

PN-ABL-651
ISN 78082



Research Triangle Institute

**ECONOMIC AND ENVIRONMENTAL IMPLICATIONS
OF CHANGES IN HEALTH STATUS AND
REDUCED FERTILITY**

Final Report

J. Brad Schwartz
Deborah E. Bender

February 1992

**TECHNICAL ASSISTANCE IN PUBLIC HEALTH, HEALTH PLANNING AND
DELIVERY, AND WATER SUPPLY AND SANITATION**

Contract No. PDC-5929-I-00-0108-00

U.S. Agency for International Development
Washington, DC 20523



Research Triangle Institute

**ECONOMIC AND ENVIRONMENTAL IMPLICATIONS
OF CHANGES IN HEALTH STATUS AND
REDUCED FERTILITY**

Final Report

J. Brad Schwartz
Deborah E. Bender

February 1992

**TECHNICAL ASSISTANCE IN PUBLIC HEALTH, HEALTH PLANNING AND
DELIVERY, AND WATER SUPPLY AND SANITATION**

Contract No. PDC-5929-I-00-0108-00

U.S. Agency for International Development
Washington, DC 20523

TABLE OF CONTENTS

	<u>Page</u>
ACKNOWLEDGEMENTS	iii
EXECUTIVE SUMMARY	iv
FUTURE RESEARCH AGENDA	vii
INTRODUCTION	1
Background.....	1
Purpose of the Study.....	2
Organization of the Report.....	3
POPULATION AND ECONOMIC GROWTH	4
Introduction and Overview.....	4
Effect of Family Planning Programs on Fertility....	7
Effect of Fertility Decline on Economic Growth.....	11
Gender Issues.....	14
HEALTH STATUS AND ECONOMIC GROWTH	15
Introduction and Overview.....	15
Health Interventions.....	15
Improved Health Status.....	17
Effect of Health Status on Economic Growth.....	18
Effect of Economic Growth on Health Status.....	21
Gender Issues.....	22
POPULATION, HEALTH AND THE ENVIRONMENT	24
Introduction and Overview.....	24
The Population/Environment Debate.....	27
Population Effects on Natural Resources.....	29
Gender Issues.....	36
APPENDICES	40
Appendix A. List of Persons Contacted.....	41
Appendix B. Bibliography.....	43
Appendix C. List of Workshops and Conferences.....	58

LIST OF FIGURES

	<u>Page</u>
Figure 1. Family Planning and Economic Growth.....	4
Figure 2. Family Planning and Fertility Decline.....	7
Figure 3. Linkages to Other Social, Economic and Cultural Factors.....	9
Figure 4. Intermediate Factors.....	11
Figure 5. Health Status and Economic Growth.....	15
Figure 6. Population, Health, and Environment.....	24

ACKNOWLEDGEMENTS

Preparation of this report was made possible through the contribution of numerous people in USAID and elsewhere (see also Appendix A).

We are particularly grateful to Ms. Sharon Benoleoil, formerly of the Asia Bureau, Health and Population, now with the Center for Development and Information and Evaluation, who originated the idea for the study. Ms. Jinny Sewell, Acting Chief for Health and Population in the Asia Bureau has been very supportive and helpful to our preparation of the report.

Others at USAID who provided significant information for the study include Mr. Thomas Morris of the Bureau for Program and Policy Coordination, Ms. Ellen Starbird of the Office of Population, Ms. Rosalie Noreem of the WID Office, and Mr. Dennis Long and Dr. Petra Reyes of the Office of Health.

We are also indebted to Ms. Carole Jolly of the Committee on Population, National Academy of Sciences, Dr. Cynthia Green, and the participants of the NRC Workshop on Population Change and Land Use for sharing their latest research.

EXECUTIVE SUMMARY

Population and Economic Growth

Population and economic growth most likely are simultaneously related. Fertility decline is likely to contribute to economic growth, and economic growth is likely contribute to the decline of fertility, but the relative magnitude of these effects is not reliably known.

Fertility decline tends to contribute to economic growth through effects on intermediate factors such as increased women's labor force participation, higher savings rates, improvements in health status of mothers and children, and increased levels of education. Economic growth, for its part, appears to contribute to fertility decline through positive effects on health status, education, and women's employment.

Where most effective, family planning programs have been found to contribute as much as 80 percent of the decline in fertility. In countries with highly unfavorable social and economic conditions, family planning programs generally are not found to be an effective means to decrease fertility. In addition, programs that operate on indirect determinants of fertility, education and health status for example, take longer and are likely to be less cost-effective than family planning programs for fertility decline.

Because of the simultaneous nature of the relationship between fertility and economic growth, policy makers continue to debate whether the emphasis should be placed on population or on economic growth. Thailand's fertility decline of the last two decades is often cited as a dramatic example of the effectiveness of a strong family planning program. Proponents argue that Thailand's success was due to the ready availability of contraceptives and a national policy which was supportive of fertility decline. Others would argue that Thailand's strong economic growth during the period was at least partially responsible for the decline in fertility.

Because population and economic growth efforts may go hand in hand, the argument for continuing to make family planning services available appears to be most convincing when favorable economic conditions are present. An important lesson learned from Thailand is that attention should be paid to policies which create favorable economic conditions for family planning programs to be most effective.

Health Status and Economic Growth

Health interventions that result in improved health status can lead to economic growth through decreases in health care expenditures, increases in labor supply and productivity of the work force, decreased absenteeism in schools and higher returns to education, and increases in the savings rate and capital formation. Economic growth can lead to further increases in health status if additional resources are devoted to effective health interventions.

Improvements in health status are valued for their consumptive as well as their investment effects. As a consumption good, better health increases well-being, directly. As an investment good, better health can increase time and energy available for work in the market and non-market sectors of the society, and increase the return to education.

While some argue that health status and economic growth are simultaneously related, economic growth appears to be an important but not an absolutely necessary factor for improving health status. Some countries exhibit significantly worse, or better, health status than the average for countries in their income class. It is likely that economic growth must be translated into resources devoted to cost-effective health interventions for improvement in health status to occur.

Within this context it is necessary to address the effect of women's health is an integral component of the health status - economic growth issue, because of the contribution which women make to household production and productivity in the workforce.

Population, Health, and the Environment

The promotion of the population, health, and environment linkages as a policy tool is based on a fairly widely accepted, intuitively logical relationship among these three factors. The exact nature of these linkages is still being debated, however, and the quantification of the relationships between the variables is far from being fully explored. In addition, the association between population, health, and the "environment" is actually through a number of environmental component parts, including effects on agriculture, desert and arid lands, forests, biological diversity, water and sanitation, urbanization, etc. The "environment" is also thought to feed-back on population growth and health status, where population and health are closely related.

The linkages between population, health and the environment can be used as an important policy tool on two fronts: a) to

strengthen the rationale for population and health programs; and b) to increase awareness of and commitment to environmental issues among selected target audiences. Funding effective family planning programs and the promotion of the concept that smaller family size is beneficial for both health and environmental purposes, can increase the demand for family planning services, and ultimately may be a positive contribution to health status and the environment.

Rapid and large population growth projected in urban areas of Asian countries during the next two decades forces careful examination of health and environmental implications. Family members are at differential risk, but mothers and children may be particularly vulnerable. Children may be most immediately affected through decreased nutrition and increased childhood infectious diseases. Mothers also may be at risk through high parity and inadequate birth intervals, as well as exposure to environmental risks through over-exposure to smoke from inadequately ventilated cooking stoves, portaging heavy containers, or long hours in poorly lit and/or unsafe factories.

Under circumstances of rapid population growth and compromised health status, the environmental balance is challenged. Because of the diversity in urban and rural populations, national policy, and topographical conditions in the developing world, it is not likely that the exact nature of the relationship among population, health, and the environment will be able to be satisfactorily confirmed empirically. The fairly widespread acceptance of the relationship, however, argues for continued funding of family planning and maternal and child health programs.

Most environmental problems are likely to be exacerbated by high rates of population growth, and fertility rates are thought to be directly affected by health status. Experts are concerned for improving health status in developing countries, and there appears to be general agreement that high rates of population growth must be reduced if solutions to environmental problems are to be successful. Program strategies, while appearing to be directed at one specific problem, need to be viewed in terms of their contribution to the solution of multiple outcomes.

FUTURE RESEARCH AGENDA

Current interest in population, health and the environment is widespread and growing, but there still exists ongoing debate and a surprising lack of demonstrable evidence for many of the linkages, and the magnitude of the effects of linkages between population and economic growth, health status and economic growth, and population, health and environment.

Sound policies which support the positive linkages between reduced fertility, health, sustainable use of natural resources, and economic growth in developing countries must be further developed. In order to be effective, however, these policies should be based on the findings of applied research.

Based on this review, our recommendations for future research include the following:

- *Comparative Studies*, either descriptive or analytic, in which a similar design is used in a number of countries within a region.

Because many characteristics of population, health, environment, and factors leading to economic growth are often culture-specific it is necessary to have comparative studies to validate findings across cultures.

- *Intervention Studies* in which questions about or education concerning linkages between environmental factors and health and family planning initiatives are examined.

Environmental concerns are increasingly of importance to health and family planning programs, and the methods to integrate these concerns effectively into future programs need to be determined.

- *Operational Studies* that investigate the effectiveness of alternative family planning and health service delivery mechanisms in terms of desired outcomes.

For example, an important question that needs to be answered for population and health policy in developing countries is whether reductions in program

funding will disrupt available family planning and health care services, result in higher birth rates, lower health status, and perhaps slow the pace of economic growth. Developing countries and donor agencies are increasingly turning to alternative financing mechanisms for the provision of family planning and health care services to promote economically efficient and sustainable markets for these services. Such operational studies can reveal the relative effectiveness of alternative strategies for service delivery.

Cost Recovery Studies, related to the operational studies identified above, but that focus on the financing of family planning and health service delivery.

Increased cost recovery through user charges for services, expanded use of risk-sharing mechanisms, and divestiture of public facilities are likely to relieve the pressure on scarce resources for the provision of family planning and health care services. The effectiveness of the alternative financing schemes in terms of the net effect on total resources devoted to family planning and health care needs to be determined.

Evaluations of Microeconomic Effects of alternative financing mechanisms on individuals and families.

Family planning and health care choices made by individuals and families are likely to be affected by alternative financing mechanisms. The extent that individual behavior is changed will likely have implications for fertility, health status, and economic growth, especially if there is a large majority of people who may not be willing and able to pay for services. These microeconomic effects need to be systematically investigated.

Evaluations of Macroeconomic Effects of alternative financing mechanisms.

The proceeds from alternative financing reforms could enable the expansion of preventive health care and family planning services for which the benefits to society as a whole are high, and which could add to the overall productive capacity of the economy through gains in worker productivity and

returns to education. Economic growth may be obtained from these efficiency gains, and from the expansion of the overall health care sector through increased involvement of the private sector. The effectiveness of these strategies to accomplish these objectives needs to be determined.

Analytic Studies of systems of relationships involving population, health, and the environment.

In none of the three major systems of relationships that were reviewed, was a single study found that rigorously takes into account the simultaneous nature of relationships. While there appears to be evidence that supports, for example, an effect of fertility decline on economic growth and an effect of economic growth on fertility decline, no studies were found that take into account this simultaneity. Similar simultaneous (endogenous) relationships appear to exist for population, health, environment, and economic growth. While it appears that, in all cases, an argument can be plausibly made that these factors are simultaneously related through a complex set of intermediate factors, no studies have attempted to systematically account for these relationships. This is particularly glaring in the case of the linkages between population, health, and environmental components.

INTRODUCTION

Background

Development planning in the United States Agency for International Development (USAID) is increasingly being driven by the achievement of economic objectives. Convincing economic rationales have long been established for agriculture, irrigation and private enterprise activities and more recently established for science and technology activities. Rationales for funding health, population and nutrition activities, however, have been of a social nature and have not always been analyzed and correlated with economic benefits. Improved health status and reduced fertility have not always been considered conditions necessary for achieving sustained economic benefits. Yet, it would seem obvious that needless child deaths, increasing population growth rates and high child and maternal morbidity will hamper efforts to develop viable economies due to the economic burden of providing health services, lost labor productivity, and increasing strains on basic services.

For a large group of Asian countries, the 1980s was a decade of low and declining economic growth rates. These countries--Bangladesh, the Lao People's Democratic Republic, Myanmar, Nepal, the Philippines, Sri Lanka, and Viet Nam--face uncertain or clouded prospects for the first years of the new decade, as well. Although development constraints vary in intensity and composition from country to country, they all share, to some degree, an ominous convergence of rapid population growth, ecological vulnerability, large numbers of absolute poor, and deeply rooted domestic and external macroeconomic problems. With an emphasis throughout USAID on doing "fewer things better," the Asia Bureau will be challenged to reassess the role that family planning and child survival will play in the Bureau's portfolio over the next several years. Senior managers in the Asia Bureau have been informed that the countries within the Asia region account for 75 percent of the annual infant deaths in all of the child survival emphasis countries worldwide and that, to date, although some gains have been made, not all of the Asia emphasis countries have fully achieved the child survival goals established in 1985.

The important role that women play in the linkages among fertility, mortality, migration, economic growth and the environment must also be considered. A seminal paper highlights this important role (Shaw 1989). The author suggests

examining women's role in these linkages from three different starting points: (1) the impact of women on environmental degradation and its consequences for population; (2) the impact of women's status on population and subsequent changes for the environment; (3) the impact of growth or change of population parameters on women and eventual consequences for the environment.

Resolute redirection of public expenditures toward family planning, preventive and basic health care services, and environmental rehabilitation and preservation of forests, soils, and water is badly needed. The future role of the Health, Population, and Nutrition (HPN) sector in the Asia Bureau may also depend, in part, on the extent that convincing arguments can be made for the economic and environmental linkages with the HPN sector.

Purpose of the Study

Research Triangle Institute (RTI) was commissioned by USAID, Asia Bureau, Office of Technical Resources, to undertake this study to explore the linkages between improved health status/-reduced fertility and sustainable economic growth and sustainable use of natural resources. While this review covers worldwide lessons, special attention is given to the linkages which exist within countries covered by the Asia Bureau.

This report provides a review of the literature, including summaries of workshops and conferences, and considers the following:

- the extent to which linkages have been established between improved health status/fertility reduction and sustainable economic growth and conservation and sustainable use of natural resources, and the validity and reliability of the findings;
- a description of the linkages that have been established or ones that are currently under exploration, and differences among these linkages in countries of the Asia Bureau;
- the case that can be made for establishing economic and/or environmental rationales for the support of HPN activities; and
- additional areas or methods of research which should be considered for further study of these linkages.

Organization of the Report

The body of the report is divided into three main sections. The first section focuses on the relationships and linkages between population and economic growth. The second section examines the linkages between health status and economic growth. The third section is devoted to the relationships between population, health, and the environment.

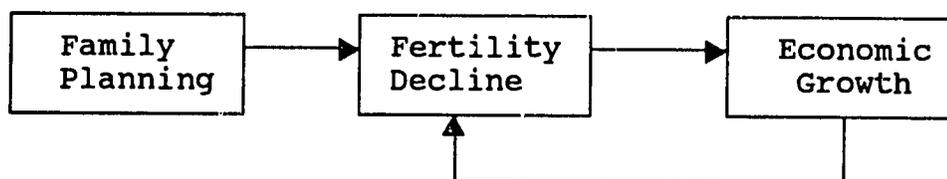
A list of persons contacted in the course of the investigation, a comprehensive bibliography, and a list of relevant workshops and conferences that have been conducted are given as appendices.

POPULATION AND ECONOMIC GROWTH

Introduction and Overview

There is a fairly well-established conceptual linkage between family planning programs and economic growth. Figure 1 provides an overview of the linkages between family planning, fertility decline and economic growth to guide the discussion and literature review. Later sections explore the validity of these linkages between each of the major components in more detail, and the empirical evidence that is available to support these linkages.

Figure 1. Family Planning and Economic Growth



The conceptual reasoning that leads from family planning programs to economic growth is straightforward:

- Family Planning programs can serve to increase contraceptive acceptance rates and prevalence, and thereby can contribute to decreases in fertility;
- Fertility Decline can contribute to economic growth through a number of direct and indirect pathways, including maternal and child health, education, women's labor force participation, and the savings rate; and
- Economic Growth, itself, can contribute to fertility decline by feeding-back through other factors. In fact, some argue that economic growth is a necessary condition for fertility decline, though there are obvious exceptions to this rule as perhaps is the case in Bangladesh.

There have been three distinct phases in the interpretation of the relationship between population change and economic growth. In the 1960s and 1970s there was an emphasis on the

negative supply-side impacts of population. Increasing populations were thought to result in diminishing returns from scarce farmland (the Malthusian notion), lower ratios of capital to labor, decreased savings, and greater expenditures on "unproductive" investments such as health and education.

In the early 1980s, the thinking was a less pessimistic interpretation of the effect of growing populations. Empirical evidence presented by Simon (1981) advanced the controversial idea that population in the long-run could actually enhance the pace of economic growth in developing countries.

In the mid-1980s, a "Revisionist Interpretation" of population's impact on economic development evolved. According to a National Academy of Sciences (NAS 1986) study, the negative impact of population growth in developing countries varies according to country. The study also reached the following conclusions, among others:

- the negative impacts which rapid population growth can have in selected developing countries are not as strong as once envisaged, particularly when viewed over a longer time period;
- population growth is often not the direct cause of problems, bad economic policies are often to blame;
- rapid population growth can, however, exacerbate existing social and economic problems;
- some of the old anti-natalist arguments have proven unsound; and
- feedbacks are increasingly important to the analysis.

Conclusions reached more recently by Kelly (1988) and Schultz (1988) and presented at a seminar sponsored by USAID in 1991 on "Demographic Change and Economic Growth," suggest a somewhat broadened interpretation of the effect of population growth on economic development that includes the following:

- reducing population growth alone will not solve severe fundamental economic problems;
- reducing population growth can buy time and flexibility, however, and may release some resources;
- strong family planning programs are justified less on economic development grounds than on family welfare grounds; and

- a lesson learned over the last two decades by family planning managers in different countries is that the success of family planning depends heavily on the underlying changes in the economic and social environment which motivate couples to demand fewer births.

Moreover, Kelly suggests that providing a quantitative estimate of the net effect of population growth on economic development over recent decades is a only remote possibility, at best.

There has long been a dynamic debate between those who would place increased emphasis on population decline or economic development. Omrar (1984) cited as one of the reasons that African leaders were reluctant to enact fertility control practices was the "fear that preoccupation with the population problem would take away emphasis on economic growth."

While several theoretical models predict a negative impact of population growth on economic growth (see Kelly 1988, for a review of theoretical economic models) there is surprisingly little empirical evidence that documents this direct linkage without considering intermediate factors of fertility on economic growth.

The NAS Working Group on Population Growth and Economic Development, for example, provided a somewhat moderate conclusion:

On balance, we reach the qualitative conclusion that slower population growth would be beneficial to economic development of developing countries (NRC 1986, p. 90).

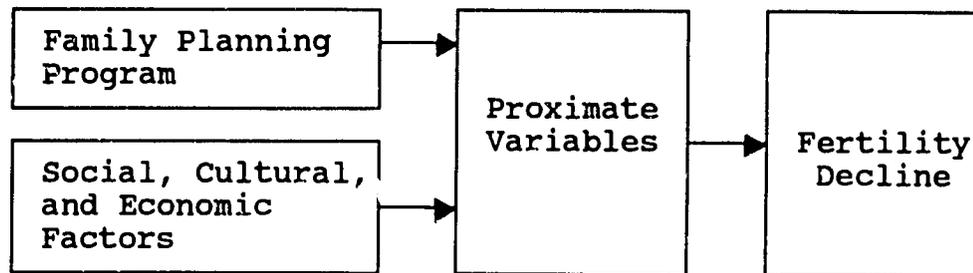
Examples of empirical studies that examine correlations between per capita output growth and population growth across countries and time include ones by Easterlin (1967), Simon (1977), and Browning (1982). Kelly (1988) discounts these bivariate correlations as simplistic and difficult to interpret. Causation is not revealed, and institutional and cultural variations across countries may hide the true underlying relationships, especially if population growth is simultaneously influenced by economic growth.

In the following sections, the linkages between family planning programs on fertility, and between fertility and economic growth, separately are reviewed.

Effect of Family Planning Programs on Fertility

A closer examination of the linkage between family planning programs and fertility decline is illustrated by Figure 2.

Figure 2. Family Planning and Fertility Decline



Family planning programs are likely to work in concert with socio-economic and cultural factors and have an effect on fertility through "proximate variables."

Proximate variables include factors such as contraceptive use, proportion married women with postpartum in-fecundability, and fecundability (Bongaarts 1978). The direct influence of family planning programs on fertility is through its effectiveness at increasing contraceptive prevalence rates. Cultural differences in social, economic, political, and familial organization also play a role in reproductive behavior and change, and must be accounted for in empirical investigations of the effects of family planning programs on fertility and, ultimately, economic growth.

There is mixed evidence on the effectiveness of family planning programs to reduce fertility. Some argue that well-organized family planning programs can be effective anywhere; others argue that if there is demand for reducing fertility, then a population will find a means to do so, with or without a family planning program.

Freedman and Freedman (1989) essentially argue an intermediate position based on the evidence available:

- there is considerable evidence that cultural differences in social, economic, political, and familial organization, as well as in value systems, play an important role in reproductive behavior and change;

- where broad-based socio-economic development has been considerable, birth control would have become more prevalent and fertility eventually reduced, with or without a program;
- family planning programs have difficulty in countries with little socio-economic development and weak infrastructure, since both demand and supply of birth control are at a low level; and
- family planning programs can help to crystallize and legitimize "latent" demand for fertility decline, that is, family planning programs can help the idea of birth control to become accepted.

There has been a substantial rise in contraceptive prevalence, a decrease in fertility, and a growing number of family planning programs in developing countries over the last few decades. Contraceptive prevalence rates in developing countries were probably below 10 percent in the early 1960's were estimated by the United Nations (1989) to be about 45 percent (32 percent if China is omitted).

The extent of the independent role of family planning programs in reducing fertility through increasing contraceptive prevalence, however, is controversial. Studies at the macro level (e.g., Lapham and Mauldin 1984) which attempt to show the strength of family program effort on fertility decline often omit important socioeconomic characteristics, but in general appear to make a plausible case for an independent family planning program effect on fertility.

There is case study evidence that the introduction of major new contraceptive methods results in jumps in contraceptive prevalence (Mauldin and Ross 1988), and cross-country multi-level analyses (Entwistle, Mason, and Hermalin 1986) suggest that family program effort does significantly affect contraceptive prevalence while controlling for within and between-country differences in socioeconomic conditions.

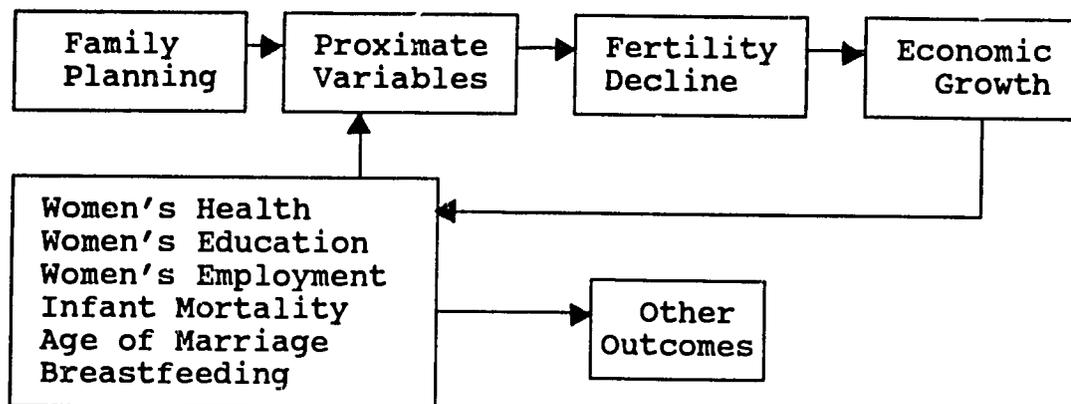
Other Social, Economic and Cultural Factors

It is not easy to generalize across cultures about family planning effect on fertility decline because what works in one culture may not work in another due to differences in social, economic, and cultural factors.

Figure 3 illustrates the linkages between other socio-economic factors, proximate variables, and economic growth. Fertility, through proximate variables, is affected by other socio-economic factors that 1) are likely to be influenced by

economic growth and 2) also have other outcomes. For example, breastfeeding has a contraceptive effect on fertility, and also has a positive affect on child nutrition.

Figure 3. Linkages to Other Social, Economic and Cultural Factors



Pilot studies show that intensive high-quality family planning efforts can increase contraceptive prevalence and reduce fertility in at least some environments with unfavorable conditions of socio-economic development. (Freedman and Freedman 1989)

Countries with little socioeconomic development and weak infrastructure are less likely to achieve a reduction in total fertility from family planning programs, because both the demand and supply of birth control are at low levels. Exceptions where the conditions were (at least initially) unfavorable and family planning programs were successful, include China (but with coercion), Indonesia, and Thailand (Freedman and Freedman 1989).

In general, within countries, higher prevalence rates and lower fertility are associated with greater or higher-quality family planning program effort. Examples where this has been demonstrated empirically include Indonesia (Warwick 1986), Taiwan (Hermalin 1978), and Malaysia (Tan Boon Ann 1987).

The Thailand Experience

Thailand, in particular, is an excellent example of a dramatic family planning program effect on fertility decline. In 25 years, Thailand has moved from fertility levels between 6.3 to 6.6 births per woman, to a society of contraceptive users,

with fertility almost at replacement levels (Bennett, et al. 1990).

The pace of fertility decline in Thailand is one of the most rapid ever experienced by any developing country. In the mid-1960's, Thailand's TFR was in range of 6.3 to 6.6 births per woman. The TFR in Thailand declined to 5.1 in 1975, followed by a rapid acceleration of the decline that resulted in a TFR of 3.7 in 1978. The TFR in 1987 was near the replacement level, 2.1 births per woman.

The impact of the National Family Planning Program (NFPP) in Thailand on reducing fertility has indisputably been significant. Calculation of the NFPP impact varies depending on the different assumptions made about potential fertility, the actual amount that fertility is assumed to decline, and the contraceptive continuation rates incorporated in the models.

Nonetheless, in all cases, the contribution of the NFPP appears to have been substantial, with estimates as high as 80 percent of the decline between 1964 and 1975 in fertility attributed to the NFPP when based on a calculation of the number of births averted through use of program-supplied contraception (Khoo 1979, Knodel 1987).

Multivariate regression analysis shows 53 percent of decline in TFR during 1962 to 1980, and 68 percent of the decline during 1972-1980 in Thailand was attributable to the NFPP (Chao and Allen 1984). During the same time period Thailand has experienced strong economic growth that some would argue has been a positive factor contributing to fertility decline as well.

Other Determinants of Fertility Decline

It is important to note that family planning programs, while found to be effective in decreasing fertility, can be used in conjunction with other initiatives that also tend to decrease fertility. Other (indirect) determinants of fertility decline include education (especially for women), income, improved health and lower infant mortality, female employment, later marriage, and longer breastfeeding.

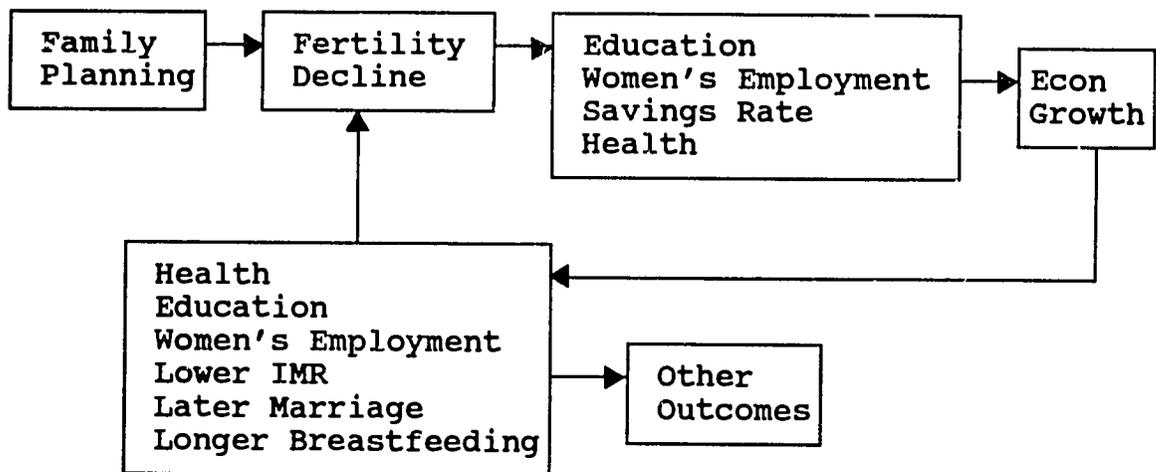
These other indirect determinants of fertility decline are associated with economic growth (a "feedback loop" from economic growth to fertility), but also are often the objective of direct interventions. However, direct family planning programs are more cost-effective than indirect development programs at reducing fertility (Simmons 1979).

Many of these determinants of fertility decline have "joint products," where reducing fertility is an outcome in conjunction with other outcomes such as improved maternal and child health, income, child nutrition, etc. Programs that operate on indirect fertility determinants, such as health promotion and education, however, generally take longer for fertility decline, and are less cost-effective, than family planning programs (Bulatao 1984, Simmons 1979).

Effect of Fertility Decline on Economic Growth

Fertility decline is thought to operate through intermediate factors to stimulate economic growth. Figure 4 illustrates the linkages between fertility decline, intermediate factors, and economic growth.

Figure 4. Intermediate Factors



Intermediate Factors

Fertility decline can operate through intermediate factors to increase economic growth in the following ways, each of which is discussed further below:

- lower fertility rates can shift the proportions of children and adults in a society. With fewer children per adult, a smaller share of total resources is required to care for children, or each child can receive more resources for health and education;

- declining fertility can enable countries to enroll higher proportions of students in school, leading to a more educated labor force;
- lower fertility rates can enable women to gain in education and employment;
- lower fertility rates may allow families to save more; and
- lower fertility is associated with longer birth intervals which can have a positive effect on maternal and child health.

Intermediate factors can serve to stimulate economic growth and increase Gross Domestic Product. Moreover, economic growth is likely to have feedback effect on fertility through intermediate factors already discussed.

Economic growth, as measured by per capita output, in many developing countries would have been more rapid in an environment of slower population growth, although in some countries the impact of population was probably negligible. The negative impact of population growth on economic growth is most likely to occur where arable land and water are particularly scarce or costly to acquire (Kelly 1988).

It is likely that there are complex (endogenous) interrelationships between fertility, intermediate factors, and economic growth that have not been fully accounted for in empirical work.

Poverty and population growth reinforce each other in a tragic circle. A lack of education, information and access to health services often leads to unplanned pregnancies and unwanted children. On a broader level, poorer countries tend to have much higher fertility rates than their richer neighbors, as nation-wide economic conditions and population growth continuously influence each other. Significant improvements in either realm can thus contribute to breaking this vicious cycle (IPPF 1990).

Education

As economic growth occurs, countries educate a growing share of the school-age population, but a decreasing proportion of the population is of school age. Gains in education improve labor productivity and wages, and thereby stimulates economic growth.

In 1980, school enrollment in four Asian countries (Japan, Korea, Thailand, Indonesia) correspond to their levels of development. In Japan and Korea, virtually all children age 6 - 11 are in school, ratios lower in Thailand and Indonesia. In Japan, 80 percent of those age 15 - 19 are in school, other countries much lower (Mason, et al. 1986).

Interventions could be a lot more focused on linkages between population and development. Increased access to female education is an obvious choice, which will benefit the society at the micro or household level as well as at the macro or economic output level (Conly, personal communication 1991).

Countries with a higher rate fertility decline enroll a higher percent of school age population, compared with countries with average rate of fertility decline. Enrollment ratios, especially for secondary education are projected to be much higher for countries with rapid fertility decline (Mason, et al. 1986).

Savings Rate

Declining child dependency due to reduced fertility is a primary force behind increased savings rates. Mason, et al. (1986) estimate that the savings rate is projected to increase to nearly 30 percent in countries with rapid fertility decline, compared to a standard 22 percent. Higher saving rates, coupled with economic growth of Gross National Product, further stimulates savings.

Economic Growth

Mason, et al. (1986) project that rapid fertility decline in selected Asian countries at first affects per capita income only slowly, resulting in a gain of just \$2 per capita more than the average after the first ten years along a simulated development path. But after 40 years, per capita GNP is over twice as high in countries with rapid fertility decline as it is in the average country. After 50 years, it is nearly three times as high in countries with rapid fertility decline compared to average countries.

Other Effects

There are other possible positive effects of family planning programs, including:

- women's labor force participation increases with declines in fertility (Mason, et al. 1986).

- family planning allows people to invest more abundantly in their children's futures as well as their own. Although family planning services alone will not eliminate poverty, they can enhance the health of mothers and children and improve the living standards for all" (IPPF 1990);
- declining fertility may delay the time at which exhaustible resources reach critical depletion levels (NAS 1986);
- declining fertility is likely to lead to a reduced rate of degradation of resources like air and water (NAS 1986); and
- declining fertility is likely to slow the recent rapid growth of cities (NAS 1986).

Gender Issues

Fertility decline results in more women working outside the home. Work outside the home has a positive effect on household income. Increased income, in turn, enables the family unit to access additional resources of the society and makes apparent the benefits of decreased family size.

While the process is clearly a cyclic one, making family planning services available and accessible is clearly a feasible intervention. And, studies have demonstrated that family planning program effort significantly effects level of contraceptive use, thus having an impact in a negative direction total fertility rates.

In countries with rapid fertility decline, women of childbearing age are projected to be much more likely to participate in the labor force. Increased women's labor force participation adds to household income, and economic growth. Such growth is has been demonstrated to have an increased effect on lowering fertility to still lower levels.

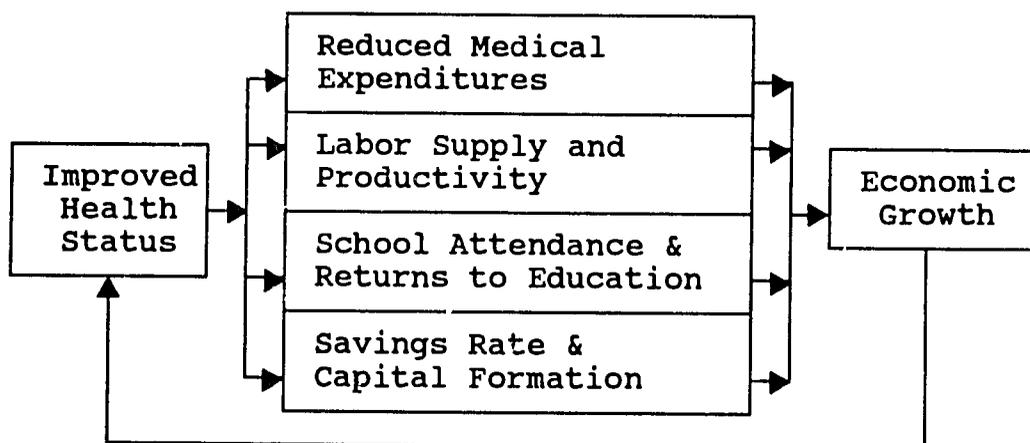
Furthermore, as will be referred to in subsequent sections, decreased fertility is likely to increase average per child (and adult) expenditures on health care, leading eventually to a healthier, more productive labor force (NAS 1986).

HEALTH STATUS AND ECONOMIC GROWTH

Introduction and Overview

Health interventions are designed to lead to improved health status. Improvements in health status can lead to decreases in health care expenditures, increases in labor supply and productivity in the work force, decreased absenteeism in schools and higher returns to education, and increases in the savings rate and capital formation. These intermediate outcomes can contribute to economic growth which, in turn, can lead to increases in health status if additional resources are devoted to effective health interventions. These relationships and linkages are illustrated in Figure 5.

Figure 5. Health Status and Economic Growth



Health Interventions

Health considerations for economic development identified in World Bank projects are both direct and indirect, and include 1) effects on inhabitants of the project area; b) direct effects on project workers; and c) introduction and spread of disease vectors.

For example, the black fly vector of onchocerciasis, (also known as river blindness) which breeds in rapidly flowing streams, has caused the depopulation of wide areas traversed by such streams in sub-Saharan Africa, because of fear of the

disease. Agricultural lands are left fallow and economic losses follow.

In the second instance, for example, project employees, because they are newcomers to a particular area, are often highly susceptible to locally endemic diseases. If such persons become exposed to leishmaniasis, which is transmitted by the bite of the sandfly, the disease is likely to spread in epidemic proportions, having substantial effects on the affected populations economic productivity (Lee 1985).

The risk of work related accidents and exposure to chemical and physical hazards are two other direct effects on project workers where the human cost in terms of economic output is high (Lee 1985).

In some development projects, the health and productivity of workers has been improved by providing low-cost meals or supplementary food on the job. This is intended to ameliorate the widespread problem of lack of stamina and increased susceptibility to infection among workers, due to poor nutrition, principally a lack of protein in the diet (Lee 1985).

The spread of vectors through lack of adequate water supply and poor or nonexistent means for disposing of human excrement are major cause of debilitating and killing diseases and a major impediment to development. "The World Bank has estimated that disease in developing countries typically takes up about a tenth of the average person's potentially productive time" (Lee 1985).

Toxic hazards can also disturb the ecological balance of an area and affect the health and nutritional status of the population. Fish killed by reduced oxygen content in impounded water is an obvious problem. Similar threats are posed by thermal pollution caused by wastewater from power plant operations (Lee 1985).

Water and Sanitation

Unlike most other types of health interventions, water supply and sanitation improvements result in a whole range of secondary non-health benefits of an economic and social nature. Improved water supplies and sanitation practices are instrumental in improving child nutrition and overall health, and this fact can and should be used as a powerful lever in developing support for water supply and sanitation improvements.

In addition, investments in water and sanitation infrastructure can lead to economic gains through: 1) increased efficiency and production of the water supply itself; 2) the payoff in terms of increased production of all goods and services; 3) increased private investment that is triggered by a public investment in water and sanitation services; and 4) increased job creation and employment (Schwartz and Johnson 1991).

While released time from finding and transporting water, greater agricultural productivity, improved community organization, and better quality of life benefit everyone, it is the lives of women that are most directly impacted. In fact, the role of women in the community and the larger society can be enormously affected by water supply and sanitation development. At one level, women's everyday lives are made easier by water supply and sanitation improvements. At another, their roles in bringing these improvements about can lead to increased status in their communities and in their countries (WASH 1990).

Nutrition and Hygiene

Regaining soil fertility so as to promote economic stability and eventually other development benefits was the primary objective of the World Neighbors in their work with Comunidad El Rosario in Honduras. Working at the grassroots level, old traditions such as adherence to moon phases and native abundant grains called "velvet bean" have been recreated.

A health center has been established in El Rosario which focuses on nutrition and hygiene. In attempts to overcome traditional division of labor, women have been taught to grow vegetable gardens. They have also received assistance in preparing foods which have not been a regular staple in their diet. Women commented that the applied nutritional practices were not only reducing the child mortality rate but were relieving some of the guilt they felt in not having been able to adequately feed their children in the past (Trejos and Solis 1989).

Improved Health Status

Improvements in health status are valued for their consumption and investment effects. As a consumption good, better health increases utility or well-being directly. As an investment good, better health increases the time available for work in the market place and non-market sectors of the economy. Improvements in health status also increase the return on investment in human capital (Grossman 1972).

Consumption effects of improved health include 1) direct health consumption effects from reduced pain and suffering and an improved sense of well-being, and 2) indirect: social interaction and leisure effects resulting from the reduced stress on the family (Andreano and Helminiak 1986).

Investment effects include 1) short-term market and non-market production effects due to increased labor supply and reduced use of medical care resources, 2) long-term production effects due to long-run changes in labor supply because of demographic effects, and 3) long-run changes in capital formation, investment in human capital, and community attitudes about risk and innovation (Andreano and Helminiak 1986).

Effect of Health Status on Economic Growth

Improved health status is thought to contribute to economic growth through intermediate variables such as savings in medical and health care expenditures, increases in labor supply and productivity, decreased school absenteeism and increased return to education, and increased savings rates and capital formation.

Medical and Health Care Expenditures

Studies of the benefits of preventing or reducing the incidence of tropical diseases include estimates of avoided treatment costs (Dunlop 1984, Horton and Claquin 1983, Paul, et al. 1986).

Economists value resources used in one sector as being equal to the opportunity cost of those resources, i.e., their value in their next best use in the economy. In a perfectly competitive labor market, wage rates will be equal to the opportunity cost of the worker at the margin. In developing countries (and elsewhere), however, labor markets are usually not perfectly competitive, and wage rates often do not measure either the value of the marginal product of the worker or the opportunity cost (Creese and Henderson 1980, Prescott and Warford 1983).

In addition, the opportunity costs of imported goods, such as locally unavailable medical supplies and pharmaceutical products may be higher than indicated by their price, because of the scarcity of foreign exchange (Horton and Claquin 1983). Thus, shadow prices are usually computed to reflect opportunity costs of labor and goods used in medical care.

Savings in health expenditures usually are estimated as the product of the cost of treating a typical case of the disease

and the estimated number of cases avoided (Paul and Mauskopf 1991).

Labor Supply and Productivity

Productivity gains associated with improvements in health status include 1) higher labor productivity; 2) higher total output; and 3) increased stock of capital, which enhances efficient use of capital (Andreano and Helminiak 1986).

Productivity gains result from decreased absenteeism from work, improved mental and physical capacity of adults and children, lengthening of working lives, reduced household resources used to care for the sick, reduced resources used to avoid illness, lowered child mortality (Andreano and Helminiak 1986).

For example, an estimate of the effect of schistosomiasis on rural banana estate workers and urban light manufacturing workers on productivity per day worked in St. Lucia indicates that schistosomiasis was associated with lower daily productivity (Weisbrod, et al. 1973).

Similarly, significant earnings differences were found between workers infected with schistosomiasis and uninfected workers in Tanzania (Foster 1977). And, significant productivity differences were found in Brazil (Barbaro and Pereira de Costa 1981).

A study of the effect of malaria on productivity in Paraguay takes into account cash and noncash agricultural production of families. The study suggests that malaria-affected families stressed the production of their cash crops at the expense of non-market production. Intra-family adjustments to illness, such as taking children out of school, were made to attempt to maintain agricultural production. Thus, total home production was decreased due to the illness (Conly 1976).

A study by Paul et al. (1986) estimated reduced disease incidence which was converted to gains in health days, and then to gains in productivity using a cost-of-illness approach. As part of the analysis, avoided health care costs and improved agricultural productivity associated with a guinea worm control program were estimated using a human capital approach. Estimates of gains in macro-productivity were derived as the product of per capita agricultural productivity and the reduced incidence of the disease expected as a result of the health program. Macro-productivity studies of this type, however, suffer from several methodological problems that mainly derive from using aggregated data that do not account for individual differences and behavior.

The conclusions of National Academy of Science (1990) expert papers with respect to productivity and economic growth from health interventions are less clear. In general, the evidence linking health effects to productivity provided in papers by Behrman, Pollitt, Martorell, Strauss, and Thomas (NAS 1990) is mixed. Behrman does not even make any tentative conclusions; Pollitt finds linkages with education but not with productivity; Martorell cannot link growth rates with productivity; Strauss makes no connections between nutrition and productivity; Thomas finds linkages between mother's health and child health, but no linkages with productivity.

School Attendance and Returns to Education

There is increasing evidence that education is positively correlated with the economic well-being of a country. King (1990) has demonstrated the links between women's education and social and economic development as well as the inverse relationship between primary enrollment rates of girls and infant mortality rates and fertility rates.

For a given level of per capita income, countries with smaller gender gaps in education tend to have longer life expectancies, lower infant mortality rates, and lower fertility rates (Floro and Wolf 1990).

Savings Rate and Capital Formation

If large changes in disease incidence occur in a region, there are likely to be long-term effects, which may differ in direction or intensity from the short-term effects. Long-term effects can occur because of changes in population size and age distribution, land supply, stock of human capital, savings ratio, capital/labor ratios, patterns of consumer demand, prices of goods, value of the marginal product of labor, household or individual attitude to innovation and risk taking.

A simulation of the effect of malaria eradication in Sri Lanka was conducted assuming that capital formation is directly determined by the amount of public and private savings, and that labor inputs are expanded because of an increased working-age population resulting from reduced mortality and increased fertility and because of decreased morbidity and debility among the work force. The results indicate a positive productivity effect of increased labor input due to eradication dominated population growth in the first eight years, but after that, growth in population exceeded growth in income (Barlow 1967).

A review of the literature relating population growth due to lower death rates to economic development concludes that population growth will slow economic development because of reduced public investment in physical capital. This reduced investment comes about as a result of the increased need for public expenditure on schools, health, and other social programs (Ram and Schultz 1979).

Effect of Economic Growth on Health Status

Economic growth is an important but not an absolutely necessary factor for improving health status. There is not necessarily a direct and constant relationship between GNP and health status. Some countries exhibit significantly worse or better health status performance than the average for countries in their income class (Wouters 1990).

Some evidence exists that mortality rates are sensitive to living standards, independent of the level of economic development (Preston 1975, Thomas, et al. 1990). Thomas (1990) finds that the predicted logarithm of per capita expenditures, a proxy for income, does enhance child survival, controlling for other factors including parents' education.

Preston (1980) tested whether mortality declines are principally a by-product of economic development as reflected in private standards of nutrition, housing, clothing, transportation, water supply, medical care, etc. or whether they are produced by social policy measures which are particularly effective. The study found that during the period 1940 to 1970 about one half of the increase in life expectancy is due to higher national levels of per capita income and literacy rate. Structural change from public health interventions accounts for the other half of the increase in life expectancy.

Wheeler (1980) found that an increase in life expectancy between 1960 and 1970 could not be fully explained by per capita income, adult literacy, population per doctor and population by nurse.

Cross-national studies like those performed by Preston (1980) and Wheeler (1980) only show associations between various indicators of economic growth and health status, and not causation. Household-level studies based on household production theory, like the one performed by Thomas (1990), suggest that economic growth is one of many factors of improved health status.

Country studies for Malaysia, Thailand, Korea, Botswana and Sri Lanka conducted by the World Bank (1990) and UNDP (1990)

suggest that moderate to strong economic growth can be translated into improvement in health status. Korea appears to be such an example. Economic growth does not necessarily guarantee health status improvement, however. Pakistan and Brazil have experienced economic growth without achieving health status improvement (Wouters 1990). It appears that economic growth must be translated into resources devoted to cost-effective health interventions for improvement in health status to occur.

Gender Issues

Within the context of a household utility maximization model, there is a need to address how women's health affects household functioning with respect to both home production and production outside the home. Using ICRISTAT data, Behrman and Deolalikar (1989) estimate the effect on wages of weight for height (instrumented with prices, farm size and an indicator of farm quality). Whereas weight for height of men has a positive effect on wages (and possible a negative effect during the peak season), more robust women are not paid higher wages. The authors suggest the differential effects may be interpreted as reflecting task segmentation (Ryan and Ghodake 1984). The most physically demanding tasks, such as plowing, are performed by men whereas women tend to weed, harvest, and thresh.

Sahn and Alderman (1988) estimate wage functions for men and women in rural Sri Lanka and include (the logarithm of) predicted per capita household calorie intake; they also find that nutrient intake has a positive impact on male wages but no effect on female wages. In the urban sector, they report that both male and female wages respond to per capita calorie intake. There is scope for more research building on these selected studies of the impact of women's health on both participation and productivity in the labor force (Thomas 1990).

Women play a dual role in the economy: on the one hand they often produce food crops or work for income, and, on the other hand, women are the primary providers of services in the home, such as child bearing and rearing as well as the preparation of food. (Thomas 1990). In Nepal, the Action Aid-Nepal Project (AAN) was organized to reverse rapid land deterioration that leaves the indigenous population with little economic opportunity emphasized education, health, agriculture, and community development activities. In addition, realizing that women needed to be financially independent, as their husband's money was not always allocated fairly or wisely, AAN also initiated an income generation project (Kanasakar 1989).

Women's health appears to have a significant positive effect on child health and survival; it is probably also associated with better health among adults in the household. There is still little evidence that women's labor market productivity is affected by her health although there are very few studies in this area (Thomas 1990). In Asia, as in many parts of the developing world, maternal mortality is a problem of serious proportions. WHO data suggest that there are about 300,000 maternal deaths annually in Asia--60 percent of all maternal deaths in the world. In South Asia, the problem is extremely severe; estimates of maternal mortality are 874 in India and 600 in Bangladesh per 100,000 live births (Kocher, et al. 1991). When a mother dies, not only is her earning capacity lost to the family, but other members of the family are more likely to suffer increased morbidity and/or mortality.

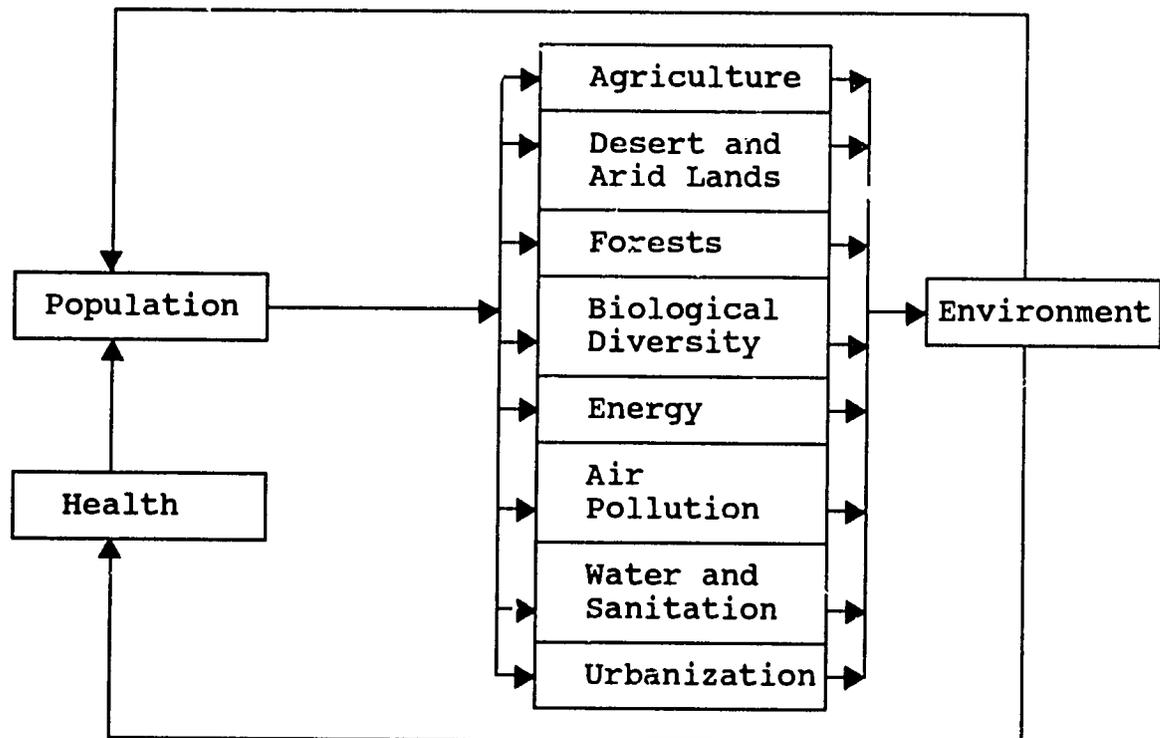
In addition, the studies to be conducted need to focus on indicators of health and well-being which are likely to be significantly related to the types of work in which women are engaged. These do not, on the whole, include tasks where body size/mass is key and where weight for height can be used as indicator. Women's sources of employment are more likely to be in market, factory or clerical areas of the work force. Indicators which are more germane are exposure to heat or cold, eye and/or back strain and extended exposure to computer screens, especially during pregnancy.

POPULATION, HEALTH AND THE ENVIRONMENT

Introduction and Overview

The relationship between population growth and the environment is intuitively logical and is fairly widely accepted. However, the exact nature of this linkage and the quantification of the relationships between the variables has not been fully explored. In addition, the association between population, health, and the "environment" is actually through a number of related component parts of what is generally referred to as "environment," as illustrated in Figure 6. The "environment" is also generally thought to feed-back on population growth and health status where, as discussed in previous sections, population and health are closely related.

Figure 6. Population, Health, and Environment



Population Growth

World population is now more than 5 billion people. Another billion people will be probably be born before the end of the

century. Further, between now and the year 2025, 95 percent of the people added to the world's population will live in developing countries (Sadik 1990).

In one of its recent studies, the World Bank (1989) asserted that no single factor has contributed more to environmental degradation in developing countries during the past decade than rapid population growth.

Human beings now inhabit approximately two-third's of the planet's land surface, converting at least one-third of natural ecological systems to human-dominated ones and impairing their life supporting services as well. These services include absorbing atmospheric pollution, providing fresh water, generating fertile soils, controlling floods and droughts, and maintaining genetic diversity.

The promotion of the population-environment relationship as a policy tool is based on the fairly widely accepted acceptance of an intuitively logical relationship between population growth (and population distribution and density) and the environment.

Within the next 35-40 years, according to the Brundtland Report, there are likely to be twice as many people on earth, consuming three times as much food, and seeking four times as much energy. (IPPS, undated).

What is still lacking is a precise knowledge of the complex nature of this relationship and formulas for the quantification of linkages between and among related the population, health and environment variables.

Cynthia Green (1992) points to five major population variables associated with an impact on the environment:

- sheer numbers;
- multiplying factors for resource consumption;
- population density;
- ecosystem overload; and
- shortened doubling times.

There are also specific examples in which population growth distribution, and density appears to have a negative impact on the quantity and quality of natural resources: 1) land use, desertification and soil erosion; 2) fuel-wood; 3) loss of tropical forests and bio-diversity and pollution.

While population is often discussed at national or global levels, it is as important to address the issue at the local or community level. There the family is the unit of analysis; and key population variables are parity, desired family size, availability of family planning services and access to contraceptives. Family planning programs offer individuals a voluntary way for individuals to take command of their own lives. Thus, they empower people, women in particular, by giving them more choices. Family planning, through increased intervals between births and decreased parity, also promotes the health of mothers and children.

Family planning offers a humane way to slow the rate of population growth--greatly reducing the demands placed upon the earth's already depleted natural resources. (IPPF, undated).

Recognition of the intersection of population and natural resources management is an "essential step towards re-orienting conservationist and development policies and programs towards a more social and human approach to environmental protection" (IUCN 1987).

Health Status

Closely related to population size and child spacing is health status. Projected increases in world population for the next 25 years may have major implications for health status. Diminishing natural resources, including increased marginal agricultural lands, forests cleared for fuel-wood, increased pollution of air and water, greater demands for energy, among others, may make sustaining gains in health status made during the child survival decade more difficult. Childhood (less than five years of age) mortality is particularly affected by inadequate child spacing. Children spaced too closely together place an increased burden on families to provide necessary resources.

The enormous population growth projected in urban areas of Asian countries projected for the next decade will have an impact not only on health status, but also on health care needs, provision of adequate health services, cost and finance issues, and issues of donor support. Addressing urban health will require increased access to infrastructure and services for family planning and maternal and child health services, water and sanitation, etc. (Kocher, et al. 1991).

Despite the lack of ability to specify exactly the relationship between the population/natural resource variables, most experts agree that unless high rates of population growth are reduced in developing countries, solutions to environmental

problems, however imaginative, will become increasingly difficult and costly.

The Population/Environment Debate

Two hundred years after Malthus, the debate on the nature of the relationship between population and the environment still continues. Simply stated, one argument is that if population grows too fast in a world of finite resources, human life, along with world resources will be exhausted. Moreover, quality of life will decline drastically during the process. (Myers 1987, Shaw 1988, Sadik 1989).

Others argue that markets will adjust and technological change will allow economic development in the face of growing populations. (Stiglitz 1979, Simon 1981, Boserup 1981). The conclusion that rapid population growth inevitably leads to environmental degradation is also challenged by two comprehensive studies. (United Nations 1984, NAS 1986).

The Malthusian/Natural Sciences Argument

The Malthusian/natural sciences argument is that natural resources are fixed in supply, and this places an upper limit on the number of people that can survive. As each person has negative impact on the environment by using up more finite resources, more people means more environmental degradation.

Current levels of world population growth are unprecedented in human history. It took all of recorded history until 1830 for the world to reach its first billion people. Today, 160 years later, there are 5.4 billion people, and one million are added every four days. If the world reaches replacement level fertility by the year 2000, world population could eventually stabilize at less than 9 billion. However, if it takes until 2080 to reach replacement level fertility, world population would grow to 14 billion, nearly triple today's size (Green 1992).

Rapid population growth often forces families to cultivate marginal lands, to denude forests in search of land and fuel, and to disrupt or destroy habitats of various animal and plant species (World Bank 1991).

World Bank (1991) research argues that rapid population growth (3 percent a year) and agricultural stagnation are the most important causes of forest degradation in western and central Africa. Further, in urban areas, rapid population growth places major stress on the capacity of these communities to provide necessary sanitary services and dispose adequately of

waste products (World Bank 1991). This is particularly true in the burgeoning cities of Asia.

Despite the intuitive logic of these arguments, and increasing frequency of anecdotal data, little carefully designed basic or applied research which links these sets of variables has been conducted.

There is still insufficient knowledge about the precise relation between rapid population growth and environmental degradation to guide policies on, and lending for, population control. (World Bank 1991).

The Neoclassical Economics Argument

An alternative argument provided by Neoclassical Economics is that increasing populations may indeed lead to scarce resources, but markets will work (raising prices of scarce natural resources) and encourage the development of substitutes for natural resources. The Neoclassical Economics advocates argue that even though the natural resource base is finite, under well-functioning markets the standard of living and output can keep up with or outstrip rapid population growth.

The possibility of substituting manmade goods for natural resources, and the ability of technology to allow more efficient use of the resources available, will allow for the economy to provide for an increasing population (Stiglitz 1979).

The prices of natural resources will increase as they become scarce, and businesses will substitute towards synthetic materials or labor. Consumers will respond to increasing prices for natural resources by shifting their consumption from resource-intensive goods to other goods (Stiglitz 1979).

As resources become scarce, producers will respond to increasing prices and seek ways to use them more efficiently. Producers will also tend to hoard scarce supplies in order to reap higher profits from anticipated future high prices (Stiglitz 1979).

Simon's controversial hypothesis that an increasing population is a long-run stimulus to economic development is consistent with this logic. As population increases, the number of consumers increase, which leads to increased demand. This increase in demand will spur producers to expand and utilize new and efficient technologies to meet the demand, and overall living standards will rise (Simon 1981).

Boserup (1981) also argues that innovation and intensification is a response to population growth. As certain resources become more scarce, technology is adopted that uses more intensively the relatively more abundant factors of production. Thus, rapid population growth can actually spur economic development.

Population Effects on Natural Resource Conservation

Among the areas in which population growth appears to have a negative impact on natural resource utilization are the following:

- land use (desertification and soil erosion);
- fuel-wood;
- tropical forests;
- biodiversity;
- water; and
- air.

Most environmental problems are likely to be exacerbated by high rates of population growth, and fertility rates are thought to be directly affected by health status. Experts are concerned for improving health status in developing countries, and there is general agreement that high rates of population growth must be reduced if solutions to environmental problems are to be successful. Program strategies, while appearing to be directed at one specific problem, need to be viewed in terms of their contribution to the solution of multiple outcomes.

The 1987 Report issued by the United Nations World Commission on Environment and Development states that in many parts of the world, populations are "growing at rates that are outstripping any reasonable expectations of improvements in housing, health care, food security, or energy supplies." In a similar vein, the Office of Population's Director, Mr. Brady (1988) stated, "Sustainable development can only be pursued if population size and growth are in balance with the changing productive potential of ecological systems."

Examples of environmental degradation related to population pressures are numerous and can be drawn from any region of the earth. Among those are the following selected examples:

- In Guatemala, 40% of the land's productive capacity has been lost through soil erosion;
- In Turkey, more than 50% of arable land is severely degraded;
- In northern India, where domesticated animal populations exceed rangeland carrying capacity, desertification is also threatened;
- Throughout the Himalayan region, watersheds have become rapidly de-stabilized, and each year an estimated 1.5 billion tons of sediment wash into the Bay of Bengal;
- During the past 25 years, Nepal has lost more than 30% of its forest cover, mainly to firewood gathering and subsistence farming.

Increasing population pressures not only strains the use of natural resources, but are also associated with high rates of poverty. Poor families living nearby Indonesia's Jakarta Bay suffer from chronic intestinal disorders because they have no choice but to fish in the bay and eat the catch. The Indian government estimates that 2.5 million of its city dwellers live their entire lives in the streets. Of India's urban poor, 65% lack tap water, and some 50% have no sanitary waste disposal.

Despite the poignancy of these all too human examples, conclusions reached by two comprehensive studies are inconclusive and somewhat contradictory. They include: 1) the relationship between population and the environment is not well understood; 2) environmental degradation is caused more by social and economic problems than by population growth; and, 3) the carrying capacity of the environment, more than anything else, determines the amount of damage that can be done by population growth (United Nations 1984, NRC 1986).

Agriculture

By the year 2000, the world's growing population may require agricultural production 60 percent greater than that of the 1980 harvest. This population growth, combined with stubborn poverty, is forcing farmers and herders in developing countries to move onto marginal and fragile land, such as mountain slopes, forests and desert margins. Further, artificially irrigated land area (which places an additional strain on water resources) is expected to double (Nelson and Sandell 1990).

In Africa, in the Gambia, one village women's Kafo (women's organization) is working on a strategy to improve natural resource utilization which is closely linked to improved family health status. With technical assistance from a private voluntary organization, the women implemented a Swamp Rehabilitation Project intended to reclaim valuable crop lands. They build (1) anti-salt dikes to prevent flooding of flat lands; (2) contourbunds; and (3) sluice gates and spillways. The project impact was high; reclaimed land led to a direct increase in agricultural output. In addition, the women of the village were quick to note improvements in health, due to increased nutritional intake, particularly among the children (Joiner 1991).

Desert and Arid Lands

Drylands maintain a fragile balance between desert and productive land. The parched lands often suffer from a fatal combination of poor land management, over cultivation, and high rates of population density. As supplies of easily accessible fuel-wood dwindle, people stop using animal dung and crop cuttings for fertilizer and begin using them for cooking fuel. As this happens, the land quickly loses fertility. In this way, as much as two-fifths of Africa's non-desert land is at risk of being severely degraded, as is a third of all non-desert land in Asia and a fifth of non-desert land in Latin America.

Policies that promote protection of fragile lands is promulgated at a regional or national level. However, it is at the local level that the implementation of these policies is judged to be effective or ineffective. In Nepal, the Majhis, who are among the country's poorest people, grow rice, millet and maize on different dry and rain-fed slopes. However, due to other activities, the forests are disappearing at an alarming rate, bringing landslides and soil erosion to the lands. During the past ten years, the Baudha Bahunapati Family Welfare Project (BBP) and the Family Planning Association of Nepal have been working together to improve agricultural production. The villagers were at first skeptical about planting trees on their limited lands, but they have come to recognize their benefits. The tree planted, known locally as Ipil-ipil, has a deep root system which does not compete with other crops for scarce nutrients and cutting of its leaves for fodder stimulates additional growth. Revenue to the village has increased, mothers are better able to care for their children, and thus rates of infant mortality have declined (Kansakar 1989).

The balance between policy and peasant preferences is a delicate one. As project managers realized, "it is only by

attending first to the villagers' basic needs that they will be open to allotting time for conservation activities (Kansakar 1989).

Forests

Forests are a vital, life-giving asset. They provide food, fuel, and building materials. Forests protect watersheds and recycle moisture. But poverty and the struggle to survive have led many developing countries to ask too much of their forests. As population grows, so does the demand for land and firewood. The result is deforestation. Approximately, 25 percent of the earth was forested in 1950. By 1980 tree cover had been reduced to 20 percent (Adams 1985). Seven out of ten people in developing countries depend on fuel-wood to meet their cooking and heating needs. Poor people clear forests for farming when they lack other economic opportunities.

In non-industrial regions, trees are inextricably linked to rural and household economies. They are used to provide fuel, fodder and food. They supply medicines and shade, increased soil richness, shelter from the wind and protection from rain. Perhaps most importantly, trees and forests provide many rural women with their only source of personal income.

The forest provides many materials that with care, skill and time can be turned into useful products--rattan canes for making furniture, fibers to make nets, ropes and mats, bamboo for baskets, gums and resins, and wood for carved figures. These activities are a major source of income for the poor, especially for rural women, including those from landless families. A survey in Fayoum Province, Egypt, for example, showed that 48% of the women there worked in minor forest industries of one kind or another. A study in Uttar Pradesh, India showed the relative importance of forest and common land to three groups of people: men, women and poor women. Nearly 50% of the latter's income comes from forest and common land, compared to only about one-eighth for men (FAO, undated).

Deforestation is not only detrimental in itself, but it sets off a chain of ecological consequences. First, erosion and runoff are increased. Second, soil impermeability results in insufficient groundwater, which in turn, reduces the amount of water available during dry seasons. Such results can be devastating in areas like south and southeast Asia where millions of valley residents depend on water from forested mountain watersheds (Nelson and Sandell 1990).

An analysis of deforestation in 38 developing countries found that population growth was a major causal factor (Allen and Barnes 1985). Slash and burn cultivation leads to deforesta-

tion as population density intensifies. The number of slash-and-burn cultivators worldwide is growing by 4 to 12 percent annually due to high fertility and migration rates (Myers 1990). In Northeastern Thailand, a survey was conducted in 8 villages to determine how Thai village life is affected by fuel shortages. Women talked of losing an important source of income when the best firewood, which is reserved for use in connection with silk making which requires accurately controlled temperatures, become scarce. Salt making, which requires hours of boiling, tends to die out as fuel-wood becomes increasingly scarce. A traditional ritual after childbirth is maintaining a comforting fire to warm the mother and child for a number of days. However, the length of time for which this fire is lit is drastically reduced when fuel is scarce. The implications of this study not only concern the use of natural resources, but also levels of income and health status of mothers and children. (FAO, undated).

Conventional statistics on rates of deforestation, or the speed at which desertification is proceeding mean little to most rural women. The reality of their daily life is the long walk required to fetch fuel and water. As nearby resources become depleted, women find it more and more difficult to collect enough fuel-wood and clean water in the limited time available. Compromises which they make to accommodate this reality include: a) using inferior wood for cooking; b) cooking less frequently or using foods which require less cooking and may be less nutritious; and c) supplementing firewood supplies with less efficient agricultural residues such as cassava stalks and dung. Because the impact of forest depletion is felt so severely by women, they are usually quite anxious to participate in decisions that are made about restoration or conservation of forest resources (FAO, undated).

It is important to note the critical role played by women in forest resource management. Rural women in tropical rainforest regions have a profound effect on their local environment through such actions as collecting fuel-wood, clearing forest for agriculture, and gathering non-timber forest products. Over time, women develop extensive knowledge of forest composition, extraction potential and management. Because women are often the primary holders of knowledge and the primary agents of forest product transformation, it is critical that the part they play in the conservation and use of biological diversity be recognized and acted upon (USAID 1990).

Biological Diversity

Less frequently addressed, but equally as important in maintaining a balanced ecosystem is biological diversity. Millions of plant and animal species, which the inspirational work of Charles Darwin drew to our attention, may disappear if extinction proceeds at the present all-to-rapid rate. This risk is particularly great in the developing world where most of the remaining pristine ecosystems are found. This wide array of flora and fauna is threatened by rapid population growth, poorly planned economic development, and changes in land use patterns and through increased use of sophisticated technologies.

Energy

One quarter of the world's energy is used by developing countries, which house three-quarters of the world's population. In addition to the obvious mal-distribution of energy use, the situation suggests development of alternative sources of energy for people in developing countries. Inefficient sources of energy take an increased toll on the energies of the poorest sectors of the population compromising health status and depriving these same people, the majority of whom are women and children, of access to health and family planning services which they so desperately need.

Air Pollution

Pollution, traditionally associated with wealthy nations, is a growing concern in the developing world. As forests are burned to clear land for settlement of new populations, carbon dioxide and carbon monoxide are put into the atmosphere, which contributes to global warming.

Crowded housing conditions are another instance in which air pollution interacts with health and population concerns. One aspect of environmental pollution--unsanitary living conditions caused by crowding and overpopulation--is found frequently in developing countries in both urban and rural areas. A direct consequence is increased rates of infectious tuberculosis.

A second instance, that of pollutants in household water supplies. Women (and their children) are particularly vulnerable to the lack of ambient air in living spaces, because they are the individuals in a family primarily responsible for the use of water in the household. Women are also the ones who manage the majority of tasks related to household waste disposal and food preparation (USAID 1990).

Water and Sanitation

Perhaps the most critical solution to water resource stress is slowing global population growth. Stabilizing population growth will reduce demand on scarce supplies while at the same time allowing sound economic development to address problems of supply, irrigation and waste disposal (Nelson and Sandell 1990).

Water scarcity due to the disparate location of supply and demand is exacerbated by rapidly increasing world population. More people place greater demand on supplies unevenly distributed over the global surface. World water resources become depleted not because of decreased quantity, but because of major increases in levels of usage. The results of this increased pressure result in depleted groundwater supplies, falling water tables, and damaged ecological systems (Nelson and Sandell 1990).

In rural areas, water and its related resources contribute directly and indirectly to the local economy. Women market fish products, and work on construction and repair of nets and traps in many areas. Marine, coral, shells, and sponges are often used for sale to tourists. Effective capacity-building in local areas to formulate and execute coastal resource management programs will rely heavily on understanding the role of both males and females in the management process and capitalizing on their potential contributions. The implementation of training and technical assistance should include both men and women to maximize the sustainability of intervention strategies (USAID 1990).

As populations migrate from rural to urban areas in search of improved amenities, increased stress is placed on water systems. In most city water systems, due to inaccurate meters, leaking pipes, and blockages within the system, as much as fifteen percent of the water cannot be accounted for (Nelson and Sandell 1990).

Urbanization

A six-fold increase in urban population has been projected for the world between 1950 and 2020. In 1950, only two cities had populations in excess of ten million. By 1975, there were seven. By the year 2000, twenty-six cities will exceed the ten million mark (Chiras 1988). Most of these are located in the developing world (United Nations 1989). About 60 percent of urban growth is due to fertility; the rest to migration from rural areas (Kols and Lewison 1983). By the end of the century, in other words, over half of the world's population will live in cities (Nelson and Sandell 1990).

It is useful to separate the different factors which, in conjunction with population, contribute to the degradation of the environment. In the case of air pollution in urban areas, it is clear that having a lower rate of population growth is going to reduce the number of vehicles. The impact of population on the generation of solid waste is relatively larger than air pollution. However, reducing population growth is neither a necessary nor a sufficient condition for environmental conservation (Arcia 1990).

One of the reasons that many people concerned about environmental issues ignore the urgency of population pressures is that the latter manifest themselves more clearly at the local level and are easily missed at the global or regional level. Linkages between population pressure and environmental degradation also manifest themselves mainly among poor people in poor communities, and it is often women who bear the most severe adverse effects (Camp 1991).

Pioneering efforts at planned urbanization have been led in some instances by women. For example, the Guarari Project in Costa Rica is significant in that it was pioneered by women (CEFEMINA) that has thus far demonstrated successful peri-urban expansion that encourages the perpetuity of rural agricultural skills and renewable land. With women at the helm, the housing project preserves the natural vegetation and habitat setting an important precedent for the environmental awareness of the youth (Dennis and Castleton 1989).

These problems are urgent and need immediate attention. One need not minimize them in order to realize that the more people that are there, the more the system is strained. The faster population increases, the more difficult it is to maintain an ecological balance or devise resource consumption patterns that reduce negative environmental impacts.

Gender Issues

The aim of rural development is to alleviate poverty. The basic reason why women now need special attention is that, though women work longer hours than men in most rural societies, they are also poorer. We have a responsibility to ensure that future development projects correct rather than worsen this imbalance (FAO, undated). In many societies, women are the individuals in the community who have primary responsibility for management of natural resources (water use, reforestation, fuel-wood, soil conservation, subsistence farming and backyard gardening, etc.). They themselves are beginning to draw the connection between overuse of these resources and large numbers of children. Consequently, while women have not been the central focus of discussion in the population-natural

resource coalition, their concerns are becoming more central as the focus of discussion moves from macro to micro models.

Among foundations, The Ford Foundation has established itself as a leader in focusing on the particular role of women in the population/environment balance. Originally the population program at Ford was quite quantitatively based; however, over time, and with data from field projects, an appreciation of the key role played by women in the success of any project came to be appreciated. As the Foundation began to hear more frequently from environmental groups, it became clear to Foundation Officers that population was the main source of environmental degradation. From this triangle of concerns, the Conference on Women, Population and the Environment held in October 1991 emerged (Brown 1991).

Case studies, prepared by International Union for Conservation of Nature and Natural Resources (IUCN), have also drawn attention to the role of women as central actors in the implementation of projects at the local level that plan realistically for environmental protection in the context of sustainable development (IUCN 1990).

How one identifies a lineage of causes between health, population, the environment and women will depend heavily on one's theoretical interests, policy objective and mandate for action (Shaw 1989). One might first assess consequences of environmental degradation on women, and subsequently, on population variables. In less developed countries, the consequences of overtaxed resources for women tend to show up in altered productivity, alterations in the allocation of women's time between labor and mothering, and increased nutritional requirements for women who must now work longer days. Moreover, the persistence of such conditions may prompt women and their families to emigrate from degraded environments to more promising ones.

Second, one might assess the consequences of women's status on population variables, and subsequent impact on the environment. Here, girls' and women's education is the most significant consideration. Education appears to affect fertility by raising age at marriage, increasing the opportunity cost of having children, increasing exposure to and acceptance of family planning, and improving child care habits, nutritional practices, and so on.

Third, one might assess the consequences of population variables on women, and subsequently how this impacts on the environment. High rates of infant and child mortality and morbidity are relevant here because of the impact on women's psychological well-being, time and energy, as well as fertility behavior and physical health. High infant mortality

rates maintain the desire for more children, thus keeping a woman on the "reproductive treadmill," and decreasing time and energy for environment-related tasks.

Whether one begins from the perspective on environment, women's health status or population, the point is clear that all are interconnected and a negative valence on one variable negatively affects the entire cycle (Shaw 1989). Establishing approaches, however, does not necessarily establish causality. Shaw argues convincingly that it is the resistance of ultimate causes to policy action which elevates the importance of more proximate, confounding causes. In contexts of economic stagnation and institutional rigidity, rapid changes in population variables (high fertility amid recent mortality decline and urban migration), have greatly exacerbated environmental degradation. While population interventions, alone, cannot eliminate poverty or guarantee sustainable development, they can buy crucial time until more ultimate causes can be addressed (Shaw 1989).

The unique role of women arises because they are managers of reproduction as well as natural resources. In developing countries, women are plagued by maternal morbidity and mortality due to insufficient birth spacing, and inadequate availability and access to health services before, during, and after the birth of an infant. In addition, closely spaced children suffer greater morbidity and mortality, and additional maternal energies are consumed in their care. All of these causes directly subtract from their energy and productive capacity for management of environmental resources. Their role as resource managers, or the quality and quantity of their human capital is directly reduced (Shaw 1989).

Shaw proposes an analytical model which has both macro and micro inputs. "Through the macro perspective, the model acknowledges the presence and power of ultimate non-population factors" (i.e., exogenous forces such as drought or civil war and structural influences from inter-sectoral or international sectors). The micro perspective identifies family members, their human capital, and population variables which impact on human capital. Shaw labels the family a "family firm." Because families are managers of resources over the life expectancy of its members, it has more impetus to provide for sustainable development than does an lone adult individual.

Examining the role of women and mothers from a family firm perspective is especially illuminating. As managers of reproduction, they directly influence the quantity and quality of human capital available to the family-- its most important resource. And, as managers of production, the health and well-being of women themselves will also impact on the

family's ability to maintain its environment and sustain its population (Shaw 1989).

Analyzing links between population, environment, and women from this perspective has three additional advantages. First, it allows us to examine the interdependent role of family members. For example, when "traditional" male family heads migrate for employment, responsibility for resource management is often shifted to women. This has implications for both environmental conservation and sustainable development. The second advantage is that it allows us to trace the multifaceted effects of increased schooling and population education on behavior of the family firm, its human capital, and effects on environments. For example, increased schooling of females tends to raise age at marriage, thus delaying first births and increasing job prospects, etc. This sequence of interrelated responses can impact positively on environments and productivity by reducing pressure on natural resources and increasing per capita investments in nutrition, health and schooling of family members (Shaw 1989).

The third advantage to using the family firm analogy is that a large majority of the world's poor are engaged in agriculture as small scale farmers or landless families. In managing their resources, especially their human capital, they behave like small firms -- optimizing where possible, adopting marketing and transport strategies, demonstrating risk-averse behavior in their reaction to new technologies, and so on. This is precisely why so much analysis of food and agricultural production in poor countries centers on the behavior of the family firm, and women's decision-making role within that firm (Shaw 1989).

Lower fertility and changing reproductive patterns may also have important indirect effects on the health of women and children. These effects include shifting attitudes away from fatalism, making it feasible for women to develop roles independent of motherhood, and increasing the resources available for each member of the family because of smaller family sizes. These indirect effects are difficult to document, but in the long run they may be equally or more significant than the direct effects of changing reproductive patterns (NAS 1989).

A means to the end cited above (i.e., stabilizing population growth) is to promote educational and employment opportunities for women, thereby improving their social status. Once women have other options and the immediate benefits of a smaller family size are demonstrated, more couples will choose to limit family size (Nelson and Sandell 1990).

APPENDICES

APPENDIX A. LIST OF PERSONS CONTACTED

USAID:

Ms. Sharon Benoleoil	Center for Development Information and Evaluation (CDIE)
Ms. Robin Espenschade	Office of Health
Mr. Dennis Long	Office of Health, Bureau of Science and Technology
Mr. Thomas R. Morris	Bureau for Program and Policy Coordination
Ms. Rosalie Noreem	Women In Development (WID) Office
Dr. Petra Reyes	Office of Health
Ms. Jinny Sewell	Technical Resource Division, Development Resources Office, Asia Bureau
Ms. Ellen H. Starbird	Office of Population

Others:

Dr. Gustavo Arcia	Research Triangle Institute, Center for International Development
Dr. Richard Bilsborrow	Carolina Population Center, University of North Carolina at Chapel Hill
Dr. John Bongaarts	Population Council
Ms. Ellen Brown	Ford Foundation, Women's Program Forum
Ms. Shanti Conly	Population Crisis Committee
Ms. Shona Cruz	Independent Consultant for Population Reference Bureau.
Ms. Geeta Rao Gupta	International Center for Research on Women

Dr. Cynthia P. Green	Consultant, Population Information Program, Johns Hopkins University
Ms. Carole L. Jolly	Committee on Population, National Academy of Sciences
Mr. Jeff Jordan	Population Resource Center
Ms. Laurie Mazor	Consultant, Ford Foundation
Ms. Peggy McEvoy	Population Council
Dr. William McGreevey	The World Bank
Ms. Alison Meares	International Union for Nature and Natural Resources
Mr. Tom Merrick	Population Reference Bureau
Mr. Michael Paolisso	International Center for Research on Women
Ms. Laurie Thrupp	World Resources Institute
Ms. Jane Walker	Research Triangle Institute, Water and Sanitation for Health Project

APPENDIX B. BIBLIOGRAPHY

- Adams, J. H. et al. 1985. Environmental Agenda for the Future. New York: Island Press.
- Agarwal, A. and S. Narain. 1985. "Women and Natural Resources." Social Action, 35(4): Oct.-Dec.
- Agarwal, A. and B. Bhatt. 1983. "Firewood in Cities I and II." New Delhi: CSE, Report No. 112 & 113.
- Agarwal, B. 1981. "Agricultural Modernization and Third World Women, Pointers from the Literature and on Empirical Analysis." Geneva, Switzerland: ILO, Rural Employment Policy Research Paper.
- Alba, F. 1989. Demographic and Economic Development in Mexico. Salud Publica Mejicana, Mar-Apr; 32(2):163-7.
- Allen, J. C. and D. F. Barnes. 1985. The Causes of Deforestation in Developing Countries. Annals of the Association of American Geographers. vol. 75 No.2, 163-184, June.
- Andreano, R. 1983. "Economic Issues in Disease Control and Eradication." Social Science and Medicine. 17:2027-2032.
- Andreano, R. and T. Helminiak. 1986. "Economics, Health and Tropical Disease: A Review." In A. N. Herrin and P.L. Rosenfield, eds. Economics, Health, and Tropical Diseases. School of Economics. Quezon City: University of the Philippines.
- Arcia, G. 1990. "Population Growth and the Urban Environment." RTI Staff Working Paper. Research Triangle Park, NC: Research Triangle Institute.
- Arnold, J. E. M., M. E. Chipeta and Y. Fisscha. The Importance of Small Forest-based Processing Enterprises in Developing Countries." UNASYLVA, 157/158, Vol, 39, Nos. 3 & 4.
- Aschauer, D. 1989. "Is Public Expenditure Productive?" Journal of Monetary Economics, 23:177-200.

- Barbosa, F. S. and D. P. Pereira da Costa. 1981. "Incapacitating Effects of Schistosomiasis Mansoni on the Productivity of Sugar-Cane Cutters in North-Eastern Brazil." American Journal of Epidemiology. 114:102-111.
- Barlow, R. 1967. "The Economic Effects of Malaria Eradication." American Economic Review. 57:130-148.
- Barnum, H. 1987. "Evaluating Healthy Days of Life Gained from Health Projects." Social Science and Medicine. 24:833-841.
- Batiwala, S. 1982. "Rural Energy Scarcity and Under-Nutrition: A New Perspective." Economic and Political Weekly XVII. 328-334.
- Behrman, J. and A. Deolalikar. 1989. Agricultural Wages in India: The Role of Health, Nutrition and Seasonality. in D. Sahn (ed.), Causes and Implications of Seasonal Variability in Household Food Security. Baltimore, Johns Hopkins Press.
- Bennett, A., C. Frisen, P. Kamnuansilpa, and J. McWilliam. 1990. "How Thailand's Family Planning Program Reached Replacement Level Fertility: Lessons Learned," Report No. 89-043-112, Occasional Paper No. 4, DUAL & Associates, Inc. and International Science and Technology Institute, Inc.
- Bilsborrow, R. and M. Geores. 1991. "Population, Land Use and the Environment in Developing Countries: What Can We Learn from Cross-National Data?" Paper prepared for NAS Workshop on Population and Land Use, Washington, DC, December 4-5.
- Bilsborrow, R. 1987. Population Pressures and Agricultural Development in Developing Countries: A Conceptual Framework and Recent Evidence. World Development. Vol. 15(2); February.
- Binswanger, H. P. and P. L. Pingali. 1985. "Population Growth and Technological Change in Agriculture." In T. Davis (ed.), Proceedings of the Fifth Agriculture Sector Symposium: Population and Food. Washington, D.C.: The World Bank.
- Blejer, M. and M. Khan. 1984. "Government Policy and Private Investment in Developing Countries." International Monetary Fund Staff Papers. Washington, D.C.

- Bongaarts, J. 1978. "A Framework for Analyzing the Proximate Determinants of Fertility," Population and Development Review, Vol. 4, No. 1.
- Boserup, E. 1981. Population and Technological Change. Chicago: The University of Chicago Press.
- Brady, N. C. 1988. "Population and the Environment," Presented at Office of Population Annual CA's Meeting. January 19, 1988.
- Brieger, W. R. and J. Guyer. 1990. "Farmers' Loss Due to Guinea Worm Disease: A Pilot Study." American Journal of Tropical Medicine and Hygiene. 93:106-111.
- Brown, L., et al. 1987. State of the World 1987. New York, NY: W.W. Norton & Co.
- Browning, M. 1982. "An Econometric Investigation of the Relationship Between Population Growth and Income Growth in Developing Countries," Ph.D. dissertation. U. Michigan.
- Bulatao, R. A. 1984. "Reducing Fertility in Developing Countries," World Bank Staff Working Paper, No. 680, Population and Development Series, No. 5. Washington, D.C.
- Camp, S. L. 1991. Population, Poverty and Pollution. Forum for Applied Research and Public Policy. Summer.
- Carrin, G. 1984. "Economic Evaluation of Health Care Interventions." Social Science and Medicine. 19:1015-1030.
- Ceceleski, E. 1984. "The Rural Energy Crisis, Women's Work and Family Welfare: Perspectives and Approaches to Action." Working Paper No. WEP 10/WP 35. Geneva, Switzerland: ILO.
- Chao, D. and K. B. Allen. 1984. "A Cost Benefit Analysis of Thailand's Family Planning Program," International Family Planning Perspectives, 10(3):75-81.
- Chiras, D. D. 1988. Population: Measuring Growth and its Impact. Environmental Science. Menlo Park, CA: Benjamin/Cummings.
- Cohen, J. E. 1974. "Some Potential Economic Benefits of Eliminating Mortality Attributed to Schistosomiasis in Zanzibar." Social Science and Medicine. 8:383-398.

- Commoner, B. 1988. "Rapid Population Growth and Environmental Stress." Paper presented to the United Nations Expert Group on Consequences of Rapid Population Growth. August 24-45. New York, NY: United Nations.
- Conly, G. N. 1976. "The Impact of Malaria on Economic Development." WHO Chronicle. 30:223-228.
- Conly, S. R., J. J. Speidel, S. L. Camp. 1991. U.S. Population Assistance: Issues for the 1990s. Executive Summary. Washington, D.C.: Population Crisis Committee.
- Creese, A. L. 1983. "The Economic Evaluation of Immunization Programs." In K. Lee and A. Mills, eds. The Economics of Health in Developing Countries. New York: Oxford University Press.
- Creese, A. L. and R. H. Henderson. 1980. "Cost-Benefit Analysis and Immunization Programmes in Developing Countries." Bulletin of the World Health Organization. 58:491-497.
- Cruz, M. C. 1991. "Population Pressure, Deforestation, and Common Property Institutions: An Overview." Paper prepared for the Second Annual Meeting of the International Association for the Study of Common Property (IASCP), Natural Resources Institute, University of Manitoba, Canada.
- Cumper, G. 1983. "Economic Development, Health Services, and Health." In K. Lee and A. Mills, eds. The Economics of Health in Developing Countries. New York: Oxford University Press.
- Dankelman, I. and J. Davison. 1988. Women and Environment in the Third World: Alliance for the Future. London, Earthscan Publications, Ltd. in association with IUCN.
- Dennis, F. and D. Castleton. 1989. Case Studies in Population and Natural Resources: Costa Rica. International Union for the Conservation of Nature and Natural Resources (IUCN) Population and Natural Resources Program.
- DeWalt, B. R., Stonich, S. C., and S. L. Hamilton. 1991. "Population and Land Use in Changes in Honduras: A Regional and Community Level View." Paper prepared for NAS Meeting on Population and Land Use, Washington, DC, December 5-6.

- Dunlop, D. W. 1984. "Theoretical and Empirical Issues in Benefit Identification, Measurement, and Valuation Related to Parasitic Disease Control in Poor Countries." Social Science and Medicine. 19:1031-1037.
- Earthwatch Newsletter. 1990. "Linking Population to Conservation. Special Report: Pakistan." 40:3-5, 4th Quarter.
- Earthwatch. 1990. Linking Population to Conservation. Special Report: Pakistan. Earthwatch Newsletter, 40:3-5, 4th Quarter.
- Easterlin, R. A. 1967. "Effects of Population Growth on the Economic Development of Developing Countries," Ann American Academy of Political Social Science, (January), 369:98-109.
- Entwisle, B., W. M. Mason, and A. I. Hermalin. 1986. "The Multilevel Dependence on Contraceptive Use on Socioeconomic Development and Family Planning Program Strength," Demography, 23, 2.
- Esrey, S. A. and J. P. Habicht. 1986. "Epidemiologic Evidence for Health Benefits from Improved Water and Sanitation in Developing Countries." Epidemiologic Reviews. 8:117-128.
- Esrey, S. A., Schiff, C., Roberts, L., and J. B. Potash. 1990. Health Benefits from Improvements in Water Supply and Sanitation: Survey and Analysis of the Literature on Selective Diseases. WASH Technical Report No. 66, Water and Sanitation for Health Project, U.S. Agency for International Development.
- Ewbank, D. C. 1990. "Establishing the Linkages between Health Programs and Health Outcomes." Paper presented to Expert Meeting on the Economic Consequences of Health Programs in LDCs, Committee on Population, National Academy of Sciences, Washington, D.C.
- FAO. Undated. Restoring the Balance: Women and Forest Resources. New York: Food and Agriculture Organization of the United Nations and Swedish International Development Authority.
- Floreo, M. and J. M. Wolf. 1990. The Economic and Social Impacts of Girl's Primary Education in Developing Countries. Advancing Basic Education and Literacy (ABEL) Project. Washington, D.C.: USAID, December.

- Foster, R. 1977. "Schistosomiasis on an Irrigated Estate in East Africa. III. Effects of Asymptomatic Infection on Health and Industrial Efficiency." Journal of Tropical Medicine and Hygiene. 70:185-195.
- Freedman, R. and D. Freedman. 1989. "The Role of Family Planning Programs as a Fertility Determinant," Manuscript. Population Studies Center, University of Michigan.
- Green, C. P. 1992. "Population and the Environment: The Decisive Decade Ahead." Forthcoming in Population Reports. Johns Hopkins University/Population Information Program.
- Grossman, M. 1972. The Demand for Health: A Theoretical and Empirical Investigation. New York: Columbia University Press.
- Hermalin, A. I. 1978. "Spatial Analysis of Family Planning Program Effects in Taiwan, 1966-1972," Papers of the East-West Population Institute. No. 48, Honolulu.
- Horton, S. and P. Claquin. 1983. Cost-Effectiveness and User Characteristics of Clinic Based Services for the Treatment of Diarrhea: A Case Study in Bangladesh. Social Science and Medicine. 17:721-729.
- Howe, J. D. 1976. "Valuing Time Savings in Developing Countries." Journal of Transport Economics and Policy. 10:113-125.
- Huston, P. 1990. Some Thoughts on Population, Equity and Sustainable Development. Journal of SID. February-March.
- IPPF. 1990. Poverty, Population Growth, and Family Planning in Latin America and the Caribbean. New York: International Planned Parenthood Federation.
- IPPF. Undated. The Crucial Link Between Family Planning and the Environment. New York: International Planned Parenthood Federation Western Hemisphere Region.
- International Union for Conservation of Nature and Natural Resources (IUCN). 1990. Case Studies in Population and Natural Resources: Report of Field Investigations and Workshop Discussion. Washington, D.C.: International Union for Conservation of Nature and Natural Resources.

- International Union for Conservation of Nature and Natural Resources (IUCN). 1987. Population and Sustainable Development. Report of the IUCN Task Force on Population and Conservation for Sustainable Development. Switzerland: IUCN Publication Services.
- Joiner, J. D. 1991. Case Studies in Population and Natural Resources: The Gambia. IUCN Population and Natural Resources Programme. January-February.
- Jolly, C. 1991. "Four Theories of Population Change and the Environment." Committee on Population, National Academy of Sciences, Washington, D.C.
- Kansakar, K. 1989. Case Studies in Population and Natural Resources: Nepal. Field Study prepared for IUCN Population and Natural Resources Programme. Switzerland: IUCN Publication Services.
- Kelly, A. C. 1988. "Economic Consequences of Population Change in the Third World." Journal of Economic Literature. 26:1685-1728.
- King, E. M. 1990. Educating Girls and Women: Investing in Development. Washington, D.C.: The World Bank.
- Kocher, J. E., Schneider, R. M., and J. E. Tavid. 1991. Asian Health Trends and Emerging Issues for the 1990s. Asia Bureau, Office of Technical Resources, U.S. Agency for International Development.
- Khoo, S. E. 1979. "Measuring the Thai Family Planning Program's Impact on Fertility: A Comparison of Computer Models," Studies in Family Planning, 10:137-45.
- Knodel, J., A. Chamrathirong and N. Debavalya. 1987. Thailand's Reproductive Revolution. University of Wisconsin Press.
- Kols, A. and D. Lewison. 1983. Migration, population growth and development. Population Reports. Series M, No. 7. Baltimore: Johns Hopkins University, Population Information Program, September-October.
- Kuhner, A. 1971. "The Impact of Public Health Programs on Economic Development: Report of a Study of Malaria in Thailand." International Journal of Health Services. 1:285-292.

- Lapham, R. J. and W. P. Mauldin. 1984. Family Planning Program Effort and Birthrate Decline in Developing Countries," International Family Planning Perspectives, 10,4.
- Lee, J. A. 1985. The Environment, Public Health and Human Ecology: Considerations for Economic Development. Published for the World Bank. Baltimore: Johns Hopkins University Press.
- Lee, K. S. 1988. "Infrastructure Constraints on Industrial Growth in Thailand." World Bank Working Paper. Report INURD WP#88-2, Urban Development Division, Policy, Planning and Research Staff, The World Bank.
- Lele, U. 1991. "Population Growth, Land Use and Development in Africa: A Retrospective and Prospective View." Paper prepared for NAS Workshop on Population and Land Use, Washington, DC, December 4-5.
- Leslie, J. and M. Paolisso. 1989. Women, Work, and Child Welfare in the Third World. Boulder, Colorado: Westview Press.
- Levine, R. E. and S. L. Huffman. 1990. The Economic Value of Breastfeeding: The National, Public Sector, Hospital, and Household Levels. Social Sector Policy Analysis Project, Bureau for Program and Policy Coordination, U.S. Agency for International Development.
- Lutz, W. and E. Holm. 1991. "Population and Land Use in Mauritius." Paper prepared for NAS Meeting on Population and Land Use, Washington, DC, December 5-6.
- Mason, A., D. B. Suits, S. Koo, N. Ogawa, M. Phananimamai, and H. Sigit. 1986. "Population Growth and Economic Development: Lessons from Selected Asian Countries," United Nations Fund for Population Activities, Policy Development Studies, Number 10.
- Mauldin, W. P. and J. A. Ross. 1988. "Historical Perspectives on Contraceptive Technology Introduction," Paper presented at the Conference on Demographic and Programmatic Consequences of Contraceptive Innovations, Committee on Population, National Academy of Sciences, Washington, D.C.
- Meares, A. C. and D. Loudiyi. 1991 (draft). Women and Natural Resources Management: An Annotated Bibliography. Washington, D.C.: International Union for Conservation of Nature and Natural Resources.

- Measham, A. R. 1986. "Health and Development: The Bank's Experience," Finance and Development, December.
- Molina Salazar, R. E., J. R. Romero Velazquez, J. A. Trejo Rodriguez. 1991. "Economic Development and Health". Salud Publica Mejico. May-June; 33(3);227-34.
- Molnar, A. and G. Schreiber. 1989. "Women and Forestry: Operational Issues." PRE Working Paper, Washington, D.C., World Bank.
- Mortimore, M. 1991. "Land Transformation under Agricultural Intensification in Relation to Population Growth in Northern Nigeria." Paper prepared for NAS Meeting on Population and Land Use, Washington, DC, December 5-6.
- Munro, D. 1990. "A Strategy for Sustainability." Earthwatch Newsletter. 40:1-2, 4th Quarter.
- Murphy, E. M. 1983. The Environment to Come: A Global Summary. Washington, D.C. Population Reference Bureau, Inc.
- Myers, N. 1987. "Population, Environment and Conflict." Environmental Conservation, Vol 14, No. 1, pp. 15-28.
- _____. 1990. "Finding Ways to Stem the Tide of Deforestation." People. Vol. 17 No 1; 11-14.
- _____. 1990. "People and Environment: the Watershed Decade." People. No.1, published by IPPF.
- National Academy of Sciences. 1989. Contraception and Reproduction: Health Consequences for Women and Children in the Developing World. Working Group on the Health Consequences of Contraceptive Use and Controlled Fertility. Washington, D.C.: National Academy Press.
- _____. 1990. Proceedings. Washington, D.C: National Academy Press.
- National Research Council. 1986. Population Growth and Economic Development: Policy Questions, Working Group on Population Growth and Economic Development, National Research Council, Washington: National Academy Press.
- Nelson, L. and C. Sandell. 1990. Population and Water Resources. Washington, D.C.: National Audubon Society.
- Ness, G. D. 1990. "Population and Environment Linkages: Obstacles and Potentials." Remarks presented at U.S. AID Cooperative Agencies Meeting, Washington, D.C.

- Ojo, K. O. 1990. International Migration of Health Manpower in Sub-Saharan Africa. Social Science & Medicine. 31(6):631-7.
- Okun, D. 1988. "The Value of WS&S in Development: An Assessment." American Journal of Public Health, 78(11): 1463-1467.
- Omran, A. R. (Ed.) with A. G. Johnston. 1984. Family Planning for Health in Africa. Chapel Hill, N.C.: Carolina Population Center.
- Panayotou, T. 1991. "Population Change and Land Use in Developing Countries: The Case of Thailand." Paper prepared for NAS Meeting on Population Change and Land Use, Washington, DC, December 5-6.
- Parnell, A. M. (Ed.) 1989. Contraceptive Use and Controlled Fertility: Health Issues for Women and Children. Background Papers. Working Group on the Health Consequence of Contraceptive Use and Controlled Fertility. Washington, D.C.: National Academy Press.
- Paul, J. E., R. B. Isley, and G. M. Ginsberg. 1986. Cost-Effective Approaches to the Control of Dracunculiasis. Technical Report No. 38. Arlington, VA: WASH Project.
- Paul, J. E. and J. A. Mauskopf. 1991. Cost-of-Illness Methodologies for Water-Related Diseases in Developing Countries. WASH Technical Report No. 75, Water and Sanitation for Health Project, U.S. Agency for International Development.
- Popkin, B. M. 1982. "A Household Framework for Examining the Social and Economic Consequences of Tropical Diseases." Social Science and Medicine. 16:533-543.
- Prescott, N. M. and J. Warford. 1983. "Economic Appraisal in the Health Sector." In K. Lee and A. Mills, eds. The Economics of Health in Developing Countries. New York: Oxford University Press.
- Preston, S. H. 1975. "The Changing Relation between Mortality and Level of Economic Development," Population Studies, 29(2):2231-48.
- _____. 1980. "Causes and Consequences of Mortality in Less Developed Countries during the Twentieth Century," in Population and Economic Change in Developing Countries, edited by R. Easterlin, New York: National Bureau of Economic Research.

- Ram, R. and T. W. Schultz. 1979. "Life Span, Health Savings, and Productivity." Economic Development and Cultural Change. 27:399-421.
- Raymont, A. 1989. Development, "Welfare," and Fertility: A simple Macroanalysis. Social Biology. Spring-Summer;36(1-2):110-3.
- Repetto, R. and T. Holmes. 1983. "The Role of Population in Resource Depletion in Developing Countries." Population and Development Review. Vol 9, No. 4.
- Ryan, J. G. and R. D. Ghodake. 1984. Labor Market Behavior in Rural Villages in South India; Effect of Season, Sex and Socioeconomic Status. In H. P. Binswanger and M. Rosenweig (Eds.), Contractual Arrangements in Employment and Wages in Rural Labor Markets in Asia. New Haven: Yale University Press.
- Sadik, N. 1989. "Rapid Population Growth and Environmental Degradation: Ultimate and Proximate Causes." Environmental Conservation. Vol 16. No.3.
- _____. 1990. The State of World Population: 1990. New York, United National Population Fund.
- Sahn, D and H. Alderman. 1988. "The Effect of Human Capital on Wages and the Determinants of Labor Supply in a Developing Country." Journal of Development Economics. 29, 2:157-84.
- Schwartz, J. Brad and Ronald W. Johnson. 1991. "Maximizing the Economic Impact of Urban Water Supply and Sanitation Investments," Draft report submitted to the Water and Sanitation for Health (WASH) Project, U.S. Agency for International Development, Washington, D.C.
- Shaw, R. P. 1989a. "Paradox of Population Growth and Environmental Degradation," Paper presented to the American Association for the Advancement of Science, Annual Meeting in San Francisco, Ca., January.
- _____. 1989b. "Population, Environment and Women: An Analytical Framework," Paper prepared for UNFPA Inter-agency Consultative Meeting on Women, Population and the Environment.
- _____. 1989c. "Rapid Population Growth and Environmental Degradation: Ultimate and Proximate Factor." Environmental Conservation. Vol. 16, No. 3.

- Shepard, D. S., U. Brinkman, M. Ettlign, and R. Sauerborn. 1990. Economic Impact of Malaria in Africa. Arlington, Va: Vector Biology and Control Project.
- Shiva, V. 1989. Staying Alive: Women, Ecology and Development. Zed Books.
- Schultz, T. Paul. 1988. "Population Programs: Measuring Their Impact on Fertility and the Personal Distribution of Their Effects," Journal of Policy Modeling, 10(1):-113-139.
- Simmons, G. B. 1979. "Family Planning Programs or Development: How Persuasive is the New Wisdom," International Family Planning Perspectives, 5(3).
- Simon, J. 1977. The Economics of Population Growth. Princeton: Princeton University Press.
- _____. 1981. The Ultimate Resource. Princeton: Princeton University Press.
- _____. 1981. "Population Pressure on the Land: Analysis of Trends Past and Future." World Development, 11, 9.
- Stiglitz, J. E. 1979. "Neoclassical Analysis of Resource Economics," in Kerry Smith (ed), Scarcity and Growth Reconsidered. Baltimore: The Johns Hopkins University Press.
- Stonich, S. 1989. "The Dynamics of Social Processes and Environmental Destruction: A Central American Case Study." Population and Development Review, 15(2).
- Tan Boon Ann. 1987. "Multivariate Areal Analysis of the Impact and Efficiency of the Family Planning Program in Peninsular Malaysia," Asia-Pacific Population Journal, 2(2).
- Thomas, D. 1990. "Women's Health and Its Consequences for Household Functioning." Paper prepared for Expert Meeting on Economic Consequences of Health programs in LDCs, Committee on Population, National Academy of Sciences, Washington, D.C.
- _____. 1990. "Child Survival Height for Age and Household Characteristics in Brazil," Journal of Development Economics, 17.
- Trejos, M. and V. Solis. 1989. Case Studies in Population and Natural Resources: Honduras. IUCN Population and Natural Resources Programme. August 3-10.

- Turner, J. E. and R. C. Klees. 1991. Environmental Health: Water, Sanitation, Wastewater Management, and Drainage. Water and Sanitation for Health Project, U.S. Agency for International Development.
- United Nations. 1984. Population, Resources, Environment and Development. International Conference on Population. New York: United Nations.
- _____. 1989. World Population Prospects 1988. New York: United Nations.
- _____. 1990. Human Development Report, 1990. Oxford University Press.
- United Nations Population Fund. 1989. Safeguarding the Future. New York: UNFPA.
- U. S. Agency for International Development. 1990. Gender Issues for the AID Environmental Strategy. Washington, D.C.: USAID, Office of Women in Development.
- _____. 1991. A Seminar on: Demographic Change and Economic Growth. An Abridged Transcript of the Four-Hour Discussion. Washington, D.C.: USAID, Office of Policy Development and Program Review.
- _____. 1991. "Towards a Healthier Environment: A Strategy for Environmental Health in LDCs." Washington, D.C.: USAID, Office of Health, Bureau of Science and Technology.
- Warwick, D. P. 1986. "The Indonesian Family Planning Program: Government Influence and Client Choice," Population Development Review, 12(3).
- WASH. 1990. Lessons Learned From the WASH Project: Ten Years of Water and Sanitation Experience in Developing Countries. Arlington, Va.: WASH Project.
- Weisbrod, B. A., R. L. Andreano, R. E. Baldwin, et al. 1973. Disease and Economic Development: The Impact of Parasitic Diseases in St. Lucia. Madison: The University of Wisconsin Press.
- Wheeler, D. 1980. "Basic Needs Fulfillment and Economic Growth: A Simultaneous Model," Journal of Development Economics, 7:435-451.

- Working Group on the Health Consequences of Contraceptive Use and Controlled Fertility. 1989. Contraception and Reproduction: Health Consequences for Women and Children in the Developing World. Washington, D.C.: National Academy Press.
- World Bank. 1984. Population Change and Economic Development. Published for the World Bank. New York: Oxford University Press.
- _____. 1987. World Development Report 1987. New York: Oxford University Press.
- _____. 1989. Striking a Balance: The Environmental Challenge of Development. Washington, D.C.: World Bank.
- _____. 1990. World Development Report 1990, Poverty. New York: Oxford University Press.
- _____. 1991. Annual Report. Washington, D.C.: World Bank.
- _____. 1991. Gender and Poverty in India. A World Bank Country Study. Washington, D.C.: World Bank.
- _____. 1991. The World Bank and the Environment: A Progress Report, Fiscal 1991.
- _____. 1991. World Development Report 1991. New York: Oxford University Press.
- World Commission on Environment and Development, "The Brundtland Commission". 1987. Our Common Future/World Commission on Environment and Development. New York: Oxford University Press.
- World Resource Institute and International Institute for Environment and Development. 1986. World Resources, 1986: An Assessment of the Resource Base that Supports the Global Economy. New York: Basic Books, Inc.
- Wouters, A. 1990. "Health and Economic Development: Issues Paper." Draft Manuscript. Office of Health, U.S. Agency for International Development.
- Wyatt, A. S. and E. P. Brantly, Jr. 1991. "A.I.D. Environmental Health Workshop: Final Workshop Report." Research Triangle Park, NC: Research Triangle Institute.
- Zonneveld, I. 1991. "Measurement of Land Use Change in Developing Countries." Paper prepared for NAS Workshop on Population and Land Use, Washington, DC, December 4-5.

_____. 1986. "Women, Poverty and Agricultural Growth in India," The Journal of Peasant Studies. 13(4).

_____. 1984. "Rural Women and High Yielding Variety Rice Technology," Economic and Political Weekly. 19(13).

APPENDIX C. LIST OF WORKSHOPS AND CONFERENCES

1. AID Environmental Health Workshop. Washington, D.C.: Hotel Lombardy. February 14-15, 1991.
2. Conference on Women and Biodiversity. Program distributed by USAID Office of Women in Development. October 4-6, 1991.
3. Economic Consequences of Health Programs in LDCs: Expert Meeting. Sponsored by Committee on Population, National Academy of Sciences, Washington, D.C. June 25-26, 1990.
4. Global Assembly of Women and the Environment. "Partners in Life." Program distributed by USAID Office of Women in Development. November 4-8, 1991.
5. Population-Environment Roundtable. Organized by the Population Resource Center. Princeton, NJ, September 11, 1991.
6. Population, Women, and the Environment. Sponsored by The Ford, John D. & Catherine T. MacArthur and Jessie Smith Noyes Foundations. New York, October 29, 1991.
7. Workshop on Population Change and Land Use. Sponsored by Committee on Population, National Academy of Sciences. Washington, D.C., December 5-6, 1991.
8. World Women's Congress for a Health Planet. Sponsored by Women's Environment and Development Organization/Women's Foreign Policy Council. Miami, Florida: Hyatt Regency Hotel. November 8-12, 1991.
9. Seminar on Demographic Change and Economic Growth. Sponsored by U.S. Agency for International Development, PPC. Washington, D.C., January 11, 1991.