often lead to smaller land holdings per family and a subsequent decrease in living standards. In addition, supplies of clean drinking water, electricity, and other modern amenities may be in short supply. These combine with the pull factors in urban areas, such as perceived economic opportunity and better access to health services, to induce large scale rural to urban migration. Some factors may work in both directions, including education. For instance, in the rural areas, those who are educated may be pushed to leave because they cannot utilize their education to the full extent in a rural setting, while those who are uneducated are pulled to urban settings in search of educational opportunities.

For Egypt's urban districts, the pull factors are very strong, as the growth in cities with a population of one million or more inhabitants indicates (see Fig.16). Rural dwellers as a percentage of the total population fell from 81% in 1907, to 52% in 1990 (WRI 1992), and urban residents are projected to outnumber their rural counterparts by the year 2000 (see Fig.17). Whether these projections are made on the basis of current rural to urban migration patterns alone, or if they also take into account rural vs. urban fertility rates as well, is unclear. That knowledge is important to the accuracy of those predictions since rural fertility rates are generally much higher than urban fertility rates, with recent figures showing around

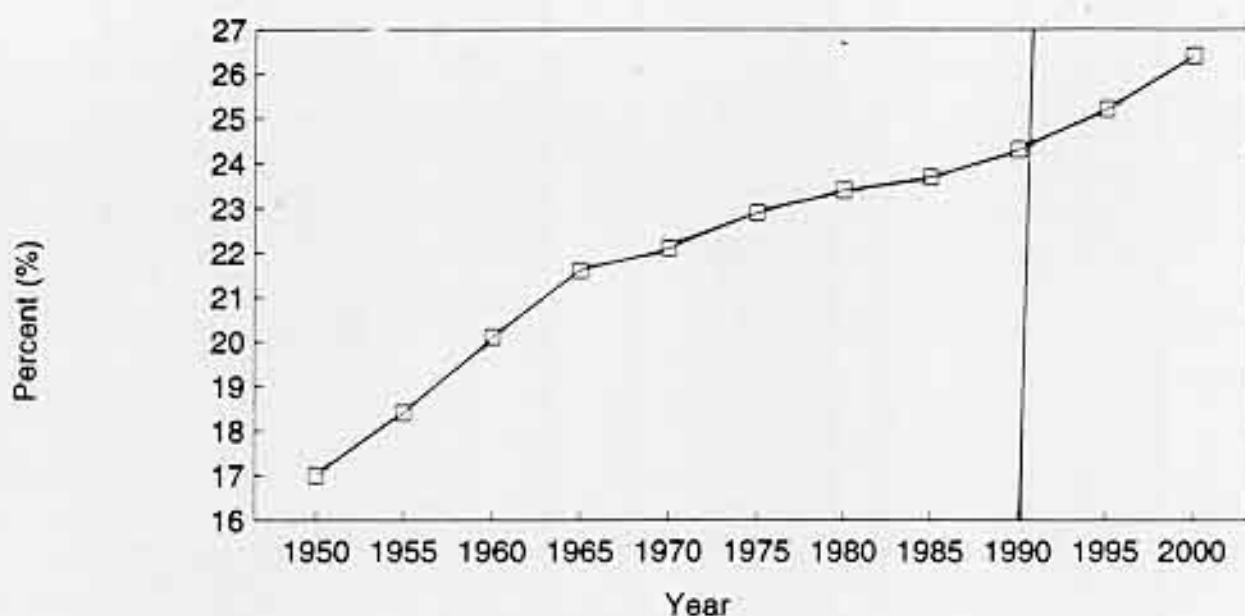


Figure 16: Population living in cities of 1 million or more inhabitants

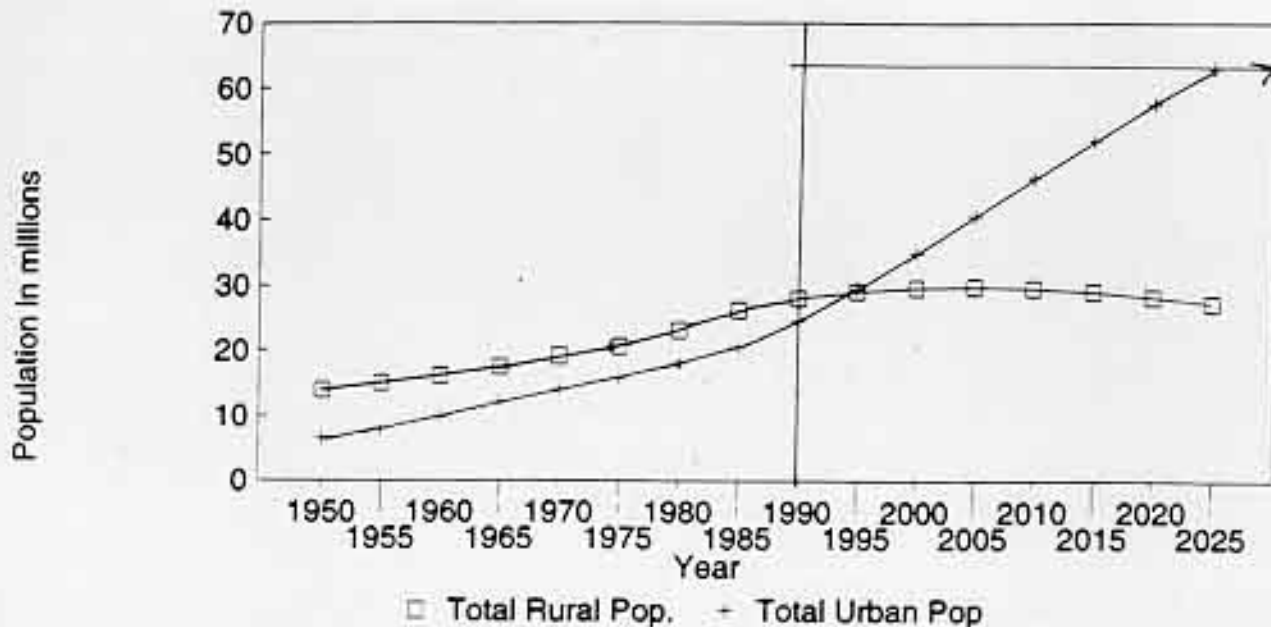


Figure.17: Distribution of total population among rural and urban dwellings.

5.7 births per rural woman, and 3.7 births per rural woman (DHS 1988). Either way the projection is made, the shift in population distribution would not be so alarming if it were not for the absence of corresponding industrial growth that usually accompanies such urbanization, employing the new urban inhabitants and providing an economic base to ensure that migration improves their standard of living.

This accelerated urbanization, fueled by out-migration from rural areas of Upper and Middle Egypt as well as the Delta, was and continues to be most profoundly directed toward Cairo and Alexandria, resulting in very uneven population distribution. Interestingly, approximately 80% of migrants moved from the rural countryside to either Cairo or Alexandria in one step. That is, they did not move to cities of intermediate size before moving to Cairo or Alexandria, but instead moved there directly. The proportion of the total population living in Cairo and its suburbs was 6.3% at the turn of the century, 17% in 1976, and almost 23% in 1990(see Fig.18), but similar figures for Alexandria were not available. This increase in sheer size is partly accounted for by the swelling numbers of migrants, representing 30% of Cairo's population as of 1970, the last year mentioned in the literature. The Suez Canal, Red Sea, and Sinai urban centers have an even larger proportion of migrants, ranging from 60-75%, though they possess smaller shares of the total population (Ibrahim 1982). In exactly what manner this urbanization transition is likely to affect the transmission of schistosomiasis will be discussed in the next section.

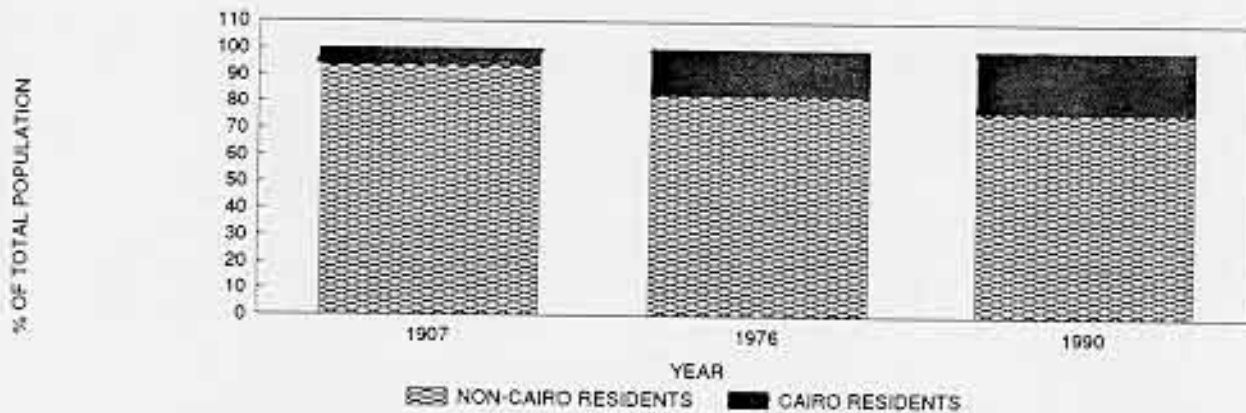


Figure.18: Proportion of the total population living in Cairo and its suburbs.

THE EPIDEMIOLOGICAL TRANSITION: CHANGES IN DISEASE

Schistosomiasis is an infectious disease, so changes in its transmission are central to the epidemiological transition. This transition is marked by a shift from infectious diseases in young age groups to degenerative diseases in older age groups as the primary contributor to mortality and morbidity. The early stages of transition yield a drop in infectious disease rates, often due to higher standards of living and improved sanitation and health care, and subsequently in death rates. As this happens, degenerative disease figures more prominently into overall morbidity and mortality rates than does infectious disease (Drake, 1992).

Egypt was well on its way to making this transition during the middle of the last century. As was cited earlier, the initial stages of transition occurred from the period 1840-1860, as small pox and cholera were wiped out by mass vaccinations, and death rates declined accordingly (Panzac 1987). But shortly after these diseases were eliminated, the epidemiological transition stalled because schistosomiasis became the new infectious scourge, infecting between 1/2 and 3/4 of the population by the early 1930s (Scott 1937).

The dynamic behind these alarming prevalence rates illustrates the interdependence of transitions. Both the agricultural and demographic transitions were instrumental in precipitating the explosion of schistosomiasis, thus impeding the continuation of the epidemiological transition at the turn of the century. Miller (1978) recognizes these interactions, saying, "*Population growth is a frequently ignored but important aspect of schistosome transmission.*" As previously mentioned, the high rates of population growth characteristic of the middle stages of the demographic transition resulted in greater food demands, therefore there was more incentive to develop agricultural land by introducing multiple cropping in already cultivated land and by reclaiming desert lands with large irrigation schemes. Perennial irrigation prevented the land from drying out between floods, and in turn provided a prime habitat for the intermediate snail hosts of schistosomiasis. Without the advent of these suitable habitats, schistosomiasis would not have flourished in Egypt.

Moreover, the doubling of the population meant higher absolute numbers of people who could possibly be carriers of the parasitic disease, thereby increasing the likelihood that water supplies could be contaminated with schistosome eggs. Also, as population growth outpaced available land space, population density increased, and that may have raised the intensity of contamination as well, though there is no literature available to support this speculation.

But after these interactions combined to allow the initially rampant spread of schistosomiasis, the rates of infection themselves underwent transition. After peaking in the late 1930s-1940s, they have steadily decreased. Table.1 summarizes both *S. haematobium* and *S. mansoni* infections over time for the Nile Delta region as well as Middle-Upper Egypt (Miller 1978).

TABLE.1: Schistosomiasis infection rates in the Nile Delta & Middle-Upper Egypt

Year	DELTA		MIDDLE-UPPER EGYPT	
	<i>S. haematobium</i>	<i>S. mansoni</i>	<i>S. haematobium</i>	<i>S. mansoni</i> *
1934	7% (both forms combined)		7%	----
1937	56%	33%	82%	----
1955	-----	-----	36%	----
1977	27%	41%	27%	----
1983	5%	39%	14.5%	----
1990	3%	23%	9%	----

* *S. mansoni* is not present in Middle-Upper Egypt

In the Delta, the decline in *S. mansoni* seems to lag behind that of *S. haematobium* for reasons that are not clear. Concentrations of *S. mansoni* tend to be in the southern half of the Delta and that may be due to the distribution of the snail intermediate hosts, differences in farming practices, and increased irrigation in conjunction with land reclamation projects in those areas. Whether these same factors are tied to the slower decline of *S. mansoni* is also uncertain. In Upper Egypt, *S. mansoni* infections have rarely if ever been diagnosed, presumably because the intermediate snail host does not reside there. *S. haematobium* infections fell as they did in the Delta, but to a slightly lesser degree.

The differential drops between *S. haematobium* and *S. mansoni* are difficult to explain. But aside from that complication, there is speculation that early reductions in infection rates may have been due to environmental conditions of unknown origin (Michelson et. al. 1993). On the other hand, more recent reductions may represent the implementation of improved prevention and control efforts by the government. Some of those efforts include safer and more effective chemotherapy in the form of oral, single-dose praziquantel, better trained health care personnel and the standardization of diagnostic techniques. Educational media campaigns aimed at keeping villagers from using canal water for domestic purposes and as a place of urination and defecation, provision of piped water, and snail extermination through the use of chemical molluscicides have helped in driving down schistosomiasis prevalence. Unfortunately, there is no data available on the extent of these efforts, making it difficult to quantify their impact.

Other factors may have contributed to the decline as well, including the urbanization transition and accompanying modernization. Specifically, mass rural to urban migration could have produced a *perceived* shortage of farm labor, thus driving farm wages up, and inducing farm owners to mechanize (Richards and Martin 1983). As a result, traditional irrigation water pumps like the Archimedes screw, which require the operator to wade in the water of the irrigation canal and put himself at high risk of schistosomiasis infection, were gradually replaced by mechanized pumps. Because prevalence of *S. mansoni* and *S. haematobium* infections have been traditionally higher in farmers and farm laborers than in any of the other occupational careers throughout both the Delta and Middle-Upper Egypt, this mechanization could have contributed to the decline in prevalence rates.

In addition to that indirect manner, mass urbanization, by shifting the balance of rural vs. urban population, decreases the absolute number of people that need to expose themselves to high risk agricultural occupations, and thus the absolute number of people contaminating water supplies falls. Not only that, but urban inhabitants have water for domestic use readily available from non-canal sources, eliminating their exposure, while prohibitions against defecating and urinating into water sources in an urban setting may additionally drive down the possibility of transmission. Also, higher literacy rates and educational levels of urban residents as compared to rural dwellers make mass informational and educational campaigns more successful. All of these features of urbanization may have aided in decreasing levels of schistosomiasis infections.

CONCLUSION: IMPLICATIONS FOR FUTURE POLICY

Numerous studies have been undertaken to assess the prevalence of schistosomiasis, dating as far back as 1935. However, there has been little attempt to look at the whole of Egyptian society and examine the interacting factors that led to the surge of infection rates around the turn of the century and through the 1930s-1940s, as well as the decline that has since followed. Looking to the agricultural, demographic, urbanization, and epidemiological sectors illuminates the mechanisms behind the spread of schistosomiasis, as they include the variables principally involved in its transmission.

In light of how these sectors have been shown to interact, the policy implications of this analysis regarding the schistosomiasis problem are as follows:

(a) If the demographic transition does not move into the late stages soon, population growth may thwart the further decline of schistosomiasis in two ways. First, high rates of population growth will continuously and more prominently contribute to the young age structure of the Egyptian population. Older children and adults tend to acquire immunity to re-infection when exposed to continued transmission (Butterworth et al. 1985), while younger children remain susceptible and thus become quickly and more intensely re-infected. Thus, as the whole of the Egyptian population becomes younger, the transmission cycle may be intensified and it will be more difficult to keep infection rates down, requiring more resources to maintain currently lowered levels of prevalence.

Second, even if population growth rates slow, total population will still increase, as will density. This could then intensify the transmission cycle, and consequently, the severity of contamination of domestic water sources with the schistosome parasite. Therefore, Egypt has great incentive to curb current rates of population growth by making family planning options more accessible, reliable, and understood by men and women alike. Also, studies should be undertaken to determine the effect of human population density on all aspects of the cycle of schistosomiasis transmission, especially in rural areas where fertility rates are higher than in urban areas and greater occupational exposure exists. Not only that, but with expanding rural to urban migration, migrants may act as carriers of the disease to increasingly dense urban centers, and the potential for transmission there needs to be more thoroughly investigated.

(b) The second wave of the agricultural transition, namely the shift from greater cropping intensity to increasing use of fertilizer and mechanized tools as the source of improved agricultural output, could also possibly influence future rates of schistosomiasis infection. Higher and higher rates of fertilizer use means higher levels of nitrates in runoff waters from fertilized agricultural land. In turn, this nitrate-enriched water can support more vegetation and algae, which are food sources for the intermediate snail hosts of schistosomiasis. As fertilizer use expands, snail populations may follow accordingly (see Fig.2). To the author's knowledge, there is no published material to support this speculation, but studies should be undertaken to investigate this possibility. Currently, it is problematic to assess the situation because of a lack of baseline studies of nitrate levels and snail populations in the canal waters, especially in light of activities such as chemical snail extermination.

Also, while expanding fertilizer use may facilitate the spread of schistosomiasis by allowing for the expansion of the intermediate snail host population, that could be entirely counteracted by the trend toward greater mechanization in Egyptian agriculture, which has the potential to eliminate, or at least greatly minimize, human contact with schistosome contaminated waters, breaking the transmission cycle. Already this mechanization has minimized contact, but again, the the scope of this trend is uncertain. The obstacles and incentive to mechanize Egyptian agriculture should be carefully studied in an effort to determine if mechanization alone will progress to a high enough level so as to break the transmission cycle completely. In addition, a detailed analysis should be made as to how these two components of the most recent agricultural transition will serve to maximize, minimize, or negate each other with respect to schistosomiasis transmission.

(c) Finally, the urbanization transition, as it progresses, will most likely continue to aid in the decrease of overall prevalence rates, for all the reasons previously cited. But there is the possible danger that urban sprawl occurs so rapidly that a disproportionate share of the country's resources are allocated to the maintenance of urban services—which is actually the current case in Egypt—at the expense of rural ones. Therefore, the provision of schistosomiasis control measures may suffer, including the availability and maintenance of rural health units and personnel, medications, piped water supplies, and snail extermination chemicals, all of which are vital in maintaining low infection rates. Fortunately, this outcome is completely amenable to political will, and the government has complete control over this possibility. Every step should be taken to ensure an equitable distribution of resources to combat the schistosomiasis problem.

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SUSTAINABILITY OF SMALL SCALE FARMING IN THE ECUADORIAN ANDES

Caroline Stem

Introduction

The landscapes of the high Andes are among the most breath-taking in the world, offering diversity in climate, altitude, flora and fauna. The mountain range stretches from Venezuela in the North to the southern tip of South America, transecting many of the countries through which it passes (see figure 1). Bordered to the West by coastal lowlands and to the East by the Amazonian rainforests, the Equatorial Andes boast elevations greater than 6,000 meters. This variation in elevation creates diverse ecosystems, ranging from cloud forests to deserts to highland meadows (or *páramos*).



Figure 1. Andean mountain range (Adapted from Knapp 1991)

While this diversity affords spectacular scenery, it also presents tremendous challenges to its inhabitants who must work with their natural environment to meet their daily needs. Throughout the Andean highlands, where small scale agriculture predominates, peasants often must farm up steep mountain slopes, spanning several thousands of feet in altitude. These slopes encompass various ecological zones, differing in temperature, rainfall, incline, drainage and soil

composition. Farming under such a diverse ecosystem would present a formidable challenge to even the most highly trained and experienced agronomist or ecologist. Yet, until recently, peasant farmers have been able to work in harmony with their environment, providing sufficient food for their families by employing sustainable strategies with minimal or no damage to their surroundings.

Recent pressures, however, have upset the balance between subsistence and sustainable utilization of resources. These pressures include governmental policies encouraging land degradation, expanding populations, increasing poverty and national and international market demands. These factors have forced indigenous farmers to farm marginal lands, decrease fallow periods and adopt destructive practices, all leading to undesirable outcomes such as high soil erosion, desertification and unsustainable rates of resource use. The consequent upset in the ecosystem equilibrium has prompted many investigations which have concluded that indigenous farmers lack the scientific knowledge necessary to best use the land and have caused the current state of degradation through ignorance. Such views, however, ignore the underlying causes mentioned above, as well as deceptively imply that modern methods of agriculture are those that best utilize natural resources.

This paper will examine the small scale farming systems in the Ecuadorian Andes to assess the inherent sustainability of peasant agricultural methods, highlighting the systems' attributes and shortcomings. It will compare techniques utilized to commercial farming procedures, discussing the feasibility of each in the Ecuadorian Sierra. Attention will be directed to the external factors and policies which have affected small scale farming, emphasizing those which have promoted land degradation. The final section will address policy implications and alternatives to minimize resource depletion and destruction.

Ecuador - Background Information

Straddling the equator on the Pacific coast of South America, Ecuador is a small, yet exceptionally diverse nation. Although only the size of Colorado, the country consists of four distinct regions: coastal lowlands, Andean highlands, Amazonian rainforest and the Galapagos Islands. Ecuador's present population of approximately 11 million is comprised primarily of Indigenous groups (40%) and Mestizos (40%), descendants of mixed race. European (10-15%) and African (5%) descendants account for the majority of the remaining 20%.

Although Ecuador is the second largest exporter of petroleum in South America, it is also one of the most impoverished nations in the Western Hemisphere. Like most developing countries, Ecuador is burdened by high external debt. Internal inflation rates, which hover around 50%, create further stress for its government and people, whose incomes do not match this pace. In 1991, the country's Gross Domestic Product was \$10.8 billion, or \$1,000 per capita (World Bank 1991). Inequalities of income distribution are significant, as evidenced by the country's global ranking as fourth in percentage of national income received by the richest 10% (Kurian 1991).

Ecuador has traditionally relied upon a single export product to support its economy. On three occasions during the last 100 years, these products have offered prospects of a solid financial future for the country. On each occasion, however, due to various market forces and external factors, the products failed to meet long-term expectations. At the turn of the twentieth century, Ecuador was the leading exporter of cocoa, but by the mid 1920's, crop disease, competition, and the Great Depression eroded this position. During the period 1948-52, banana exports grew tenfold, forming the base of the Ecuadorian economy during the 1950s and early 1960s. In the mid 1960s, however, a substantial drop in the volume and value of exports significantly degraded the financial importance of the banana industry to the economy. Bananas were replaced in the marketplace by petroleum shortly after the 1967 discovery of vast amounts of petroleum in the sparsely populated Ecuadorian Amazon, known as the Oriente.

Despite the importance of petroleum to the Ecuadorian economy, agriculture still plays an important role, contributing approximately 15% to the Gross Domestic Product in 1986 (World Resources Institute 1992-1993). Moreover, the decline in the world market prices for oil during the 1980s has further strengthened the importance of agricultural activities to the Ecuadorian economy. Most agricultural activity takes place in the Coast and Sierra, although the Amazonian sector has experienced significant increases in farming during the last couple of decades. The coastal area is primarily dominated by commercial farming activities, producing tropical crops for export, such as bananas, cacao, coffee and sugar cane. In contrast, the Sierra highlands support

essentially small scale peasant agriculture, characterized by production of cereals and tubers including potatoes, barley, legumes and wheat.

Ecuadorian Andes

The Ecuadorian portion of the Andes can be subdivided into four distinct regions: the outer faces, northern hillsides (*páramos*), northern valley bottoms and the southern sierra (see figure 1). The outer faces encompass elevations from 1,200 to 3,000 meters on either side of the mountain range. The climate is humid, with precipitation exceeding 2,000 mm. per year and a median temperature of 20° C. During most of the century, the outer faces have remained inaccessible and covered with forests. During the past 25 years, however, colonization has increased dramatically, leading to widespread logging and soil loss from steep slopes (Southgate and Whitaker 1992a).

The northern hillsides and *páramos* extend from just north of Cuenca in the South to Ecuador's northern border and include steeply sloped lands, as well as the gently sloped meadows of the high mountains. Rainfall and temperatures vary dramatically according to changes in altitude throughout the region, with less rainfall and lower temperatures typical of higher altitudes. During the second half of the twentieth century, the agricultural frontier has been steadily advancing into this area. Soil erosion and declining fertility are incessant problems in the northern hillsides and *páramos* (Southgate and Whitaker 1992a).

The northern valley has temperatures averaging 12° - 18° C and tends to be the driest region of the sierra. This mild climate has historically attracted settlement. Significant quantities of beans, potatoes and other crops are produced in this region, despite shifts to livestock production due to relatively higher market values of dairy and meat products as compared to traditional Andean crops (Southgate and Whitaker 1992a).

The final region of the Ecuadorian Andes, the southern sierra, extends from just north of Cuenca to the Peruvian border in the South. Temperatures and rainfall are similar to other areas of the Ecuadorian highlands, with average temperatures ranging between 10° C and 15° C and average rainfall from 600 mm to over 1,000 mm. The most distinctive characteristic of the southern sierra is its soils, which, unlike the rest of the Ecuadorian Andes, are not of recent volcanic origin. Another distinction lies in the urban competition for land well-suited to farming, as the prime fertile land lies in the valleys in which people tend to settle. In general, conditions for crop production are much less favorable than in the rest of the Ecuadorian sierra. Cattle ranching is the major activity throughout the region. Poverty-stricken peasant farming systems surround Cuenca and Azogues (Southgate and Whitaker 1992a).

While the regions of Ecuador's highlands vary considerably, this paper will analyze the small scale farming systems within the area as a single entity. Lack of data and research distinguishing between the different ecosystems prohibits an inter-region analysis. Some attention, will focus upon the outer faces of the Andes and the southern sierra, but most emphasis will center upon the northern hillsides and *páramos* and the northern valley bottoms, as these regions tend to be the most similar in climate, topography and agricultural activities. In general, reliable sub-national data is virtually non-existent, with the exception of a few small, specialized studies. Consequently, much of the analysis present in this paper focuses upon either urban/rural separated data or aggregate national data with extrapolations made to the Andean region. These extrapolations are based upon the types of crops, the amount of cattle ranching, the size of farms and other factors which differ from region to region.

State of the Land

One of the most notable features of land degradation in the Andean highlands is high rates of soil erosion. The Andes, like many young mountain chains, are characterized by precipitous slopes and the easy displacement of surface materials. Potential soil loss is great in 47.9% of continental Ecuador, especially along the outer faces of the Andes and the sides of intermontane valleys. As illustrated in figure 2, erosion is active or in the process of becoming active in 12.1% (315,000 ha) of the country and is particularly severe in the Sierra (Southgate and Whitaker 1992b).

Agricultural activity greatly accelerates overland erosion. Soil loss rates are especially high on small farms where erosive crops such as maize are grown and where erosion control practices tend to be undeveloped or under-utilized. Consequently, land productivity has declined rapidly in the Sierra with over 341,000 hectares (60%) of cropland abandoned or converted to

pasture since the mid-1960s (Southgate and Whitaker 1992b). Indeed, with an annual growth rate of 2% in cropland and pastures, Ecuador is one of the highest in Latin America (see figure 3). This growth in pasture has come at the expense of a decline in forest and woodland area. The peasant farmers' endless search for increasingly scarce fertile soil continues to expand the agricultural frontier, simultaneously decreasing total forest and woodlands.

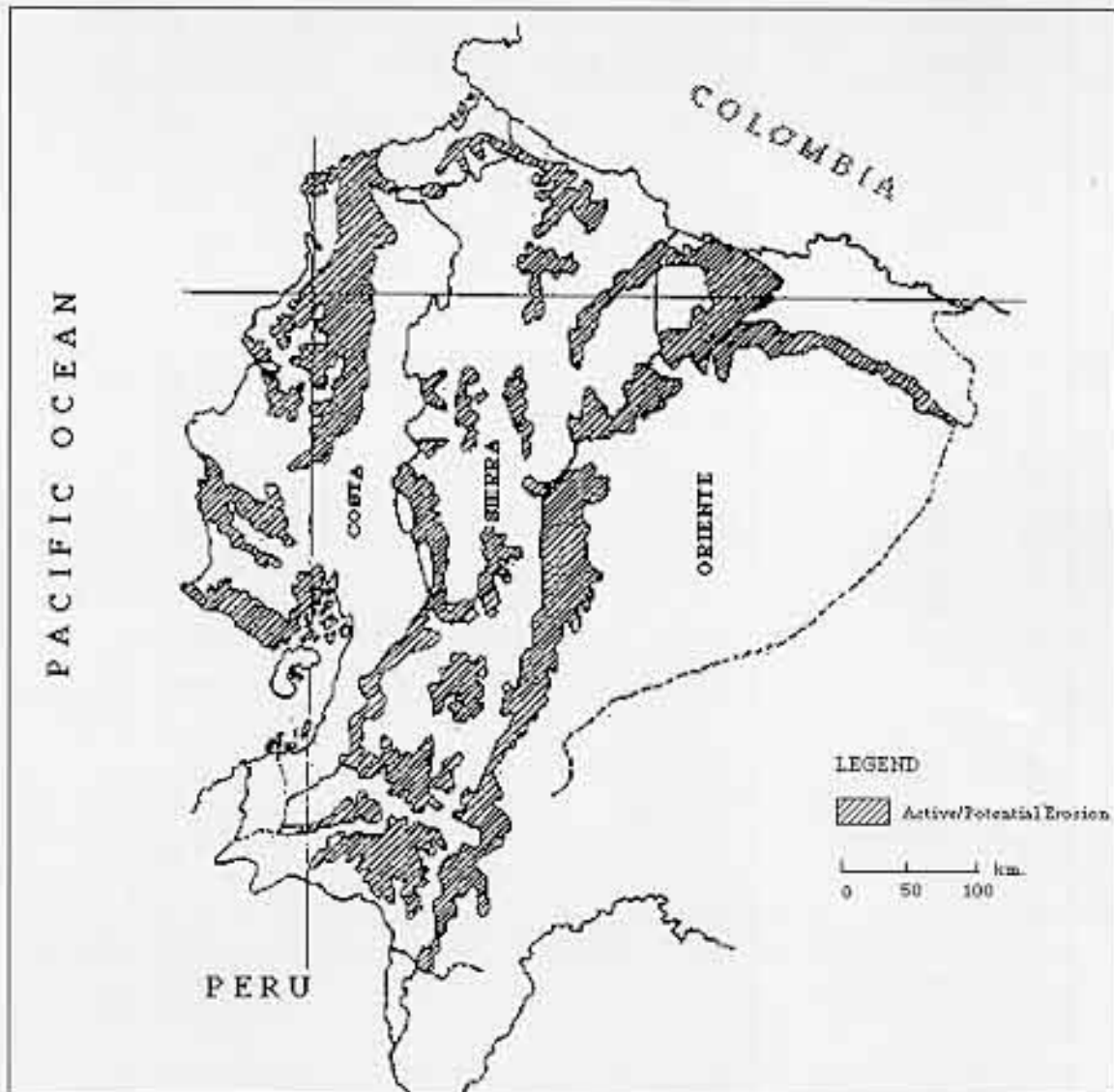


Figure 2. Active or potential erosion throughout Ecuador (Adapted from Southgate 1992a)

Further complicating land degradation is the practice of livestock grazing on the abandoned lands. Contemporary livestock production in Ecuador dates back to the Spanish colonization. The livestock introduced were different from the native camelids in that the new species had sharp, cloven hooves which fracture the soil. In addition, sheep, cattle and goats produce more damage than llamas, as they are more adept at digging out stems and roots beneath the soil surface. Consequently, they can cause greater harm to Andean pastures where plants are not adapted to heavy grazing (Southgate and Whitaker 1992a). Regeneration becomes less and less likely as these lands continue to be used for ecologically-incompatible purposes.

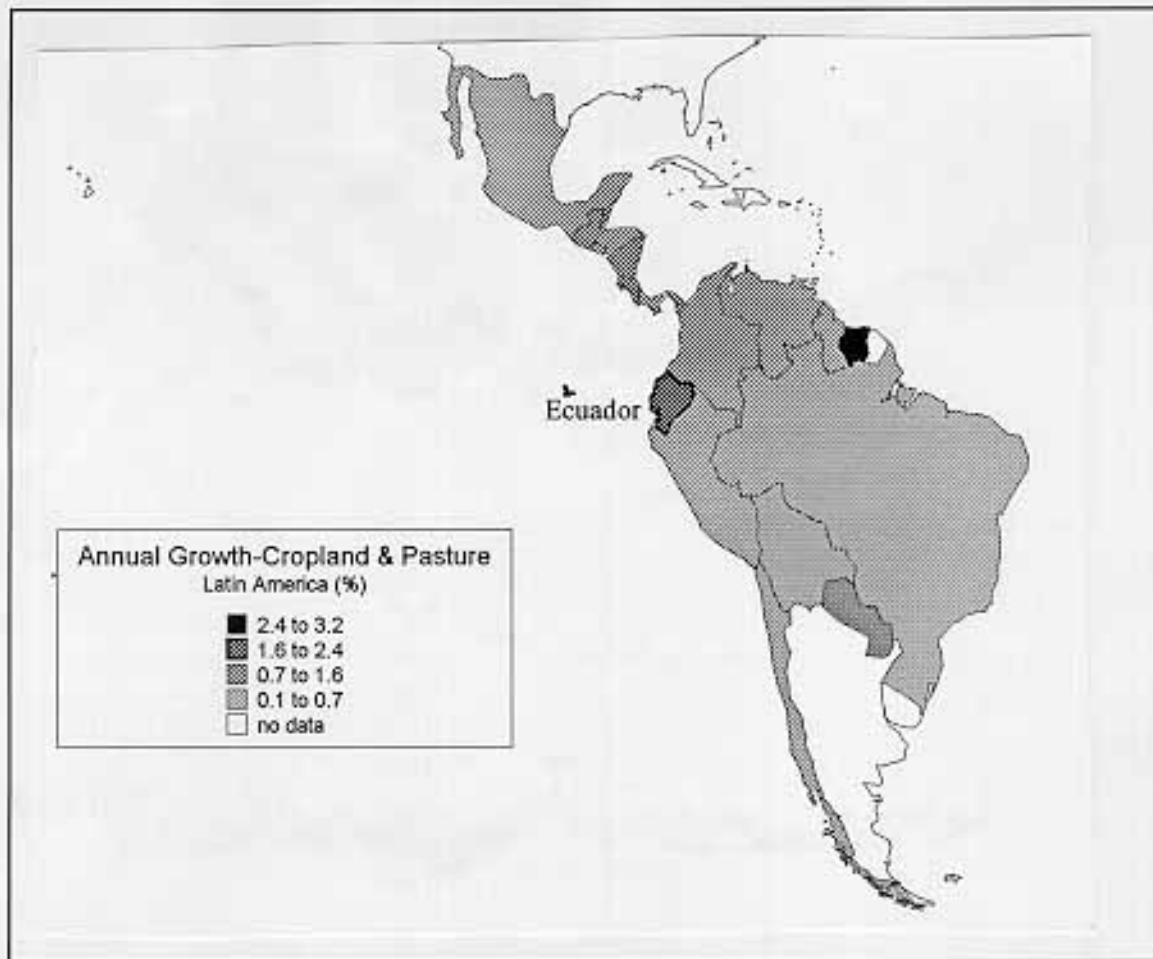


Figure 3 Annual growth rates in cropland and pasture for Latin America. Ecuador = 2%. (Data source: Southgate and Whitaker 1992).

Small scale Farming

This paper will refer to small scale, peasant and indigenous farming systems as those which involve relatively small plots of land (less than 10 hectares) owned by families who rely upon the crops primarily for subsistence but may also generate modest surpluses for sale in local markets. Employing this definition, the Andean highland agricultural systems are predominantly small scale, while coastal systems are primarily commercial.

Much of the literature refers to peasant farming systems as "traditional". It is important, however, to recognize that such terminology implies that the methods used have not been influenced by external forces. In reality, there are very few truly traditional agricultural systems, as there are few societies that have not been exposed to modern societies. Spanish colonization of the Americas in the 15th century influenced both Andean and Latin American agriculture through the introduction of non-native crops, livestock production and European technologies. With the colonization and adoption of European crops and methods came a loss in the base of empirical knowledge gathered over thousands of years. In addition, European exploitation of the natural resources through mining impacted farming methods. For example, mining activities in Peru led mountain dwellers to abandon hillsides, leading to the gradual disappearance of terracing. When they resettled in later years, they did not observe this technique to prevent erosion. Nicolo Gligo asserts that despite European introduction of a considerable amount of technology, many indigenous groups still cultivated in the traditional, pre-Colombian manner and consequently only partially lost their ecologically-adapted practices (Altieri and Hecht 1990). Thus, when referring to small scale farming systems and indigenous knowledge, it is important to bear in mind that both pre-Colombian and European methods have played an important role in shaping them.

Present small scale farming typically employs methods requiring intensive human labor, relying upon minimal external inputs, with little or no use of fossil fuels. Production is primarily for family subsistence, although many farmers do generate surpluses for local markets in order to supplement their income. Other activities such as plant gathering, cattle raising, handicraft production, fishing and off-farm labor also complement their income.

The techniques utilized by peasant farmers are highly dependent upon the climate and topography typical of the region. Many practice swidden agriculture, more commonly known as "slash and burn". This method involves the cutting and drying of brush or forest and subsequent burning of the area. The burned vegetation serves as a rich fertilizer, but this technique exhausts the fertility of the soil within one to two years, at which time the land must lay fallow for 10-20 years. Such methods have been hailed by many development specialists as evidence that indigenous groups are ignorant and lack scientific knowledge to farm in harmony with their environment. Swidden agriculture, nevertheless, can be effective in weed and pest control, as well as ecologically-safe. It does, however, depend upon insulation from population pressures and the demands of commercial agriculture (Schusky 1989). As there are few populations that are isolated from these forces, this practice has not been sustainable in most of the Andean region.

Latin American, and Andean peasant farming is characterized by complex cropping methods such as polycultures and agroforestry systems. These techniques serve to minimize risk of crop loss to pests, disease and natural disasters and exhibit several other ecological properties such as biodiversity, nutrient recycling capabilities, and soil and water conservation features. These methods, as well as swidden farming, are only a few of the many practices utilized by Andean farmers. The following section which will address both advantages and disadvantages to peasant farming and will provide a more comprehensive picture of small scale farming.

Advantages of Small Scale Farming

As the primary focus of this paper is the ecological effects of Andean peasant farming practices, most of the advantages and disadvantages presented will emphasize environmental impacts. As previously discussed, small scale farming systems make minimal use of external inputs. For example, many use manure for fertilizer rather than invest in costly products. They also enhance soil fertility through the use of irrigation, periods of fallow, rotation and the harvesting of ditch and tank silt (Knapp 1991). Similarly, many farmers use complex cropping systems in order to minimize crop damage due to insects and other pests. These methods diminish the need for pesticides which pose health threats to farm workers and consumers, as well as environmental hazards through their interaction with land, water and air ecosystems. In addition, because many small scale producers do not rely upon pesticides, they are less likely to experience long-term problems, such as pesticide-resistant strains. While both of these practices may be, in part, economically-motivated, the end result is less land degradation.

Multiple cropping, another peasant strategy, involves either more than one crop occupying the same land simultaneously or a crop rotation sequence. As Stephen Gleissman notes, multiple cropping results in increased production and more efficient resource use, since the land can be occupied for longer periods of time with no decrease in yield (Altieri and Hecht 1990). For example, studies in Tabasco, Mexico found that maize yields could be stimulated up to 50% beyond monoculture yields when planted with beans and squash (see table 1). While the yields of beans and squash declined, the total yields for the crops planted together were higher than for an equivalent amount of land used for monoculture crops (Altieri and Hecht 1990). While this study did not focus upon Andean agriculture, it is merely presented as an example of the merits of multiple cropping systems.

Another environmentally-sustainable practice typical of Andean highland farmers is the use of animal and human power as opposed to mechanized strategies heavily dependent upon machinery and fossil fuels. A secondary benefit of the use of animal power is the increase in the amount of manure available for use as fertilizer. In addition, the domestication of animals provides many families with a complementary source of food, as well as income through market sales. Cattle-ranching is often seen as a resource-intensive practice, but Ernest L. Schusky argues that this does not have to be the case (Schusky 1989). He cites the importance of animals for traction and manure. He also advocates the use of pastures on sloping lands unsuitable for feed crops as cattle-grazing areas, asserting that proper management could reduce the impact upon resources. While the value of animal traction and manure is evident, the raising of cattle along

sloping lands would seem to only add to the severe soil erosion characteristic of the Ecuadorian Sierra.

TABLE 1
Yields of Polyculture Maize/Bean/Squash as Compared to Monocultures
Planted at Four Different Densities, Cardenas, Tabasco, Mexico
Source: M.F. Amador (Altieri and Hecht 1990)

	Monoculture densities				Polyculture
	33,000	40,000	66,000	100,000	
Densities of maize ^a					50,000
Yield (kg/ha) ^b	990	1,150	1,230	1,170	1,720
Densities of beans	56,800	64,000	100,000	133,200	40,000
Yield (kg/ha)	425	740	610	695	110
Densities of squash	1,200	1,875	7,500	30,000	3,330
Yield (kg/ha)	15	250	430	225	80

^a Densities expressed as number of plants/ha.

^b Yields for maize and beans expressed as dried grain, squash as fresh fruits

The environmentally-sustainable practices employed by small scale producers have the additional advantage of being economically sustainable. Indigenous cultivation strategies, characterized by crop variety, serve as an economic risk reduction method. A blight which may destroy all potatoes would leave subsistence farmers less vulnerable than those who practice monoculture systems, as subsistence farmers would have other crops which may not be susceptible to the same pest. Another potential economic benefit for small scale farmers is their minimal reliance upon external inputs such as fertilizers, pesticides and machinery. An indirect benefit of low pesticide and fertilizer use is the minimal occupational exposure and presumably lower health costs. In addition, minimal input use, due to its inherent sustainability, would allow the land to be used for a longer period of time, further increasing economic gains.

Thus, the advantages of small scale farming systems are numerous. They include low use of external inputs, utilization of ecologically-sustainable techniques such as polycropping and crop rotation, and reliance upon intensive animal and human labor instead of mechanical labor. While peasant farming is not as resource-intensive as commercial farming, it is characterized by several disadvantages which interfere with its sustainability. The following section will address some of these disadvantages.

Disadvantages of Small Scale Farming

Several of the advantages of Ecuador's Andean peasant farming systems could also be considered disadvantages. Most, however, deal with economic rather than environmental aspects. The primary ecological drawback of the small scale Andean farming systems is the practice of farming up mountain sides with little or no use of any erosion-evasive techniques such as terracing. Although slope drainage features are sometimes constructed, producing semi-terraces, peasant farmers rarely employ bench terraces or raised fields (Knapp 1991). Thus, most small scale farming systems have substantially contributed to the high rates of soil erosion in the Ecuadorian highlands. While many people have directly linked soil erosion to peasant agriculture, this paper argues that the systems are actually an intermediary agent in the process, with the underlying cause being external policies, market demands and other factors.

Another disadvantage of subsistence agriculture is the intensive labor requirements. Many farmers find themselves with little time available to devote to other income-generating activities. While the agriculture described in this paper is subsistence, it is not self-sufficient. Poverty constraints have obligated families to undertake other activities such as fishing, hunting, handicraft production and employment outside of the farm in order to augment their incomes. Intensive labor requirements leave farmers with little time to devote to social and family activities, leading to a probable decline in quality of life.

Farm production often falls short of meeting household needs. The necessity for cash is apparent in even the most remote Andean villages. Because their systems are designed for subsistence, peasants are often incapable of generating sufficient surpluses to sell in local markets. This reality has led many to migrate to urban areas in search of employment. Problems surrounding urbanization and migration will be discussed in a later section of this paper.

Under ideal circumstances, subsistence farming should exert little stress upon the environment and should be sustainable, both ecologically and economically. This, however, has not been the case in the Ecuadorian Andes. Many people in the development and science fields have argued that peasant agriculture systems degrade the environment and have led to severe erosion in the Ecuadorian highlands, as well as throughout the Andes. They argue that small scale producers lack the scientific knowledge and technology to effectively maintain their land. The following section will explore alternative explanations for the causes of environmental degradation.

Unsustainable Agriculture - Causes

This paper does not deny that peasant farming systems have contributed to land degradation in the Ecuadorian Sierra. Small scale farmers are often the direct link to land misuse and deterioration, but to attribute the ecological degradation solely to their farming systems would be to ignore the true underlying causes. Small scale farming itself is not unsustainable, but external factors have forced it to become increasingly so. This section will examine separately each of these factors and how they have adversely impacted both peasant agriculture and land deterioration.

Social and Economic Factors

Poverty

Andean peasants have historically constituted one of the most impoverished groups in Ecuador. While Ecuador experienced a boom in growth during the 1970s as a result of petroleum revenues, peasant economies have not shared in the wealth generated. Modernization of the economy has actually increased inequalities between social classes (see table 2). Policies favoring commercial farming have forced small scale producers deeper into poverty. Table 2 emphasizes the inequity of income distribution between these two groups of farmers.

In order to meet subsistence needs, indigent farmers often must exploit natural resources through methods that are unsustainable in the long term, but profitable in the short term. Such methods would include the raising of livestock on hillsides, the farming of steep slopes and the expansion of agricultural frontiers to increase production. Approximately two-thirds of the increase in production between the mid 1960s and mid 1980s is linked to the expansion of agriculture into forests and other previously untouched environments, while improved productivity only constituted one-third (Southgate and Whitaker 1992b). Figure 4 illustrates how the growth in permanent pasture area seems to be mirrored by a decline in forest and woodland area. Figure 5 depicts the expected growth in pasture area and the decline in forest and woodland area. Utilizing a linear projection, actual permanent pasture area will exceed forest and woodland area within the next decade.

TABLE 2
Income Sources in Ecuador Sierra by Farm Size (1978)
Source: Adapted from de Janvry and Helfand (Altieri and Hecht 1990)

Farm Size (ha)	Home Consumption	Net Monetary Ag. Income	Payment in Kind	Trade (%)	Handicrafts	Ag. Wages	Non-Ag. Wages	Total per Capita Income (\$)
0-1	9.4	13.6	0.6	7.1	4.3	24.4	40.6	129
1-2	15.3	30.1	1.2	4.2	2.1	23.9	23.2	93
2-5	16.8	49.2	0.7	4.3	0.6	15.5	12.9	124
5-20	14.7	64.9	1.0	6.0	0.8	5.6	7.0	210
20-100	6.3	81.0	1.0	5.2	0.6	1.1	4.8	761
100+	1.1	88.0	3.9	1.9	0.0	0.3	4.8	5,433

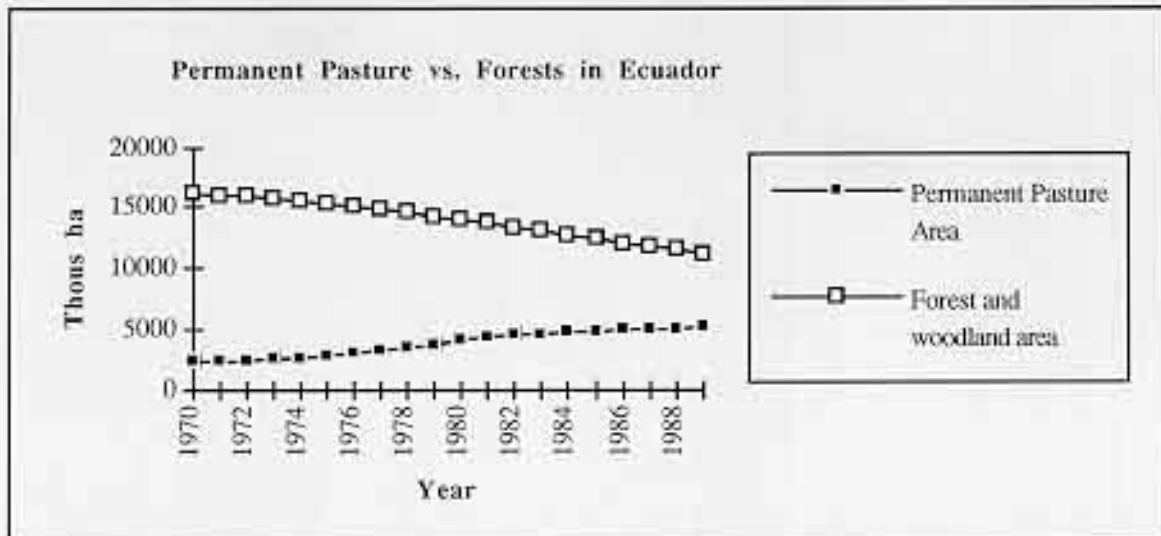


Figure 4 . Growth in permanent pasture area as set off by a decline in forest and woodland areas (WRD Data 1992-1993)

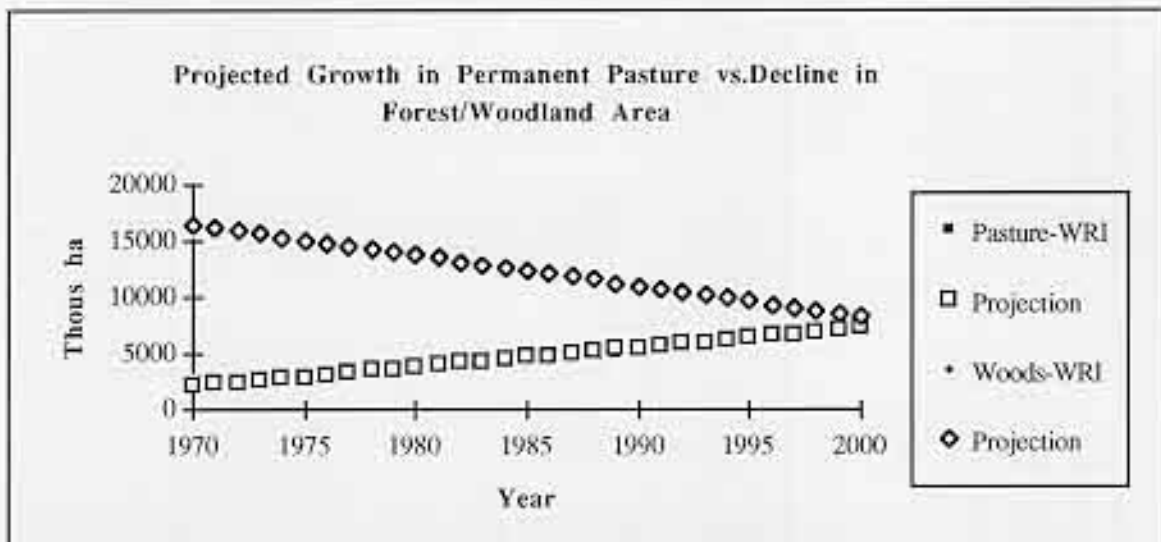


Figure 5. Projected linear growth in permanent pasture area as set off by a decline in forest and woodland areas, $r^2 = .9741$, C.I. = 95% (WRD Data 1992-1993)

In addition to promoting the exploitation of natural resources, poverty has also driven small scale farmers to generate surpluses for market sales and to search for outside labor. Most peasant farmers have found they must supplement their income through additional sources (e.g., handicrafts, wage labor), as money derived from surplus sales contributes little to their household income (see table 3). The need to generate surpluses, however, may force peasants to utilize unsustainable techniques, including expansion of activities and the reduction of fallow periods. In addition, they may be forced to devote attention to other income-generating activities, leaving less time to invest in conservation techniques. For those with little land, the importance of wage labor and migration is heightened. Urban migration may lead to ecological degradation by serving as an incentive to exhaust all resources before abandoning the land. The following section will examine in more depth how migration and circulation have led to further land degradation.

TABLE 3
Sources of Income - Select Andean Areas
Source: Adapted from de Janvry (Altieri and Hecht 1990)

Region	Year	Farm Size (ha)	Share of farm households (%)	Share of income derived from (%)		
				Farm	Wages	Other
Cajamarca (Peru)	1973	0-3.5	72	23	50	27
South Bolivia	1977	0-5	67	38	*	*
Sierra (Ecuador)	1974	0-5	77	37	44	19
Coast (Ecuador)	1974	0-5	77	48	41	11

* Sum of wages and others = 68%

National and International Market Forces

Economics have played a strong role in altering subsistence farming systems. With global population expansion and increasing food demands, governments throughout the world have turned to commercial farming methods to fulfill these demands. National and international markets have placed pressure on Ecuadorian farmers to employ large scale monoculture systems characterized by high yields, low labor inputs and heavy reliance upon chemical products and machinery. These systems generally lead to extensive environmental degradation, including contamination of soils, waters and air, depletion of germplasm and decreased soil fertility. In addition, they are susceptible to epidemics due to the lack of biological diversity inherent in monoculture. Their effect on Andean small scale farmers has been to exacerbate poverty through increased competition which does not favor the low-yield peasant-based system.

National and international markets have stimulated the growth in cultivation of non-native crops and industrial crops, such as barley, tobacco and coffee with a resultant decline in market value for indigenous highland crops. Gligo asserts that these markets have contributed to the expansion during the past century in the agricultural frontiers throughout Latin America (Altieri and Hecht 1990). He also contends that in the past thirty years, Latin American small scale producers have lost a significant degree of food security due to the product specialization demanded by international forces (see table 4). Andean farmers have not been immune to these forces. They have seen a decline in the market values for crops, such as potato and corn, in favor of tropical crops, such as banana and cacao. While Ecuadorian highland farmers are primarily subsistence farmers, they do rely upon markets for surplus income generation. Declines in the value of their crops, therefore, have exacerbated their poverty, ultimately leading to the unsustainable utilization of land described earlier.

TABLE 4
Growth Rates of Output of Major Crops in Latin America Between 1950 and 1976 (%)
Source: Bernstein, Crow and Johnson 1992

Industrial and Export		Food	
Cotton	1942	Beans	72
Sugar cane	573	Maize	62
Soya	447	Cassava	12
Tobacco	300	Wheat	-43

In addition, high demand among national and international markets for beef products has led many farmers to divert resources to the more profitable but ecologically unsustainable livestock raising. The resource-intensive practice of cattle rearing has compounded soil erosion and the expansion of agricultural activities. Figure 6 depicts the growth in cattle-raising activities in Ecuador as related to the growth in pasture lands. This figure shows that a growth in permanent pasture has followed a similar trend to the increase in livestock production. It is possible that the

greater emphasis on cattle ranching has been a significant factor stimulating the growth of permanent pasture area.

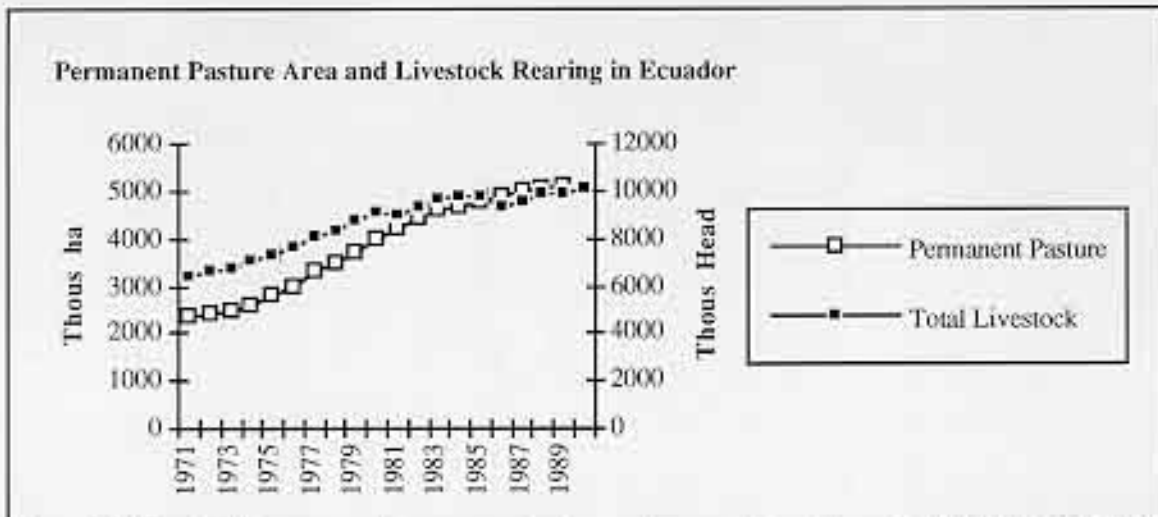


Figure 6 : Relationship between growth in permanent pasture and increase in livestock rearing (WRD Data 1992-1993)

Demographic Factors

Population Growth

Ecuador's high population growth, while characteristic of most developing countries, is one of the highest in Latin America (see figures 7 and 8). The World Resources Institute estimates annual population growth rate during 1990 as 2.56%, but predicts this rate will continue its declining trend in the future (WRD 1992-1993). Despite the decline in growth rate, the absolute population will continue to increase and exert further stress upon Ecuador's resources. The nominal increment in population will depend upon whether increases will follow a linear, exponential or logarithmic model. While the World Resources Institute depicts an almost linear increase in population, regression analysis indicates that past data more strongly resemble an exponentially increasing population in Ecuador ($r^2=0.9992$, 95% C.I.). Figure 7 depicts the three corresponding scenarios for Ecuador's population expansion. It does not display a logarithmic projection, as the r -squared value was quite low, $r^2=0.2779$. Regardless of which projection will most clearly parallel reality, Ecuador's population is increasing at a high rate and will continue to do so well into the twenty-first century.

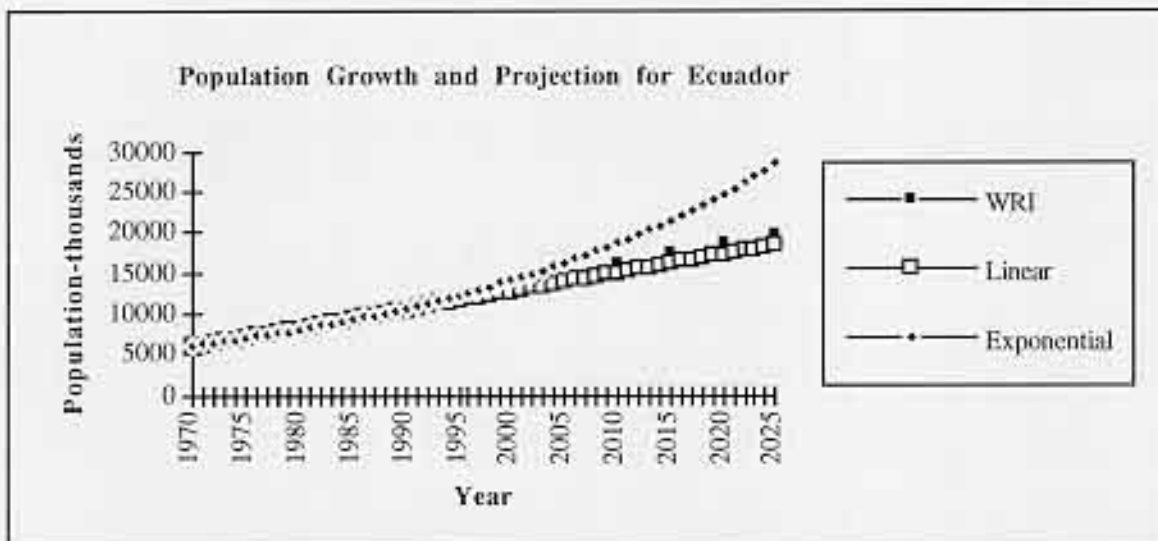


Figure 7. Actual and estimated population growth based on forecasts by World Resources Institute and linear and exponential projections (WRD data 1992-1993)

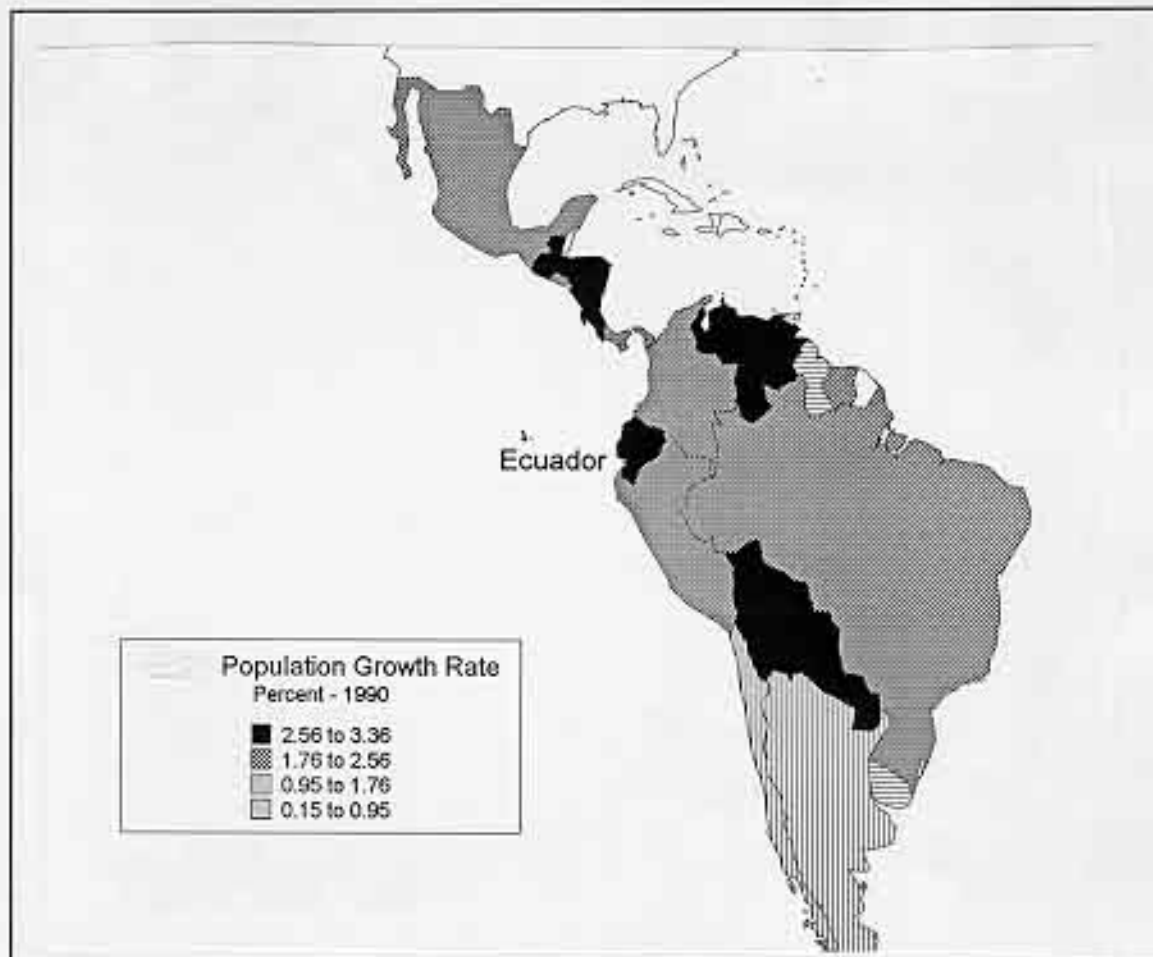


Figure 8 Urban population growth rates for Latin America (1990). Ecuador = 2.56. (WRD Data 1992-1993)

Fertility rates are considerably higher in the rural areas of Ecuador than in the urban areas. The 1987 Demographic and Health Survey (DHS) reported that rural women have a global fertility rate of 5.5 while their urban counterparts have one of 3.5. Thus, rural women would give birth to an average of 5.5 children over the span of their lifetime, while urban women would give birth to an average of 3.5 children. These differences were similar among rural and urban areas of both the Sierra and the Coast. The DHS also found that the average age at first childbirth among rural women was much younger than among urban women (20.3 years vs. 23.8 years). In addition, the survey found that knowledge, utilization and acceptance of contraceptive techniques were consistently lower among rural women than urban women. Religion, education and culture as well as access to health care services, play important roles in these disparities.

Implications for environmental degradation in rural areas of the Ecuadorian highlands are particularly severe. Nominal growth in population, both rural and urban, will place greater demands upon the natural resources to sustain these numbers. For example, increase in population will lead to even higher fragmentation of land, as lands are divided among family members through inheritance mechanisms. Despite agrarian land reforms, average farm size in the Ecuadorian Sierra had decreased from 2.1 hectares in 1954 to 1.9 hectares in 1974 (see table 5). Fragmentation of ownership, due to population increases, as well as changes in land use and tenure systems, has reduced the area available for implementing long-term fallow systems. As a result, a decrease in soil fertility and an increased incidence of agricultural pests have been observed in Andean agriculture (de Janvry and Garcia 1987).

TABLE 5
 Number and Average Size of Small Farms in the Andes Over Time
 Source: Adapted from de Janvry, Sadoulet and Young 1989.

Countries	Years	Max. Farm Size (ha)	# Farms	% of Farms	% of Area	Avg Size (ha)
Colombia	1954	10	648,115	71.0	6.9	2.9
	1970		859,884	73.0	7.2	2.6
Ecuador	1954	5	212,153	82.0	11.0	1.6
	1974		298,965	77.0	13.0	1.3
Ecuador Sierra	1954	10	234,596	90.0	16.0	2.1
	1974		280,974	87.0	18.0	1.9
Peru	1961	5	699,427	82.9	5.2	1.3
	1972		1,083,775	77.9	6.6	1.4
Venezuela	1950	5	125,990	53.7	1.2	2.1
	1971		121,778	42.3	1.0	2.2
Latin America	1950	Small Farms	4,134,000			2.4
	1980		7,949,000			2.1

In addition, with more mouths to feed but fixed amounts of land to cultivate, rural families will be pushed even further into poverty. Not only rural growth, but also urban growth will promote further expansion of the agricultural frontier. Ecuador has one of the highest urban population growth rates in Latin America, with average annual growth between 1985 and 1990 at 4.7% (based on WRD Data 1992-1993). National market forces, stimulated by this high urban growth rate, will lead to a greater emphasis on excess production, necessitating the use of chemical inputs and the mechanization of labor. Families will be forced to expand farming into marginal lands and untouched forests, migrate to urban areas in search of employment or seek work with larger land-owners. All of these actions have environmental ramifications. Expansion into marginal lands will lead to further soil erosion, while the clearing of forests to pursue agricultural activities will reduce the biodiversity of these ecosystems and also lead eventually to erosive and infertile soils.

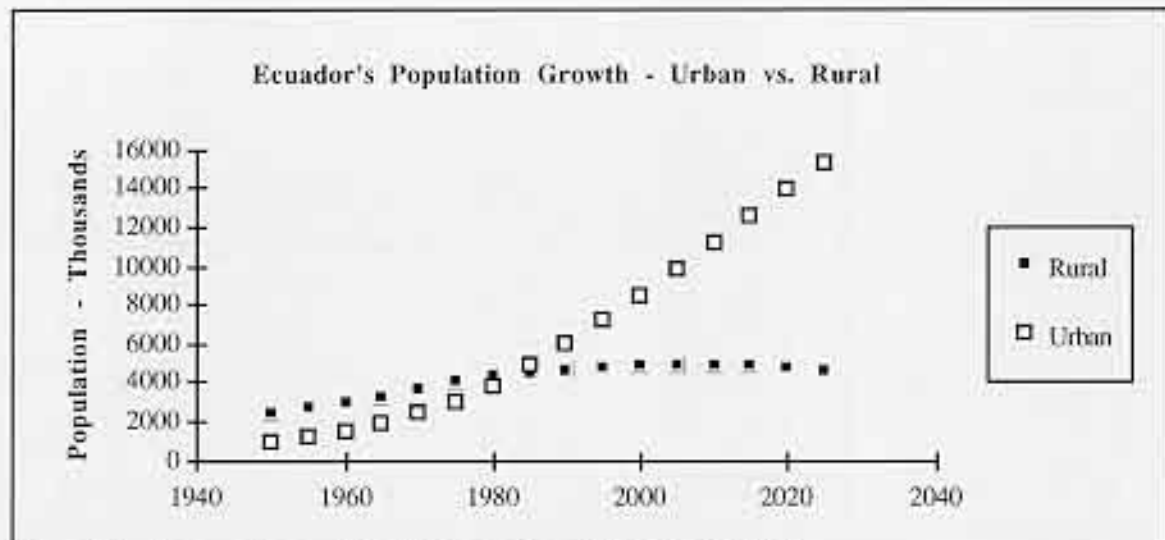


Figure 9. Rural versus urban population WRI projections (WRD data 1992-1993).

Migration and Urbanization

Migration provides incentives to exhaust land which will be abandoned, as well as adds to urban degradation, since the cities lack the infrastructure to support massive waves of

immigration. Outside employment with larger land-owners decreases the amount of time available to devote to labor-intensive subsistence agriculture and also provides the support to commercial farming systems that often employ unsustainable farming methods. While population pressures do play a significant role in land degradation, structural conditions and policies promoting inequalities in distribution of land further exacerbate this situation. De Janvry and Garcia maintain that the environmental impact of the rural poor is often low as compared to that of large landowners, timber and mining companies, and national governments (de Janvry and Garcia 1992).

Urbanization and migration, demographic factors impacting small scale farming methods, have been touched upon in previous sections. The interaction between migration and land deterioration is a two-way one; land deterioration can stimulate migration, and migration can provide incentive to exhaust the land before abandoning it. The search for outside labor to supplement household incomes has played a primary role in the trend toward urbanization. While rural-to-urban migration rates in Ecuador are not as high as in much of Latin America, migration does merit attention, especially in relation to environmental degradation. Moreover, Southgate and Whitaker argue that it is possible that migration rates are based upon rural population densities which have remained fairly constant in the past two decades. These rates, however, do not account for reverse migration which has put mounting demographic pressure upon previously unpopulated areas (Southgate and Whitaker 1992a). Reverse migration is especially manifest in the colonization of the Ecuadorian Amazon since the discovery of oil in 1967. Annual population increases from 1974 to 1990 were 4.7% in the Amazon, while the rural population growth for all of Ecuador was .8% (Southgate and Whitaker 1992a).

Losses in soil fertility, declining crop yields and scarce land availability all contribute to rural-to-urban migration. Peasant farmers who can no longer sustain their families and generate excess income have been forced to urban centers in search of employment. As an alternative, they may search for temporary employment with large landowners and return to their homes after the harvesting seasons. Brown et al. refer to this as circulation and assert it is more common among small scale Sierra farmers than their coastal counterparts. They claim that, through choosing circulation rather than migration, farmers reflect strong ties to both land and culture (Brown, Brea and Goetz 1988).

Recent attention has focused upon the possibility that migration leads to land deterioration. In this sense, land degradation could be regarded more as a consequence than a cause of rural-to-urban migration. This theory purports that inefficient financial markets undervalue properties, providing incentive to migrants to deplete resources, squeezing out whatever profits possible before they move to the cities (Southgate and Whitaker 1992a).

Another means by which migration promotes land degradation is through the loss of indigenous knowledge with the movement to urban settings. The loss of knowledge often leads to the adoption or utilization of ecologically-unstable methods of land cultivation. Similarly, when migration occurs between rural areas, peasants may attempt to utilize techniques which were sustainable in their area of origin but are not sustainable in their new environment. Due to the vast differences in soils and climates within Ecuador, techniques employed in one area are not transferable to other areas. This has been the case in the Ecuadorian Amazon, where colonists have settled from all over the country and have tried to farm soils or raise livestock on land which is far too fragile to support agricultural activities. They have cleared vast amounts of rainforest only to later abandon their plots when the land is no longer fertile.

Demographic forces have significantly intensified land degradation in the Ecuadorian Andes. High population growth exerts dual pressures through its contribution to increasing market demand and its direct role in the expansion of the agricultural frontier and the depletion of natural resources. Migration and urbanization, prompted by land deterioration, places stress upon the inadequate urban infrastructure and leads to a loss in the base of traditional knowledge. In addition, migration and urbanization provide incentives to exhaust the land before leaving it, thus further exacerbating land degradation in the Ecuadorian sierra.

Policies

While demographics play an instrumental role in natural resources exploitation, policies are conceivably the primary cause of land degradation in the Ecuadorian Andes. Forces initiating and supporting these policies range from the government to development agencies to national and international companies. In general, they are biased in favor of commercial farming and have

successfully managed to keep small scale farmers fixed in poverty. This section will highlight various policies which impact peasant farming systems in Ecuador and will explore consequent resource misuse.

Land Reform and Land Policies

Agrarian reform laws, enacted in 1964 (and subsequent years), were developed to more equitably distribute land concentrated among large landowners under the *hacienda* system. This system, which dominated economic, political and social arenas from the late 17th century to the early 20th century, strongly resembled European feudalism. While the land reform was implemented as a method to break-up these large landholdings and establish equity, the reality is that little has changed. Prior to land reform, farms of less than five hectares constituted 90% of all holdings and 16% of farmland in the Ecuadorian highlands. In 1974, ten years after the enactment of agrarian reform, these percents were 87% and 18% respectively (see table 5).

In addition, commercial producers were able to hold onto the more fertile soils, while peasant farmers were allocated less desirable parcels. Brown et al. assert that agrarian reform failed in its goal because large landholders and industrialists were able to shift the emphasis of the law to favor output and production efficiency over equality (Brown, Brea and Goetz). The environmental consequences of this aspect are similar to ones previously discussed. The lack of land available to peasants has led them to farm marginal lands which may not have been claimed or to expand their frontiers. Those who cannot increase their land base must search for outside employment, leaving little time to devote to agriculture and the implementation of labor-intensive conservation measures.

The Land Reform Law, like many governmental policies, contains provisions which mandate the degradation of land. For example, Article 48 stipulates that "idle" Andean páramos and fallow land are subject to agricultural colonization. This encourages the colonization of these fragile ecosystems and accelerates soil loss (Southgate and Whitaker 1992b). These policies foster tenure insecurity and reduce incentives for private investment in restoration. Moreover, they ignore the inherent value of fallow land and send the signal that only intensive use of land is "productive".

Access to Credit Markets

Andean peasant farmers have also been indirectly denied access to credit markets. Lenders restricted from charging higher rates seek out large borrowers with substantial resources and collateral. This practice allows them to minimize risk, as well as reduce processing costs. As a consequence, farmers must rely upon informal credit markets with high interest rates. Southgate asserts that the long-term benefits of soil erosion cannot be realized in the short-term without financial intervention (Southgate 1992). Lack of access to financial markets discourages investment in some technologies which may enhance their productivity or in research which could provide them with information on sustainable resource utilization. While this paper has proposed that Andean agriculture isolated from external factors could be sustainable, the acquisition of research and technologies could assist them in adapting to these exogenous forces.

Bias Favoring Commercial Farming

As most government policies are biased towards production rather than subsistence, the peasant agriculture systems, by their nature alone, are at a disadvantage. It is also likely that large commercial farmers have greater pull among political forces and have probably helped shape some of the policies that favor them. Gligo supports this hypothesis for Latin America as a whole. He asserts that, by manipulating public investments, influential groups, often connected to high-income landowners, have benefited from investment flows and have enjoyed huge subsidies. Moreover, other state policies concerning prices, loans and inputs also favor these sectors (Altieri and Hecht 1990).

Government Intervention in Economy

As in most Latin American countries, the Ecuadorian government has intervened in its economy, setting price controls for food, fuel and other goods. This intervention is a response to meet the subsistence needs of an impoverished population. At the same time, however, the declining prices for agricultural commodities have adversely impacted the management of land inputs to Ecuador's highland agricultural economy. Ecuador's development strategy based upon

import substitution and industrialization, coupled with an over-valued currency and food price controls, has severely depressed commodity prices (Southgate 1992). Farmers have responded by increasing activities in the more profitable, yet more resource-intensive livestock rearing and dairy production.

Lack of Recognition of Positive Contributions

In general, the Ecuadorian government, as well as development agencies, have failed to recognize the contribution of the small scale farmer to the economy and the sustainable use of the land. Through an emphasis on production and high yields, they have underestimated the importance of peasant farming, valuing quantitative aspects rather than qualitative aspects of agriculture. Such thinking is likely to result in long-run degradation, as it rewards short-term, unsustainable methods over long-term ecologically-sound ones.

Recently, limited attention has focused upon tailoring research to the needs and circumstances of peasant farmers. While these organizations encourage peasant participation, their focus is still production-oriented, examining methods to increase yields through technology transfer and innovation. This has been the approach of Ecuador's Instituto Nacional de Investigaciones Agropecuarias (INIAP - National Institute of Agricultural Research). Their mission is to overcome social barriers which have prohibited the adoption of scientific methods and technologies developed at the center (Altieri and Hecht 1990). While the activities of INIAP are important in minimizing land degradation in the Andes, they simultaneously promote the supremacy of modern, scientific technologies over simpler ones. Moreover, these farmers have centuries of knowledge upon which they base their farming methods and are not likely to readily accept or adopt foreign methods presented to them by an external agency.

The effect of policies upon small scale producers in the Ecuadorian highlands plays an critical role in sustaining poverty and environmental degradation. These policies distort incentives, favor large landowners, emphasize short-term goals of production over long-term ones of sustainable production and disregard the importance of peasant knowledge in supporting agriculture. The following section will address policy options for Ecuador and their implications for peasant farmers and land degradation.

Policy Alternatives and Implications

Ecuadorian officials are faced with potentially competing goals: meeting the basic needs of its citizens and halting the severe deterioration of its natural resources. The obstacles in meeting either present a formidable challenge. How to balance them is even more perplexing. Viewing the situation from a holistic standpoint, the goals are interrelated and should not be separated. From a practical point of view, however, this may not be possible. Outlined below are various options which strive to integrate both fulfillment of citizen needs and preservation of the environment. While not perfect, they do enumerate deficiencies in the current system and suggest more effective and equitable policies.

Confronting Poverty

Potentially the most important and challenging task before the Ecuadorian government is the alleviation of poverty. This paper has highlighted the various avenues through which poverty has stymied peasant farmers and promoted environmental degradation. Mitigation of poverty is an admirable goal, but is one that must be achieved through various routes. The interconnectedness of attitudes, policies, demographic factors and economics in relation to poverty should be heeded in any action designed to allay indigence.

One essential step in combating poverty and land degradation is the scrutiny of existing policies which encourage inefficient use of resources. The previous section discussed the effect of agrarian reform upon peasant farmers and the use of land. Many of those policies were developed before heightened population pressures and the recognition of the importance of undisturbed ecosystems in the regulation of the environment. Reform laws define productivity in quantitative terms which encourage the expansion of agricultural frontiers. Stipulations mandating the clearing of land in order to establish ownership are outdated and, if left unchanged, will deplete Ecuador of its natural resources. For an economy reliant upon a rich natural resource base, such policies encouraging their depletion will destine Ecuador to incessant poverty and environmental destruction. Perhaps through the formation of a consortium of policy officials,

scientists and peasants, the government could formulate laws and policies that would more adequately address current concerns.

Reforming Policies

Another area requiring reform is the determination of economic and financial policies. Both are biased towards large scale farmers who have greater financial and political control. Low-interest loans should be reserved for those with limited finances. As mentioned earlier, commercial farmers have greater access to these loans because banking institutions seek to minimize their financial risk by operating with those groups that have established credit. Such action is sound from a business standpoint. As a consequence, however, small farmers must rely upon higher interest loans. Government, therefore, must make it profitable or attractive to lending institutions to deal with indigenous farmers. This may necessitate the establishment of an insurance program which would compensate banks for those peasants that default on their loans. Another possibility would be to establish tax incentives for those institutions that seek out the higher-risk small scale producers. Yet another option would be to eliminate subsidies of products, such as fuels, pesticides and chemical fertilizers. Many of the wealthier large scale farmers who depend upon chemical and mechanical inputs benefit from these subsidies. This is not the group most in need of subsidies. Moreover, subsidizing such products encourages increased consumption and consequent heightened environmental degradation. Through elimination of these subsidies, additional government revenues would be available to help finance low-interest loans exclusively for indigenous farmers. Regardless of the route pursued, it is clear that credit markets must be opened up to allow those in need to mitigate financial stress and invest in improved farming techniques.

Family Planning

Family planning will also be critical in minimizing land degradation. Rural population growth in the Ecuadorian Sierra warrants substantial attention, as growth rates are consistently higher than those in urban areas, as well as in the rural coastal areas. While population pressures exerted upon the land could be averted through more equitable land distribution, long-term considerations warrant the need to address population growth.

Family planning is a sensitive issue especially in the Andean highlands, an area noted for its conservative society. The 1987 Demographic and Health Survey results illustrate the inability of most national and international organizations to successfully promote modern methods of birth control. This is partially due to a resistant public, but even more important is the lack of experience in effectively educating on this sensitive topic. DHS found that, among the many couples who indicate they do not wish to increase their family size, only 39% of rural couples and 59% of urban couples use any type of family planning. The survey results indicate a basic knowledge of contraceptive methods, but a low understanding of the reproductive cycle and a general preoccupation with adverse health effects due to modern contraceptives. In order to promote the adoption of family planning methods among Ecuadorians, it will be essential to provide communities with better information, as well as easier access to planning services. Education should focus upon both health and economic benefits to women, children and families achieved through better family planning. In addition, special attention should be devoted to addressing religious and cultural factors, as well as ensuring privacy in consultations. In order to develop effective communication and education skills in the family planning area, organizations should work together, drawing upon each other's resources and experience.

Involvement of NGOs

To implement family planning programs and other rural development activities, the Ecuadorian government should encourage the involvement of local nongovernmental organizations (NGOs). From a development point of view, there are several advantages to working with NGOs, especially those that are of national, regional or local origin. Due to the typically strong ties with the target communities, NGO support often lends credibility and legitimacy to programs of outside organizations. NGOs are more in touch with the needs and desires of the local communities and, while not completely independent of government, they do enjoy an autonomy which allows them to be more flexible and creative than their governmental counterparts. In addition, their proximity to and close affinity with the communities in which they work reduces the bureaucracy inherent in many government agencies. Generally, NGOs

tend to be leaner and, simultaneously, more efficient than government. Their coherent missions enable them to define positions more clearly, press for innovative solutions and experiment in ways that governments find difficult (Korten 1990).

Recognition of the Contribution of Indigenous Knowledge

A final area demanding attention involves the acknowledgment of the value of indigenous knowledge. Many scientists in the international arena are slowly coming to recognize that peasant methods and knowledge are neither backwards nor primitive. Rather, they incorporate techniques honed through trial and error over hundreds and sometimes thousands of years. In fact, corporations, such as Merck Pharmaceuticals, have formed alliances with indigenous groups in order to draw upon their extensive knowledge and familiarity with their natural environment. Merck, currently working with groups in Costa Rica to extract medicines from tropical plants, relies upon shamans and traditional healers to augment Western science's understanding of the value of medicinal plants and herbs. Similarly, in Ecuador and throughout the Andes, formal recognition of the useful and sustainable aspects of indigenous farming must be encouraged. Researchers need to appreciate the value of peasant farming techniques such as crop rotation, diversity and extensive fallow periods. While yields may not approach those of commercial agriculture, the farming methods, under ideal circumstances, exert minimal pressure on the environment.

Concluding Remarks

Much of the information presented in this paper relies upon national and urban/rural data with interpretations of likely effects within the Ecuadorian highlands. While not perfect, lack of data and logistical difficulties in acquiring subnational data when working outside of the country have necessitated this approach. Whenever possible, specific examples and data on Ecuadorian peasant farmers in the Sierra have been utilized. While many reports have been written as to the value of subsistence farming methods, few provide data to support their conclusions. Thus, this paper has combined existing data with processes of deduction based upon familiarity with Ecuador to arrive at many of its conclusions.

Subsistence farmers are crucial to Ecuador's economy. Andean rural farmers meet a substantial proportion of the national demand for traditional food products. Past and present policies, however, have largely overlooked and underestimated their contribution. Mounting concern over the depletion of Ecuador's natural resources has led some to reproach this group for their contribution to environmental degradation. Such attacks, however, have neglected the true causes, including poverty, market demands, population pressures, inequitable policies and a lack of understanding of small scale farming methods. This paper brings to light these oversights and advocates the need for policy reform, as well as a readjustment of attitudes toward the contribution of indigenous knowledge.

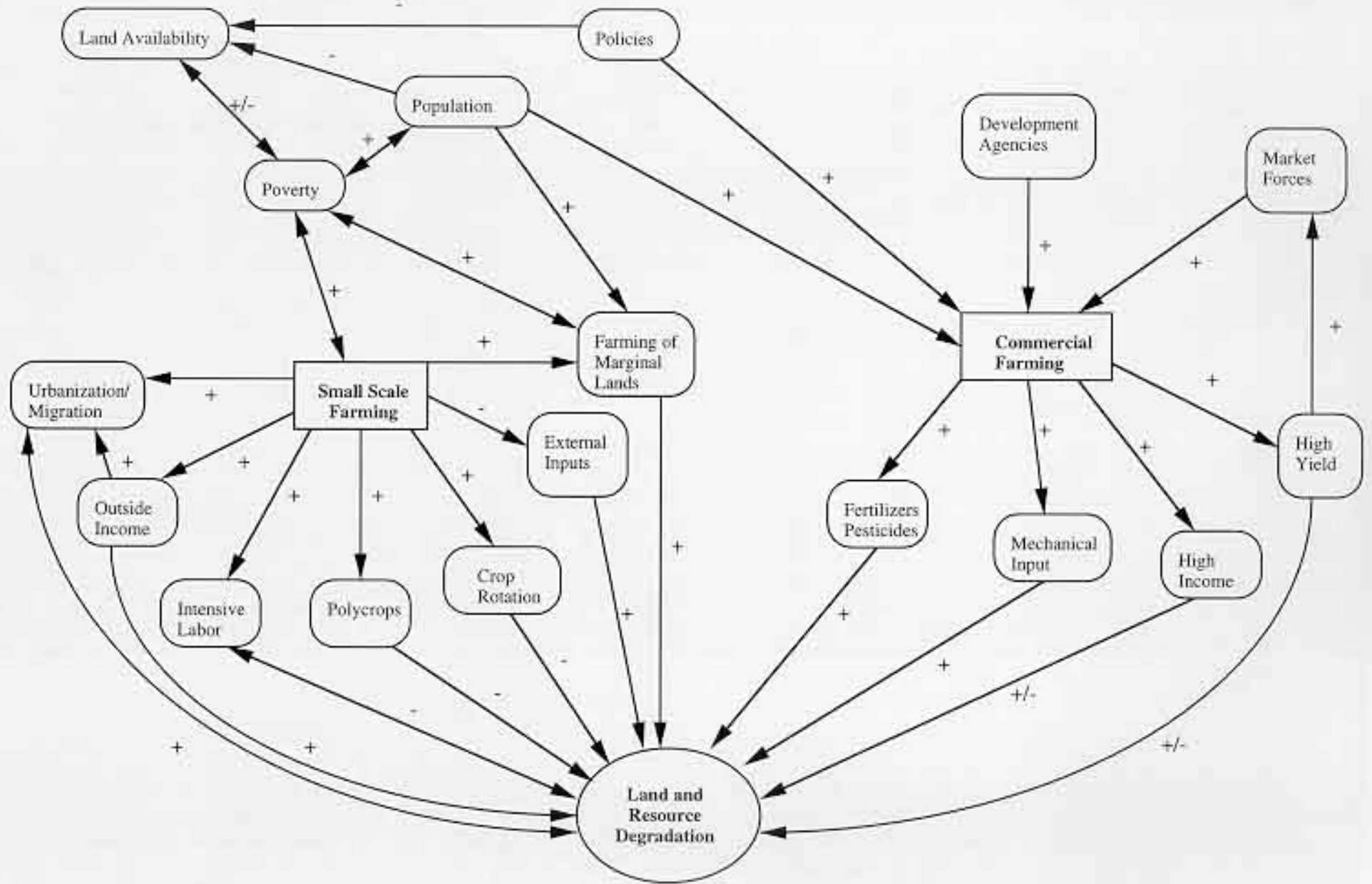
With a potential for soil erosion in 47.9% of the country, the Ecuadorian government must act quickly to preserve their natural resources base for future years. Policies must be adjusted to reflect reality, as well as to provide more equitable access for peasants to credit markets and other areas of the economy. Such adjustments will both alleviate poverty and slow the destructive processes which now threaten Ecuador's fragile ecosystems. Institutional impediments, competing interests and a general lack of attention to long-term planning will challenge the practical implementation of the discussed changes. Nevertheless, it is worthwhile to stress the importance of the need for change with the hope that, over time, governments will come to recognize that preservation of natural resources is in their long-term interest. The hope is that it will not be too late in coming.

This study has primarily examined the situation of the Ecuadorian Sierra and its peasant farming system. Many of the situations presented and the conclusions drawn, however, cross international boundaries. Most countries of Latin America find themselves faced with swelling environmental crises. Like Ecuador, countries in Latin America, as well as around the world, need to utilize foresight in setting their goals and developing their national policies. Recognition of the need to work with peasant farmers, rather than impose external methods upon them, is an essential step in arriving at more sustainable farming methods. Policies must give equal weight to development strategies and environmental preservation, working towards the ultimate goal of a mutually nurturing relationship.

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Sustainability of Small Scale Farming in the Ecuadorian Andes



THE ROLE OF WOMEN IN POPULATION/ENVIRONMENT DYNAMICS IN COSTA RICA

Kim Stone

Introduction

This paper looks at the interconnections between fertility, environmental degradation and the situation of women in Costa Rica. This Central American country is bordered by the Caribbean Sea on the east and by the Pacific Ocean on the west. The estimated 1992 population was just over three million people. Costa Rica is a peaceful country with a democratic government. In 1990, it had the third highest per capita GNP in Central America. Women have had the right to vote since 1949. As can be seen in Figure 1, literacy in Costa Rica is on a par with many developed countries at 93% for both males and females.

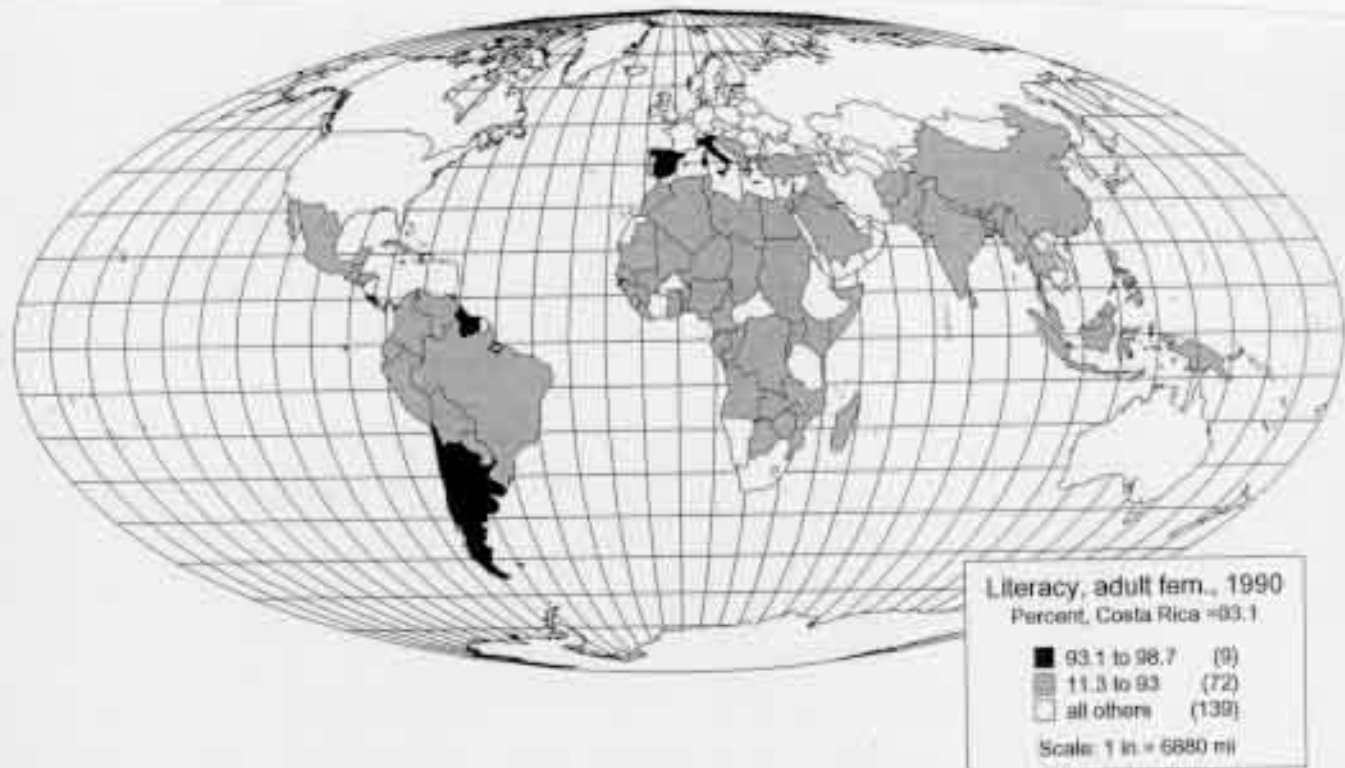


Figure 1. Map of Worldwide Literacy.

Costa Rica's total fertility rate in 1990 was 3.3 children per woman -- one of the lowest in Central and South America, as is illustrated in Figure 2. The country has many features which are considered to be determinants of low fertility, such as its high literacy rate and relatively high GNP per capita. However, the total fertility rate in Costa Rica is still above replacement level (see Figure 3). The natural increase in population at this level of fertility is 2.4%, meaning that the population will double in 29 years at current rates, according to World Resources Institute calculations.

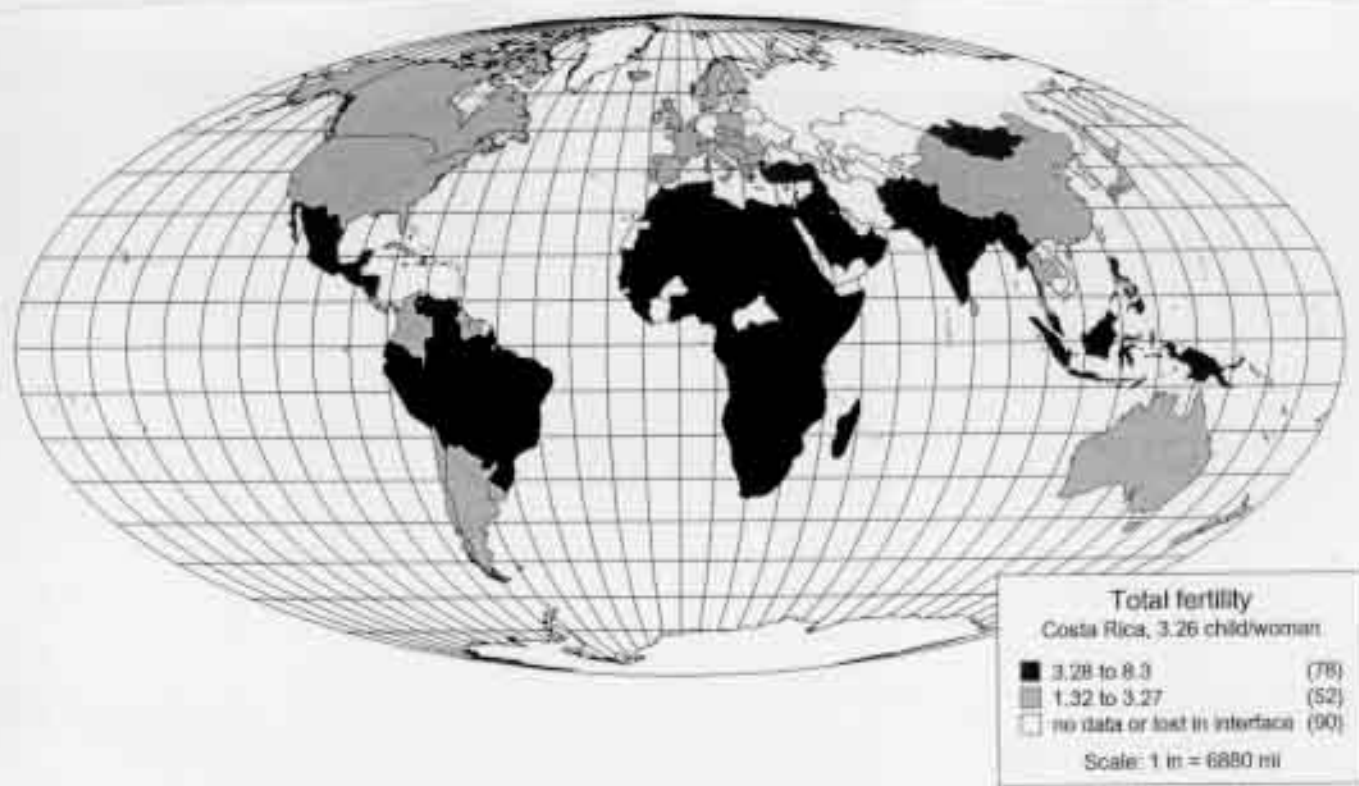


Figure 2. Map of Total Fertility Rate Worldwide.

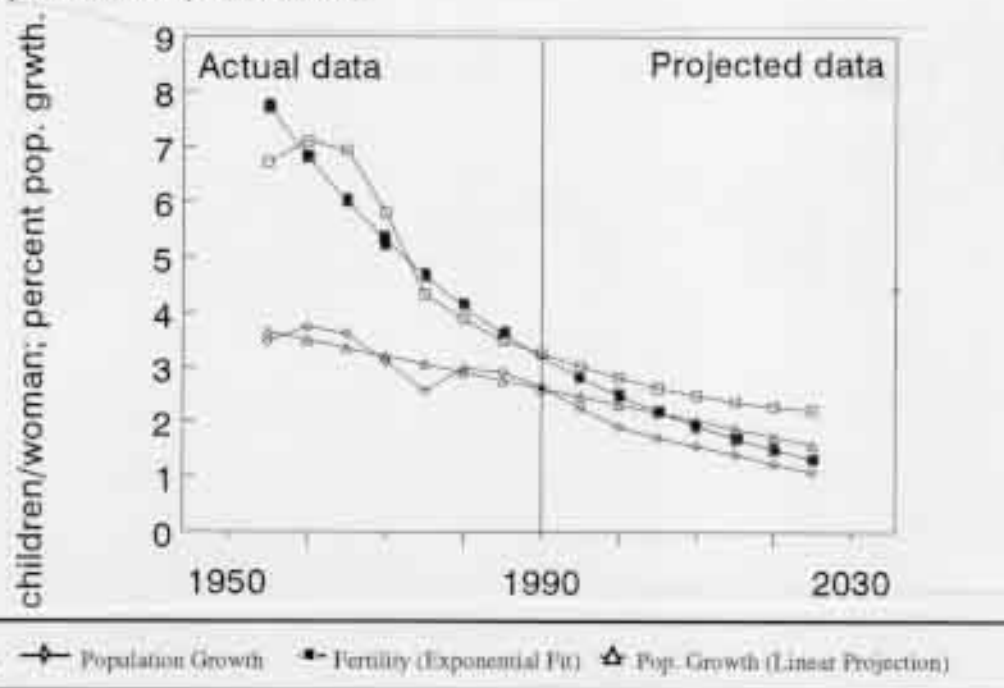


Figure 3. Total Fertility Rate and Population Growth. Data from the World Resources Database and curve fits.

According to the projections of the World Resources Institute, the total fertility rate in Costa Rica will continue to decline until it reaches replacement level in the year 2025. However, I believe that environmental degradation is an obstacle to further fertility decline in Costa Rica and throughout Latin America. In this paper, I will seek to explain why fertility appears to have stabilized at a Total Fertility Rate of 3.3 by examining the demographic transition in Costa Rica, measures of environmental degradation and the status and roles of women in the country. While rural families previously relied on subsistence agriculture for their livelihoods, as environmental quality deteriorates, they must find supplementary income sources. This increases demands on women's time and expands their tasks. In addition, one of the only

resources that women control is the labor of children. These two factors may induce women to keep their fertility high.

The Demographic Transition

The demographic transition model is central to studies of population. Knodel says that this model describes the shift from high levels of mortality and fertility to low levels of mortality and fertility (Knodel, 1992). This transition is also related to the shift from agricultural to industrial societies and from rural to urban. Most developed countries have already completed demographic transitions. In these countries, improvements in sanitation, health, nutrition and technology caused the death rate to decline followed by decreasing birth rates. The gap between fertility and mortality gradually closed and the two measures stabilized at a level of about zero population growth.

In recently developing countries, mortality has declined rapidly, assisted by the export of medical and agricultural technology from more developed countries. These technologies have helped to increase food production, improve sanitation and increase the availability of safe drinking water. Resulting improvements in nutrition and health, and decreases in infectious and parasitic diseases, have lowered death rates. For example, according to the World Resources Institute, by 1980, 100% of Costa Rica's urban population and 68% of the rural population had access to safe drinking water. By 1988, 84% of Costa Rica's rural population had safe drinking water (World Resources Institute, 1992).

While death rates have declined rapidly in developing countries, birth rates have remained high. The gap between birth and death rates in less developed countries has led to rapid population growth in these areas. The combination of historically high birth rates and low death rates is also self-perpetuating. Because both crude birth rates (CBR) and crude death rates (CDR) are influenced by the age structure of the population, young populations have high CBRs since a larger proportion of their populations are of childbearing age. In Costa Rica, the Total Fertility Rate (TFR) decreased from 6.7 children per woman in 1955 to 3.3 in 1990. TFR is an estimate of the total number of live births that a woman would have if she were exposed to a given set of age specific fertility rates throughout her lives. Replacement fertility is 2.1. If Costa Rica's TFR continues to decline as suggested by the World Resources Institute, the population distribution will show a higher proportion in older age and the CDR will increase.

As can be seen in Figure 4, Costa Rica is currently in the midst of its demographic transition. During the thirty year period from 1955 to 1985, the CDR dropped almost seventy percent, from 12.6 deaths per thousand to 4.1. During the same time period, the CBR went from 47.3 births per thousand to 30.2.

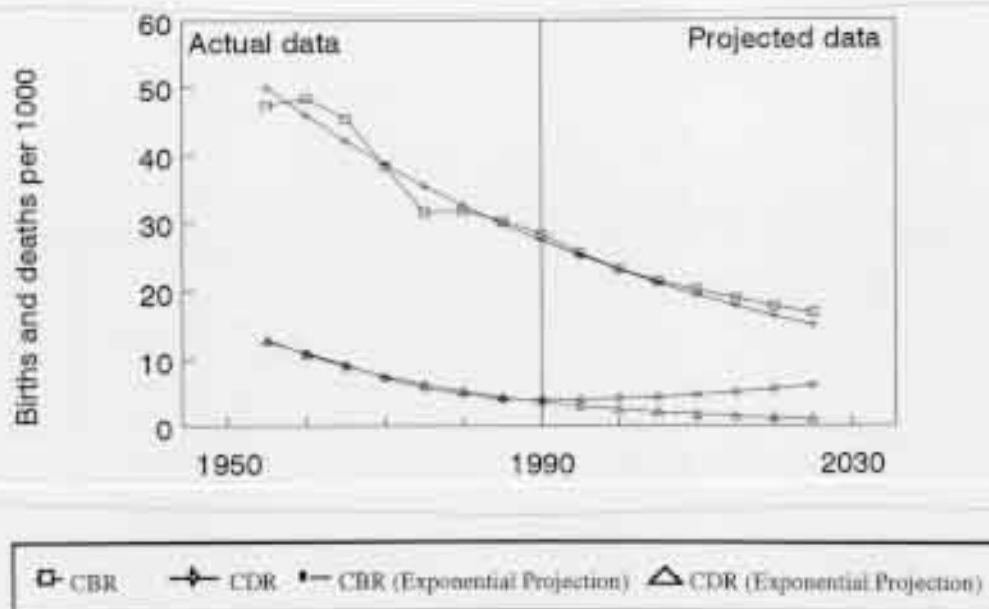


Figure 4: The Demographic Transition in Costa Rica. Data after 1989 is based on projections by the World Resources Institute (WRI, 1992).

Costa Rica's CBR has remained fairly constant since 1975 when it reached a level of 31.5 births per thousand. Demographic transition theory is not easily applied to this situation. The drop in the CBR has not kept pace with the lower CDR, so while the two statistics have begun to converge, the process is very slow and seems to have stabilized, at least temporarily.

Environmental Degradation

The two main environmental problems in Costa Rica are deforestation and decreased land and soil quality. As population increases, further demands are placed on natural resources and, depending on consumption patterns, the environment may deteriorate further.

Increased pressure on biological resources arises because of increasing human populations, changing consumption patterns, and new technologies. Although agricultural intensification will continue to be necessary, its impact on biological resources is not predetermined. (Soule and Kohn, 1989)

Ecological transitions naturally accompany growth. However, these transitions may make it more difficult for people to survive on the land if they do not know appropriate techniques of food production for the changed land conditions, or if the newly cultivated land is not suitable for agricultural production. Increases in the population of a country can lead to environmental degradation as more demands are placed on natural resources. In Latin America, land has been deforested to increase pasture and cattle ranching lands. However, soils from forest lands are not necessarily suited to these uses. According to Carriere, the US Agency for International Development has divided land into five categories based on the climate and the condition of top soil. Each area is classified as suitable for pasture, forestry, permanent crops, protection, or clean-tilled crops depending on the risk of erosion and the intensity of cultivation which the land can sustain without deteriorating (Carriere, 1991). Table 1 shows the classifications for Costa Rican land. Much of the low-risk land that is suitable for clean-tilled crops is unused. However, much more land is used for pasture than is suitable for that purpose. In addition, the increased amount of land used for export industries such as cash crops and cattle ranching has decreased the land available to grow subsistence crops and has pushed native peoples off land suitable for farming and into fragile forest areas.

TABLE 1
Suitability of Land for Cultivation (km²): Costa Rica

	Zero to Moderate Erosion Risk	High to Extreme Erosion Risk	Actual Land Use (1980)	Total Susceptible Land
Pasture	1451	3205	19000	4656
Forest	6784	9304	18000	16088
Permanent Protected	539	7619	*	8158
Clean-tilled	700	11791	*	12491
Total	9437	0	2250	9437
	18911	31919	37250	50830

Source: Carriere, 1991

* Data Not Available

The Forestry Transition

Costa Rica was originally rich in forest land, but deforestation began on a small scale as early as the colonial period, starting the forestry transition. Carriere says that the first wave of deforestation began in the 1830s as the Meseta Central and hillside volcanic forests were cleared to make way for coffee cultivation. Deforestation accelerated in the 1970s mainly due to pasture expansion for export cattle ranching. In 1970, Costa Rica had about 26,000 square kilometers of forests (about 51 percent of the country). 7,000 square kilometers of the forests were lost from 1970 to 1980, reducing the forest cover to 36 percent of the land mass. Forest area was down to 31 percent, or 16,000 square kilometers, by 1987 (Carriere, 1991). In 17 years, Costa Rica lost 38 percent of its forest. Figure 5 shows the approximate pattern of deforestation from 1940 to 1983. Early deforestation occurred primarily in the Meseta Central region which was mainly cleared for coffee plantations (Carriere, 1991). Spreading from there,

deforestation extended to cover most of the Northwest portion of the country by 1961. Toward the late 1970s and early 1980s, the forest land covered only the northeast corner of the country and a portion of the southwest. However, the remaining forests were scattered through the country in bits and pieces, leaving little contiguous forest land.

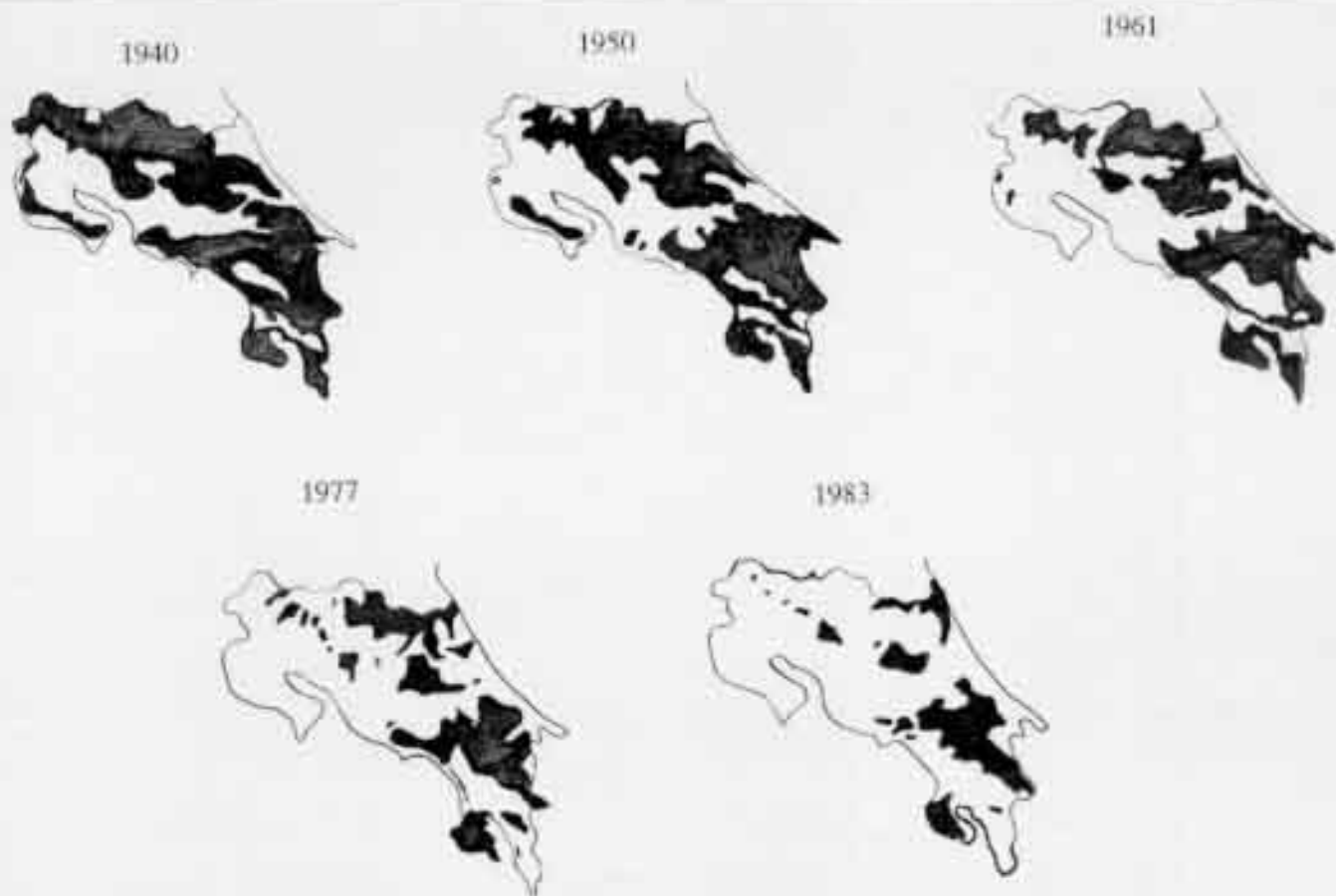


Figure 5. Deforestation in Costa Rica from 1940 to 1983. Shaded areas signify forest areas (Carriere, 1991)

Recently, Costa Rica has taken steps to preserve its forests by putting most of the remaining forest land in legally protected reserves. However, a study by a private environmental organization, Fundación Neotropical, indicated that landless peasants were illegally cutting trees in these reserves. According to the study, 25 percent of the reserves were cleared between 1985 and 1988 (Carriere, 1991).

Much of the deforested land in Latin America is used to produce exportable crops. "Latin American countries increasingly provide fodder crops for livestock reared in western Europe, and dedicate a significant proportion of their cultivated area to what are termed 'winter fruit and vegetables' consumed in the United States" (Redclift and Goodman, 1991). Forest has also been cut to make way for cattle ranching. "Today over two-thirds of Central America's best agricultural land is devoted to ranching" (Redclift and Goodman, 1991). According to Woodwell:

Deforestation, often touted by governments, land speculators, and others as the route to wealth, is rarely recognized as impoverishment of the landscape and the cause of human poverty... the expansion of human activities is rapidly reducing the habitability of the earth. The question is how to stop the process in a world in which demands for food and other resources in support of an expanding population already exceed supplies; where human welfare, even survival, are often advanced as the reason for allowing further destructive exploitation. (Woodwell, 1993)

Regardless of the reasons for deforestation, the consequences to the environment are far-reaching. Forests are important both globally and locally. Many of the biological and ecological functions necessary for the survival of the Earth take place in tropical forests. Locally, forests are a reservoir of biodiversity; they protect against drought and flood by absorbing and storing water, ensure soil fertility, protect slopes from erosion, and moderate climates. Globally, forests serve as a sink for heat-trapping gases in the atmosphere and protect the biotic potential of the land.

The Agricultural Transition and The Consequences of Deforestation

Closely related to the forestry transition is the agricultural transition. In Costa Rica, this includes both the conversion of lands from forest to agricultural and pasture lands, and the new agricultural techniques used on these lands. Costa Rica's environmental degradation is not due solely to deforestation, but also to the ways in which its land has been used since being deforested. Figure 6 shows land use in Costa Rica from 1970 to 1989. While the amount of cropland remained fairly stable during this period, it is clear that the decrease in forest and woodland area mirrored the increase in pasture lands.

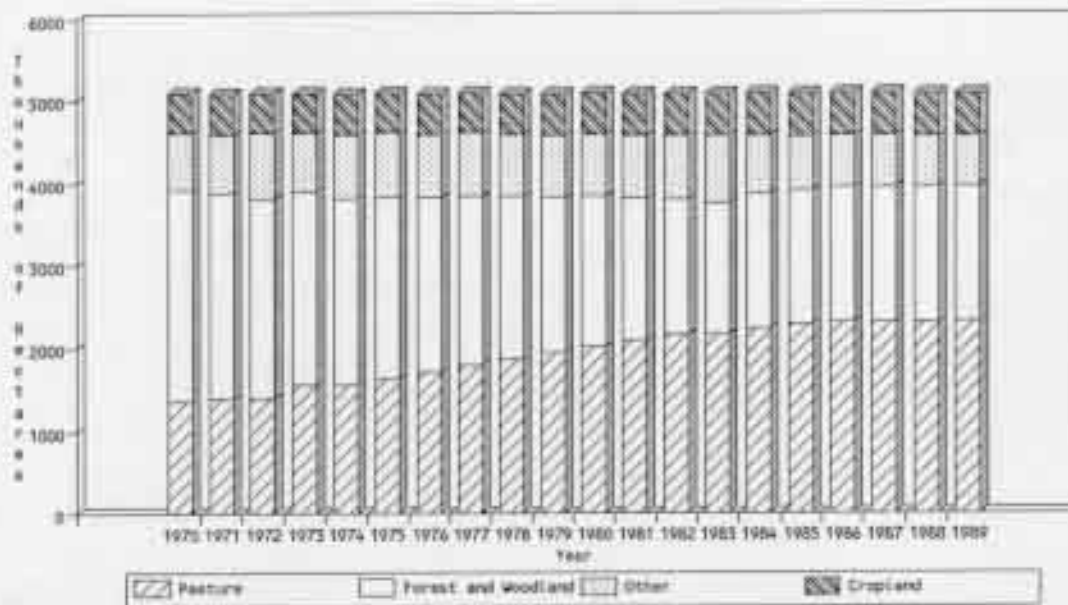


Figure 6. Land Use Patterns in Costa Rica. Cropland is land under temporary and permanent crops or temporarily fallow, garden or meadow land. Permanent pasture is land that has been under cultivation or has been used to forage natural crops for at least five years. Forest and woodland areas include both natural and planted stands of trees. Other land is uncultivated land, grassland, wastelands, wetlands, roads and built-on areas (World Resources Institute, 1992).

Forests are able to live on nutrient poor soils and most tropical forests grow on highly acidic, sandy or clay soils. These soil properties make previously forested land unsuitable for agricultural crops which can not adapt to these conditions. Much previously forested land in Costa Rica is used for agriculture and cattle grazing making inputs of fertilizers and chemical pesticides necessary to achieve desired yields. However, these methods are not sustainable over the long-term and plots must be abandoned as the soil quality is degraded and erosion takes over. The World Resources Institute has classified Costa Rica as an area where soil degradation is of serious concern (World Resources Institute, 1992). This degradation makes the situation particularly difficult for poor people in rural areas who live off the land. The population of Costa Rica is increasing; hence, demands on its natural resource base are expanding as well. Carriere explains the impacts of deforestation and land degradation on Costa Rica during this time of increasing population:

Land degradation through loss of nutrients, compaction and erosion directly reduces the actual and potential productive capacity of the country at a time of rapid population growth. Unplanned, poorly managed deforestation such as has been taking place in Costa Rica has

several negative consequences. As well as being the prime cause of land degradation, it also leads to the erosion of river banks, the silting up of rivers and watersheds, the appearance of cycles of floods and drought, the disruption of fishing grounds, interference with the normal operation of hydroelectric schemes, loss of habitat for threatened plant and animal species and most of all, loss of future economic opportunities through the exploitation of extractive forest reserves on a sustainable basis. These trends are reducing the country's natural resource 'capital' thus creating further obstacles for future generations grappling with the challenge of improving the living standards of a growing population from a diminishing resource base. (Carriere, 1991)

Another consequence of deforestation is that the roads built for loggers to access the forests enable landless squatters to enter fragile, previously inaccessible lands. This land is used for fuelwood gathering or slash and burn agriculture until the soil is degraded and the land abandoned or used later for cattle ranching. (World Rainforest Movement, 1990) The emphasis on export crops may encourage this migration by forcing peasants into forests to make way for pastures and export agriculture. This emphasis often leads people to engage in unsustainable or environmentally destructive agricultural practices, such as farming rainforest land, in order to feed their families. According to Carriere, crops can only be grown on the deforested land for a maximum of five years. Then peasants move on to clear new plots and the abandoned land is sold to ranchers who use it as pasture for four to six years. At this point, the soil is degraded and the land is subject to erosion and desertification. The cycle continues as loggers, peasants and ranchers move further into the forest (Carriere, 1991).

The Effect of External Debt on the Environment

According to Kandiyoti, many Latin American countries, including Costa Rica, borrowed money beginning in the 1950s to buy imported technology and capital to establish their industrial bases, increasing their external debt. Thus began the region's reliance on export agriculture as a source of hard currency. This dependency was promoted by international and bilateral agencies who offered incentives for countries to produce and export crops. However, chemical inputs and machinery were necessary to increase productivity, leading these countries to borrow further and increasing their external debt.

Costa Rica's external debt began to increase dramatically in the mid-1970s as is shown in Figure 7. However, as is seen in the graph, exports have not kept pace with the escalating debt. During the 1970s, Costa Rica's reliance on traditional fuels declined dramatically at a time when the country's Gross National Product per capita (GNP/c) was increasing. It appears that Costa Rica was borrowing money to pay for modern fuels to power its new technology (e.g. agricultural machinery run on oil or gas) and for electrification of rural areas. As the country's cash economy expanded, so did GNP/c, with the exception of a period of economic depression in the 1980s.

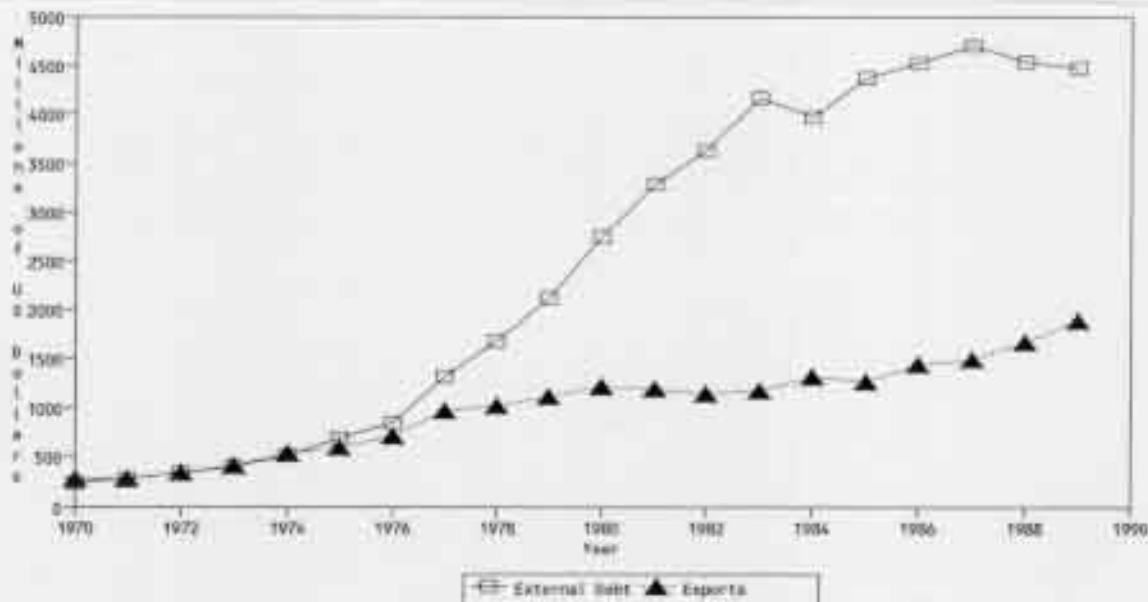


Figure 7. Costa Rican External Debt and Exports

The rapid escalation of Costa Rica's debt in the 1970s follows a sharp decline in traditional fuel use as a percent of the country's total fuel use (see Figure 8). A possible explanation for these sharp movements is that after Costa Rica increased its reliance on non-traditional fuels, the prices of these fuels increased dramatically during the worldwide energy crisis of the 1970s. However, Costa Rica was already dependent on these new fuel sources and increased its debt to pay for them.

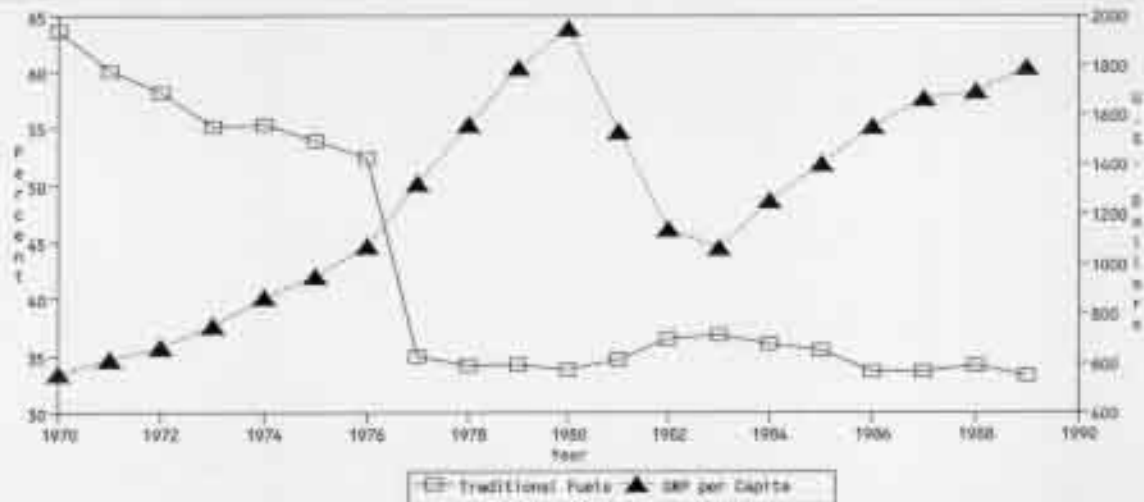


Figure 8. Traditional Fuel Use as Percent of Total and Gross National Product per Capita.

The vicious cycle of increasing debt and expanding exports led to increased cultivation. Cultivation of unsustainable lands caused rapid soil degradation and decreased crop yields. Therefore, the total amount of land under cultivation had to be increased in order to continue at the current rate of production. Land available for subsistence agriculture was reduced because of the emphasis on export crops. According to Kandiyoti, per capita cultivation of subsistence crops in Latin America decreased by 10 percent between 1964 and 1974 while the cultivation of export crops grew by 27 percent (Kandiyoti, 1985). As the production of subsistence crops decreased due to environmental deterioration and the increased cultivation of export crops on the land, families began to rely more heavily on cash income.

The Effect of Environmental Degradation on Women's Tasks

Previously, both men and women worked the land to produce food for themselves and their families. With the increased reliance on cash income, many men migrated to work in cities or on other farms for cash, leaving women to take up an increasing share of the work at home. With men's labor unavailable for subsistence production, women are left to produce enough to feed their families in addition to performing their daily domestic tasks, including collecting water and fuelwood, food processing, cooking, taking care of children and doing laundry. Days are very long for these women who must perform their domestic chores before or after their other work. According to Kandiyoti, women may work on domestic tasks from 3 to 6 am or from 4 to 9 pm (Kandiyoti, 1985). Landless women may engage in subsistence farming, commodity work and domestic chores for wealthier households as well as their own housework. In addition, sometimes daughters are sent to work as domestic servants in urban areas to increase the family's cash income.

As men increasingly take up wage-work, women take charge of subsistence agriculture, the household's secondary activity, as an extension of their domestic work. The access of women to rural labour markets is clearly limited to less permanent low-wage sectors and their subordination is reflected both in their levels of remuneration and the sort of work they do...The intervention of merchant capital in areas where it stimulates production,

without becoming directly involved in raising productivity through new technologies, may create an increased demand for labour. (Kandiyoti, 1985)

The migration of husbands to work far from home may also make women more dependent on children for emotional support. The only resource over which women have control is the labor of their children. So, women may choose to have more children to help them grow food, perform domestic tasks, or take care of younger children while women work for cash incomes.

While increased population is generally given as a reason for environmental deterioration, degradation of the environment also puts increased pressures on those who must live off these lands. In many instances, poor women bear an increased burden due to the less healthy environment. In rural areas, especially, women perform dual roles, including both domestic and agricultural tasks in their days. Environmental conditions help to determine the productivity of the land and, in turn, the amount of land that must be planted to achieve the desired yield. Therefore, as the environment becomes degraded and soils become less fertile, more work is necessary to grow the desired amount for food or export crops, more labor is required, and fertility may increase in response.

Obstacles to Further Fertility Decline

Women in Costa Rica do not have access to resources to help them with subsistence production. If they do work for cash, their wages are given to their husbands. However, the work opportunities available to women are generally poor. According to Stein, the industries which moved into Costa Rica beginning in the 1970s were labor intensive and women have been relegated primarily to low-wage, low-prestige jobs (e.g. housekeepers, artisans, salespeople, and assembly line workers) (Stein, 1984). In a study of the male-female wage differential in Costa Rica during the early 1980s, Gindling concluded that women who entered the workforce during the recession to "help maintain family incomes in the face of falling real earnings for the primary family worker" were less educated and earned lower wages. During this time, a disproportionate number of women entered low-paying sectors of the workforce (Gindling, 1993).

For women who do hold paying jobs, female employees are legally entitled to four months of paid maternity leave in Costa Rica. However, there are no safeguards to ensure that employers do not fire women simply for being pregnant and, if a woman is fired unjustly, she does not have to be re-hired. Similarly, laws entitling women to time off for breastfeeding of infants are not logistically workable. Although employers are supposed to provide sites at the workplace for this, they rarely do. Even if they did, there is no one to transport the infant from home to work and back, and not enough time for women to travel home and back to feed their infants (Saint-Germain and Morgan, 1991).

Looking at many of the laws and statistics, it appears that women and men have equal status in Costa Rica. However, speaking about the legal situation in Costa Rica, Chase remarks, "our laws and our Constitution were made for and by men seeking to maintain their veto power...and are a social mirror of the profound prejudices in our society against women" (Chase, 1988).

One misleading statistic is the literacy rate. Costa Rica offers free, compulsory education to its citizens through the ninth grade (Saint-Germain and Morgan, 1991) and the literacy rate is 93% for both men and women (see Figure 1). Although this is one of the highest literacy rates in the world, the content of Costa Rican education may not help to advance women's social status. Saint-Germain and Morgan state that textbooks use male role models and present women in domestic situations while men are shown in a variety of roles. For example, they quote Norma Jimenez about her experience in school in Costa Rica:

I learned to read and write with a book called "Paco and Lola" where Papa appears reading the newspaper and Mama making tortillas. You see? It is a cultural pattern; Papa is waiting for Mama to serve him dinner. That's the pattern that we have had... Within 100 years the new society will have eliminated that pattern, that Papa studies and Mama sews, for Papa the good life and for Mama work, Papa requires and Mama complies. But it is not a law. I tell you, in Costa Rica there is a surfeit of laws, an overabundance. Compliance with these laws is what is lacking. (Saint-Germain and Morgan, 1991)

Laws in the areas of economics and property rights grant women equality on paper, but not in practice. Property rights are an area where women's second class status is apparent. While there are communal property rights for married couples, property is generally in the name of the husband. It is difficult for women to secure loans since they have no collateral, and women are rarely eligible for land under most government land distribution programs. Thus, men have control of the land and its products and, by extension, control of women.

In the political arena, women gained the right to vote in 1949 along with the right to be elected to public office (Saint-Germain and Morgan, 1991). However, according to United Nations Statistics, women held only about 7% of the executive offices and no ministerial level positions in 1987. The number of women in parliament almost doubled from 1975 to 1987, with women occupying 5.3 and 10.5 percent of the seats, respectively, in those years (United Nations, 1991).

Urbanization in Costa Rica

In looking at the interactions between population, environmental degradation and women's roles, it is important to look at the urban/rural population distribution. Rural societies tend to be primarily agricultural while urban dwellers are more often employed in the industrial and service sectors. Urban and rural dwellers have different lifestyles, thus affecting most of the factors that I have addressed. For example, the roles of women and children, workloads, nutrition, sanitation and education are all different in urban areas.

Costa Rica's population is almost equally distributed between urban (54%) and rural (46%) areas. A combination of rural to urban migration and population growth have caused the urban population to gradually increase. As is shown in Figure 9, the rural and urban populations are predicted to equal out by the year 1995, according to estimates by the World Resources Institute. After that, urban dwellers are expected to outnumber rural. However, the absolute number of people in rural areas will still increase and as long as the population grows, the number of people living off the same land will continue to grow. While the proportion living in urban areas may grow, there will be a higher absolute number in rural areas because of the continuing population growth (see Figure 3). Therefore, urbanization should not have an exceptional impact on population, environmental degradation or the roles of women in Costa Rica.

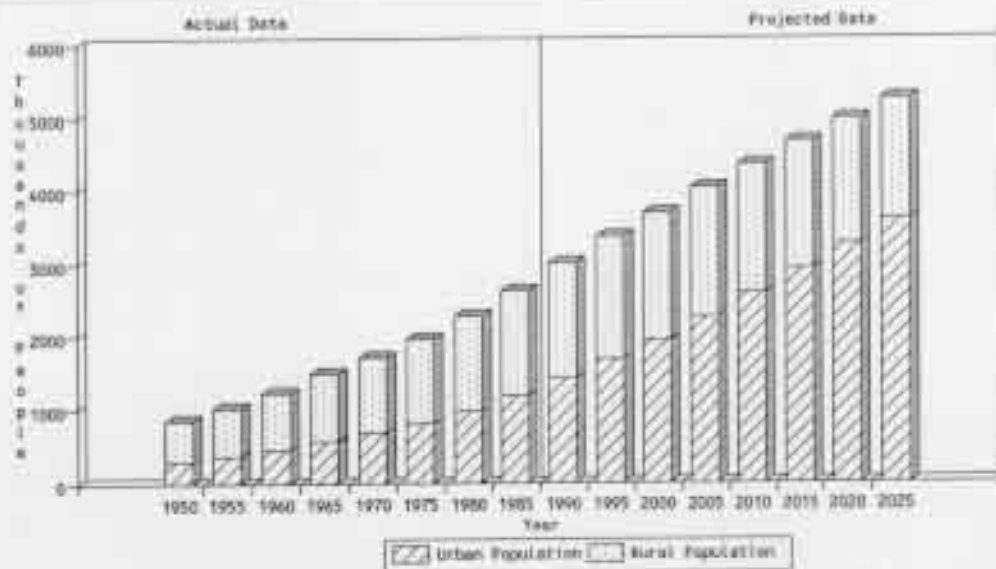


Figure 9. Urban/Rural Population Distribution in Costa Rica. Data after 1989 is based on projections by the World Resources Institute (World Resources Institute, 1989).

Conclusions and Recommendations

Women around the world have dual roles; mother and producer. There are trade-offs that are necessary for women to perform both roles, sometimes voluntary and other times dictated by circumstances. In countries such as Costa Rica where women do not have access to or control of resources, their situation is particularly difficult. The labor of her children may be the only resource that a woman in a developing country can control. This labor can help women to increase their production, or allow them to work for cash by leaving older children to take care of domestic tasks and infant care. Childbearing can also be empowering and can provide emotional support to women. As Nadia Youssef states, "(s)tripped of her economic/productive role, woman has to depend on motherhood performance for status and prestige and on her children's labor as a strategy for survival" (Ward, 1984). Under current

conditions, women will continue to have many children. For fertility to decline further, we must improve women's lives, empower them, and change the conditions under which they live.

In Costa Rica in 1989, 69.5% of married couples were using some form of birth control (World Resources Institute, 1992). This high contraceptive prevalence rate indicates that a significant proportion of the population has knowledge of and access to some form of birth control. However, further increasing contraceptive use will be more difficult because it may involve changing social and cultural patterns. Some women are not willing to reduce fertility because children serve valuable roles in the present circumstances. As the environment is further degraded, the situation will only get worse. Women's work will become more difficult and time consuming as soils are degraded and subsistence farming is forced onto less fertile lands. A large number of children take some of the burden of this work off women. Labor is not the only incentive to have children; babies also provide emotional support, especially to women whose husbands work far from home for long periods of time. Rather than simply offering alternatives to childbearing, women must be given options which are rewarding and which enrich their lives enough for them to decide, voluntarily, to have fewer children.

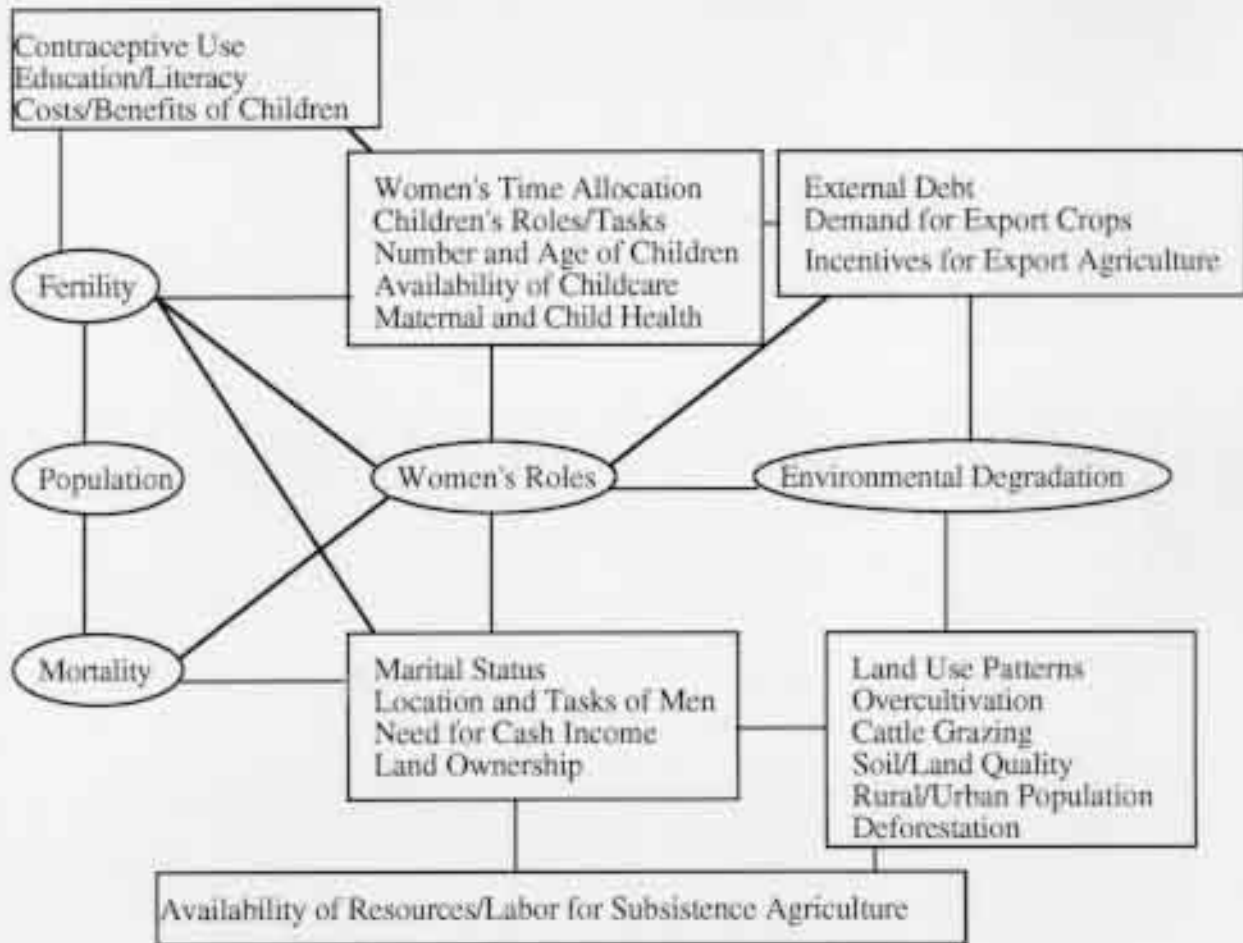
The following are recommended actions that I believe would help Costa Rica to slow its population growth rate, complete its demographic transition and slow environmental degradation:

- Change the content of education to include professional women as role models and to teach both men and women that there are viable alternatives to childbearing for Costa Rican women.
- Take aggressive steps to stop and reverse soil degradation and deforestation. Teach rural men and women sustainable land management techniques and insure that those actually working the land — including women in subsistence agriculture — have access to adequate resources to implement these techniques.
- Decrease reliance on export agriculture and cattle ranching. Seek more environmentally friendly ways to increase cash income and to reduce external debt.
- Gather data on women's workloads, tasks, and time allocation in urban and rural areas to determine how the situation could be changed to reduce demand for children.
- Offer women access to resources and control of the land. Ownership of the land by those who farm it will encourage more sustainable resource use. In addition, this gives women control of their own lives and enables them to see viable alternatives to childbearing.

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**INTERCONNECTIONS BETWEEN ENVIRONMENTAL DEGRADATION,
FERTILITY AND WOMEN'S ROLES**



EARLY-STAGE HEALTH AND DEMOGRAPHIC TRANSITIONS: INFECTIOUS DISEASE AND HEALTH SERVICES IN MALAWI

By Amy D. Sullivan

I. INTRODUCTION

It sounds obvious, but is important to remember: in order for countries to plan for the future, there must be some idea of what the future may bring. In these days of rapid change at a global scale, this future can be difficult to predict. However, it is possible to construct models based on what has been seen to be important in other countries, as well as what one knows of the region or country of concern. There is increasing recognition that it is vital to consider more dynamically the interactions between populations and the environments in which they live.

A useful tool in considering these interactions is to think in terms of transitions. There are as many types of transitions as there are things that effect populations. Some of the most frequently considered are demographic, agricultural, toxicity, and epidemiologic transitions (Drake, 1991; Meadows, *et al.*, 1992). Different patterns of transition can be seen in many parts of the world. Relationships between and among transitions -- in terms of timing and extent -- can impact on the quality of life in a given a society.

Unfortunately, it is impossible to look at all of the transitions going on in a given population at a given time. Limitations include insufficient data to track events, as well as the "intellectual overload" of trying to visualize everything concomitantly. Thus, in order to make models of transitions usable, it is useful to focus on particular subsets that could answer questions about a particular policy question. The purpose of this paper is to gain insights into the health environment in Malawi: At what stage is this country with respect to the epidemiologic and demographic transitions?, and What issues emerge as future priorities for Malawians with respect to these two transitions?

The demographic transition in Malawi is considered with respect to the health transitions beginning in occurring in that country. (The broader term "health transitions" is used to encompass both epidemiologic and health services transitions.) Demographics are an integral component of considering the health needs of a population overall, as those needs shift with the specific populations at risk. For example, not only do infectious diseases disproportionately affect the young, but if one has a relatively rapidly increasing young population than the appropriate resources must be planned to address their needs. Also, when a country's potential health resources are particularly limited, more thought can be given to the cost-effectiveness of planning population growth.

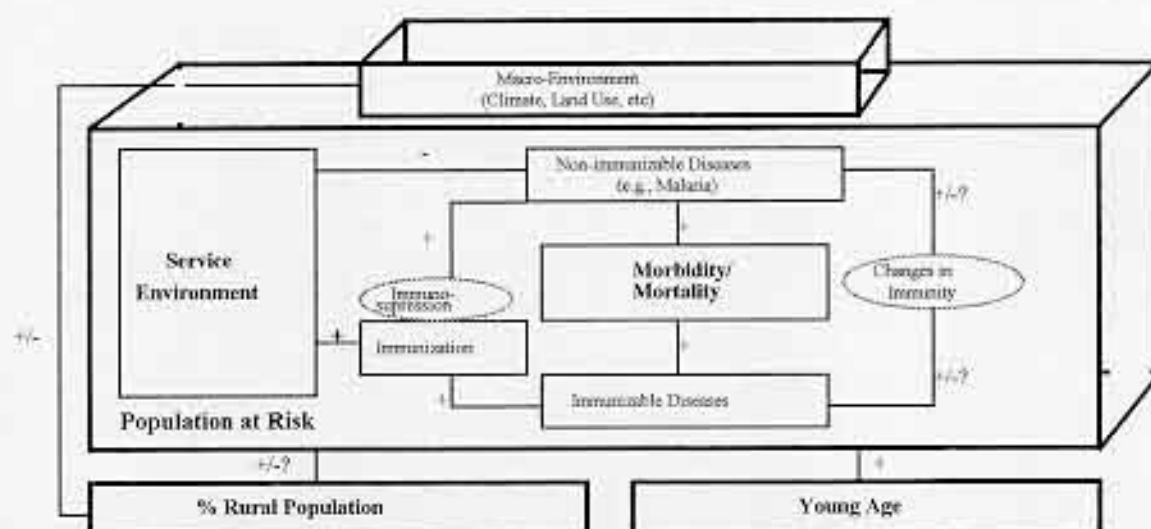
The health issues considered here with respect to the transition are those that one would expect to find in a relatively poor Sub-Saharan African country: infectious diseases and the health services that deal with them are at the center of this evaluation. The two major aspects of the former considered here are immunizable diseases and malaria -- an important disease for which there is no immunization and no easy way to treat those most at risk. Those populations most at risk are young children and pregnant women. Because of the paucity of data available on the latter, young children are focused on.

This evaluation is structured so that infectious disease is considered in the context of health services and demographic "environments". This word is given in quotations to reflect the idea that it is not a physical environment as such that is being looked at (e.g., climate, soil, land use); however, as social environments with certain structures of their own, their importance is equally important. The reasons for skirting the more traditional "environments" is discussed in more detail later. For now, suffice to say, this choice does not mean to underestimate the obvious importance of the physical environment, but rather to

highlight other issues considered. The population-environment dynamic itself is a driving force behind the consideration of all transitions. At this point in time in Malawi, the environment is a key factor in the potential for an epidemiologic transition and the main force restraining the transition.

The overall model considered is given in Figure 1. Within this model, the focus is on population at risk, the service environment, and malaria. More specifically, this paper will briefly review what the major types of diseases among young children in Malawi are, as well as what drives the importance of these diseases -- i.e., what are the environmental, economic and other factors that appear to sustain the present disease profile in this country. Two transitions that could effect this profile -- the demographic and health services transitions -- are then considered in greater detail. Other more specific topics also are considered in the context of the health services/demographic/infectious disease interactions seen. Policy recommendations are then made as to how to affect the demographic transition and improve the situation regarding the prevalence of infectious diseases.

Figure 1: Model of the effects of demographic environment, service availability, and other factors on infectious diseases



II. MALAWI: A REVIEW

A. General Conditions

Malawi is a small country (approximately 46,100 sq. miles, or roughly the size of Pennsylvania) in the southern part of East Africa, bordered by Zambia to the west, Tanzania to the north and east, and Mozambique to the south and east. There are three regions in the country: the Northern and Central regions run along the western shore of Lake Malawi, and the Southern Region is to the south of the lake. Malawi has a tropical climate, with a rainy season that last roughly from December to April. Malawi is, economically, a Fourth World State. The material standard of living is very low by Western standards.

The economy is predominantly agricultural, though there are government development plans aimed at diversification. The main exports are tea, sugar, and tobacco (UN Statistical Yearbook, 1992). Subsistence agriculture is practiced. Crop use intensity varies throughout the country, but in most areas it ranges from 5-50% of land use. Almost all of this use is for traditional (non-mechanized) agriculture (United States Agency for International Development, 1992). There are small areas, in the extreme north and south of the country, where land use drops below 5%, and a roughly equal area, mostly in the north, where land use

exceeds 50%. In the northern and central areas, maize production tends to parallel the crop land use patterns observed. The association is not seen in the southern area. Food deficits are greater in the south (ranging from requirements of 20 to over 90 metric tons per year) than in the north-central areas (ranging from requirements of under 50 to excesses of over 20 metric tons) (USAID, 1992). It should be noted that Malawi has been very hard hit in recent years by the drought in the region. It is estimated that roughly 85% of the country's population was effected by this drought in 1992 (UN, 1992).

Literacy rates are low for men and women (relatively lower for women), and mortality rates for infants, children, and pregnant women are among the highest on the continent. Literacy and health indicators vary considerably within the country. The Northern Region has higher levels of female literacy and lower levels of infant mortality than the other regions. This variation is important to remember when interpreting the results discussed here – results obtained from national level data.

D. Demographics

The population of Malawi in 1990 was about 8,754,000. Population density is, on average, higher in the southern half of the country (USAID, 1992). The high rate of population growth is dramatically illustrated by the population pyramids shown in Figures 2a and 2b. The annual population growth rate as of this year was 3.52. The total fertility rate (TFR) was an extremely high 7.6. The age distribution is heavily weighted toward the bottom of the pyramids, with roughly 19% of the population below the age of 5 years (including 15% from 1 to 5 years old). Almost 45% of the population is below the age of 15 years. Only between 2 and 2.5% of the population is over 65 years old. In each age group there are slightly more males than females. This difference is especially evident in the youngest age groups. According to MacCormack, this difference in this young age group may be a reflection of women having relatively high status in Malawi, though this point is difficult to establish without differential infant and child mortality rates (MacCormack, 1989). Most of the population (about 88%) is located in the rural areas. It is not known how the population in the urban areas compares to that in the country overall. (United Nations, 1977; United Nations, 1991; WRI, 1992)

Figure 2a: Age structure. Malawi, 1977 and 1991 (Data source: UN Statistical Yearbook)

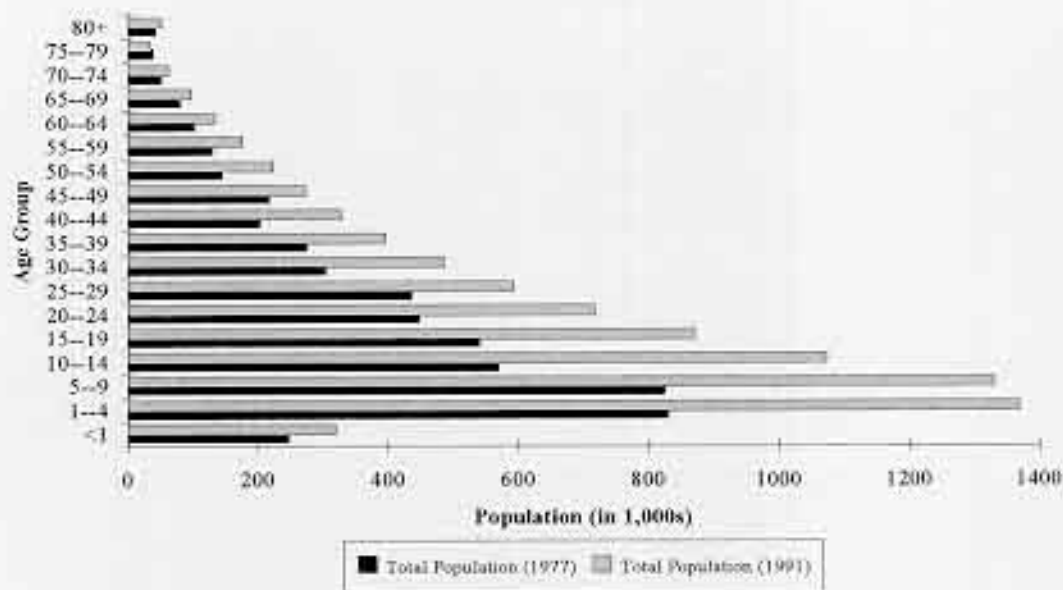
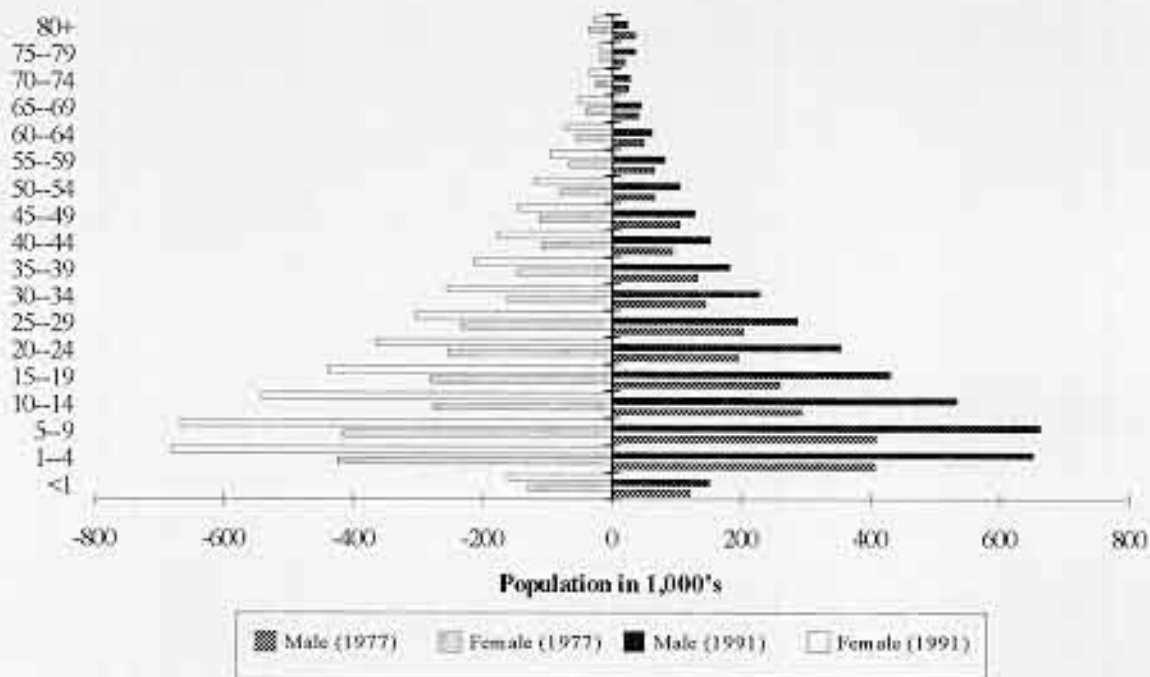


Figure 2b: Age structure by gender. Malawi, 1977 and 1991 (Data source: UN Statistical Yearbook)



Population planning does not appear to be a government priority. There has been very little attempt at introducing contraceptive use on a wide scale. As of 1989 the contraceptive prevalence was only about 7% (WRI, 1992). Also, it is not clear how government economic initiatives might affect migration patterns in the up-coming years.

C. Health Concerns

Infectious diseases are the defining health problems of Malawi. Data from the early eighties, given in Tables 1a and 1b, illustrates this point. There has probably been little significant departure from this pattern over the past decade, with the possible exception of those diseases covered in Expanded Programme for Immunization (DPT, TB, measles, and polio are the major immunizations provided through EPI). The age of this data brings up another point to consider regarding the analysis: the quality, consistency, and age of data from Malawi is limited. There have been some well carried-out studies that have provided useful information, but national data collection related to health, with the possible exception of population and hospital bed counts, has been sporadic. Admittedly, there has been historically a rather limited health care infrastructure (such infrastructures tending to be the primary generators and users of health-related statistics).

Tables 1a and 1b reflect the importance of not only infectious diseases, but of immunizable diseases and of malaria specifically. Among the clearly immunizable diseases, measles, TB, and tetanus are important causes of mortality. The data is such that other categories, e.g., pneumonia, may also contain cases of immunizable diseases. As for malaria, it is, itself, an important cause of morbidity and mortality, the extent of which could be underestimated here. For example, malaria in infants is difficult to distinguish

Table 1a: Most frequent causes for out patient services. All ages. Malawi, 1982 (Data source: WHO, 1987)

RANKING	REASON OUT-PATIENT VISITS
1	Malaria
2	Respiratory diseases
3	Abdominal/G.I. tract
4	Diarrhoeal diseases
5	Skin diseases
6	Eye diseases
7	Limb/joint
8	STDs
9	Hookworm/other helminths
10	Trauma/accidents

Table 1b: Most frequent causes of hospital deaths. Malawi, 1982. (Data source: WHO, 1987; Kalipeni, 1993)

RANKING	LEADING CAUSES OF HOSPITAL DEATHS	
	ALL AGES, 1982	CHILDREN 0-4 YEARS, 1983
1	Pneumonia	Measles
2	Nutritional deficiencies	Pneumonia
3	Measles	Nutritional deficiencies
4	Malaria	Malaria
5	Anemia	Anemia
6	Diarrhoeal disease	Diarrhoeal diseases
7	Accidents/injuries	Tetanus
8	Tuberculosis	Nervous system
9	Nervous system	Accidents/injuries
10	Pregnancy complications	Tuberculosis

from respiratory diseases, it is an important underlying cause of anemia, in cerebral malaria convulsions are not uncommon, and it is an important cause of low birth weight (a major risk for infant and child mortality in general). Also, while deaths from immunizable diseases have probably gone down in recent years (due to EPI), deaths from malaria are less likely to have decreased significantly.

Malawi is endemic for malaria. *Plasmodium falciparum* is the cause of virtually all cases of malaria in Malawi. *P. falciparum* is an important cause not only of general malaria, but can also cause cerebral malaria. Young children are especially at risk for cerebral malaria. The *Anopheles gambiae* complex of mosquitoes are the most common vectors of *P. falciparum*. These mosquitoes tend to be particularly adaptable and long lived. Thus the argument that a relatively large proportion of the health burden in Malawi is environment-constrained: because of the nature of this vector and the climate in which it exists, the basic reproduction rates of disease for malaria are extremely unlikely to fall below 1, and are more likely to approach values up to 1000 -- i.e., transmission alone may have to be reduced but up to 1000-fold in order to have an impact on the disease (Bradley, 1991). The ability to achieve such reductions through spraying or other gross, physical environmental changes may be possible in urban areas, but is unlikely in rural areas. Bed nets distributed via the health care infrastructure are likely to be a vital component of reducing reproduction numbers in rural areas. This issue, the potential impact of population distribution within the country on malaria, is discussed in the context of the analysis.

Local variations in malaria prevalence are common in other endemic countries. In the Gambia, observations over many years indicate that areas only miles away from each other can vary considerably with respect to prevalences of parasitemias. Part of this variation is likely related local physical environment and land use patterns. However, because of the wide local variations in malaria, an investigation of the impact of land use would require sub-national data. Such data is not available for this analysis, but an evaluation of such data would be important in determining priority target areas for a national malaria control program.

The impact of nutritional iron deficiencies on malaria is not clear. While it is an important risk for improper development in general, it is possible that iron has a negative impact on the outcome of malaria in young children and pregnant women. More research is needed to clarify this issue.

The other major cause of morbidity and mortality, especially in young children is diarrhoeal disease. In fact, these diseases will likely increase in importance as immunizable diseases decrease with EPI. Safe water supply is still an issue in Malawi. In the late 1980's only 77% of the urban population and 37% of the rural population had access to a safe supply. It is not clear whether watery diarrhoea or other types are more prevalent. If watery diarrhoea is the greater problem, then distribution of ORS should be a priority. As of the late 80's only about 10% of the population were reported to be getting ORS. (WRI, 1992)

D. Health Services

Over the past decade the government of Malawi has spent between 4 and 7% of its national budget on health services (WHO, 1987; WRI, 1992). In 1982 almost half of this expenditure went to hospitals while only about a third went to primary health care. In a country with so many basic health needs, the cost-effectiveness of such a distribution should be re-assessed.

The Malawi Ministry of Health maintains hospitals down to the district level and community outreach services have been receiving increasing attention. Approximately 80% of the population have access to some health care as of the mid 1980's (World Resources Institute, 1992; UNICEF, 1993). Ante-natal care is available, and estimates of the number of women using these services are as high as 70% (Taylor, unpublished). Part of the ante-natal program has included promoting use of chloroquine prophylaxis during pregnancy. Since chloroquine resistance has become common in Malawi, the prophylactic has shifted to Fansidar. Fewer than half of all births in the late 1980's were attended by trained health care personnel (WRI, 1992).

As is discussed later, EPI in Malawi did not get going until after 1980. However, coverage now appears relatively high -- approaching at least 80% for all immunizations as of 1991. Other than the ante-natal program mentioned, specific activities sponsored by the Ministry of Health regarding Malaria control are not defined. There are bed net trials presently ongoing, and chemotherapy for the disease appears to be relatively available. It should be noted that the therapies presently being used in Malawi are less likely to lead to complications of severe anemia in young children. The slow action of chloroquine and the subsequent incomplete treatment of malaria had, until recently, lead to extremely high parasitemias (and subsequent anemia) in this population, but newer drugs are faster and more complete, reducing this risk (Taylor, unpublished).

III. DATA ANALYSIS

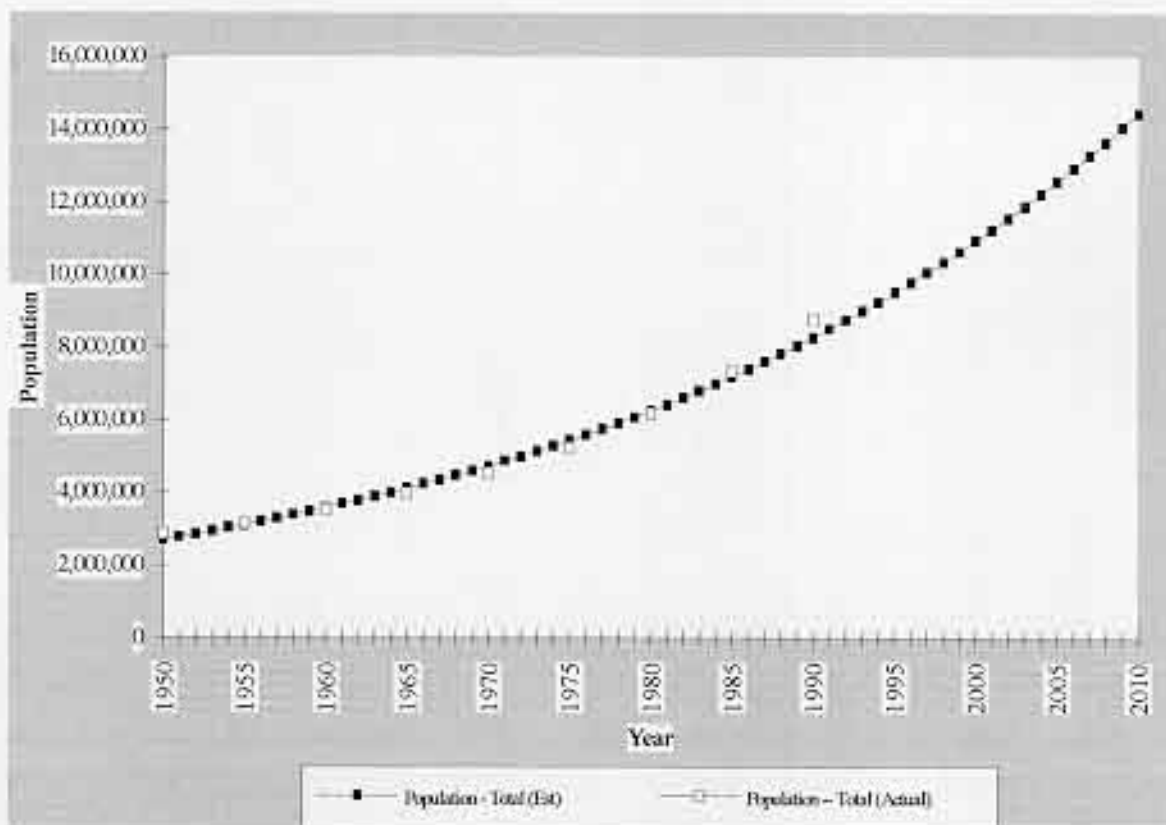
A. Data Sources

The World Resources 1992-93 Database was the primary source of data used (WRI, 1992). Information within the database comes from various United Nations sources. Thus, some of the information is from the Malawi government, and some is from independent data collection. The WRD was supplemented with WHO and UNICEF data published elsewhere. Data on under 5 mortality, and to a certain extent IMR, was obtained from The World Bank (Feacham and Jamison, 1991).

A. Demographic Transition

The population of Malawi is growing at an exponential rate (Figure 3). Since 1950 alone, the population has at least tripled, going from about 2,900,000 to almost 9,000,000 people. With the TFR at 7.6, there is no sign that this rate of growth will slow considerably in the near future. The annual growth rate, which had been increasing linearly up to around 1980, has begun to level off at about 3.5%. This point is encouraging, but the rate of growth, though not increasing as rapidly as it had been, is still extremely high. Also, the population growth momentum in a country like Malawi will impact upon growth stabilization even when replacement level fertility has been reached.

Figure 3: Population of Malawi, 1950 - 2010 (Data source: WRI, 1992)



The driving mechanism behind this increase can be seen in Figures 4a and 4b. In Figure 4a, one can see that, while the crude birth rate (CBR) is beginning to decline slightly, the crude death rate is falling exponentially. The changes in crude birth rate are linear, but there is an interesting break in the trend around 1980, the slope shifts from positive to negative. A possible proximate cause for this shift is discussed later. If population growth is added to the picture, one can see (Figure 4b) that the population is increasing proportionately to the divergence of the birth and death rates. This classic pattern is commonly seen early in demographic transitions (Meadows, *et al*, 1992).

Figure 4a: Crude Birth Rate and Crude Death Rate. Malawi, 1955 - 2010 (Data source: WRI, 1992)

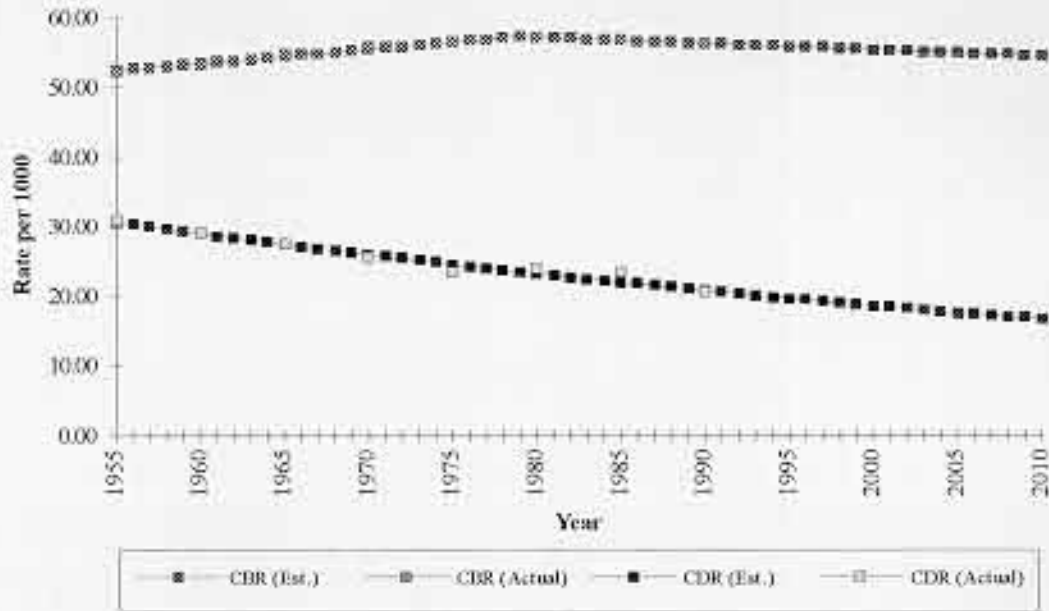
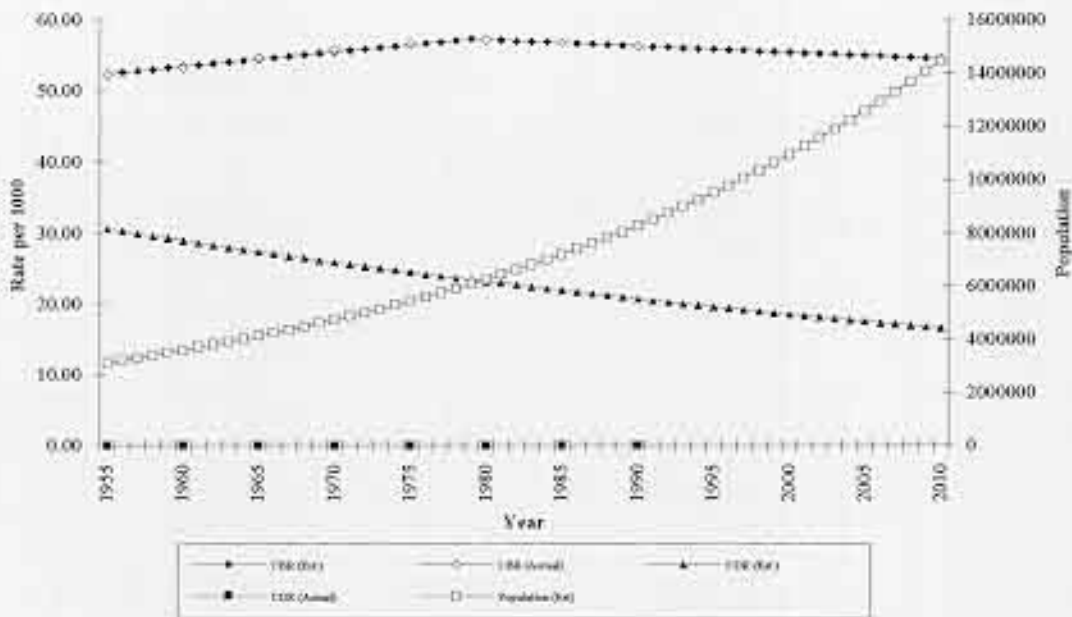
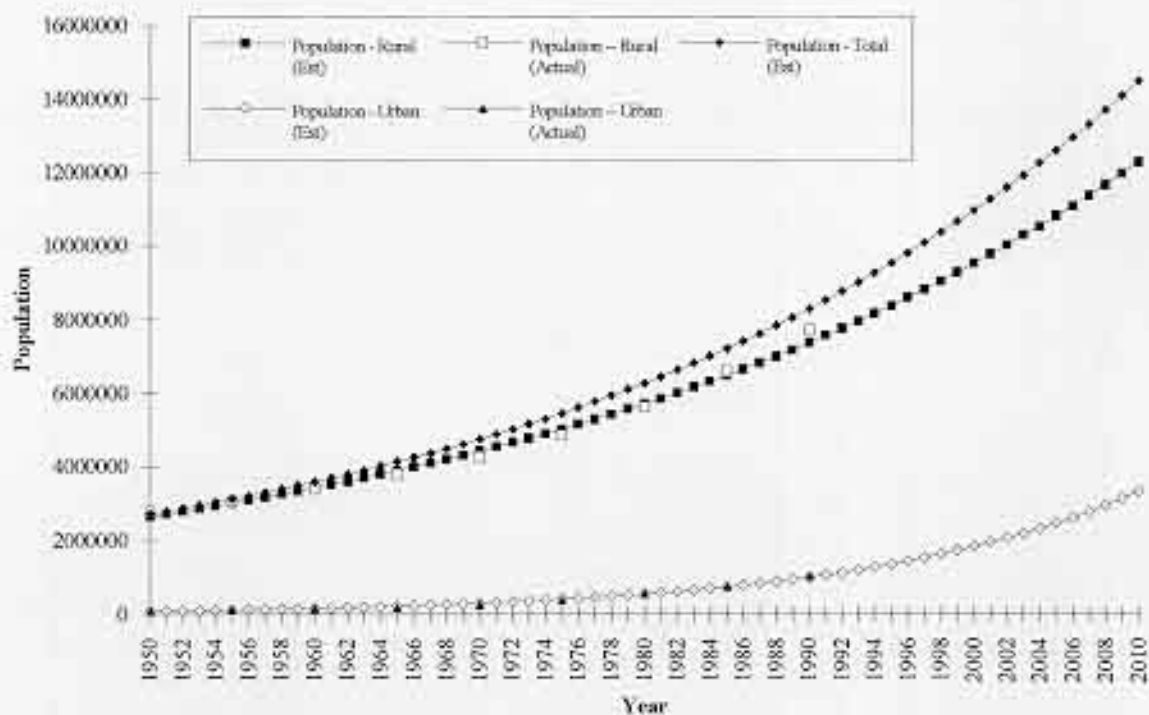


Figure 4a: CBR and CDR with respect to population. Malawi, 1955 - 2010 (Data source: WRI, 1992)



The distribution of the population within Malawi is changing at a somewhat lower pace. Unlike many parts of the world where the tendency toward urbanization has been dramatic, Malawians appear to be remaining a predominantly rural population. However, the urban population is growing at a faster pace than the rural population (Figure 5). The relevant contributions of migration and differential mortality to this situation are not clear. It is also important to keep in mind with respect to planning that, while the urban population is still relatively small in comparison to the rural population, the absolute number of people in urban areas is growing such that the number of individuals living in urban areas by the end of this century will almost equal the population of the entire country only 40 years ago. The health problems of the urban population will have an important impact at the national level.

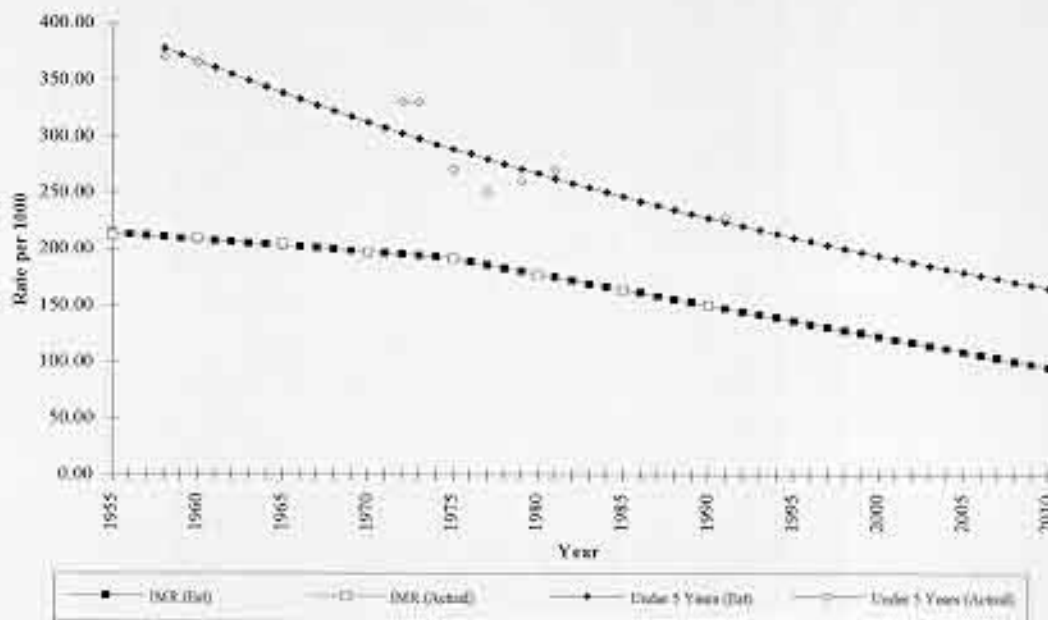
Figure 5: Comparison of Urban and Rural Population to Total Population, Malawi, 1955 - 2010 (Data source: WRI, 1992)



B. Health Transitions

The epidemiologic transition has not yet started, though the ground work of reducing the impact of infectious disease has begun. Infant and child mortality rates (Figure 6) are still characteristic of a population coping mainly with infectious diseases. Child mortality is assumed to include children between 1 and 5 years of age. Both IMR and under 5 mortality rates do appear to be decreasing rapidly, though both were extremely high to begin with. The risk of dying before age five is far higher in Malawi than in other East African countries, and compares more with the risks seen in West African countries.

Figure 6: Infant and Child Mortality Rates: Malawi, 1955-2010. (Data sources: WRI, 1992; UNICEF, 1993; Feacham and Jamison, 1991)



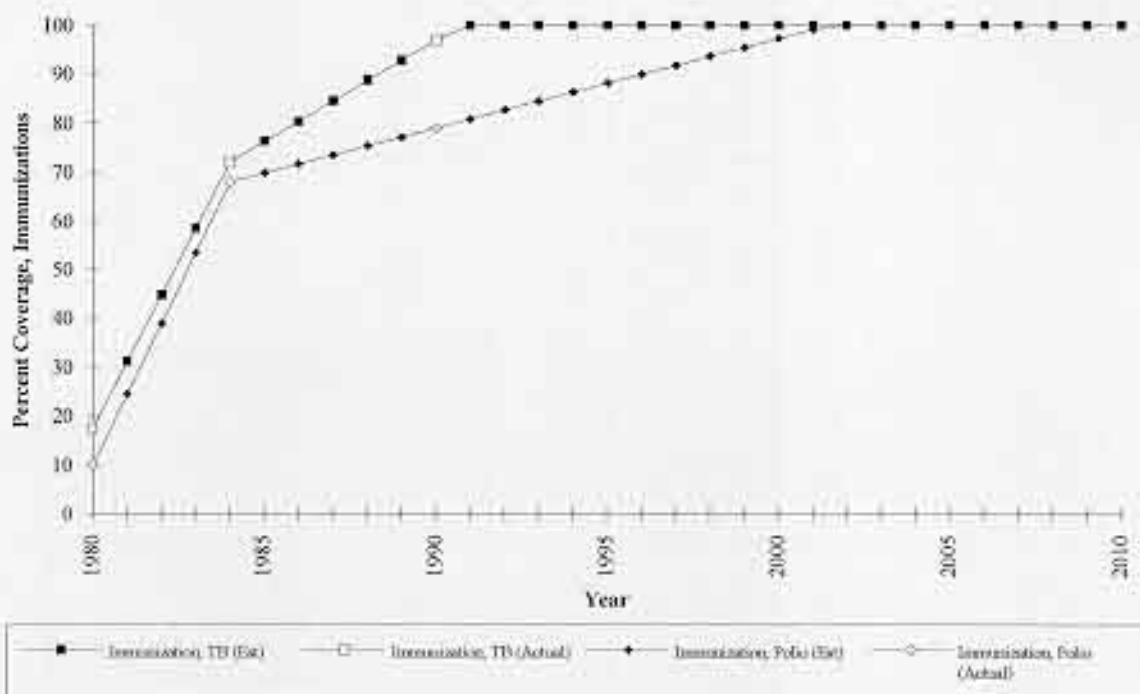
One very unusual feature of the IMR and under 5 statistics in Malawi is that the under 5 mortality rates far exceed those for infant mortality alone. The opposite is usually expected. This pattern could be an artifact of miscategorization, i.e., failure to differential between older infants and young two year olds, but such is unlikely to fully explain the discrepancy. However, if malaria is as serious a health problem as it appears, than such a pattern of mortality may not be unexpected. Those at greatest risk for dying of malaria are children between the ages of 1 and 5 years. A combination of maternally acquired immunity and lower rates of mosquito bites are thought to be factors in this phenomenon. Also, contributing to this pattern may be the high risk of malnutrition among children in Malawi. As noted in an earlier section, a regional drought has seriously affected the country in recent years, and even before this drought, poverty may have substantially increased risk of severe malnutrition. Malnutrition, like malaria, tends to disproportionately affect children between the ages of 1 and 5 years.

The nature of the decreases in infant and under 5 mortality are also interesting. IMR has had two distinct linear phases of decline, which may indicate a Gompertz type of function (though the tailing-off is not yet seen). The decline was slow up through the mid-70's, but appeared to change, to a faster rate of decline, after this point in time. Interestingly, the timing of this increasing decline is consistent with an impact resulting from the intensive implementation by the government of well-baby programs (growth monitoring and nutrition education for mothers) in the early and mid-1970's (McIntosh, unpublished). Current opinion of these types of programs is that they tend not to have a substantial impact on the populations they serve. While there are other possible explanations for the pattern seen here, the possibility that the well-baby program of the government did have an impact deserves further investigation. At present, it appears that IMR is decreasing more rapidly than under 5 mortality. The fit of the curve to under 5 mortality is poor, but the best fit appears to be a decreasing exponential trend. Though still decreasing, it appears that under 5 mortality will level off well above the IMR.

Transitions in health services are difficult to detect owing to the lack of data and the difficulty in establishing the importance of those statistics available. For example, though statistics exist for the percentage of Malawians with access to health services, it is not clear how often these services are used by most people or how appropriate these services are. Out-patient services at hospitals are crowded (Mills, *et al.*, 1993), but the proportion of individuals in any given community using these services is not established. It does appear that many of the services given in this environment may be better suited to a different mechanism of health services delivery.

The increase of EPI coverage can be considered as a subset of the health service infrastructure. This increase has been dramatic (Figure 7). It is not clear though why the numbers for TB and polio immunizations are so different, as the same workers in theory give both of these shots with in the same program. Another issue regarding these numbers is that they may not accurately represent the proportion of immunized individuals a community. For example, in Bangladesh, coverage rates refer to the proportion of a set target number being immunized. The target numbers can be incorrect. In one area, the target number exceeded the number of children alive in the area so that while the coverage rate was only around 70%, a far greater percentage of the children (approaching 100%) had probably been immunized. Overall the numbers for the Malawi EPI program indicate a successful outreach program.

Figure 7: Immunization Coverage. Malawi, 1955-2010. (Data source: WRI, 1992; UNICEF, 1993)

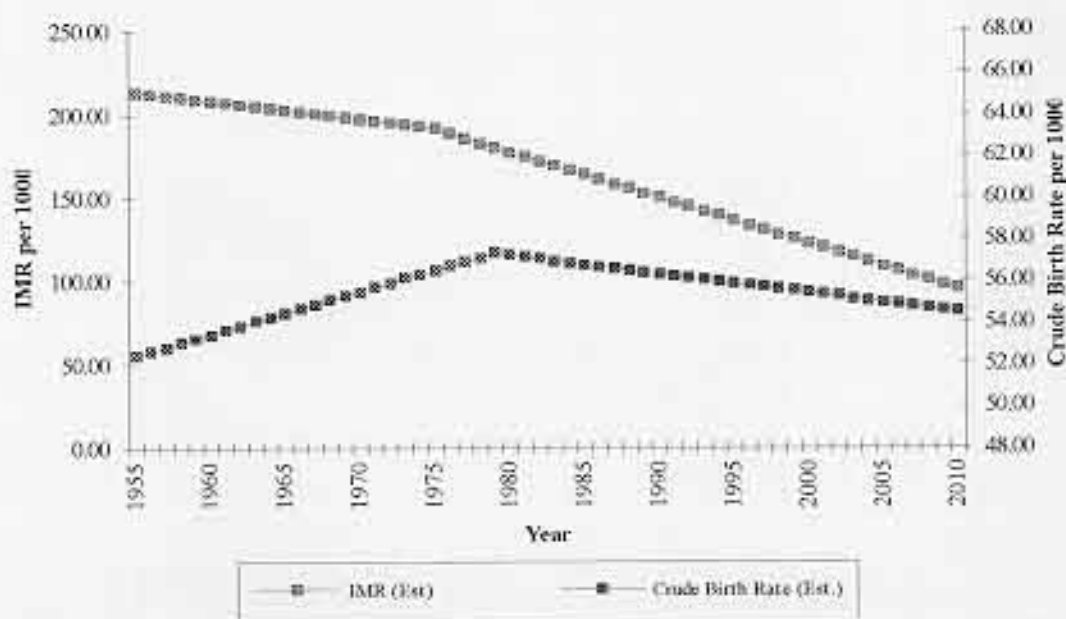


Because it is a separate vertical program, generalizing the trends seen in EPI to other aspects of health services may not be appropriate. For example, another potential indicator of health services activity, contraceptive prevalence, is extremely low, only about 6% as of the late 1980's. Even if primary health and family planning programs are not formally linked, one would expect to see higher CPR's in a "healthy" health services environment.

C. Interactions Between Transitions

One interesting interaction between the health and demographic transitions considered can be seen with respect to IMR and CBR (Figure 8). As mentioned above, the IMR began to decrease at an accelerated rate in the late 1970's. Shortly after this shift, there is a turn around in the CBR, going from an increasing to a decreasing trend. Though there are many possible explanations, it is interesting to speculate that, if these patterns are true, this interaction could reflect a decreased demand for children as their survival improves. This interpretation could have important implications for health and family planning services delivery. It would emphasize the importance of child survival with respect to demographic transitions (i.e., slowing the rate of overall population growth).

Figure 8: Comparison of IMR and CBR, Malawi, 1955-2010. (Data source: WRI, 1992)



IV. DISCUSSION

Evident from the models and discussion presented above is that explosive population growth and high infant and child mortality rates – stemming from high incidence of infectious disease – are important problems to be dealt with in Malawi. One way in which these two issues inter-relate is given in the comparison of infant mortality rates and crude birth rates. However, there are many other interactions on which one can speculate. In this section, some such speculations are made. Some of these observations are well supported, others are merely possibilities that would require further research to substantiate. Also, transitions not previously discussed, such as the education transition, are considered.

The direct and indirect impact of family planning on the health of Malawians could be considerable. Direct effects would include decreasing infant, child (Rahman, 1992), and maternal mortality. Indirect effects would be felt through the decreases in population pressure and the shifts in the age structure. The former assertion is an entire topic of its own, and no attempt is made to cover this topic here. However, the

impact of population pressure on quality of life has been noted in many countries (PED Monograph, 1993). As for the former, shifts in the age structure will influence the numbers of individuals susceptible to disease (i.e., non-immune individuals) and the numbers of people requiring specific health services in the population. Effects of family planning on population growth are considered first, than effects of population growth on health are discussed.

A. Impact of Family Planning on Population Growth in Malawi

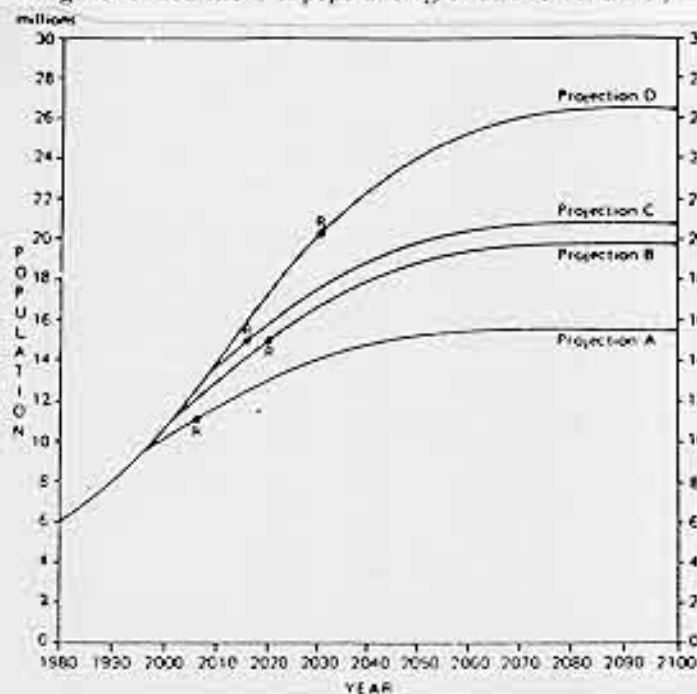
The explosive population growth of Malawi is pictured in Figure 3. This projection assumes that no attempts will be made to control growth. In fact, the government does appear to be adopting measures for family planning in its health programs (McIntosh, unpublished). Blacker (1993) has published some interesting predictions regarding the influence on population growth of reducing TFRs in Malawi. Various population outcomes are predicted based on when replacement level fertility is reached and what the influence of the growth momentum is at that time. The alternative outcomes are given in Figure 9.

Calculations assume a TFR of 7.6 in 1980. From this point, decreases in fertility to replacement level, R, "...would require a reduction of [4-5] children per woman to a TFR of 3.31." (Blacker, 1993) Because of the growth momentum, population continues to grow for a period of time before leveling off. Each projection, A-D, makes the following assumptions:

- A: Decline starts in 1990, reaches replacement level (R) in 2005, and stabilizes at 15 million.
- B: Decline starts in 1990, reaches replacement level (R) in 2020, and stabilizes at 20 million.
- C: Decline starts in 2000, reaches replacement level (R) in 2015, and stabilizes at 21 million.
- D: Decline starts in 2000, reaches replacement level (R) in 2030, and stabilizes at 27 million.

Clearly, prediction A would be the best possible outcome for Malawi. However, as their family planning program is only now getting started, such a rapid reduction to replacement level fertility is unlikely. An optimistic but more realistic outcome is likely to lie between options B and D. A reduction in TFR could be seen as early as 1995. As the family planning program is just starting, it may take a number of years to optimize services; thus, it will probably take longer than 15 years (and hopefully less than thirty years) before replacement TFR is reached. Prediction C is the closest estimate to this intermediate view, with population leveling off at around 21 million. Such an outcome will require intensive effort and commitment on the part of the government.

Figure 9: Predictions of population growth. From Blacker, 1993.



B. Impact of Population Growth on Health in Malawi

This section reflects an area in which a great deal of research is still needed: the following comments are quite speculative. In order to consider the impact of population growth on health in Malawi, let us first go back to the age distributions given in Figure 2a. It may be recalled that the about 19% of the total population was below age 5, with roughly 15% of the total between 1 and 5 years of age. To give conservative estimates of the influence of this population structure, it will be assumed that infants (i.e., <1 year old) are relatively protected from the impact of infectious disease by maternally acquired antibodies (acquired both *in utero* and through breast milk). Thus, infants will be considered only at risk for mortality with respect to low birth weight. Programmatically, they will only be considered in the context of EPI, in which immunizations are given to infants as well as young children and mothers. In this context, two major aspects of health are discussed – the influence on infectious disease (especially malaria) of non-immune individuals entering a population, and the impact on health services of a rapidly growing number of potential clients.

Malaria is emphasized among infectious diseases because of the long period of time it takes to develop immunity to this disease. Most children begin developing their own immunity to malaria (as opposed to maternal immunity) by about 1-2 years of age. By 5 years of age, most children have developed immunity sufficient to protect them from fatal cases of the disease, but it is not until almost adolescence that children actually develop an immunity that protects them from the parasitemia itself. Immune suppression in pregnant women decreases the influence of this acquired immunity, and pregnant women are thus more susceptible to serious malaria attacks than are other adults. In many other common infectious diseases (e.g., polio, measles), immunity is acquired more completely and more quickly. So, while the non-immune group for malaria may be assumed to include several ages at a given point in time and place (i.e., larger non-immune population), the non-immune groups for other diseases may include only one or two ages at the same point in time and place (i.e., smaller non-immune population).

Children between 1 and 10 years are susceptible to malaria parasitemias. Elsewhere in Sub-Saharan Africa, estimated prevalences of parasitemias in the 1-10 year age group range from 80 to 100% (Feacham and Jamison, 1991; Greenwood and Pickering, 1993). If we assume point prevalences of 80% parasitemia in Malawi, that means in 1991 there may have been as many as 2,160,000 children, almost 25% of the total population of the country, with appreciable malaria parasitemias. Just among children from 1 to 5 years, this number would be roughly 1,100,000 children (about 12.5% of the population). As the population grows, so does the number of children with malaria parasitemias. If the population were to get any younger, the relative number of parasitemias would also grow. Fortunately, with the implementation of family planning programs, this trend can be reversed – i.e., as the TFR goes down, the population ages, decreasing the proportion of parasitemias in the population at any given point in time.

The impact can also be assessed in terms of morbidity and mortality. Children between the ages of 1 and 5 years are susceptible to severe malaria. Of the children in this age group, the case fatality rate for malaria is estimated at 10% (Benenson, 1990). One study from The Gambia, gives a malaria attack rate of 0.2 attacks/child/year. Assuming that the bulk of these cases were to occur in 1-5 year olds and that only those children with parasitemias could develop cases, that gives a potential of 220,000 cases of malaria per year in the under 5 age group, and (assuming no child has more than one case in a given year) as many as 22,000 deaths from malaria in a given year. That is to say roughly 1 in every 62 children between the ages of 1 and 5 years of age may have died of malaria in 1991. This estimate is conservative, and only includes the immediate cases of malaria in children. There exists excess mortality and morbidity in addition to these numbers. For example, malaria in pregnant women can contribute to low birth weight in children increasing subsequent risk of mortality, and the impact of malarial anemia on an already malnourished child could be devastating.

While the above figures are unreliable, they do perhaps provide a point of departure for estimates at the impact of malaria on the health services delivery infrastructure. As many as 220,000 individuals may seek

treatment for malaria alone in a given year in the early 1990's. If the population increases by about 50% by the year 2010, as indicated by prediction C above (Blacker, 1993), then by this year (assuming the population structure remains constant), almost 330,000 children would potentially in need of treatment for malaria. Also, programs like EPI will need to be providing immunizations to as many as 50% more children than it is reaching now (assuming none of the EPI diseases are eradicated in the next 15 years). Again, if the population were to grow older over these next fifteen or so years, the proportionate burden would decrease.

The figures given above are highly speculative. One thing that they highlight is the need for better information on disease prevalences in Malawi. For example, not only might prevalences of malaria parasitemia in Malawi differ from those elsewhere, but the attack rate of the disease may differ greatly between this country and The Gambia. Without better data, only an educated guess can be made as to the actual situation. Such guesses are not sufficient if health services delivery is to be optimized.

C. Female Literacy and Health Transition Interactions

An important transition that has not been addressed with respect to health is the education transition. The main reason that this transition has not been discussed is a lack of longitudinal data. However, sub-national data on female literacy has been analyzed by Kalipeni (1993) in the context of finding determinants of infant mortality in Malawi. Although the existence of a literacy transition nationally is arguable, regional differences in literacy may be considered as a proxy to look at the possible influence of such a transition on health. As pictured in Figure 8a and Figures 9a through 9c, female literacy appears to have a definite, inverse association with infant mortality.

The interpretation of this relationship is not as clear as the visual association would suggest. For example, in Figure 8b, one can see that maternity beds per 10,000 women also is associated with IMR -- a point which could indicate a better overall social service environment in the north. This possibility is plausible, as the Northern District historically has been well served by missionary schools and hospitals (Kalipeni, 1993; Taylor, 1993). Interestingly, in cross-sectional regression analyses of both the 1977 and 1987 data, female literacy becomes insignificant when women's participation in agriculture is controlled for. This observation implies a possible role for MacCormack's arguments regarding the importance for health of women's status as measured by a net economic contribution to family resources (MacCormack, 1988). Of course, the most significant underlying factor in all of these associations is geographic location itself -- i.e., living in the Northern District is the best single predictor of reduced risk of infant mortality.

Kalipeni, citing Caldwell's theory on the importance of women's autonomy in health, suggests that Malawi may be either an anomaly where women's autonomy does not predict better health status, or a country where rapid changes, introduced from outside the country, have positively influenced women's autonomy over time. The emphasis given by the author to the former may be misplaced with respect to health behavior. Kalipeni describes the matrilineal and matrilocal nature of the ethnic groups living in the Southern and Central Districts, and then assumes, not unreasonably, that these patterns indicate cultures with greater female autonomy. However, persons working in the southern part of Malawi have noted that, in general, women need male permission to receive certain types of health care. The major messages that come from these discrepancies are that a.) female literacy is only one component of a diverse set of socioeconomic factors that influence health in Malawi, and b.) more research is needed with respect to women's health seeking behavior and what factors drive this behavior in Malawi.

Figure 8: Female literacy rates and maternity beds, by district in Malawi. From Kalipeni (1993)

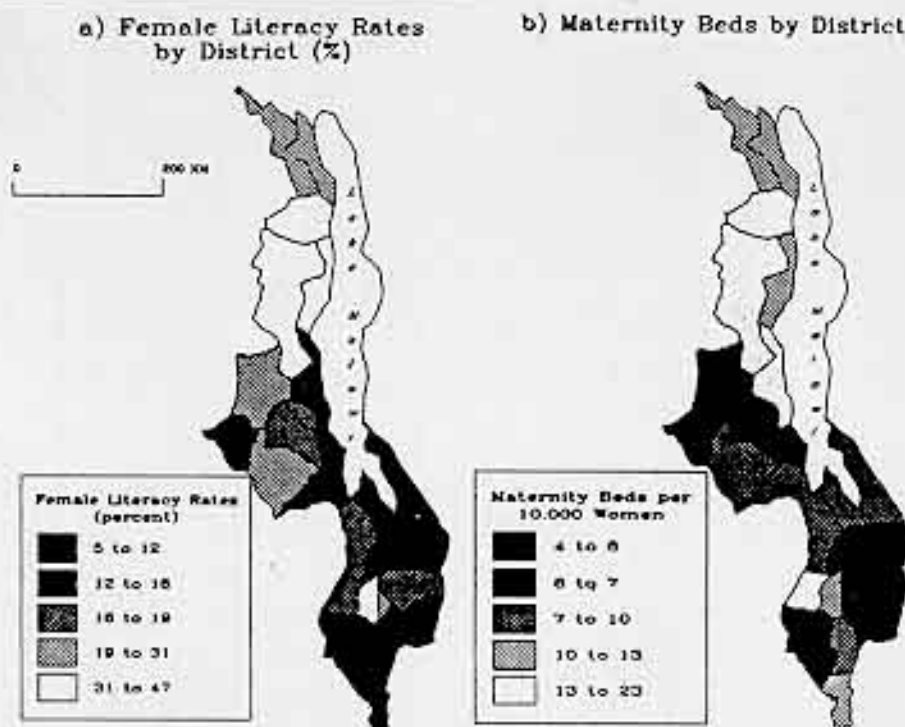
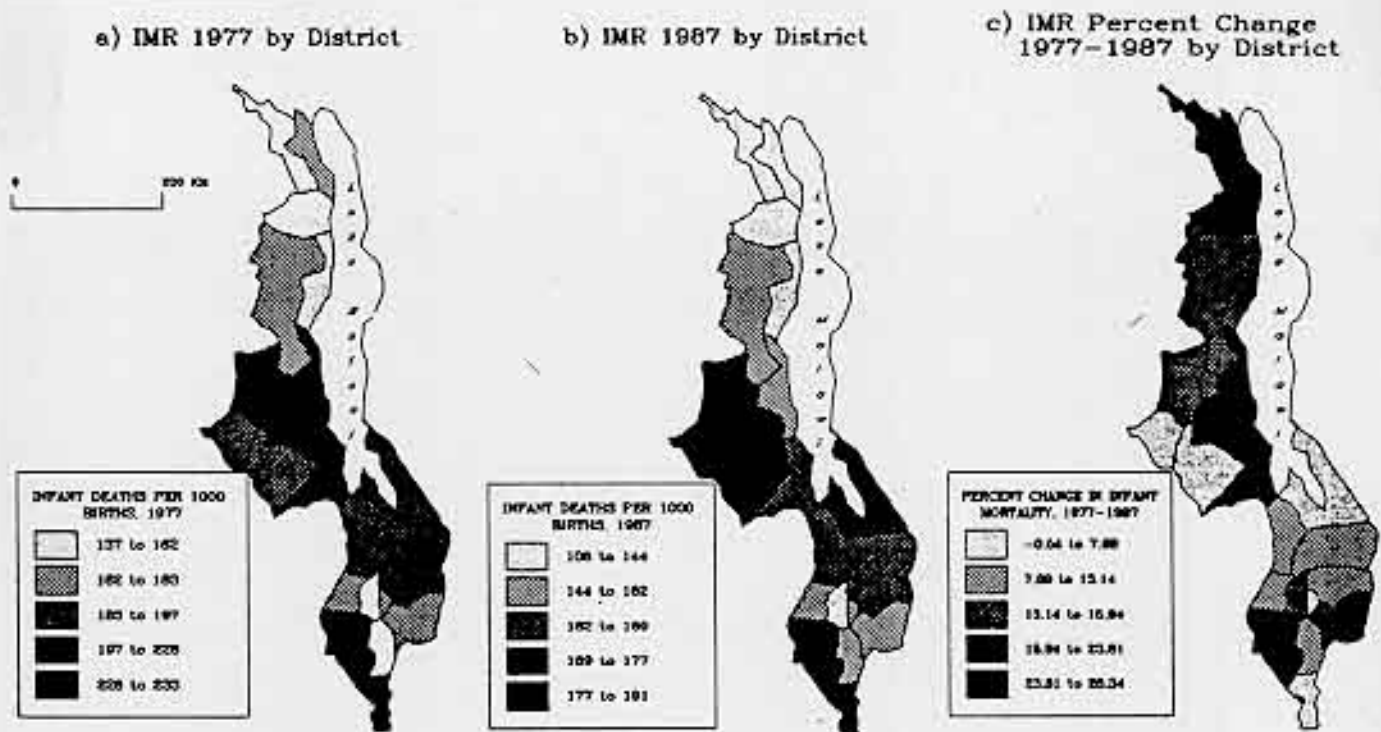


Figure 9: IMRs, by district in Malawi. From Kalipeni (1993)



V. RECOMMENDATIONS

Based on the observations made in the above sections, some recommendations have been made. These recommendations are by no means exhaustive. They only address a few of the primary points made, and are rather broad. The following recommendations are made:

1.) **Prioritize FP in the context of a community based primary health care program**

Population growth and age structure have a substantial impact on the health of Malawians. Implementation of family planning programs will not only limit ultimate population size to a more sustainable number, but also have a positive effect on health. Family planning services should be implemented through existing (and improving) primary health services for two reasons:

- Creating a separate infrastructure for family planning would take a great deal of time, and looking at the population predictions put forward by Blacker, time is the main thing that Malawi does not have with respect to population growth, and
- Perhaps more importantly, family planning can truly be considered a health intervention. Beyond the perhaps dubious numbers given above, there is very good research that shows how family planning can decrease risk of maternal mortality (by reducing parity and allowing for spacing), improve quality of women's lives (Simmons, unpublished), and increase the likelihood of survival of children. Also along these lines, it is important to remember that it may be more useful for women to structure programs that consider children's health, reproductive health, and family planning as a unified concept reflecting family health (Bruce, 1990).

2.) **Improve the capacity of the Malawi government to monitor the health of the population through developing efficient health reporting and Management Information Systems (MIS).**

A great deal of work has been done on the development of MIS for health programs in different countries. One success story in Sub-Saharan Africa has been the infrastructure developed to monitor implementation of the guinea worm eradication program in Ghana, where in 1992 84% of known affected villages were submitting reports of guinea worm cases on time, and close to 100% of reports were submitted eventually (CDC, 1993). Of course, this reporting program was targeted to a single disease. In countries where the information reported is more diverse, such as in Bangladesh, systems are not necessarily as efficient, but they can provide useful data (Hossain, unpublished). Improved knowledge of the health problems in Malawi will allow for better tailoring of services to address those problems.

3.) **Make permethrin-impregnated bed nets an important component of primary health care programs in Malawi.**

Studies are presently being carried out in Malawi on the effectiveness of permethrin-impregnated bed nets in controlling malaria parasitemia. In The Gambia, bed nets distributed through community health programs have been shown to have an important effect on reducing numbers of severe cases of malaria (Alonso, *et al.*, 1993). Other studies have supported, or at least not contradicted, these findings (Beach, *et al.*, 1993). The results from the present study in Malawi will be important for determining the best way in which to implement such a program. Possible testing of other anti-malarials should also be considered with respect to malaria prophylaxis and treatment in Malawi. Even in an atmosphere of responsible drug distribution (such as in Malawi), the large numbers of cases of malaria requiring treatment may increase likelihood of developing drug-resistant strains of *P. falciparum*, especially as health services improve and more cases actually get treated. Knowledge of the usefulness of other anti-malarials may prove useful as drug resistance increases.

4.) **Continue support of EPI**

The impact of EPI can not be assessed because of lack of data, but its effectiveness in other countries has been validated. Use of ORS may need to receive increased attention, as diarrhoeal disease is likely to increase in proportion to immunizable diseases as those immunizable diseases are brought under control.

5.) Improve knowledge of women's health needs (both for themselves and their families).

Women tend to access health services in disproportionately large numbers compared to men, especially in seeking services for their children. Primary health services are available in Malawi, but there is still a long way to go with respect to the health status of the population. More information is needed on the accessibility and quality of services with respect to the primary users of these services.

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GOVERNMENT POLICIES IN A COMMERCE TRANSITION IN THE SOUTH ATLANTIC AUTONOMOUS REGION OF NICARAGUA

Noreen White

Introduction

There are notable differences in Nicaragua between the Pacific and Atlantic coasts. The majority of the population, the administrative seat, and the main economic and social activities are concentrated on the Pacific coast. On the Atlantic coast there are few urban areas and there are many areas only loosely connected to the economic and social system of the rest of the country. The Atlantic coast of Nicaragua is an underdeveloped zone within an already underdeveloped country. Demographic characteristics are also different between the two zones, Pacific and Atlantic, with the latter having the greatest economic and social infrastructure deficits.

The Atlantic coast is subdivided into three regions: Rio San Juan Region, North Region, and South Region. The South Atlantic Autonomous Region, the focus of this work, is the least populous zone of the country; it contains 6.6% of Nicaragua's total population, although the Atlantic coast as a whole accounts for more than 50% of the total area. Figure 1 shows at the left, the geographical distribution of the South Atlantic Autonomous Region (RAAS). The RAAS is subdivided into seven municipalities, which contain members of the six ethnic groups: Mestizos, Creole, Miskitos, Garifunas, Sumus, and Ramas. The majority of these ethnic groups are located in small communities along the coastal areas. The community of Bluefields is the RAAS regional seat; it contains the majority of the urban population. The principal commercial centers are also located in Bluefields because of the relative facility of communication with the rest of the country.

The population density in the RAAS is low compared to the density along the Pacific coast. Table 1 shows the comparison in population density between the Pacific coast and the RAAS; these data are unreliable --- population values from 1987 to 1993 were based on estimation according to the annual population growth rate established by the National Institute for Statistics and Census (INEC). It appears that the Pacific coast continues to have the major concentration of the total population (Johnson Research Associates, 1970).



Figure 1 Map of the South Atlantic Autonomous Region.

TABLE 1
Pacific and Atlantic Population Density

	Area* (in Km ²)	Population		Density	
		1978	1993	1978	1993
Pacific Region*	18,007.04	2,441,849	3,500,000	135.6	194.4
RAAS	16,716.00	78,447	93,823	4.7	5.6

* Areas covered by water not included.

* Central zone not included.

Source: INEC, 1986 Boletín Demográfico; Pobreza Crítica, 1987 Manuscritos elaborados por el equipo técnico del proyecto "Pobreza Crítica".

Population Transition

The population figures of the South Atlantic Autonomous Region (RAAS) do not follow usual growth patterns. The reasons for the unusual fluctuation are migration and immigration. A substantial number of people migrated internally during the late 60s from rural to urban areas in order to better their economic conditions. In the 80s, war also caused additional movement of population from rural areas. Finally, the hurricane of 1988 ("Joan"), with wind velocities of up to 250 km/h devastated the Atlantic coast causing losses of up to 90% in the infrastructure, the economic setting, and the social structure. The combination of all these factors forced uneven, and unusual, population growth patterns.

From the 19th century well into the 20th century, the population of the RAAS grew only moderately. From 1968 to 1993, however, there was a surge in population growth from 31,272 in 1968 to 79,342 in 1993 (Instituto Nicaraguense de Estadísticas y Censos--INEC, 1985). The estimate of population growth, made by INEC in 1985 was for growth at 3% annually until 1981, and then at 5.5% annually from 1982 to 1993. Figure 2 shows the fit of an exponential curve to using the 5.5% increase applied initially to the 1968 data and repeatedly thereafter. The fit over this time period appears quite good. However, when analyzing the available data from 1968 to 1981, the rate given by INEC does not fit the actual data--INEC gives a rate of 3.0% until 1981--the actual data shows a 3% increase from 1982 to 1990, and a 5.5% increase both before and after this period (Figure 3). This observation based on the actual data is in direct contradiction to the statements about growth rates above; the statements attributed to INEC and the actual data do NOT match--indeed, they appear to be at least partially reversed. Thus, a critical next step is to determine WHY this mismatch exists--is it the result of a blunder--rechecking all sources and translations and interpretations made by the author must be done. If there is no blunder on the part of the author, and if this mismatch is written down, and therefore likely to be used by others, it becomes imperative first to expose this difficulty so that one does not have a choice of data to support either of two conflicting viewpoints, and then to question carefully any projections that have been (or will be) made on the basis of either interpretation of the data--the pattern of rates presented in the graph do NOT, by themselves, warrant any projection of greater than 5.5% increase in the future.

There might be any number of reasons for this difficulty shown by the mismatch; estimations were made by observation of population movement because there was an absence of detailed regional historical statistics. What the reports of the growth rate suggest (rather than the data themselves), is an accelerating population growth; however, when the actual data are graphed, they do not support this idea (Figure 3).

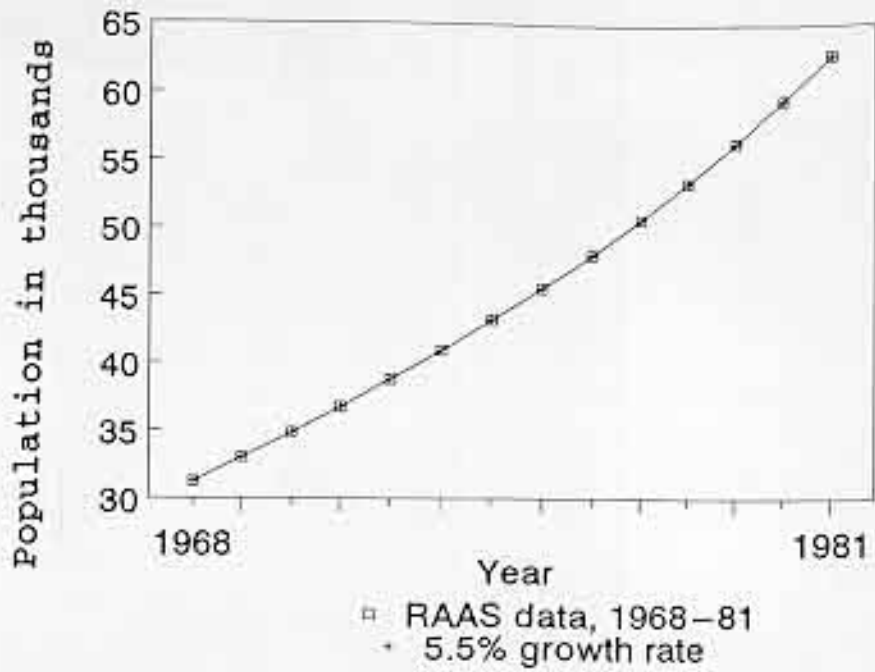


Figure 2 RAAS Population Growth at 5% (1968 - 1981)

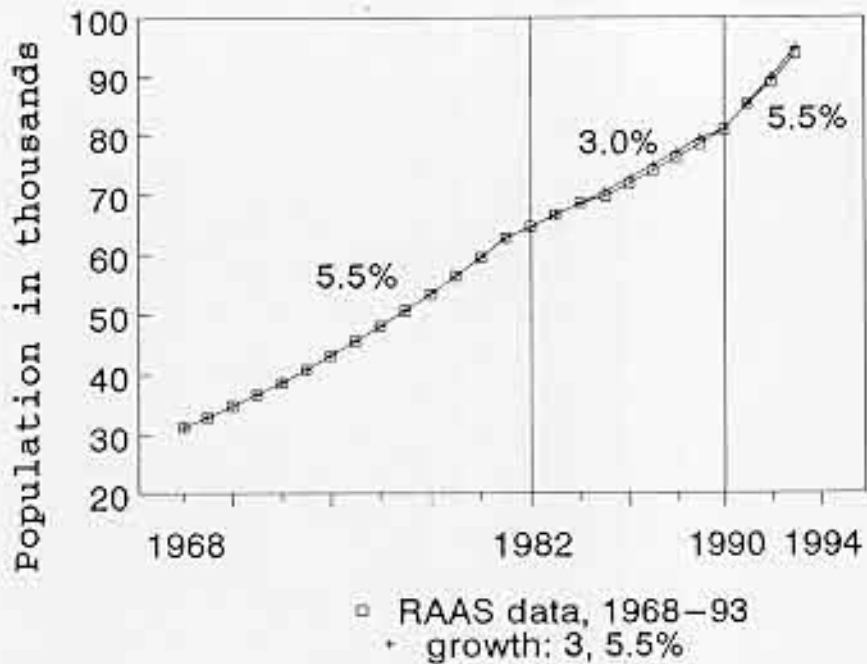


Figure 3 Combined Growth Rates, 3% and 5% (1968 - 1993)

Based on the INEC statements (rather than on the data in the graph), INEC expects the population continue to grow at about 5.9% annually from 1994. Clearly, this is a projection whose bases in actual data should be questioned, given the noted mismatch between reports and actual data—there was no apparent reason, from the data, for choosing this particular rate. There is some hope that in the period following 1994 the socio-political situation of the country will become more stable (again, in conflict with the INEC-projected 5.9% increase); the war which caused massive migrations of families, and in some cases entire communities, to the interior and exterior of the country, will have then come to an end.

This concern with population growth is relatively recent; earlier, there was no great concern on the part of the people or of the regional government with overpopulation. Although there were high densities in some areas, the overall population density was not high then, nor was it expected to be high in the future. Migration rates were higher during the period of war and the hurricane; this increased migration in turn brought economic and social difficulties to the region, resulting in overcrowding, slums, and unemployment. What has caused the population of the RAAS to grow exponentially during part of the recent past has been the different disturbances which have affected the whole country, in addition to the various local disturbances cited above. It is the set of these disturbances that have driven the population to reproduce itself, from itself (Meadows, Meadows, and Randers 1992).

The majority of the people who came to the urban areas looking for better life conditions were attracted largely to the industrial fishing and commerce sectors. However, fishery was not then supported by the government, so commerce, both formal and informal, seemed an attractive alternative because of the inequity between supply and demand. One reason for this inequity rested on foreign economic relations/policies: acquire the capital and the technology needed to raise the standard of living; diversify the economy; insulate against fluctuations in the world prices for primary products and adverse trends in terms of trade; and, achieve a measure of national economic self-sufficiency and independence through regional economic integration, causing a disadvantage to economic colonialism in the region (Johnson Research Associates, 1970).

Domestic Trade Structure

The productive apparatus of the RAAS is a result of an enclave economy that created a convenient regional situation for the transnationals who invested in minimal infrastructure necessary to assure their operations (importation and exportation). As a result, this infrastructure remained and provided an articulation with the exterior and a subordination of the internal market.

These enclaves functioned to commercialize the Atlantic coast economy. The population from 1890, until some decades later, depended almost totally on wagework, which encouraged

mercantile production in the region and commercial exchange with the neighboring countries of the Caribbean, Honduras, and Costa Rica (CIDCA, 1987).

Until 1979 the existent commercial network in the RAAS was private. The commercial activity was in the hands of the Chinese, even though there were some Americans who owned commercial establishments. These merchants acquired their products from representatives they had in Managua, utilizing aquatic transportation to introduce the products to the region, and also to export internal products to the Pacific.

This commerce was not planned. No one was put in charge to regulate the articulation with the exterior--the result of development by the merchants, the foreign companies, and the Somoza family. Even when this lack seems not to mesh with the national picture, the economy as a whole remained functional, thereby preventing the collapse of the interior market during the period of crisis in which the United Fruit Company and the Gold Mining Company withdrew from the region.

However, this situation served to integrate the Caribbean economy and to foster its separation from the national state. As a consequence the region became a closed terrestrial net, shutting off communication between the Atlantic coast and the rest of the country. The only way to access the interior of the country is through the Escondido River to El Rama, a port linked with the terrestrial national net through the Managua-Rama road. Objectively, the transformation in 1979, when the Sandinistas overthrew the Somoza government (which had ruled the country for more than 30 years) created a basic disarticulation of the RAAS economy, affecting the productive base by rupturing the exchange possibility with the Caribbean.

The post-revolutionary interruption of commerce with the Caribbean was designed to integrate the Atlantic and the Pacific coasts. This action affected strongly the productive base of the RAAS economy, which already experienced the situation in which the alternative supply from the Pacific was not flowing freely on the one hand because of the lack of means and facilities, and on the other hand because of the national economic crisis.

Sandinista Government Intervention in Domestic Trade

After 1979 the new government, with the efforts to better the cultural, social, political, and economic situation in the RAAS, however began interrupting the exchange with the Caribbean and establishing stores for basic products with reasonable prices, but did not offer products that the population acquired from the commercial exchange with the Caribbean. This situation caused discontent among the regional population which was not prepared to accept the abrupt transformation from the enclave economy to regional integration (Pobreza Critica, 1985).

Therefore, with the purpose of reactivating the exchange with the Caribbean, the Sandinista government created in 1986 the Caribbean Commercial Corporation (CCC). This corporation

responded to the necessity of continuing with the traditional and historical commerce practice with the Caribbean trying to increase the low scale exploitation of exportable natural resources, and also the satisfaction of the demand of imported products for consumption and supply material and equipment to encourage the production.

However, the CCC did not succeed. First of all because the war was at its highest point and therefore did not permit the corporation to realize its importation and exportation operations; second, because it was difficult to fulfill the transactions that the population once did in their own convenient way before the creation of the corporation; and third, because the level of the local economy was depressed by the Chinese and Americans, owners of the largest commercial establishment in the region. The Chinese and Americans immediately left the country after the revolution fearing that the Sandinistas would take reprisal against them.

Due to CCC failure, the government introduced another economic alternative to the region as a desperate intention to incorporate the Atlantic with the Pacific: Agro-industry. There was no doubt that the extreme marginalization of the RAAS required great efforts to propose an accelerated economic expansion utilizing the favorable circumstances, in order to widen the employment opportunities, as the only way for an underdeveloped country to cover basic necessities of the population and initiate the redistribution of income.

However, this policy was not commensurate with the realities of the RAAS environment and the existing conditions. The policy of economic development of the RAAS through the implementation of agro-industries, whose presence in the Atlantic coast did not have economic and social justification, soon showed that it was not absorbing the unemployment labor force existent in the region (25.6%). The native experience and tradition throughout this period was in fishing, the most disregarded sector in policy of development investment in the RAAS.

Since the fishing industry was not being supported financially, the unemployed population saw trading as an alternative to meet their basic needs (Pobreza Crítica, 1987). The high proportion of apparent value added by commerce, relative to the gross domestic product was only partly attributable to the economic contribution derived from commercial activities (Johnson Research Associates, 1970). To some extent it was the result of a commercial policy oriented toward low volume and high markups. This policy, while due in some measure to the persistence of an earlier mercantile tradition, also reflected the constraints imposed by a small market.

Commerce Transitions and Women's Appearance in Commerce

The commerce situation has changed rapidly. In the last ten years, the RAAS have experienced a rapid growth of the commerce activity, giving the impression of being swallowed up by a big market (CIDCA, 1992). The commerce activity has spread to the point that in the

urban areas that, of each ten houses, at least six houses were converted partially into small stores. The commerce has grown to the extent that neither the local authorities nor the government representatives know with precision how many commercial establishments appear and disappear in the region in recent years.

The most relevant variables considered decisive in commerce transitions in the RAAS are shown in Figure 4. These variables are related, as mentioned earlier when addressing the population transition, to the warlike conflict that began in the 80s. The conflict caused the disarticulation of the social organization of rural communities provoking stress in the local economy as rural populations migrated to urban centers. This migration caused a considerable increase in the population density and serious damage to the regional productive system.

Hurricane "Joan" devastated the RAAS in 1988. As a consequence, it affected the productive system and the social infrastructure, as well as governmental policies which with the liberation of commerce and the implementation of a conversion plan in 1990, induced a large amount of the RAAS population into the commercial world, thereby converting the region into a big market. It is interesting to note the appearance of women in the commercial stage just after hurricane Joan in 1988. Their significance is underscored by the change of government in 1990 when Violeta Chamorro (a woman), the current president of Nicaragua, came to power. Natives from the RAAS interpret the commercial growth as a clear demonstration that Nicaragua has yielded and is now living under the rule of free commerce. The unexpected appearance of hundreds of merchant women gave rise not only to a close fight to occupy new spaces in the market, but also to a confrontation between diverse ideological representations, social practices, and commerce styles.

The actual involvement of women in commercial activities explains the ways in which the power relationship is reconstructed. In different ways, women found in commercial practices effective strategies to solve power conflicts, frequently manifested in violent ways. Precisely because of the confrontation and polarization of different ideological positions where merchant women are involved, the society model separates ideally, presented through political organization of designed governmental teams, a political vanguard, and religious groups.

However, women continue their transformation from domestic workers to professional of commerce activities, even though in most cases the household being an empire reserved for women has converted into an infernal place, provoked by husbands who were returning from the war, parents who were demanding financial help, or just a succession of bad luck.

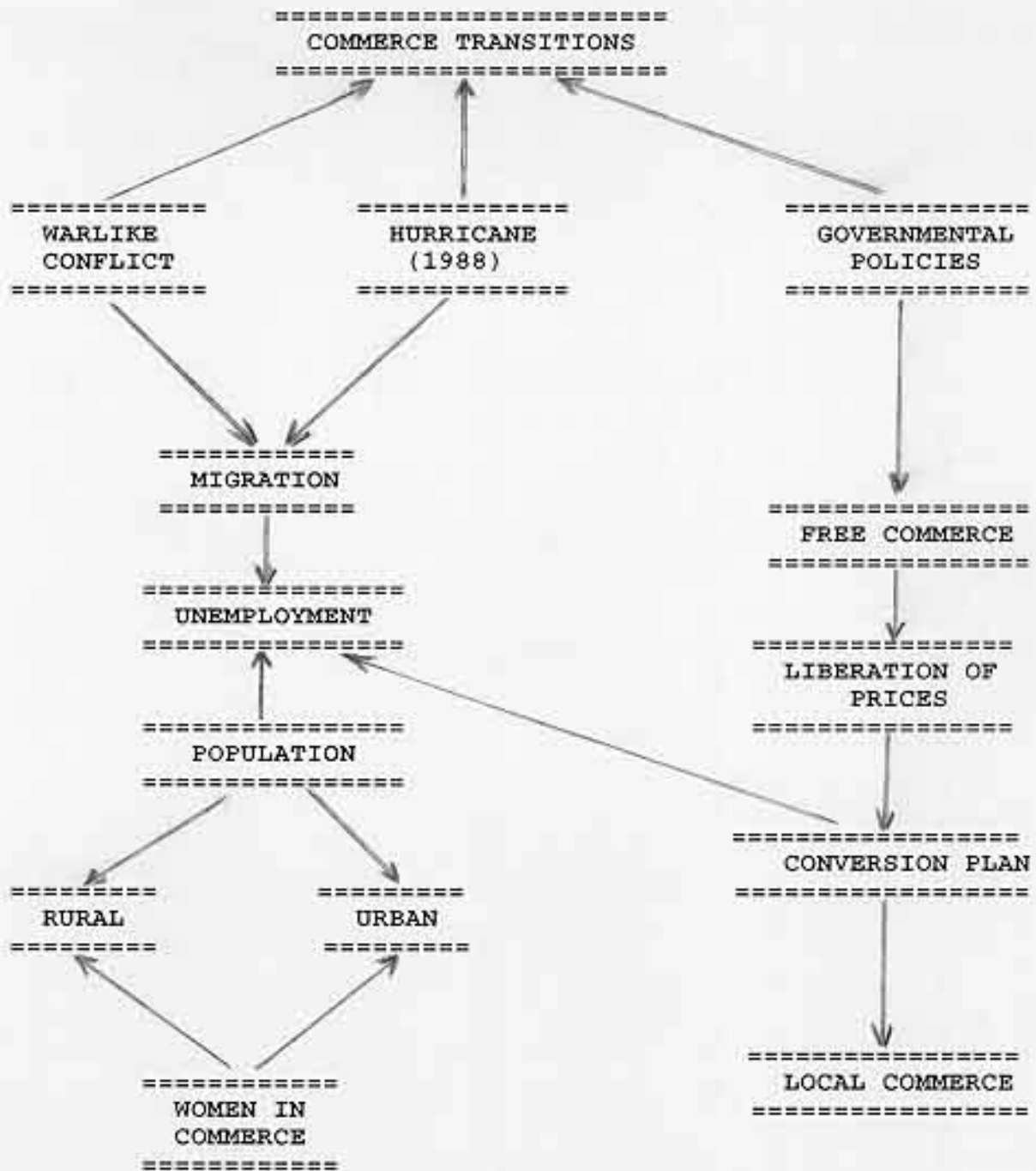


Figure 4 Schematic Model

Reconstruction of Commercial Practices After Transitions

But beyond the idiosyncratic explanation about free commerce, in the RAAS, it is widely recognized that the growth of commerce is associated with the struggle for survival, the displacement of the years of war, the increase of unemployment, voluntary or involuntary, with governmental policies, and with natural disaster (Torres and Vernooy, 1992). However, no matter what factors determine the commercial growth, in the particular case of the RAAS, people involved in this activity have faced constraints that obligate them to the painful process of social reconstruction. This reconstruction involved the commerce, itself, far more than the mere reconstruction of the commercial establishments.

The starting over process has been a sorrowful but hopeful situation characterizing the recent historical situation of the region. Until now the region has exhibited three different drastic situations that demanded a rapid transition from destruction to reconstruction. In 1987, through a constitutional decree of the regional government, alternatives were implemented to the commerce activity after the disaster and distrust of the war. Also in 1988 with the devastation of the hurricane, the starting over process was not only material reconstructions but also a social reorganization of the region. Finally, in 1991 after the electoral dispute the starting over was an attempt to re-establish the social agreement between the citizen and the governmental institutions.

In any event, the complexity and dynamic of the process of commerce change completely erased the three stable characteristics attributed to the commerce in the economics manuals (Rojas R. Alejandro, 1991). In the first place, the geo-economical delimitation of the region is provisional which implies that the local economic frontiers are not definitive. Second, the commerce is no longer limited to the traditional and specific central space reserved for the commercial professional elite who guarded a close relation with the local authorities. This shift also implies changes in the typology of merchants which introduced a wide variety of commercial practices. The negotiation of prices which were conceived as a key point for the social order and the auto-regulation of commerce are now taking place in situations more complicated than the simple schemes of exchange offered in different interpretations of the supply and demand law of economics.

Local Interpretation of Commercial Practices

The commercial practices developed on streets, houses, and commercial establishments have acquired diverse meaning, related to the liberation of commerce. When questioning the commercial growth as to whether or not it is related to authorization or ideological promotion, there are three different interpretation currents.

The first interpretation is from those who militate with the Sandinism, for whom the liberation of the commerce was an initiative of the Sandinista government as part of a political movement during the electoral campaign.

The second is a contrastive interpretation from merchant women who are the backbone of Chamorro's government. They conceive the commerce development as part of the accomplishment of Chamorro in her electoral campaign in which she promised to free commerce if she won the presidential elections. However, these same women explain that some ex-Sandinistas militaries were the ones who benefitted from the commerce liberation, and who sent their women to trade on the streets. The third interpretation is related to the fatality of the devastation of the hurricane, that caused losses of more than 90% of the socio-economic regional structure, and thus facilitated the appearance of thousands of merchants from all over the country who came to "reactivate" the regional economy by creating a big market.

These interpretations show the relevance of a government that authorized or promoted the commerce growth or is not capable of controlling this growth. However, the different interpretations cannot be read objectively because those who are involved in the commerce interpret the situation according to their convenience.

Regional Government Policy in Commerce Transitions

The commercial growth also induces the liberation of prices which then causes protestation among the different population sectors. This situation forced the regional government of the RAAS to elaborate a measure to stabilize the rise of prices.

Thus, the regional government created the Commission for Regulation of Prices. The Commission was formed by five members: two representatives of the regional government, two from the regional council, and one from the city hall.

The Commission initiated its operation, complying with the regional government expectation. The region was declared in emergent state. The Commission established prices for the basic products, and also nominated 25 inspectors to oblige merchants to comply. In addition, the Commission communicated sanctions for those who altered prices, from fines to the removal of commercial license, depending on the seriousness of the case (Julio Fletes, 1991).

Nevertheless, neither the regional government nor the Commission took merchants into consideration when establishing the new measurement, which immediately caused discontent among merchants for whom the new prices were inadequate.

The merchants' attitude toward the establishment of prices, induced the Commission to hold a series of meetings with merchants to negotiate the definite prices. The Commission explained that the measurement of controlling prices was not a contradiction with the free commerce decreed by Chamorro's government.

Policy Recommendations

Theoretically the law of free supply and demand means that through an invisible hand prices are regulated. Thus, the mechanism of the invisible hand leads to an equilibrium point when the amount of product supplied is equal to the amount demanded. The function of the mechanism is free, without the intervention and control of external forces (Vernoooy y Torres, 1992). Therefore, the interpretation of free commerce was being utilized as a mechanism to argue the fulfillment of the current government, although in practice this mechanism was incongruent, indeed contradictory, within local tradition of the commerce in the RAAS, where different factors condition the supply and demand.

At the same time, the regional government emphasized the democratic operation of the Commission in complete concert with merchants. The Commission imposed the dispositions using as an excuse a portion of the Political Constitution of Nicaragua that expresses the responsibility of the State to regulate the supply of basic products, even when the country is living under a free commerce economy. Therefore, the creation of the Commission for Regulating Prices and the implementation of its policy has controlled the daily life of the region in which the different actors and social groups attempt to defend their economic and political interests.

The creation of the Commission could also be interpreted as an intent of the regional government to demonstrate before the regional population their capacity of independent operation from the national government and the national policies. Obviously, the success of the regulation of prices would create a positive change in the regional government image, which until now has been characterized as incapable to promote initiatives and programs to begin the autonomy of the region at economic, social, and cultural levels.

Unfortunately, the creation of the Commission intensifies the existent conflicts within the regional political/administrative structures and the social groups affected by the measurement (the merchants). However, merchants were the most affected sector; in the drastic measures taken by the Commission to control commerce, they established prices that led merchants to bankruptcy.

The policy involving prices demonstrates the crucial importance of a precise analysis of the formulation and execution of intervention processes. This analysis should focus on the changes of policies and measurement as a result of different interpretations, negotiations, and operations that lead to the process of placing these into practice. It is also necessary to analyze the intervention process from different perspectives, to help clarify the rapid adaptation to new circumstances of the social actors involved. The creation of the Commission for Regulated

Prices by the regional government has generated a series of problems that even today have not been solved.

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