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RURAL DEVELOPMENT, HEALTH, MORTALITY AND FERTILITY IN RURAL NORTHEASTERN TANZANIA

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PREFACE

The origins of this project trace back to early 1973 when, as a field staff member of the Population Council and a Research Fellow at the University of Dar es Salaam, I commenced a research project on the determinants of fertility in rural Northeastern Tanzania. Field work and data collection were completed during the second half of 1973. Analysis of the data proceeded intermittently from 1974 through 1976, initially at the University of Dar es Salaam and later at Michigan State University, and a few papers were published (see Bibliography).

As is frequently the case, this study generated more data than it was possible to analyze in the time available at the Universities of Dar es Salaam and Michigan State. The analysis had provided answers to some of the questions which motivated the original work, it failed to (at least adequately) answer others, and it prompted many new questions.

Some of those new questions related to relationships between mortality and fertility, and the determinants of health status and mortality. Although the study was not initially designed to address these questions, it appeared that some data which were generated by the study might be able to provide some insights into the relationships of interest. The analyses and discussion presented in this report extends that earlier work and presents new results from analysis of these data.

Regretfully, due to delays in obtaining funding approval for this most recent phase of the work, it could not be started until shortly before I took up a three-year assignment with the Ford Foundation in

Delhi (September 1978). This subjected the work to numerous disruptions, and it has, as a consequence, been less tidy and intellectually less rewarding than would have otherwise been the case. Nevertheless, with considerable difficulty I have finally been able to complete this report, and I appreciate the extension of time granted by U.S.A.I.D. and the Harvard Institute for International Development which enabled me to do so.

Although this entire research effort -- whose conceptual roots trace back to at least 1971-72 -- actually evolved in several discrete phases, in retrospect it has in a real sense been a single project with many closely-related components.

Since the beginning this entire project has been solely my responsibility, and I alone am therefore responsible for any shortcomings. However, many people and institutions made significant contributions -- some at critical stages in the work, and I am deeply indebted to each of them.

Funds for this work have come from five sources. The Population Council provided a grant to support data collection, processing and analysis in Tanzania. This was supplemented by funds from the Bureau of Resource Assessment and Land Use Planning (IRALUP) of the University of Dar es Salaam. The Interdisciplinary Communications Program of the Smithsonian Institution supported further analysis and writing during the period October 1975 through May 1976. The Department of Agricultural Economics at Michigan State University provided support through my appointment as a research assistant for the summer of 1976 and during my earlier graduate studies. The United States Agency for International

Development provided funds in support of the most recent analysis phase which resulted in this report, while I was on the staff of the Harvard Institute for International Development and later serving concurrently as Program Officer for Population, Health and Nutrition with the Ford Foundation in New Delhi.

Colleagues and friends in Tanzania and elsewhere who gave valuable assistance at various stages over the years include Professor A.C. Mascarenhas, Director of BRALUP, Professor R.A. Henin, Dr. Douglas Ewbank, Mr. Tom Zalla, Mr. Ian Thomas, Mr. E.K. Sekatawa, and Mr. S. Jiwani, all of whom were my colleagues at the University of Dar es Salaam; also Messrs. Mpogolo, Ngallaba, Doamai, Kalembo, Lyakura and Mbura of the Bureau of Statistics, Government of Tanzania. Ms. Nina Cohen assisted with data processing at Harvard University. Two people who have been especially helpful at many stages of the work are Professor Carl Eicher of Michigan State University, and my wife Sally. Others who made helpful suggestions along the way include Drs. Lee Bean, Derek Byerlee, Donald Heisel, Carl Liedholm, T. Paul Schultz, Frederic Shorter, George Simmons, and Robert Stevens.

1. INTRODUCTION AND SUMMARY

1.1 Introduction

Among all the major regions of the world, tropical Africa currently has both the highest birth rates and highest death rates. Crude birth rates are generally in the upper 40s per thousand for tropical African countries (with, however, considerable variation -- from the low 40s to the mid-50s), compared to about 35 for Latin America and about 30 for Asia as a whole. Among tropical African countries, crude death rates range from about 15 per thousand to about 25, and average nearly 20. For Latin America, the average crude death rate is about 8 per thousand, for Asia it is just over 10. In mortality and fertility decline, sub-Saharan Africa is clearly lagging far behind other major areas of the world.[1/]

This paper reports and discusses the results of an analysis of the relationships between a set of socioeconomic conditions (and changes therein) and demographic characteristics and changes in rural Northeastern Tanzania. The socioeconomic conditions include education, economic status, occupation, age at marriage, forms of marriage (polygyny and monogamy), breastfeeding practices, various health-related behaviors, and others.

Two major, related, concerns motivated interest in this topic. One is the evidence that for most of tropical Africa fertility has not yet begun to decline and appears to be rising in some major areas, and the prospects are that the total population of tropical Africa will increase

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1/ See, for example, Population Reference bureau, 1980 World Population Data Sheet.

severalfold during the next century or so. Moreover, during the past few years evidence has begun to accumulate showing that the fertility transition in tropical Africa appears to be particularly complex, with a tendency for fertility to rise under some circumstances. Henin (1968, 1969) found this in rural Sudan, there is some evidence that this is happening in Tanzania (Henin, et al., 1977; Kocher, 1979), Zaire (Romaniuk, 1980), Lagos (Lesthaeghe, Page and Adegbola, forthcoming), and elsewhere in Nigeria (e.g., Caldwell and Caldwell, 1977, forthcoming; Dow, 1977; Orubuloye, forthcoming; and Santow and Bracher, forthcoming). Recent survey evidence shows that in the past 15 years or so the total fertility rate in Kenya has risen from less than 7 to over 8, and the crude birth rate has risen to over 50 per thousand (e.g., Population Reference Bureau, October 1979).

The second major motivating concern is the prevailing high levels of infant, child, and general mortality in tropical Africa. The overall infant mortality rate is about 150 per 1000 livebirths in tropical Africa, and in a few countries it exceeds 200. Moreover, mortality in the 1-3 age group is especially high in tropical Africa. In some areas, 35 to 40 percent of the children die before reaching age 5 (Adegbola, 1977).

In these circumstances, the following three questions are important and urgent:

(1) Under what circumstances can fertility be expected to decline significantly in tropical Africa?

(2) What are likely to be the causal relationships -- if any -- between mortality decline (especially among infants and children) and subsequent fertility decline in tropical Africa?

(3) What are the major determinants of mortality, and of mortality decline, in tropical Africa?

Survey data from four rural areas of Northeastern Tanzania are analyzed in chapter 5 in an attempt to suggest some answers to these and other questions. Preliminary to the presentation of these findings in chapter 5, chapters 2 and 3 present some substantive background and theoretical and conceptual frameworks within which this analysis was approached. Chapter 4 provides a brief survey and description of the study areas in Northeastern Tanzania. Chapter 6 presents conclusions and offers some recommendations.

1.2 Summary of the Findings

The results of this study can be summarized as follows:

Although the data analyzed here are from rural areas of tropical Africa, infant and child mortality rates in these study areas are relatively low. The data do not permit a careful estimate of infant and young child mortality rates, but they do suggest that at least during recent years preceding the (1973) survey, approximately 90 percent of the children were surviving to at least age 5. This is quite high by rural Tanzanian and tropical African standards, and is consistent with a large amount of other inferential evidence which suggests that in these study areas infant and child mortality rates had declined substantially in the decades preceding the survey.

However, the extent to which parents perceived that infant and child mortality rates had been declining varied substantially among the study areas. Among both men and women, in the two Moshi areas between 60 and 90 percent of the respondents said they thought child survivorship had been improving, while only 15 to 40 percent of the respondents in the two Lushoto areas believed this to be the case. When characteristics which are associated with these responses are analyzed, education is the variable which is most closely associated with the opinion that child survival prospects have improved. To a lesser extent, parents of higher economic status as well as those who have experienced little or no mortality among their own children are also likely to believe that child survival prospects have been improving.

Regression of variables associated with actual mortality experiences among a woman's children provide little solid knowledge as to why some children die and others survive. The results do suggest the following:

- the mother's educational level does not appear to be directly related to actual mortality experiences among her children (contrary to conventional wisdom),

- equally surprisingly, (reported) duration of breastfeeding did not appear to be related to mortality experiences among a woman's children,

- "hospital delivery" was the only variable which was consistently positively related to survival among a woman's children,

- there is no evidence that household economic status is closely associated with child mortality experiences in the household.

Although these results are surprising -- and disappointing in that they fail to provide much insight into why infant and child mortality is as low as it appears to be in these areas, it is possible that for some of the critical variables measurement was sufficiently imprecise so as to obscure whatever real relationships might exist.

There was a generally consistent positive relationship between hospital deliveries (assumed to be a proxy for utilization of health care services) and survival experiences among a woman's children. Analysis of factors associated with whether or not a woman delivered in a hospital shows that education is important. Educated women, or wives of educated husbands, are more likely to give birth in a hospital than are women with less education (or with less educated husbands). This is not surprising. It does, however, suggest that education does -- at least indirectly -- contribute to improved child survival prospects. That is, educated parents are more likely to adopt behaviors -- such as utilization of pregnancy-related medical services -- which improve the prospects that their children will survive, even though no direct relationship between education and survivorship is evident.[2/]

The study concludes with an analysis of characteristics associated with actual fertility, and those associated with parental indications about desired fertility (whether or not a respondent with 5 surviving children

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2/ As noted in chapter 5, education may also lead to some practices which reduce the child's survival prospects, in particular, bottle-feeding.

wants more children). At the simplest level, there are three primary parameters which determine how many children a woman will give birth to during her lifetime: (1) the age at which she commences childbearing, (2) the intervals between subsequent births, and (3) the age at which she has her final birth. In one of these study areas (M2), age at marriage and age at first birth had risen substantially in the years preceding the survey while in the other three areas there had apparently been little change in age at first marriage. This rise in age at first marriage in M2 was most strongly associated with substantial increases in educational attainments of these same women.[3/] However, once married, women in M2 on average were giving birth at closer intervals. Although they on average start child-bearing 3 to 4 years later than women in the other study areas, it appears likely that by the middle or latter part of their reproductive period, their fertility will have "caught up" with or surpassed that of women of the same age in the other study areas (unless they deliberately terminate child-bearing earlier).

Analysis of the characteristics of the woman and her household which are associated with her fertility suggest that once women marry, fertility is subsequently determined or constrained by breastfeeding and the (probably related) practice of prolonged sexual abstinence (which seems to be on the demise, particularly in M2), and to a lesser extent by infant mortality which shortens the interval between the birth of that child and a subsequent birth.

3/ It was not simply a matter of women remaining unmarried while in school. Many girls were leaving school at about ages 13 to 15 after 6 or 7 years of education but not marrying for another 5 to 8 years, while earlier, girls generally married in their mid-'teens.

Finally, there is evidence from this study area that a substantial proportion of parents would like to terminate childbearing after achieving 5 or more surviving children. However, whether or not parents (at that stage) said they wanted more children does not seem to be closely related to their educational levels or economic status, or even the child mortality experiences among their own children. The only variable with which the desire for no more children was consistently related was the actual number of surviving children the parent had.

Chapter 5 presents these results in more detail. Chapter 6 offers some of conclusions derived from this study together with a few recommendations.

2. SOME SUBSTANTIVE BACKGROUND TO THESE TOPICS

There are three major areas of scholarship which are closely related to the subjects of this research. One is the considerable theorizing, and some research, on the relationships between infant and/or child mortality, and subsequent fertility, frequently referred to as the "replacement effect" or the "child-survival hypothesis." The second is the theoretical and empirical work on natural fertility and its determinants, and on the determinants of the production of births and surviving children as distinct from the determinants of the demand for (or desired number of) births or survivors. My own earlier research on socioeconomic development and fertility in rural Northeastern Tanzania attempted to assess the relative contributions of various supply characteristics and demand conditions in determining fertility.

The third major area of intellectual interest is on the determinants of mortality, mortality change, and mortality differentials. Until quite recently this has been a relatively neglected area of scholarship and research.

2.1 Replacement and the Child Survival Hypothesis

Especially during the early and mid-1970s conventional wisdom generally held that there is probably a strong causal relationship between the levels of infant and child mortality and the level of fertility in a

population.[1/] This argument was perhaps most formally, and strongly, presented as the so-called "child-survival hypothesis" (see Taylor et. al., 1976). It is hypothesized that parents have some family size goal (number of surviving children), and as a result of their desire to achieve that family size goal, they attempt to replace children who die. Moreover, because parents in high mortality, traditional societies realize that the risks of child deaths are high, they may in effect "over-compensate" by having somewhat more children than they would otherwise prefer, as a hedge against possible future deaths among their children. (This is sometimes referred to in the literature as an "insurance" or "hoarding" strategy.) Finally, a further aspect of this hypothesized relationship is that if infant and child mortality rates decline substantially -- and with the important condition that parents are aware that survival prospects for their children are now much better than they were in an earlier (but presumably recent) time, parents would then prefer to have correspondingly fewer births.

During the early and mid-1970s this so-called hypothesis achieved the status of "conventional wisdom." [2/] In May 1975 the Committee for

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1/ The causal relationship has usually been hypothesized to run from mortality to fertility. Some researchers and analysts, however, have argued that it is at least as plausible that the principal casuality is the reverse, that high fertility (at least in some cases) is an important cause of high infant and child mortality rates. For example, see Wray (1971) and Scrimshaw (1978).

2/ This was in no doubt partly due to disappointing results of conventional family planning programs, as well as the gradually increasing pre-occupation in the development field with the desirability of improving education, health and general socioeconomic conditions in order to create circumstances favorable to fertility decline (all of which became a central theme at the 1974 Bucharest World Population Conference).

International Coordination of National Research in Demography (CICRED) hosted a scientific meeting to study available evidence on the effects of infant and child mortality (and mortality decline) on fertility, and several papers from this meeting were published (Preston, 1978a). The principal conclusion to emerge from this effort was that, "... on average, an additional child death in the family, ceteris paribus, leads to far less than one additional birth" (Preston, 1978b: 11). In other words, the direct fertility response to declining infant/child mortality was found to fall far short of being fully compensatory, and therefore mortality decline would inevitably result in more rapid population growth.[3/]

However, the central question before the CICRED participants was narrow and limited: "What is the impact of a child death in a family on the parents' subsequent fertility?" (Preston, 1978b: 4). The child-survival perspective can be substantially broadened to include the fertility-related attitudes or behavior of parents in response -- not just to mortality experiences among their own children -- but also to mortality experiences of others in their community; or still more broadly, to their perceptions of general child survival prospects, which may or may not closely reflect real survival prospects. Preston calls this the "insurance strategy" (1978b: 10) and notes that this might imply that in effect parents compensate "in advance" for possible child mortality, and in such cases the observed relationship between child mortality and

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3/ Schultz (1976) reached a similar conclusion.

subsequent fertility under-represents the real relationship (Preston, 1978b: 14).[4/]

There is very little evidence concerning the relationship between mortality and subsequent fertility in tropical Africa. One review concluded that, "... it does not currently seem possible to assess the strength of the mortality-fertility relations in Africa"(Cantrelle, Ferry and Mondot, 1978: 199). One would expect, however, that in conditions typical of tropical Africa, there would be relatively little replacement effect. As Preston observes,

> The obstacles (to replacement) are clearly expected to be greatest in populations with high average family size goals, fatalistic attitudes toward reproduction, son preference, high secondary sterility, and poor contraceptive

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4/ Actually Preston identifies two different ways parents might approach their insurance strategy. One is to base it completely on mortality experiences among their own children. "In this case, the observed degree of replacement in the family will be an accurate indicator of child mortality effects, although behavior will depend on birth order of the child in a different fashion than it would under a strict replacement strategy (stronger reaction to low birth order deaths, weaker to higher birth order deaths)" (1978b: 14). The other is based on experiences outside the family ("extrafamilial effects of child mortality on fertility") -- i.e., the extent to which parents "pre-compensate" for potential child deaths, using as criteria their observations and perceptions of the experiences of others (e.g., their parents, others in the community) for deciding on the number of births they should have in excess of the number of surviving children they want. If this is the case, "... replacement effects will understate the consequences of mortality decline for fertility reduction" (Preston, 1978b: 14).

> technology. It is therefore not surprising to find the least evidence of replacement strategies among populations at low levels of social development. On the other hand, the replacement rate receives a significant boost from interval effects in such populations. (1978b: 14).5/

Although the research by Preston and his collaborators has contributed substantially to understanding direct and short-term causal relationships between child mortality and fertility within families, much remains speculative concerning the extent to which the still high infant and child mortality rates in most of Africa and much of Asia serve as a disincentive to long-term and large fertility reduction.

2.2 Natural Fertility, and the Effects of Supply Factors on Fertility

The concept "natural fertility" has come to mean marital fertility in the absence of deliberate birth control. That is, it is the level of child-bearing which occurs in the absence of any deliberate effort -- regardless of parity -- to limit total births. However, natural fertility can be -- and usually would be -- constrained by certain behavioral or biological conditions, such as sexual abstinence, breastfeeding, spouse separations, amenorrhea, sterility, sub-fecundity, etc. The commonly used index of the extent to which actual marital fertility deviates from a standard natural fertility schedule is Coale's index, m (Coale, 1971).

5/ By "interval effects," Preston means the biological response of ovulation and pregnancy subsequent to an infant's/child's death (resulting from cessation of lactation and/or sexual abstinence sooner than would have been the case had the child not died). Based on data from Bangladesh, Preston estimates that in populations with near universal and quite long breastfeeding (over 2 years), an early infant death could reduce the birth interval by up to 50 percent (Preston, 1978b: 9).

During the past 15 years or so numerous economic analyses of the determinants of fertility -- both in low fertility, high income populations, and in high fertility populations -- have been undertaken. Virtually all of these analyses have proceeded on the (usually implicit) assumption that parents "control" fertility, and that fertility is predominantly determined by demand (desired number of children) considerations. Although economists have long recognized that acquisition of most goods is a function of both demand characteristics and supply conditions, supply factors were generally neglected in most of these analyses.

The work of Richard Easterlin was a notable exception. A principal objective of his early work (Easterlin, 1969) was to attempt a synthesis of economics and sociology so as to provide a fuller understanding of the causes of fertility change. This effort directed considerable attention to the role of aspirations and when and how they are acquired. (Most "demand analyses" also assume that aspirations or preferences are fixed, and that changes in fertility are caused only by changes in incomes and relative prices.) However, Easterlin's work also included attention to characteristics which in economic terms affect the production or supply of children, such as fecundity, frequency of intercourse, and use and efficacy of specific fertility control methods, traditional and otherwise.

Subsequently, Easterlin and others have explicitly incorporated the determinants of supply (or production) of children into economic models

and analyses of the determinants of fertility.[6/] This then permits the analysis of circumstances in which the supply of children (actual number of children a parent has) and demand for children (number of children desired) may be unequal -- i.e. in disequilibrium.

Further elaboration of this supply-demand disequilibrium approach to analyzing the determinants of fertility is offered in the next chapter.

2.3 The Determinants of Mortality and Mortality Decline

Until rather recently, much of the limited amount of research on determinants of mortality (and of mortality decline) in developing countries had been conducted by researchers from public health fields. There is also a substantial body of scholarship on the causes of long-term mortality decline in the West (primarily on the experiences of the 18th and especially 19th centuries). The dominant interpretation in this body of scholarship is that mortality decline in Europe during the 18th and 19th centuries was primarily <u>not</u> the result of medical advances and interventions but rather due to long-term generalized improvements in agricultural, economic and social conditions resulting particularly in improvements in nutrition, housing and clothing (see, for example, McKeown, 1976a, 1976b).

6/ This work includes Easterlin, 1975, 1978; Easterlin, Pollak and Wachter, 1980; Kocher, 1976, 1977, 1979; Jejeebhoy, 1978; and Lesthaeghe, Ohadike, Kocher and Page, forthcoming.

The still-dominant interpretation of the causes of the large mortality declines during the past few decades in developing countries is that these have been primarily the result of the widespread application of western medical and public health technologies (e.g., pesticides, vaccines, drugs) which have wrought their health benefits largely in the absence of substantial socioeconomic development. Thus, the Western long-term mortality decline is attributed to profound societal change, while the developing country mortality decline is attributed to application of widespread Western technologies in the absence of profound societal change. The observation that mortality decline in developing countries has been far more rapid than the earlier decline in Western countries is believed to support this interpretation.7/

Some "revisionist" interpretations of the causes of mortality declines in developing countries have surfaced in recent years. Navarro (1974, 1976) argues that public health investments in Latin America have been so meagre that they could not possibly be the principal source of the large mortality declines which have taken place there in recent decades. Other analysts have observed that the experiences of several developing countries seem to support the interpretation that mortality decline has been associated with a broad set of educational, behavioral,

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7/ It took an entire century for life expectancy to increase as much in the now industrialized countries as it increased during the 20-year period 1950-70 in developing countries (Morawetz, 1977: 48).

agricultural and social changes and not just public health technologies (see for example, Sharpston, 1976; Kocher and Cash, 1979).

However, very few empirical studies have been undertaken on the relative importance of various factors associated with mortality, and with mortality decline, in developing countries. Preston (1980) attempted the Herculean task of disentangling the various principal causes of long-term mortality decline, and of identifying the relative importance of each. He concluded that mortality reductions in developing countries during the period 1940 to 1970 (when life expectancy increased from about 39 years to about 60 years) were not simply a by-product of socioeconomic development. He estimated that at least half (and possibly as much as 80 percent) of this increase in life expectancy was due to government public health, nutrition, education and related programs. (He also concluded that the distribution of incomes and access to services also affected the pace of mortality decline.[8/]) Preston's data were of necessity

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8/ After conducting an international cross-sectional analysis of the relationship between income distribution and mortality, Rogers (1979) also concluded that income distribution is strongly and consistently related to mortality. "The results for life expectancy at birth suggest that the difference in average life expectancy between a relatively egalitarian and relatively inegalitarian country is likely to be as much as five to ten years. The distribution of income may not be the only factor operating of course -- inequality in income distribution is likely to be associated with inequality in access to health and social services, in education, and in a number of other aspects of society relevant to mortality" (p.350).

highly aggregative (national-level data), and conclusions should be accepted with some caution.

However, support for the view that directed public health and related interventions can make major contributions to mortality decline, even in the absence of substantial economic development, is provided by an assessment of the results of 10 major developing country experiences in providing basic health and nutrition care (Gwatkin, Wray and Wilcox, 1980a, 1980b). The authors concluded that well-designed and effective health care projects could reduce infant and child mortality by as much as half over a 5 to 10 year period, and at very low cost.

One non-income factor of apparently great importance in affecting mortality decline is education. Grosse (1980), in a cross-sectional analysis, found that the single variable of percentage of a population literate explained 78 percent of the variation across countries in life expectancy and 75 percent of the variation in infant mortality rates. (Other variables in his regression equations were "sanitation" -- represented by percent of urban population with water taps; "economic" -- represented by percent of the labor force in agriculture; health expenditures; and health personnel and facilities.)

There have been few empirical studies of the effects of education on mortality, and mortality decline, in developing countries. Puffer and Serrano (1973) found that mother's education together with pregnancy-related medical care were favorably associated with levels of infant and child survivorship in a group of very diverse Latin American

settings. Caldwell (1979) concluded that the educational level of mothers was the single most important determinant of infant and child mortality differentials among the Yoruba in Nigeria. According to his analysis, education leads to a set of complex and profound changes in family structure and relationships, and these changes contribute to both infant/child mortality decline and to fertility decline.

Cochrane et al. (1980) reanalyzed data from several developing country studies on the relationships between education (and selected other variables) and child mortality. Despite some problems of data deficiencies and non-comparability among some of the studies, educational level of mothers was found to be consistently and fairly strongly related to child survivorship. In one bivariate analysis of data from nearly 30 countries on the relationship between maternal education and child mortality, "... it appears that an additional year of schooling reduces mortality for infants and children by 9 per 1,000. There is no evidence that this effect differs by urban and rural area, but there is evidence that it is cumulative and becomes stronger as a woman ages" (Cochrane, et al., 1980: 76). Among the factors studied, per capita income and literacy or maternal education were always strongly related to life expectancy and infant/child mortality. Somewhat less significant was income distribution. Associations between these important factors and life expectancy/mortality were stronger for a given point in time than for changes in life expectancy/mortality over time. The authors also concluded that income differences cannot explain more than about half of

observed mortality difference (Cochrane, et al., 1980: 30, 92).[9/]

Another possible important cause of high infant mortality -- and a major obstacle to substantial decline in infant mortality -- may be high fertility. Scrimshaw (1978) cites evidence from several anthropological studies around the world which suggests that in many societies high infant mortality is at least partly the result of (avoidable) underinvestment in infants and young children by parents and the community, and that this appears to be due in part to an unconscious (perhaps sometimes even conscious) effort to limit the number of surviving children (in the absence of effective methods of fertility control).

Despite these recent advances in knowledge about factors associated with mortality and mortality decline, some important questions remain unanswered.

9/ In an earlier exhaustive review and analysis of the effects of education on fertility, Cochrane (1979) concluded that education may increase or decrease individual fertility. Generally, when it contributes to reductions in fertility, the fertility decline is greater in response to women's education than men's education, and for the educated in urban as compared to rural areas. But in countries with low levels of female literacy, education (of women) is more likely to raise fertility (by increasing fecundity and natural fertility -- see chapter 3 of this paper). This (typically) more than offsets the fertility depressing effect of delayed marriage. Thus, Cochrane concluded that education increases the supply of surviving children and reduces the demand for surviving children. In another paper on the same topic, Caldwell (1980), after analyzing both 19th century Western and contemporary developing country experiences, concluded that "mass" education is perhaps the single most important variable precipitating the onset and sustained fertility decline phases of the demographic transition.

- What are the major determinants of mortality in "traditional" communities?

- How does additional schooling of mothers result in improved survivorship among children (as studies analyzed by Cochrane et al., and Caldwell, suggest)?

- To what extent are there differentials in mortality levels and mortality decline patterns among rural communities with otherwise similar educational and socioeconomic characteristics?

- What are the major determinants of mortality <u>decline</u> within communities?

- Are there important differences in the extent to which different groups (age, parity, class, etc.) within a community participate in or benefit from mortality decline?

The next chapter offers a theoretical framework for conceptualizing some of the relationships described (or hypothesized) in this chapter. The Tanzania study areas are then described briefly in chapter 4, and chapter 5 presents the results of the analysis of data from these study areas.

3. CONCEPTUAL AND THEORETICAL PERSPECTIVES AND PRINCIPAL HYPOTHESES

The initial point of departure for offering a theoretical framework for the analysis presented in chapter 5 will be my earlier description of a model of the determinants of fertility (e.g., Kocher, 1979). This framework will then be expanded to explicitly incorporate mortality decline, together with some hypotheses and illustrations of how changes in mortality and fertility -- and their respective determinants -- might be expected to interact during the course of the transition from a traditional rural socioeconomic setting to a modernizing (or Westernizing) one.

3.1 Determinants of Fertility: Supply-Demand Disequilibrium

Earlier (section 2.2) it was noted that recent works of Easterlin, Kocher and others explicitly incorporate consideration of <u>supply</u> as well as demand determinants into the economic analysis of fertility. This section will briefly summarize my earlier elaboration of this approach (Kocher, 1976, 1977, 1979).

Presumably at any point in the child-bearing period, including most importantly, at its conclusion (and possibly later as well), each individual parent will perceive herself or himself as being in one of the following three conditions with respect to the relationship between the number of living children she or he would like to have and the number she or he actually has:

1) Number desired exceeds the actual number (excess demand),

2) Number desired and actual number are identical (supply-demand equilibrium), or

3) Actual number exceeds number desired (excess supply).

"Determinants of supply" are the biological and cultural/behavioral factors which directly affect conception, gestation, child-birth and child survival.[1/] Many of these are the so-called intermediate variables first systematically described by Davis and Blake (1956). For purposes of the description here, the supply variables affecting fertility can be conceptualized under three categories:

1) Those which determine the age at which child-bearing commences,

2) Those which affect the spacing or intervals between births, and

3) Those which determine the termination of child-bearing.

Intermediate <u>supply</u> variables which may be important determinants of the age at which child-bearing commences include biological determinants of age of menarche and cultural determinants of the age at which a woman first has coitus and its frequency thereafter. Intermediate

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1/ "Supply of children" here means simply the actual number of children born (or alternatively, the number surviving if so formulated); it would include the results of any deliberate (intentional) efforts to space, limit, or terminate child-bearing, and in this it differs from the concept "natural fertility" which refers to levels of child-bearing which occur in the absence of any deliberate effort -- regardless of parity -- to limit total births.

supply variables which may determine the date of termination of child-bearing include the biologically-determined age of menopause and possibly social and cultural norms governing widow remarriage (or lack of same) and changing frequency of intercourse (including terminal abstinence) as related to the age of the woman and her husband, and possibly the ages and marital statuses of her children.

Intermediate supply variables which are potential determinants of the spacing between births include the following (Bongaarts, 1978, 1980):

1) Lactational infecundability,

2) Frequency of intercourse (including abstinence),

3) Sterility, and

4) Spontaneous intrauterine mortality.

Frequency of intercourse may in turn be affected by non-demand related factors such as both voluntary and involuntary separation of spouses and prolonged periods of sexual abstinence due to lactatational or other culturally-determined taboos.

Presumably the number of surviving children is ultimately of greater importance to parents than the number of children born. The number of surviving children is the number born less the number subsequently decreased. The number surviving can thus increase if the number born increases (with survivorship rates unchanged) or if the survival rate rises, or both.

Figure 3.1 is an illustration of hypothesized relationships

between supply of surviving children and demand for surviving children for typical women who have completed child-bearing. The figure illustrates hypothesized changes in the relative relationships between supply and demand over time as an initially traditional society undergoes socio-economic modernization.

As illustrated in Figure 3.1, it is hypothesized that in traditional African societies, women (used as a shorthand for parent or parents) typically want more surviving children than they actually end up with; that is, they experience excess demand.[2/] Further in traditional African societies the number of surviving children is determined (or constrained) primarily by so-called intermediate supply variables.[3/] One possible initial consequence of economic, educational and health improvements is to cause changes in intermediate fertility variables (e.g., post-partum sexual abstinence, duration of breast-feeding, incidence of foetal wastage) which may result in higher fertility. Another set of possible consequences of economic, educational and health improvements

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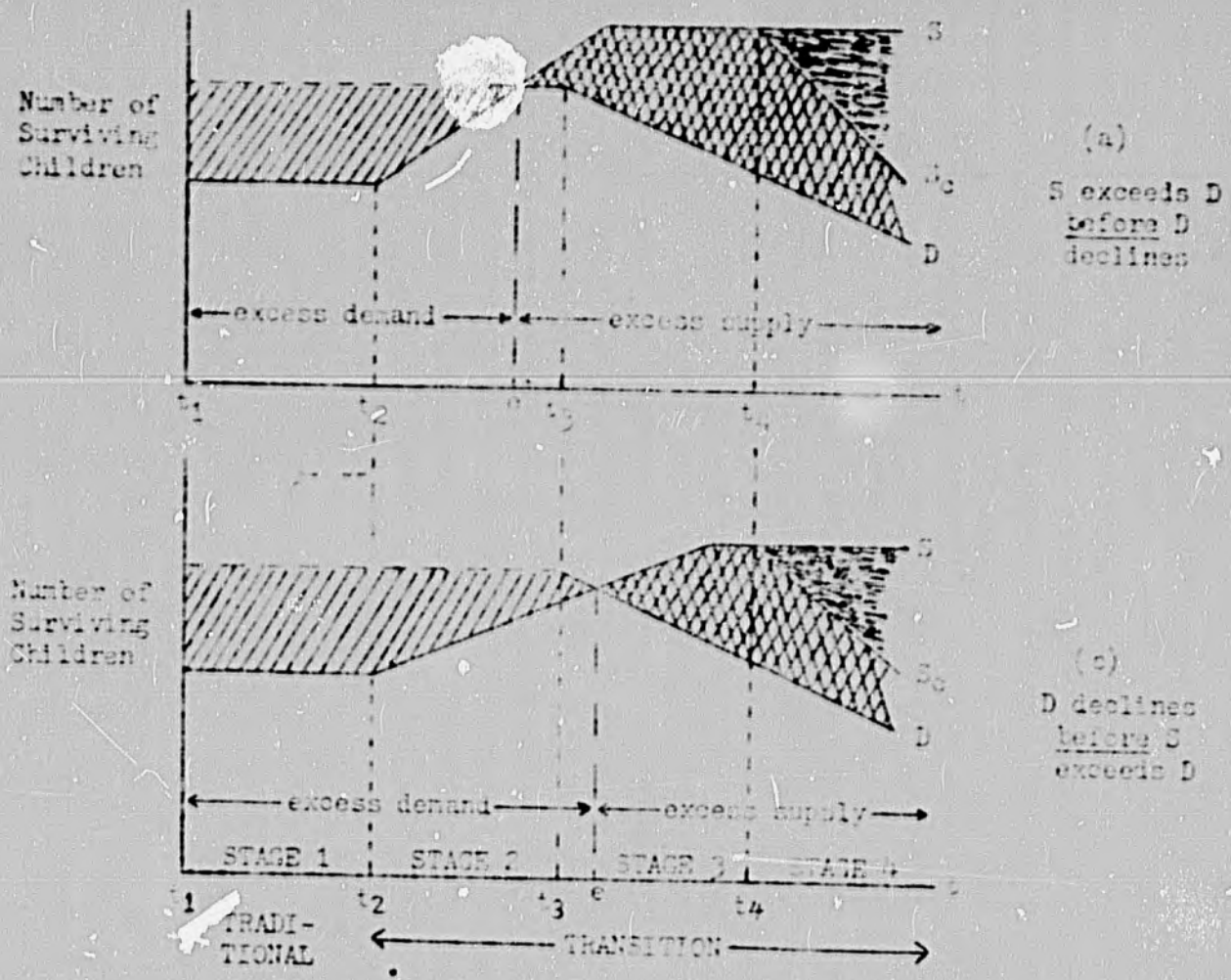
2/ Ware (1975), for example, refers to 33 KAP and other surveys carried out in tropical Africa during the 1960s, all of which indicated that desired numbers of children were very high. In all these studies the vast majority of respondents wanted five or more children. In a volume edited by Caldwell (1977), contributions by Caldwell and several other authors offer evidence and examples of social, economic and cultural conditions in African societies which support and sustain the desire for high fertility.

3/ Tabbarah (1971) was perhaps the first to advance a model of transition from a traditional society in which parents typically have lower fertility than they desire to a modernizing society in which parents typically have excess fertility.



D = Demand: Desired Number of Surviving Children (for completed family size)
S = Supply: Number of Surviving Children with Unregulated Fertility (completed family size)
S_c = Decline in Actual Number of Surviving Children Due to Deliberate Fertility Control

Deficit Fertility (excess of desired number of surviving children over actual number)

Surplus Fertility (excess of actual number of surviving children over desired number)

Amount of Deliberate Birth Prevention, measured by number of children averted

Transition Stages

t_2 = beginning of Stage 2: Average Number of Surviving Children begins to Rise

t_3 = beginning of Stage 3: Desired Number of Surviving Children begins to Decline

t_4 = beginning of Stage 4: Beginning of Individual Practices (contraception, abortion, etc.) to Intentionally Reduce Fertility.

Notes: The absence of a solid line for D to the left of t_3 is intended to portray the possibly indefinite nature of desired number of surviving children in traditional and early transitional societies. The relevant characteristic of D in this area is that it exceeds S.

Figure 3.1 Hypothetical relative levels and trends in demand for and supply of surviving children for a typical woman who has recently completed fertility in a transitional rural society.

is a decline in infant and child mortality rates. Either rising fertility or declining mortality will cause an increase in the number of surviving children for the typical women (commencing at point t_2 in Figure 3.1).[4/]

The second significant point in this model is when demand for children starts to fall, identified as t_3. Possible specific causes of declining demand are numerous and varried and will not be discussed at length here. In economic terms they are conceptualized as rising net costs of children and a shift in tastes and preferences away from large families (see, for example, Leibenstein, 1974, 1978; Caldwell, 1976, 1978). To the left of point e in the model, demand exceeds supply and women (parents) would presumably do whatever they could to increase the number of surviving children. To the right of e, number of surviving children exceeds the desired number, and women would presumably want to hold down fertility.

In this model, rising survival rates would unambiguously improve prospects for fertility decline, by either increasing the amount of excess supply (if women are in a situation to the right of point e) or reducing the extent to which demand exceeds supply (to the left of

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4/ While declines in duration of post-partum abstinence, duration of lactation (and lactational infecundability) and reduced incidence of foetal wastage would all tend to reduce birth intervals (thereby increasing both fertility and number of surviving children), declining rates of infant and toddler mortality would have the opposite effect. However, as Bongaarts (forthcoming) demonstrates by a numerical example, the fertility-reducing effect of declining infant and toddler mortality is likely to be small compared to the fertility-raising effects of changes in these other intermediate supply variables.

point e) and hence hastening the time at which supply begins to exceed demand.[5/]

Figure 3.2 is an illustration of the larger socioeconomic environment within which women and their families live, and of some of the hypothesized linkages which may affect changes in mortality and fertility during the development process. The model postulates that changing social, economic, educational and health conditions can result in rising survival rates for infants and children.

Earlier analyses of these data have suggested that length of lactation and polygyny (both of which may in part be proxies for duration of sexual abstinence) as well as age of marriage are all negatively related to fertility, while child mortality is positively related to fertility (Kocher, 1979). Woman's level of education is positively related to her age at marriage but negatively related to length of lactation and polygyny. Thus, female education tends to reduce fertility by delaying the onset of childbearing but tends to raise fertility by reducing the average interval between births.

It is also hypothesized that education of women will result in improved survival rates among their children, and that greater access to and utilization of health care facilities will have the same effect.

5/ Further elaboration of some of the implications of this model are provided in Kocher (1979), and Lesthaeghe, Ohadike, Kocher and Page (forthcoming).

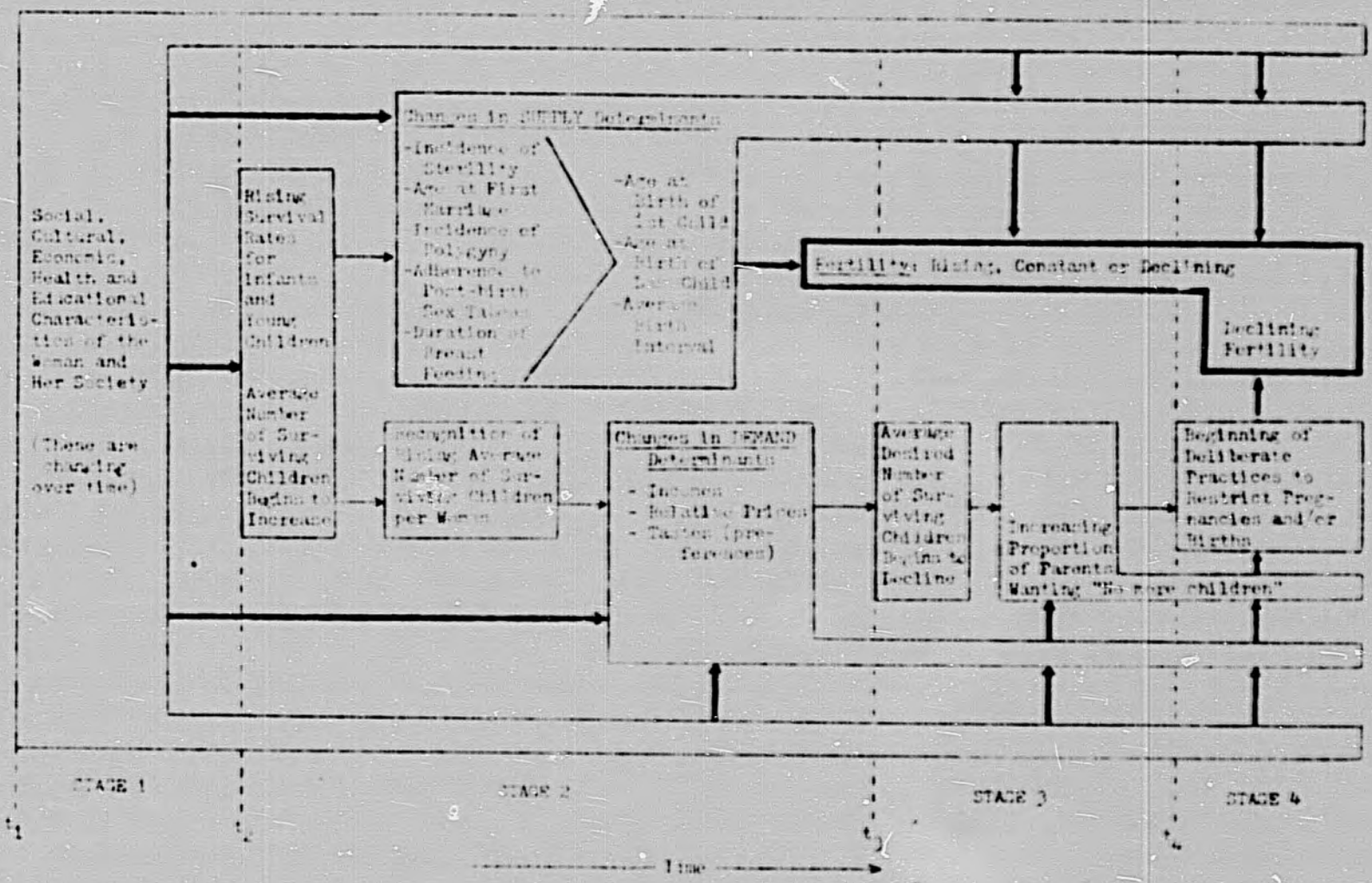

Figure 3.2 Model of hypothesized socioeconomic and demographic transition in rural Africa and the linkages to mortality decline and fertility change, and eventual fertility decline.

3.2 Determinants of Mortality and Mortality Decline

In a commentary on a paper by Preston, Durand (1980) offers a simple but useful framework for considering the process of long-term mortality decline and its possible various determinants. Here I will borrow from Durand's approach, but will introduce some modifications into his conceptual scheme. I will also put forward a somewhat different interpretation of the dominant determinants of mortality during various major "phases" of long-term mortality decline.

Durand (1980: 341) suggests that there are three fairly distinct phases in the long-term mortality transition, as follows:

1) pretransitional phase, in which expectation of life fluctuates around a nearly constant long-term level;

2) initial transition phase, in which expectation of life increases irregularly at a relatively slow long-term average rate;

3) "takeoff" phase, in which expectation of life rises at a steady, rapid rate;

4) final phase, in which expectation of life rises slowly and appears to be approaching a ceiling at a high level.

Figure 3.3 is a highly stylized illustration of trends in mortality and life expectancy during these four phases.

Durand suggests that in Western countries, the following were the principal causes of the initial phase in the mortality transition (stage M2 in Figure 3.3):

> ... increasing understanding of the importance of hygiene and proper feeding of children, linked with the advance of popular education in the industrializing countries, played an influential part ... (also) such social actions as protection of water supplies, urban sewerage, swamp drainage, quarantine practices, restriction of child labor, and regulation of conditions of women's employment (1980: 343).

As for the "take-off" phase - M3 (which Durand identifies as beginning around the decade of the 1890s in Western countries),

> It seems clear that this turn of the trend was primarily a result of the first revolution in death-control technology produced by the validation and wide acceptance of the germ theory of disease ... Meanwhile, increasing income and health-protective social actions continued to contribute to gains in e (life expectancy), and it seems a reasonable hypothesis that the tightening control of fertility may also have contributed to the quickening reduction in child mortality (1980: 344).

According to Durand, developing countries did not begin to benefit from these death-control technologies until the 1920s, and in some cases the 1940s or 1950s. However, the 1940s and 1950s witnessed major advances in the fields of immunization, chemotherapy, and chemical control of disease vectors, and developing countries benefited very substantially from their application.

Generally speaking, most of the countries of Africa and Asia (excluding China and East Asia) would appear to be currently part-way through the "take-off" phase (stage M3 in Figure 3.3). During recent decades, infant mortality, for example, has declined substantially. In African countries it has, on average, declined from well over 200 per thousand births, to about 140 currently. In Asia during the past four

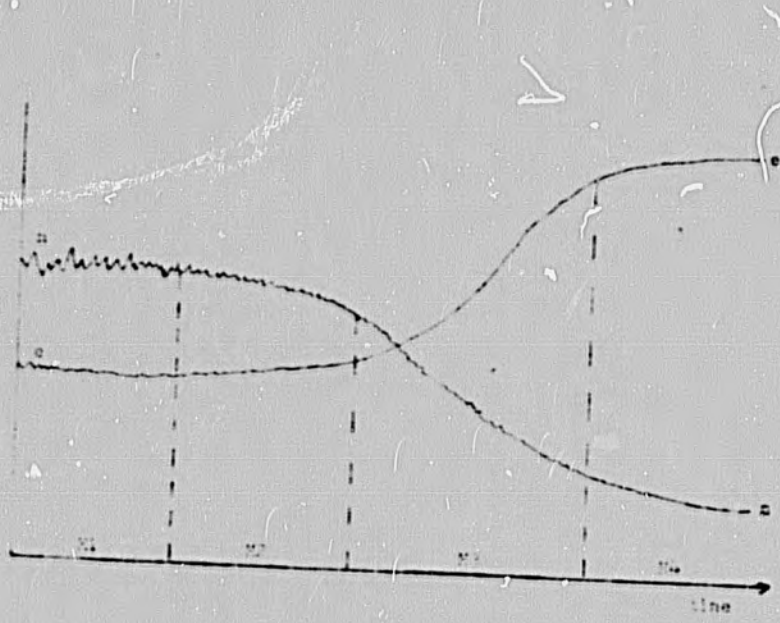

Figure 5.3 Hypothetical Illustration of Long-term Mortality Transition

m = mortality
e = life expectancy

M1 = pretransitional phase
M2 = initial phase of transition
M3 = "takeoff"phase
M4 = final phase

(See text for further elaboration)

decades or so, infant mortality on average has declined from in excess of 150 per thousand births, to about 100 currently.

However, Durand (1980), Preston (1980), Grosse (1980) and others have noted the apparent slow-down in mortality decline in developing countries during the past 10 years or so. Preston (1980), among others, attributes this primarily to a slow-down in creation and application of new technologies, and in implementation of various public health programs.

If Figure 3.3 is a plausible (if highly stylized) representation of the progress of the mortality declines experienced, and expected, in developing countries, what are the causes? Moreover, why have mortality declines in developing countries apparently slowed down partway through the take-off phase (M3 in Figure 3.3)?

What little is known of the determinants of mortality and dominant causes of mortality decline suggests that the relative importance of various factors probably varies quite considerably over the course of the transition. It is plausible that in Stage M2 (initial mortality transition), mortality in developing countries declined for about the same reasons that it had earlier declined in Western countries. That is, public health and medical technologies played almost no role at all. Rather, it was general (if often limited) improvements in food production and food consumption, improved transportation, better governmental administration (and capability to respond to localized crisis or stress situations), etc. In South Asia, for example, sustained, if moderate,

mortality decline apparently occurred during the late 19th and early 20th centuries (interrupted in 1918-19 by the influenza epidemic), and this happened despite negligible public health and medical interventions.

What about the "take-off" phase (stage M3 in Figure 3.3)? With respect to developing countries, the causes would appear to be substantially different from those for Western countries. And indeed, one might hypothesize that this phase in the developing country experience could usefully be broken into two segments (M3a and M3b). I would hypothesize that in Stage M3a, rapid mortality declines were caused primarily by imported (and highly effective) public health technologies (this is the conventional interpretation described earlier in section 2.3). These required very little behavioral change on the part of the beneficiaries, and little or no socioeconomic development. The resultant health improvements and mortality declines were often very large.

However, experiences of the last decade or so seem to suggest that the extent to which this process can reduce mortality is limited, and these limits are reached at an earlier stage in the long-term transition (and at higher levels of mortality) than has previously been appreciated. Such technologies have been widely applied in Asia, with notable successes- yet (excluding China and East Asia), infant mortality in this region remains about 100 or so (per 1000 live births), and considerably higher in South Asia.

I would hypothesize that in <u>developing</u> countries, <u>completion</u> of this long phase of mortality transition requires very substantial

behavioral changes. "Imported" technologies may be sufficient to greatly reduce mortality (e.g., from infant mortality rates of around 200 plus to about 100), but they are apparently incapable of bringing mortality down to moderate levels (e.g., infant mortality rates less than 50) in the absence of very profound behavioral changes by the client/recipient populations themselves.[6/] This interpretation would appear to be fully consistent with the experiences of Kerala and Sri Lanka, for example, where infant mortality is now 50 or less.

Therefore, in analyzing the mortality experiences of any particular developing country population, it will be important to identify which part of this long-term mortality transition the population has recently experienced, or is currently experiencing.

3.3 Combining the Fertility and Mortality Frameworks

Figure 3.4 presents a high simplified and stylized effort to combine the approaches to analyzing determinants of both fertility and mortality, as discussed in sections 3.1 and 3.2 above. For Figure 3.4, certain assumptions are made about levels of mortality, fertility, and desired number of surviving children, throughout the long-term mortality and fertility transitions. The key components of Figures 3.1 and 3.3 are then combined in this illustrative figure.

6/ A probably closely related condition is that client populations have easy access to an effective, if basic, health care delivery system.

For purposes of illustration in Figure 3.4, the following assumptions are made:

- initial (pre-transition) fertility is 6 livebirths per woman (f),

- initial child-survivorship (to adulthood) is 3 children per woman (f-m), and the other three children die during childhood (m),

- initial desired number of surviving children is 6 (d-m), which implies a desired fertility of 9 livebirths (d),

- M1 is the pre-mortality decline traditional phase (from Figure 3.3); it corresponds to S/D1 which is the pre-transition phase in the supply-demand (for surviving children) relationship (Figure 3.1),

- M2 is the initial mortality decline phase; this implies that during this phase, d (desired fertility) would also decline, if desired number of surviving children (d-m) remains constant,

- M3 is the mortality decline "take-off" stage,

- rather early in the M3 mortality stage, fertility is shown to begin to rise (f'); this is assumed to be due to behavioral changes (related to duration of sexual abstinence, duration of breast-feeding) and possibly biological or health improvements (declining sterility, improved fecundity) which result in reduced (average) birth intervals, a smaller proportion childless, and rising (average) fertility,

- a bit later, desired number of surviving children (d-m) is shown to begin to decline, as d diverges to d'; that is, desired number of surviving children is shown to decline from 6 children to progressively smaller numbers (as represented by d'-m);

- soon, at point e, desired number of births (d') and actual number of births (f') are shown to be equal; that is, the transition from demand for surviving children exceeding supply (left of point e) to supply exceeding demand (right of e) occurs. Previously, women would presumably want to increase the number of surviving children (by reducing child mortality and raising fertility above level f'); subsequently women presumably would like to reduce fertility to below f', to the level d',

- shortly thereafter, women begin to deliberately reduce fertility (point t_4 and the beginning of stage S/D4 where fertility unambiguously declines),[7/]

- stage M4 is reached when mortality has achieved moderate to low levels (Figure 3.4 shows this occurring when well over 90 percent of children survive through childhood).

The relationship between mortality, fertility, actual numbers of surviving children (supply) and desired numbers of surviving children (demand) illustrated in Figure 3.4 assume that parents do not have an insurance or hoarding strategy regarding (expected) child survivals and desired fertility. It further assumes that parents have perfect knowledge about changing (declining) infant and child mortality and about future mortality experiences among their own children.

7/ "Natural fertility" is represented by f and f' up to the point e (at which point women are assumed to begin to deliberately restrict fertility). Thereafter natural fertility exceeds actual fertility (f') by an ever larger amount. d and d' correspond to D (actual demand for surviving children) in Figure 3.1; (d-m) followed by (d'-m) corresponds to S (actual number of surviving children) in Figure 3.1

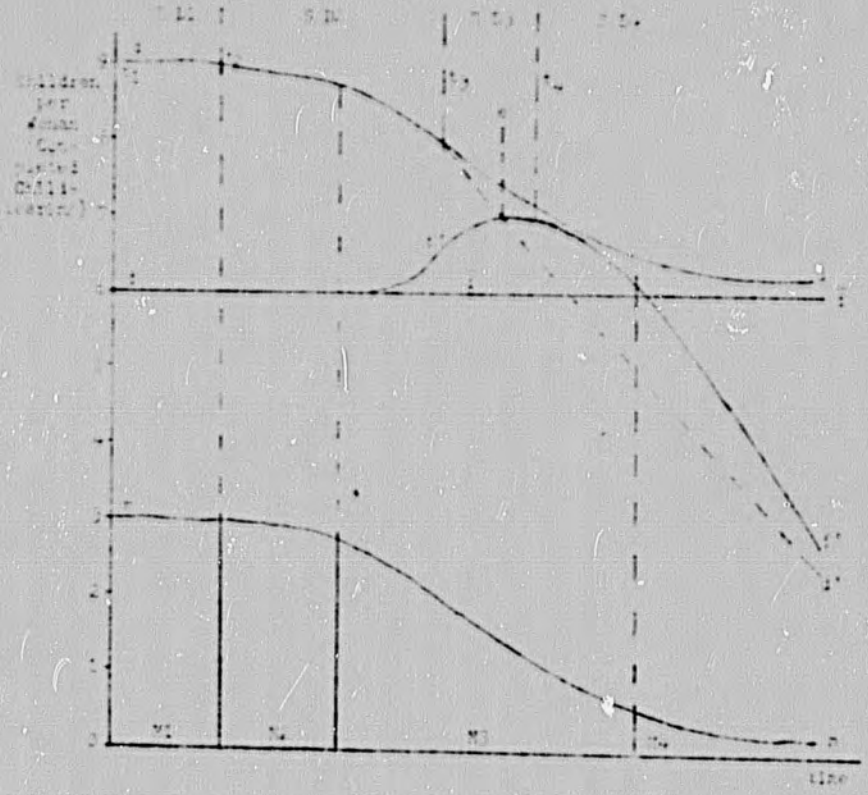

Figure 3.4. Hypothetical Illustration of the Mortality and Fertility Transitions

D = number of livebirths (per woman, at completion of child-bearing).
B = number of livebirths which terminate in childhoods (per woman).
fm = number of actual surviving children (through childhood, similar to S in Figure 3.1
dm = desired number of surviving children, similar to D in Figure 3.1.
d = desired number of total births, given m and given dm
f'= actual fertility (number of livebirths per woman): initially rises, subsequently falls
f = fertility, if the initial level remained unchanged
d'= actual desired number of surviving children (begins to decline at t_3)
d = desired number of surviving children, if the initial level remained unchanged
S1, S2, S3, S4 = correspond to supply-demand (for surviving children) stages in Figure 3.2
e = point of supply-demand equilibrium (from Figure 3.3)
M1, M2, M3, M4 = correspond to stages in the long-term mortality transition, from Figure 3.3

Figure 3.5 illustrates the effects of incorporating an insurance strategy into this framework. As another alternative, it also shows how "lagging" perceptions of declining infant and child mortality could alter the process of declining demand. If, because of uncertainty about future deaths among their children, parents have an insurance strategy and therefore seek fertility which is higher than would be required due to average child mortality alone,[8/] then desired fertility might fall more rapidly than child mortality (provided parents perceive fully the extent to which child mortality has fallen). This is shown by d_i in Figure 3.5. On the other hand, if parents do not perceive (or do not fully perceive) the extent to which infant/child mortality has fallen, than for any given desired number of surviving children (d-m in Figure 3.4), the decline in d will lag somewhat behind the decline in m, as shown by d_p in Figure 3.5.

3.4 Principal Hypotheses for the Data Analysis

The hypothetical illustrations accompanying the preceding discussion of the roles of various intermediate and more distant determinants of fertility and mortality, and of fertility and mortality

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8/ As an example: Parents might really think four surviving children would be sufficient but because of uncertainties about future survivorship among their children, they might conclude they should attempt to produce six surviving children (as implied by d-m in Figure 3.4) as a hedge against the possibility that a larger than average number of their own children might die prematurely.

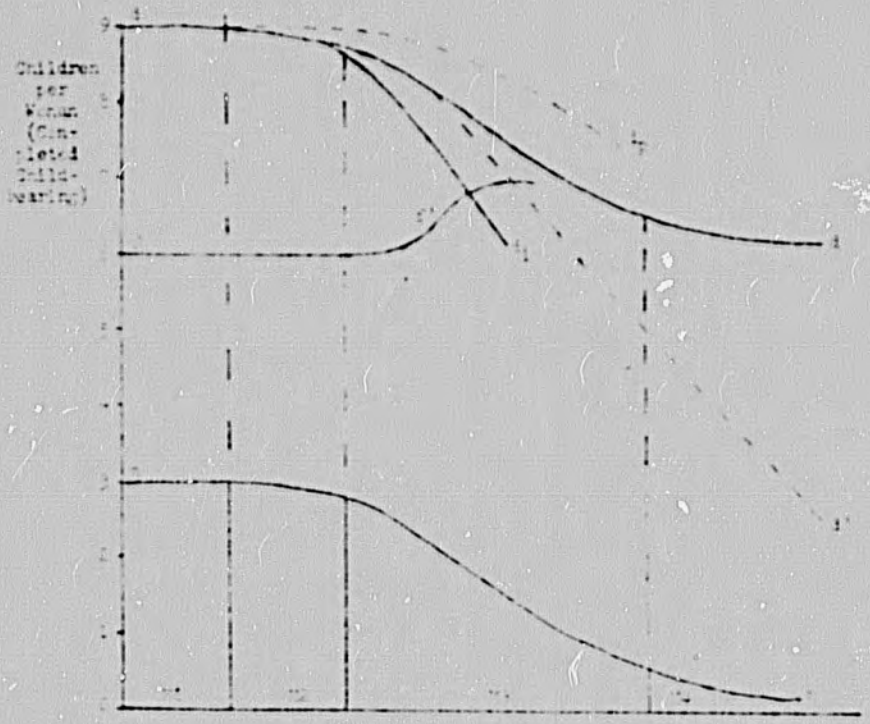

Figure 3.5. Hypothetical illustration of the mortality and fertility transition, showing the possible implications of (a) an insurance strategy, and (b) of failure by parents to fully perceive the extent of real improvements in child survivorship prospects.

f = number of livebirths (per woman, at completion of child-bearing)
m = number of livebirths which terminate in child deaths (per woman)
$f-m$ = number of actual surviving children (through childhood)
d_{min} = desired number of children, assuming no insurance strategy and perfect knowledge (including of future child deaths among their own children) by parents
d_s = desired number of surviving children, assuming parents have an insurance strategy, and they accurately perceive the increasing child survival prospects.
d_p = desired number of surviving children, assuming the perception by parents of increasing child survivorship prospects lags behind actual increases in child survivorship rates.

(See text for discussion)

declines, are oversimplified. However, they provide a useful framework for setting out hypotheses for analyzing the data available for this study.

In chapter 5, the results of the analysis of data from these study areas which are associated with the following three major health and demographic variables will be presented: (1) child survivorship, (2) utilization of health care services, and (3) fertility.

Hypotheses related to each of these three dependent variables can be summarized as follows:

(1) Childhood survivorship will be:

  (a) positively related to the utilization of health care services,

  (b) positively related to the educational levels of the parents, and particularly of the mother,

  (c) positively related to quality of health-related behavior of the mother, and particularly to her length of breast-feeding, and

  (d) positively related to the economic level of the household.

(2) Utilization of health care services will be:

  (a) positively related to the level of "modernization" of the parents; specifically, this would be related to,

(i) the educational levels of the parents (especially the mother), and

(ii) the relative modernity of their attitudes (as measured by the selected indicators), and

(b) positively related to the economic level of the household as a measure of the extent to which parents can afford to incur the costs -- in money, time, and inconvenience of utilizing health care services.

(3) Based on the theoretical approach described earlier in this chapter, if a woman is in an excess demand situation, then her fertility can be expected to be:

(a) positively related to the number of years she has been married,

(b) negatively related to her duration of breastfeeding,

(c) negatively related to the rate of infant/child survivorship among her children,

(d) negatively related to length of her periods of sexual abstinence, and

(d) positively but weakly related to, (i) the economic level of the household, and (ii) the educational levels of herself and her husband.

Controlling for age at marriage, a woman's average birth interval can be expected to be:

(a) positively related to her average duration of breast-feeding,

(b) positively related to infant/child survivorship among her children,

(c) positively related to length of her periods of sexual abstinence, and

(d) negatively but weakly related to, (i) the economic level of her household, and (ii) the educational levels of herself and her husband.

The next chapter will briefly describe the relevant characteristics of the study areas and of the populations included in this analysis. This will be followed by presentation and analysis of the main findings from this study (chapter 5).

4. DESCRIPTION OF THE STUDY AND THE STUDY AREAS

Data for this study and these analyses were collected during the second half of 1973 from four rural areas in Northeastern Tanzania, by means of demographic and socioeconomic questionnaires administered to adult members of about 1500 households. Tables 4.1 and 4.2 provide selected summary socioeconomic, education and demographic data for these populations. It may, however, be helpful to provide some further background information about these populations before highlighting the data in Tables 4.1 and 4.2.

Each of these four rural areas is well-watered, fertile and densely-settled. As shown on the map (Figure 4.1), two of the study areas (L1 and L2) are located in Lushoto district and two (M1 and M2) in Moshi district. At the time the data were collected, there were about 1000 households and roughly 5000 people in each of these four areas. The areas ranged in size from about 7 to 10 square kilometers giving average densities of roughly 500-700 per square kilometer, although some residents of each area also cultivated land and grazed livestock outside the area, so that the land effectively supporting these populations is somewhat larger. All four areas are located at elevations between 1050 and 1850 meters.

Based on accounts of early European travellers, Christian missionaries, European settlers and (German) government officials (all of whom first entered these areas in the late 19th century), as recently as the early 1900s these were still quite traditional rural African

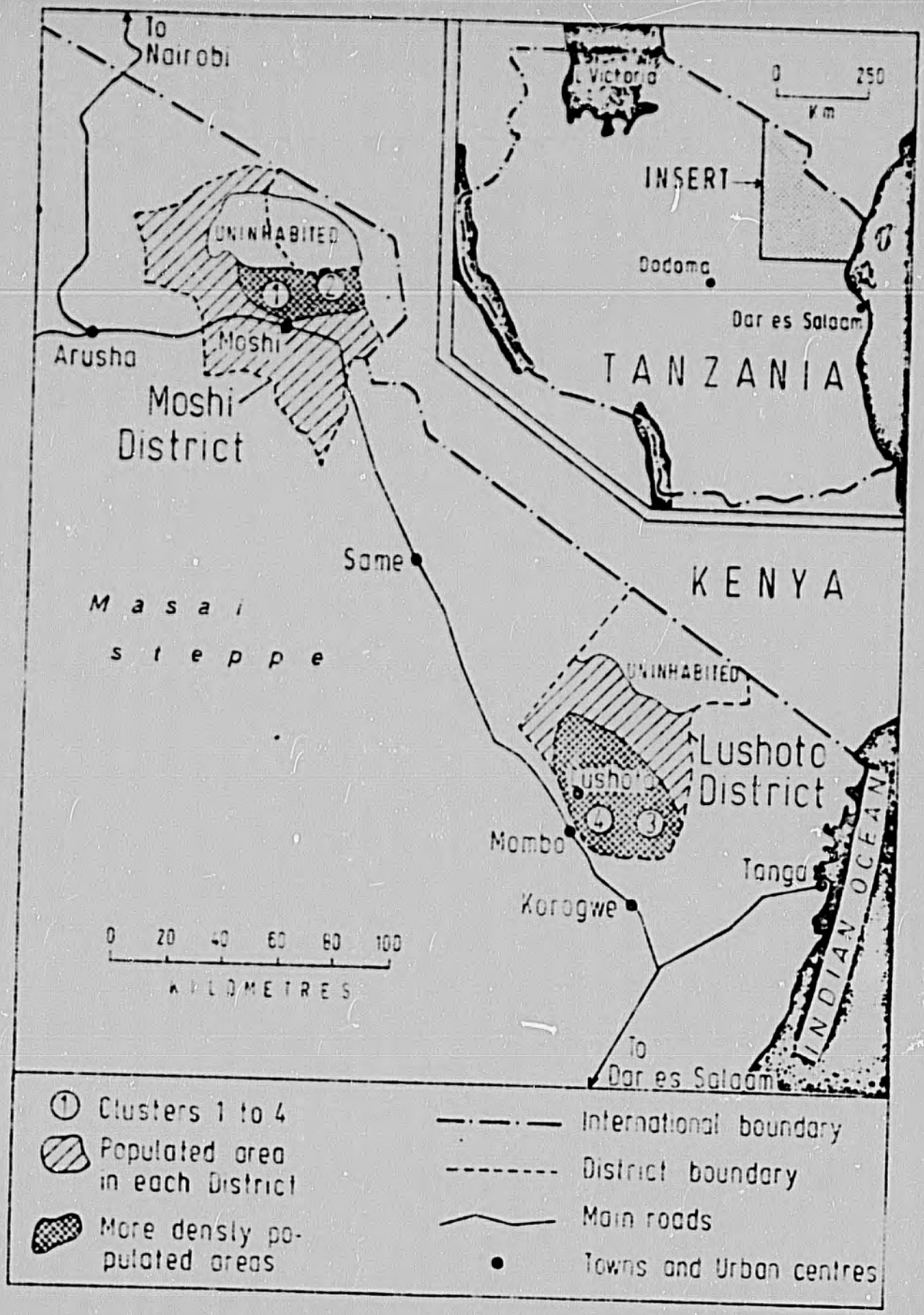

Figure 4.1. Study areas within Moshi and Lushoto Districts, Tanzania

societies.[1/] Almost all residents adhered to tribal religions. Formal (Western-style) schools and medical services were only beginning to be established. Very little commercialization of agriculture had taken place. Birth rates were high -- probably close to 50 per thousand, and crude death rates were probably not yet much below their historic average levels -- perhaps 40 per thousand (with average expectations of life at birth not much above 25 years). Almost no one had received any formal education.

However, considerable socioeconomic development and improvements in living conditions have occurred in all four areas during this century. By 1973 crude death rates had declined to about 12-15 per thousand, average expectation of life at birth was 50-55 years, and most children were receiving at least some primary education. Most residents no longer followed traditional religions, substantial numbers of households (especially in the Moshi areas) resided in non-traditional and relatively expensive houses, and almost all households participated in the cash economy although per capita incomes probably still did not exceed about $50 per year.

These are currently rural societies in transition. They are clearly not yet developed, but they are also no longer traditional (see Figures 3.1 through 3.5). There are also large differentials in the levels and spread of the changes, both within and among the four areas,

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1/ For more details, see Kocher, 1979.

some of which are reflected in the characteristics shown on Tables 4.1 and 4.2 -- e.g., formal schooling, age at first marriage, incidence of polygyny, and duration of breastfeeding.[2/] Generally, the four areas can be ranked from the one having experienced the least change to the one having experienced the most change, as follows: L1, L2, M1, M2. This is the case, for example, for women's education (columns 6 and 7, Table 4.1).

Some of the more relevant and notable differences among the areas are the following: In M2 age at marriage has apparently risen substantially in recent years (Table 4.1, column 9) and in M2 child-bearing is now commencing at a later age (column 4). Women age 20-24 had only half as many livebirths in M2 as in the other three areas, while differences among women 25-29 were less pronounced, and M2 women age 30-34 had somewhat more livebirths than women in the other areas. Other notable behavioral changes presumably related to these are the dramatically declining prevalence of polygyny in M2 (column 12) and to a lesser extent in M1 with apparently little change in L1 and L2, and the substantial decline in the average duration of breastfeeding (Table 4.2, columns 2-5) which may at least in part be the consequence of the demise of prolonged postpartum sexual abstinence, particularly in M2 and possibly also in M1 (not documented in this study, but locally widely reported to be the

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2/ Some of these data are also presented in Kocher, 1976; and Kocher, 1979. More detailed descriptions of the socioeconomic and demographic characteristics of the populations of these four areas are also provided in these two sources.

Table 4.1 Selected Characteristics of Northeastern Tanzania Study Areas in 1973: Part 1.

Area	Current Age (1)	Years Born (2)	Livebirths: Ave. No. (3)	Livebirths: Ave. 2 or Fewer (4)	% With Formal Schooling: "Some" (5)	% With Formal Schooling: 4 or More Years (6)	Age at First Marriage: Years When Age 20 (7)	Age at First Marriage: % Married Before Age 20 (8)	Male Incidence of Polygyny: Approximate Years Born (10)	Male Incidence of Polygyny: Current Ages (11)	Male Incidence of Polygyny: % Men Reported Polygynous at least once (12)
I	20-24	1949-53	1.3	85%	21%	9%	1969-73	61%	1914-33	40-59	41%
	25-29	1944-48	3.4	24%	13%	5%	1954-68	70%	pre-1914	60+	40%
	30-34	1939-43	4.6	11%	8%	0					
II	20-24	1949-53	1.8	74%	28%	18%	1969-73	73%	1914-33	40-59	47%
	25-29	1944-48	3.7	34%	29%	10%	1954-68	72%	pre-1914	60+	62%
	30-34	1939-43	4.9	14%	26%	6%					
III	20-24	1949-53	1.6	76%	8%	3%					
	25-29	1944-48	3.6	29%	40%	16%	1963-73	61%	1914-33	40-59	23%
	30-34	1939-43	4.9	15%	26%	12%	1954-68	58%	pre-1914	60+	54%
IV	20-24	1949-53	0.8	92%	73%	32%					
	25-29	1944-48	3.0	42%	42%	13%	1969-73	34%	1914-33	40-59	10%
	30-34	1939-43	5.0	17%	40%	10%	1954-68	60%	pre-1914	60+	62%

case).[3/] Presumably the substantial recent increase in women's educational attainment, especially in M2, is an important contributor to all these other changes.

It is also interesting that perceptions of declining child mortality seem to be strongly associated with these other general differences in the extent of social change. Estimates based on model life tables (see Henin et al., 1977) indicate that female life expectancy at birth in each of the four study areas is in the 50-55 year range (Table 4.2, column 6), implying that infant and child mortality has probably fallen substantially in recent decades in all four areas. The great majority of respondents in both Moshi areas (and particularly M1) believe that child mortality has been declining, but in the Lushoto areas (and particularly L1) the majority believe otherwise (Table 4.2, columns 8 and 9). Finally, columns 10-12 (Table 4.2) show that for given numbers of surviving children, in most cases a higher proportion of Moshi (and particularly M1) respondents desired no more children than did Lushoto respondents.

In summary, a great deal of socioeconomic and related changes have taken place in these rural areas of Northeastern Tanzania during recent decades. All four areas have experienced considerable change,

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3/ It was not possible to recruit female interviewers for this study, and pre-testing demonstrated that questions concerning sexual abstinence were too sensitive for male interviewers to ask of female respondents. In the absence of data on abstinence, duration of breastfeeding may be considered a proxy (of unknown accuracy) for duration of postpartum sexual abstinence.

Table 4.2 Selected Characteristics of Northeastern Tanzania Study Areas in 1973: Part 2.

Rural Area	Reported Duration of Breastfeeding: Current Age	Mean (months)	Standard Deviation (mo.)	% Breast-fed More Than 24 Months	Estimated Female Life Expectancy (years)	Perceptions of Mortality Changes: Age	% Who Believe Children Less Likely to Die[1]: Men	Women	Want No More Children: No. Surviving Children	% Who Want No More Children: Fathers	Mothers
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
L1	20-34	32	11	56%	53-55	20-29	23%	20%	0-2	3%	12%
	40-44	36	11	71%		50-59	41%	10%	3-4	10%	27%
									5-6	30%	50%
									7+	40%	54%
L2	20-34	26	10	33%	50-52	20-29	33%	21%	0-2	2%	9%
	40-44	32	10	73%		50-59	36%	15%	3-4	20%	21%
									5-6	47%	52%
									7+	44%	62%
M1	20-34	24	11	25%	50-52	20-29	8%	14%	0-2	9%	15%
	40-44	31	9	60%		50-59	31%	7%	3-4	34%	47%
									5-6	60%	58%
									7+	69%	84%
M2	20-34	20	12	16%	53-55	20-29	65%	45%	0-2	18%	15%
	40-44	31	12	45%		50-59	26%	78%	3-4	21%	40%
									5-6	42%	58%
									7+	61%	69%

[1] From among the following three categories: 1) less likely, 2) same likelihood, and 3) more likely. Excluded are all "don't know" responses; these ranged from 2 to 7 percent of the total.

[2] For women ages 20-44 and for husbands less than age 55 with at least one wife less than age 50.

but the changes have been very uneven, both among and within the four areas.

In the next chapter, results of further analysis of the possible relationships among various of these socioeconomic characteristics -- and changes -- and mortality and fertility will be presented, approached from the theoretical perspectives offered in chapter 3.

5. FINDINGS

This chapter presents and discusses the results of the analyses of the Tanzania data. Results are presented on the following: (1) numbers of births, child survivals, and implied survivorship among the women included in the study, (2) parents' perceptions about changes in child survival prospects, (3) factors associated with child survivorship, (4) relationships between child mortality and the utilization of health care services, (5) factors associated with fertility levels and differentials, and (6) factors associated with whether or not parents, with a given number of surviving children, want more children.

5.1 Births and Survivorship

The principal sources of data on child mortality for this study are the reports by women respondents of their numbers of deceased children. This information was recorded in pregnancy histories in which respondents attempted to recall each livebirth, including those now deceased.

Table 5.1 shows the average number of reported livebirths by five-year age groups of respondents, together with the proportions surviving at the time of the interview. Several observations can be made, as follows:

(1) The proportions of children surviving are comparatively quite high for rural Africa, and imply rather low infant and young

Table 5.1 Average Reported Number of Livebirths, and Reported Proportions of Children Born Alive and Still Surviving at the Date of Interview, for Women Currently Married, and Married Once Only.

	L1		L2		M1		M2	
Ages of Women	Average Number of Births*	Reported Proportions Surviving**	Average Number of Births*	Reported Proportions Surviving**	Average Number of Births*	Reported Proportions Surviving**	Average Number of Births*	Reported Proportions Surviving**
1	2	3	4	5	6	7	8	9
20-24	1.9	.837	1.9	.906	2.1	.924	1.6	.952
25-29	3.4	.900	3.7	.889	3.5	.908	3.4	.943
30-34	4.7	.920	4.9	.889	5.1	.860	5.5	.897
35-39	6.2	.906	6.3	.888	6.2	.824	6.0	.858
40-49	6.5	.865	7.5	.879	6.7	.877	7.0	.830

* The sum of the number of children reported born alive and still living, and the number reported born alive and subsequently deceased.

** = $(1 - \frac{\text{Reported number of children deceased}}{\text{Reported total livebirths}})$

child (age 1-4) mortality rates.[1/] However, additional evidence of rather low infant mortality rates in these four areas is provided by the results of the analysis of the 1973 National Demographic Survey (NDS) data for the Northeastern highlands area of Tanzania. The NDS Northeast highlands area estimates are derived from seven population clusters, four of which are the subject of the present study. The infant mortality rate in 1973 for the Northeast highlands area (seven clusters) is estimated to have been in the low 60s per thousand livebirths, and the probability of dying before age 2 is estimated to have been about 75 per thousand

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1/ For example, for all four areas combined, the reported average number of livebirths for women age 20-24 is just under two (see Table 5.1). With an average birth interval of about 2.20 to 2.55 years (see Table 5.17), this implies that for age group 20-24, the average interval between date of birth and date of interview is approximately two years (i.e., an average of roughly one year since the second birth and 3 to 4 years since the first birth). With reported proportions surviving (Table 5.1) for women age 20-24 ranging from 0.887 (L1) to 0.952 (M2), this implies that in these four areas combined, cumulative mortality during the first two years of life is less than 100 per thousand livebirths.

(Hogan and Jiwani, 1977: 215-16).[2/]

(2) For the younger two age groups (20-24 and 25-29) of women, survival proportions among their children are higher in the two Moshi areas than in the Lushoto areas, and they are highest for both age groups in M2.

(3) In M2, implied survival proportions decline progressively from the youngest to the oldest age groups. This is to be expected for at least two reasons. First, as women become older, the average ages of

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2/ The Tanzania National Demographic Survey (NDS) data were analyzed by 12 "mode of life" zones in Tanzania. Estimates of infant mortality ranged from a low of about 55 for the Southeastern Lake Victoria basin, to a high of about 140 for the Morogoro plateau. Estimates of the probability of dying by age two ranged from about 65 per thousand in the Northwestern highlands to about 180 per thousand in the Morogoro plateau.

Although the NDS analysis did not disaggregate mortality estimates by clusters, it seems unlikely that estimates of infant mortality rates in these four study areas would be higher than estimates for the remaining three clusters in the Northeastern highlands (and the former could plausibly be lower), for the following reasons: Two of these additional three areas are at lower (and therefore possibly less healthy) elevations than are the four study areas. Although detailed socio-economic and educational data are unavailable for these three additional areas, personal observations suggest that conditions in all three are probably somewhere between the Moshi and the Lushoto levels described in this study. That is, their socioeconomic and educational characteristics are likely to be at higher levels than those in the two Lushoto areas, but lower than in the two Moshi areas. Access to health services is probably no better in these 3 additional areas -- and it may be poorer -- than in the four Moshi and Lushoto areas. Thus, it seems unlikely that health and mortality conditions would be better in the 3 additional areas than in the 4 areas studied here, implying that inclusion of these 3 additional areas does not produce a downward bias in the mortality estimates for the four study areas.

their children also increase, meaning that the children are subjected to more years of mortality risk, and since even among older children the survival probabilities are less than one, the average proportions of children surviving should decline as the average age of mother rises.[3/] Second, it is plausible though not documentable that infant and child mortality rates in these communities had declined during the 20 years preceding the survey. If this is the case, it would also result in lower infant and young child survival rates among children born in the 10-20 year period preceding the survey than among those children born within 10 years before the survey.

However, the proportions of children surviving do not uniformly decline -- from youngest to oldest mothers -- in the other three areas. In M1, it declines from age group 20-24 (.924) through age group 35-39 (.824) but then rises to .877 for age group 40-49. In L1 it starts to rise with age group 25-29, and in L2 with age group 25-29, and in both areas reported proportions of children surviving are higher for women age 35-39 than among women age 25-29.

This means that there must be under-reporting of child deaths (and hence of births), especially among the older cohorts. Thus, especially among the older cohorts, the proportions of children actually

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3/ For the 12 modes of life zones of Tanzania, estimates of the proportions surviving to age 5 range from about 895 (per thousand births) in the Northeastern highlands to about 770 (per thousand births) in the Morogoro plateau (Hogan and Jiwani, ibid.).

surviving must be lower than the proportions reported surviving (in Table 5.1). The extent of under-reporting, and therefore of over-estimation of proportions surviving, is unknown. The data for M2 are consistent and plausible, but presumably they too may be subject to some under-reporting. Presumably the data for the younger age groups are the least inaccurate, since a substantial share of these women have some formal education (especially in the Moshi areas), and since the effective period of recall is much less than for the older cohorts. For all of these reasons, to the extent possible subsequent analysis of the data will be restricted to younger women.

Despite the limitations of these data, they show that survival prospects for infants and young children in these four study areas are relatively good in comparison with most areas of rural Tanzania and tropical Africa generally. It seems likely that infant and young child mortality rates had declined substantially in the decades preceding the 1973 survey.

5.2 Perceptions about changes in child survival prospects

Both adult women and adult men respondents were questioned whether they thought survival prospects of young children had improved in recent decades. Columns 7-9 in Table 4.2 (chapter four) present responses to this question for both men and women, ages 20-29 and 50-59. In the two Moshi areas, about 60 to 90 percent of the respondents believe that survival prospects have improved. The corresponding percentages

are about 15 to 40 in the two Lushoto areas. Although it seems plausible that the actual decline in infant and young child mortality rates has been somewhat greater in the two Moshi areas than in the two Lushoto areas, in the previous section it was shown that actual rates have probably declined substantially in all four areas, and that differentials among areas do not appear to be large.

Tables 5.2 and 5.3 present further data related to parental opinions as to whether child survival prospects have improved in recent decades. Data in Table 5.2 are presented for women currently married and married only once, ages 25-44. The patterns are generally consistent with the data shown in Table 4.2 (which were for age groups 20-29 and 50-59) and show that only about one-quarter of the women of child-bearing age in the two Lushoto areas believe child survival prospects have been improving, while 64 percent of the women in M1 and 76 percent of the women in M2 believe this to be so. Table 5.3 shows that among husbands, ages 25-59, the pattern of differences among the four study areas is similar to that for the women, but in all cases the percentages of husbands who believe child survival prospects have been improving are higher than for the women: 37 versus 24 percent in L1, 45 versus 26 percent in L2, 86 versus 76 percent in M1 and 70 versus 64 percent in M2. Thus, it appears that among the four areas, differentials in perceptions of mortality decline are larger than are differences in actual mortality decline.

Table 5.1 Average values for independent variables hypothesized to influence whether a woman is of the opinion that children are less likely to die these days than in the past, for women currently married and married only once, ages 25-44.*

Variables		Opinion**	L1	L2	M1	M2
(1)		(2)	(3)	(4)	(5)	(6)
- Percentage of women who are of the opinion that children are less likely to die these days than in the past		Less Likely	24.1	25.9	76.3	64.2
		Same or More Likely	75.9	74.1	23.7	35.8
- Building Quality: An index of the quality and value of the respondent's house (values range from 0 to 6)	**	Less Likely	0.58	1.14	2.47	2.96
		Same or More Likely	0.72	0.75	2.52	2.49
- Cash Crop Earnings: Estimated cash earnings from sale of crops produced in 1973 by the respondent's household in Tanzanian shillings (Shs= $1)	**	Less Likely	503	510	617	594
		Same or More Likely	471	478	612	564
- Husband's Employment: Percentage of husbands who have a non-agricultural wage-paying job	**	Less Likely	21.0	38.1	40.2	30.2
		Same or More Likely	23.3	41.7	40.7	37.3
- Woman's Education: Woman's number of years of formal schooling	*	Less Likely	0.47	2.05	2.10	2.23
		Same or More Likely	0.93	0.67	1.56	1.27
- Husband's Education: Husband's number of years of formal schooling	**	Less Likely	3.79	4.86	4.95	4.28
		Same or More Likely	4.43	4.32	4.63	4.27
- Woman's current age		Less Likely	31.3	30.7	32.1	32.7
	**	Same or More Likely	31.2	31.5	29.5	31.8
- Delivery: Percentage of women whose last baby was born in a hospital	**	Less Likely	21.1	23.3	69.0	57.6
		Same or More Likely	18.3	38.3	77.8	64.2
- Prenatal Care: Percentage of women who received prenatal medical care during their most recent pregnancy	**	Less Likely	42.1	23.8	74.7	66.0
		Same or More Likely	31.7	15.0	70.4	71.2
- Percentage of Woman's children (born alive) who are still alive	**	Less Likely	92.8	84.4	88.1	91.8
		Same or More Likely	89.8	89.9	90.8	84.7
N			79	81	114	105

* From among the following response categories: (1) less likely (to die these days), and (2) same likelihood (as in the past) or more likely to die these days. Excluded are all "don't know" responses; these ranged from 2 to 7 percent of total responses.

** Expected to be the larger value, based on hypothesized relationship with the dependent variable (opinion regarding child survival prospects today compared with the past).

Table 5.3 Average values for independent variables hypothesized to influence whether a woman's husband is of the opinion that children are less likely to die these days (than in the past), for husbands ages 25-59

Variables		Opinion*	L1	L2	M1	M2
(1)		(2)	(3)	(4)	(5)	(6)
- Percentage of husbands who are of the opinion that children are less likely to die these days than in the past		Less likely	36.8	44.6	86.0	70.1
		Same or More likely	63.2	55.4	14.0	29.9
- Building Quality: An index of the quality and value of the respondent's house (values range from 0 to 6)	**	Less Likely	0.75	1.30	2.35	2.85
		Same or More Likely	0.52	0.70	1.38	2.63
- Cash Crop Earnings: Estimated cash earnings from sale of crops produced in 1973 produced by the respondent's household, in Tanzanian Shillings (Sh 8=$1)	**	Less Likely	542	561	627	628
		Same or More Likely	465	481	581	592
- Husband's Employment: Percentage of husbands who held a non-agricultural wage-paying job	**	Less Likely	7.1	32.4	28.8	16.9
		Same or More Likely	18.8	32.0	38.4	18.4
- Woman's Education: Woman's number of years of formal schooling	**	Less Likely	0.61	1.49	2.31	1.69
		Same or More Likely	0.79	0.98	1.92	1.84
- Husband's Education: Respondent's number of years of formal schooling	**	Less Likely	3.89	4.59	4.00	4.17
		Same or More Likely	4.35	4.22	3.85	3.79
- Husband's current age		Less Likely	39.5	36.8	37.9	40.1
	**	Same or More Likely	37.1	36.7	38.8	37.7
- Percentage of Respondent's children (born alive) who are still alive	**	Less Likely	90.8	87.7	87.0	88.2
		Same or More Likely	90.2	85.4	83.3	86.0
- Number of respondent's children who are now deceased		Less Likely	0.50	0.80	0.78	0.83
	**	Same or More Likely	0.69	0.65	1.31	0.76
N			76	83	93	127

* From among the following response categories: (1) less likely (to die these days), and (2) same likelihood (as in the past) or more likely to die these days. Excluded are all "don't know" responses.

** Expected to be the larger value, based on hypothesized relationship with the dependent variable (opinion regarding child survival prospects today compared with the past).

Tables 5.2 and 5.3 also give average values for several other variables hypothesized to be associated with each opinion category. (These variables are subsequently included in a discriminant function analysis, with the results shown in Tables 5.4 and 5.5.) The data in Tables 5.2 and 5.3 suggest that, generally speaking, respondents from economically better off households are more likely to believe that child survival prospects have been improving (the only exception is women in L1), although the differences are generally not large. Similarly, better educated parents are more likely to believe that child survival prospects have been improving. Again, the only exceptions are both women and their husbands in L1. There appears to be no consistent pattern by age of respondent. Except in M2, women who received prenatal medical attention are more likely to believe child survival prospects are improving (although there is no consistent pattern among women based on whether or not the last child was born in a hospital). Finally, men who believe child survival prospects are improving on average have experienced slighly better child survival rates among their own children than have men with a contrary opinion. This is also true for women in L1 and M2, but not for women in the other two areas.

Tables 5.4 and 5.5 present the results of a discriminant function analysis of these same variables, with opinion concerning child

survival prospects as the dependent variables.[4/] These results show that among the women, education is the variable most closely associated with the opinion that child survival prospects have been improving. (Only in L1 is there no relationship, although L1 is the only area in which the education of the woman's husband is related to her opinion regarding changing child survival prospects. As Table 5.2 shows, average educational attainment for women in L1 is less than 1 year while for their husbands it is about 4 years.) In the two Moshi areas older women are more likely than younger women to have a favorable opinion. In M2 both household wealth and child survival experiences are positively associated with a favorable opinion about changing child survival prospects. Finally, place of most recent birth is unrelated to women's opinions, although in L2 prenatal medical care is positively related to a favorable opinion.

Among husbands, again in the two Moshi areas education is positively associated with a favorable opinion. In both Lushoto areas both wealth and estimated current income are positively related to a

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4/ Discriminant function analysis a method for creating linear combinations of independent variables which attempt to maximize the separation of two dependent groups for a dichotomous dependent variable. The discriminant functions are of the following form: $D_i = d_{i1}Z_1 + d_{i2}Z_2 + \ldots + d_{ip}Z_p$, where D_i is the score on the discriminant function i, the d's are weighting coefficients, and the Z's are the standardized values of the p discriminating variables used in the analysis. The d_{ij}'s are called standardized discriminant function coefficients and are analogous to standardized beta coefficients in multiple regression. Each coefficient represents the relative contribution of that variable to the function (Klecka, 1975).

Table 5.4 Standardized Discriminant Function Coefficients and Selected Indicators of the Discriminating Power of the Resulting Functions, for the Independent Variables given in Table 5.3 (the dependent variable is the woman's opinion as to whether child survival prospects have been improving), for women ages 25-44.

Variables	Expected Sign	Areas			
		L1	L2	M1	M2
(1)	(2)	(3)	(4)	(5)	(6)
- Building Quality: An index of the quality and value of the woman's house (values range from 0 to 6)	+	--	--	--	--
- Cash Crop Earnings: Estimated cash earnings from sale of crops produced in 1973 by respondent's household, in Tanzanian shillings (Sh 8 = $1)	+	--	--	--	0.255
- Husband's Employment: Dummy variable indicating that the husband holds a non-agricultural wage-paying job	+	--	--	--	-0.327
- Woman's Education: Woman's number of years of formal schooling	+	--	0.994	0.539	0.826
- Husband's Education: Husband's number of years of formal schooling	+	1.000	--	--	--
- Woman's Current Age	-	--	--	0.932	0.453
- Delivery: Dummy variable indicating that the woman's last baby was born in a hospital	+	--	--	--	--
- Prenatal Care: Dummy variable indicating that the woman received prenatal medical care	+	--	0.341	--	--
- Survival rate among the woman's children	+	--	--	--	0.502
- Number in Group 1 (fewer dying)		19	21	87	108
- Number in Group 2 (not fewer dying)		60	60	27	59
- Group 1 as % of total		24.1%	25.9%	76.3%	64.7%
- % Correct if "random"		62%	61%	69%	53%
- % Correctly classified		80.0%	77.8%	76.3%	69.7%

Notes: -- = Excluded from the analysis because tolerance level is too low

Table 5.5 Standardized Discriminant Function Coefficients and Selected Indicators of the Discriminating Power of the Resulting Functions, for the Independent Variables given in Table 5.4 (the dependent variable is the husband's opinion as to whether child survival prospects have been improving) for husbands, ages 25-39.

Variables	Expected Sign	Areas			
		L1	L2	M1	M2
(1)	(2)	(3)	(4)	(5)	(6)
- Building Quality: An index of the quality and value of the woman's house (values range from 0 to 6)	+	0.348	0.665	0.385	--
- Cash Crop Earnings: Estimated cash earnings from sale of crops produced in 1973 by respondent's household, in Tanzanian Shillings (Sh 8 = $1)	+	0.609	0.746	--	--
- Husband's Employment: Dummy variable indicating that the husband holds a non-agricultural wage-paying job	+	-0.383	--	0.490	--
- Woman's Education: Woman's number of years of formal schooling	+	--	--	--	--
- Husband's Education: Husband's number of years of formal schooling	+	--	--	0.721	0.644
- Husband's Current Age	?	0.723	--	--	0.798
- Number of respondent's children who are now deceased	-	0.680	--	0.454	--
- Number in Group 1 (fewer dying)		28	37	80	89
- Number in Group 2 (not fewer dying)		48	46	13	38
- Group 1 as % of total		36.8%	44.6%	86.0%	70.1%
- % Correct if "random"		53%	51%	72%	56%
- % Correctly classified		68.4%	62.7%	86.0%	70.1%

Note: -- = Excluded from the analysis because tolerance level is too low.

favorable opinion (as hypothesized). In L1 and M2 older husbands are more likely to have a favorable opinion. Finally, in both L1 and M1 husbands who believe that child survival prospects have not improved have generally experienced more deaths among their own children (as hypothesized).

In summary, the statistical associations between these independent variables and the dependent variables (opinions as to whether or not child survival prospects have been improving) are generally not strong, but (with the exception of husband's non-agricultural employment), the relationships are at least not contrary to what was hypothesized, and in some cases there is a statistical association -- particularly for education, economic conditions, to some extent previous child mortality experiences, and respondent's age.

5.3 Factors associated with actual (reported) child survivorship

It was hypothesized that child survival prospects would be positively related to each of the following four characteristics of the mother and the household:

1) economic level of the household,
2) education level of the child's mother and father,
3) access to and utilization of health care services,
4) the mother's duration of breastfeeding.

Some data on economic levels of households, on education levels of parents, and on utilization of health care services are given in Tables 5.2 and 5.3, broken down by whether or not the respondent believed that child survival prospects have been improving in recent years. Some additional data should be provided at this point. Table 5.6 gives average values of the housing index, by area. Table 5.7 gives average values of the estimated cash earnings from sale of crops in 1973 by the respondent's household, in Tanzanian shillings. Table 5.9 provides data on utilization of medical care facilities during pregnancy; specifically, the percentage of women who delivered their most recent babies

in a hospital, and the percentage of women who visited a medical clinic at least once during their most recent pregnancy, by age group of mothers.

The quality and value of housing is assumed to be a proxy for household wealth. By this measure, there is a straight-forward progression among the study areas, with L1 being the poorest, followed by L2, then a substantial jump to M1, with M2 by far the best-off area. Estimated value of household crops produced and sold are assumed to be proxies for current household income. Table 5.7 shows that by this measure of current income, L2 is slightly better off than the other 3 areas, with L1 again the poorest area. All households carried on some agricultural activities. However, as Table 5.8 shows, between 8 percent (in L1) and 23 percent (in M1) of the men, and between 4 percent (in L1) and 8 percent (in L2) of the women also had non-agricultural wage-paying jobs. Thus, at least for these households, the value of crops produced or sold is an inadequate proxy for current income.

Table 5.9 shows the percentages of women in each area, by 5-year age group, who utilized medical services during their most recent pregnancies -- specifically, those who delivered their babies in a hospital, and those who visited a clinic at least once during their most recent pregnancies. For women 20-34, less than 20 percent in L1 delivered their most recent babies in a hospital (25 percent among age group 20-24), compared to nearly 40 percent in L2, about 60 percent in M2, and around 70 percent in M1. Very few women age 35 and older in the two

Table 5.6 Index of Housing Quality and Value, in 1973

Area	Average Value	N*
(1)	(2)	(3)
L1	0.47	300
L2	0.69	290
M1	1.71	442
M2	2.46	460

* Includes all households in each of the four study areas.

Table 5.7. Estimated Average Shilling Values (per household) of Thirteen Crops Produced and Sold in the Twelve Months Preceding the 1971 Survey.

Area	Estimated Average Shilling Values	
	Produced	Sold
(1)	(2)	(3)
L1	725	481
L2	1053	817
M1	837	729
M2	976	748

Approximate exchange rate: Shillings 8 = $1.00

Table 5.8. Percentage of respondents who held non-agricultural wage-paying jobs.

Area	Men	Women
(1)	(2)	(3)
L1	8%	4%
L2	22%	8%
M1	23%	6%
M2	20%	7%

Table 5.9. Medical Care During Pregnancy, by Current Age of Women (for women currently married and married once only).

A. Percentage Who Delivered Their Most Recent Baby in a Hospital

Current Age Group	L1	L2	M1	M2
(1)	(2)	(3)	(4)	(5)
20-24	25	36	74	71
25-29	19	42	79	62
30-34	13	39	55	52
35-39	11	16	51	57
40-44	11	21	46	42
45-49	19	7	43	26

B. Percentage Who Visited a Medical Clinic at Least Once During the Final Three Months of their Most Recent Pregnancy.

Current Age Group	L1	L2	M1	M2
(1)	(2)	(3)	(4)	(5)
20-24	74	88	86	97
25-29	79	80	86	82
30-34	68	86	75	92
35-39	60	59	70	76
40-44	57	67	59	60
45-49	48	28	44	35

Lushoto areas delivered in a hospital, while nearly half of the women 35-49 in the two Moshi areas did so.

The differences between the two districts are much smaller regarding the percentages who visited a prenatal clinic. Among women under age 35, nearly 75 percent did so in L1, and the percentages in the other three areas exceed 80. Even most older women report having received prenatal care in all four areas.

Tables 5.10 and 5.11 present the results of regressions in which proxies for these and other characteristics are used as independent variables; the reported percentage of the woman respondent's children surviving is the dependent variable. Table 5.10 gives the results of a regression which includes a broad age group of women (ages 20-34), with parity unspecified (for women currently married, married once only), for each of the four areas and for the Lushoto areas and the Moshi areas combined. Independent variables are measures or proxies for utilization of health services, mother's education, and three separate indicators of household economic status. All five independent variables are expected to be positively associated with child survival. Only one of the five -- place of delivery of the last child -- shows a consistently positively relationship with child survival. It is also a statistically significant relationship in L1, L2, and M1, but in M2 the relationship is both weak and not statistically significant.[5/]

5/ The largest and statistically strongest relationship between place of delivery and child survival is in M1. The coefficient of 13.8 implies that the survival rate among the children of women whose last child was born in a hospital is about 14 percent higher than among women whose last child was born at home, ceteris paribus.

Table 5.10 Regression Results for (Reported) Percentage of Children Surviving. Women Currently-married (and married only once), Ages 20-34.

Independent Variables	Expected Direction of Relationship	Areas				Lushoto	Moshi
		L1	L2	M1	M2		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
DELIVERY:							
A dummy variable indicating that the woman's last baby was born in a hospital	+	8.1	13.4θ	13.8*	4.2	9.3*	8.7*
		(1.673)	(2.416)	(3.274)	(1.057)	(2.580)	(3.036)
WOMAN'S EDUCATION:							
Number of years of formal schooling	+	-1.8	0.2	-0.4	-0.9	-0.8	-0.6
		(1.302)	(0.145)	(0.555)	(0.987)	(0.863)	(1.110)
BUILDING QUALITY:							
An index of the quality and value of the woman's house (values range from 0 to 6)	+	1.2	-3.8	0.7	-0	-2.1	0.5
		(0.457)	(1.654)	(0.675)	(0.000)	(1.296)	(0.787)
HUSBAND's EMPLOYMENT:							
A dummy variable indicating that the woman's husband has a wage-paying job	+	-3.2	-3.9	-0.2	0.0	-5.0	-0.2
		(0.661)	(0.632)	(0.045)	(0.000)	(1.288)	(0.077)
CASH CROP EARNINGS:							
Estimated cash earnings from sale of crops produced in 1973 by the woman's household	+	0.1	0.1	-0.3	-0	0.1	-0.2
		(0.389)	(0.935)	(1.273)	(0.032)	(0.580)	(1.138)
CONSTANT		89.9*	82.1*	79.0*	88.6*	88.1*	84.1*
		(32.89)	(19.23)	(19.69)	(22.10)	(37.75)	(30.10)
R^2		.03[illegible]	.080	.069	.012	.045	.031
N		127	113	190	170	240	360

Notes: Regression coefficients are outside parentheses; t-ratios are inside parentheses

* = significant t-ratio at .01 level

θ = significant t-ratio at .05 level

ƒ = significant t-ratio at .10 level

There are several possible explanations for this very poor statistical association between a woman's education level and survivorship among her children, and between economic status of her household and child survivorship.

(1) The expected strong relationships may simply not exist. That is, at least in these populations, differences in household economic and educational characteristics do not make much difference in determining which children die and which survive.

(2) The hypothesized relationships may actually exist, but (a) the proxies used here do not adequately represent the real variables (e.g., household economic status or health-related knowledge), and (b) the data are too imprecise (e.g., on child mortality), or both.

(3) The data may be insufficiently disaggregated for real relationships to show up. Perhaps stricter controls for age and parity should be introduced (e.g., confining the analysis to a 5-year age group of women all with parity n).

Within the constraints of the available data, Table 5.11 represents an effort to both refine and expand the analysis by limiting the dependent variable to women age 25-29 with three live births, and by including the following additional independent variables: (1) duration of breastfeeding; (2) woman's current age; and dummy variables indicating, (3) whether or not the woman is married to a polygynous husband, (4) whether she is of the opinion that child survival prospects are improving, and (5) whether she thinks there are advantages to having a large family.

Table [illegible]: Regression results, and averages and standard deviations, for (reported) percentage of children surviving, women currently married (and married only once), ages 25-[illegible], with three livebirths.

Variables	Expected Direction of Relationship	Regression Results		Average Values and Standard Deviation	
		Lushoto	Moshi	Lushoto	Moshi
(1)	(2)	(3)	(4)	(5)	(6)
PERCENT SURVIVING: Percentage of Woman's children (born alive) who are still alive				93.8 (13.2)	95.4 (11.7)
DELIVERY: A dummy variable indicating that the woman's last baby was born in a hospital. (Percentage of women whose last babies were born in a hospital)	+	1.4 (0.025)	7.6 (2.588)▼	27.2 (42.4)	69.4 (46.7)
BREASTFEEDING: Number of months the woman breastfed her last baby which was weaned	+	-0.3 (1.021)	- -	33.6 (10.6)	25.6 (13.6)
WOMAN'S EDUCATION: Number of years of formal schooling	+	4.3# (4.672)	-2.8# (2.271)	0.7 (1.6)	1.9 (2.3)
WOMAN'S CURRENT AGE:	-	-1.6 (0.473)	-1.0 (0.460)	27.0 (1.6)	26.5 (1.5)
BUILDING QUALITY: An index of the quality and value of the woman's house (Values range from 0 to 6)	+	-2.6 (0.[illegible])	-1.1 (1.296)	0.5 (1.1)	2.2 (2.2)
HUSBAND IS POLYGYNOUS: A dummy variable indicating that the woman's husband is polygynous (Percentage of women who are married to polygynous husbands)	-	1.9 (0.008)	6.8 (0.619)	48.7 (50.0)	5.6 (23.2)
"CHILD MORTALITY HAS DECLINED": A dummy variable indicating that the woman thinks children are less likely to die these days than in the past. (Percentage of women who think so).	+	-5.9 (0.401)	12.1# (5.764)	22.0 (42.4)	56.3 (50.0)
"LARGE FAMILIES HAVE ADVANTAGES": A dummy variable indicating that the woman thinks there are advantages to having a large number of children. (Percentage who think so).	+	- -	4.2 (1.027)	58.3 (50.0)	44.4 (50.4)
CONSTANT		151.4	115.2	-	-
R^2		0.354	0.339		
N		27	36	27	36

Notes: -For columns 3 and 4, regression coefficients are outside parentheses; t-ratios are inside parentheses
* = significant t-ratio at .01 level
# = significant t-ratio at .05 level
▼ = significant t-ratio at .10 level

-For columns 5 and 6: Average values are outside the parentheses; standard deviations are inside the parentheses

Column 2 indicates the hypothesized direction of the relationship between each independent variable and the dependent variable (percentage of children surviving).

There are relatively few cases because the analysis was limited to women ages 25-29 with three livebirths. Therefore, the regression results are shown only for the two Lushoto areas combined and the two Moshi areas combined. The results are again disappointing. Few relationships are in the hypothesized directions, even fewer are statistically significant, and some of these are in the direction opposite to that hypothesized. In the Moshi areas, hospital delivery is positively associated with child survivorship, but it is not statistically significant. There is a slight negative relationship between woman's education and survivorship, with statistical significance at the .05 level. And there is a fairly large and statistically significant (.05 level) positive relationship between the opinion that child mortality is declining and child survivorship (it was earlier hypothesized -- and it seems plausible -- that the direction of causation would be from survivorship to perceptions, unless the latter is serving as a proxy for some set of "non-traditional" attitudes and behaviors). In Moshi there is no significant statistical relationship between survivorship and the remaining variables, including reported duration of breastfeeding.

The only statistically significant relationship in the Lushoto areas is between mother's education and survivorship, and the relationship is positive (as hypothesized). There is no obvious

explanation why this relationship should be positive in Lushoto and negative in Moshi. It is possible, however, that in Moshi more educated women are more likely to bottle-feed, and that this results in somewhat higher mortality among their children, while this does not appear to be the case (or seems less common) in Lushoto.[6/] Another contributing factor could be that educated women in the Moshi areas might be reporting child mortality more accurately than uneducated women, thereby biasing the regression results. Again however, it is not possible to test this hypothesis.

These results are somewhat confusing to say the least. The only relationship that is consistently in the hypothesized direction is that between place of delivery of the last birth (also assumed to be a proxy for general utilization of health care services) and child survivorship. All other variables produced weak, absent, or contradictory relationships.

5.4 Child mortality and utilization of health care services

In the preceding section it was found that among the variables hypothesized to affect child survivorship, only "place of delivery" (hospital versus home) consistently showed the expected relationship, and was usually statistically significant.

6/ The research did not provide data with which to study this, although health workers in the Moshi area thought bottle-feeding was on the increase (e.g., Lindner, 1975). There were no reports of a similar trend in the Lushoto areas.

Table 5.12 lists eight variables which are hypothesized to influence whether or not a woman's most recent baby was born in a hospital or at home. "Hospital delivery" is hypothesized to be related to each of these variables as follows:

- positively, with the woman's level of education,
- positively, with the husband's level of education,
- positively, with the woman's religion being Christian,
- negatively, with the woman's current age (women currently ages 25-44 only),
- positively, with the quality and value of the household's building(s),
- positively, with estimated value of the household's cash crop earnings,
- positively, with the husband having a wage-paying non-agricultural job, and
- positively, with the woman being of the opinion that children are less likely to die these days than in the past.

As shown at the top of Table 5.12, the percentage of women whose last baby was born in a hospital ranged from 19 in L1 to 72 in M1. In all four areas, the average educational levels of women who gave birth in a hospital were almost twice as high as among those who gave birth at home (although all educational attainments for women are low). The average educational differences among their husbands are comparably smaller but still as expected. Nearly all women (of this age group) in the two Moshi areas were Christian, but less than one-third

Table 5.12 Average Values for Independent Variables Hypothesized to Influence whether a Woman's most Recent Baby was born in a Hospital or at Home, for Women Currently Married and Married only once, ages 25-44.

Variables	Place of Delivery	L1	L2	M1	M2
(1)	(2)	(3)	(4)	(5)	(6)
DELIVERY: Percentage of Women whose last babies were born in a hospital	Hosp.	19.2	37.5	71.9	57.4
	Home	80.8	62.5	28.1	42.6
WOMAN'S EDUCATION: Number of years of formal schooling	*Hosp.	1.27	1.07	2.34	2.24
	Home	0.73	0.88	1.16	1.35
HUSBAND'S EDUCATION: Husband's number of years of formal schooling	*Hosp.	5.00	5.01	5.07	4.34
	Home	4.11	3.88	4.47	4.16
WOMAN'S RELIGION: Percentage of women who are Christian	*Hosp.	26.7	33.3	97.6	100.0
	Home	17.5	26.0	96.9	100.0
WOMAN'S CURRENT AGE	Hosp.	29.7	30.6	30.9	31.7
	*Home	31.4	31.9	32.8	33.3
BUILDING QUALITY: An index of the quality and value of the woman's house (values range from 0 to 6)	*Hosp.	0.47	1.13	2.70	3.09
	Home	0.73	0.95	1.88	2.51
CASH CROP EARNINGS: Estimated cash earnings from sale of home-grown crops, in Tanzanian Shillings (Sh 8=$1)	*Hosp.	379	568	618	568
	Home	495	554	607	602
HUSBAND'S OCCUPATION: Percentage of husbands who also have a non-agricultural job	*Hosp.	33.3	53.3	41.5	38.7
	Home	20.6	30.0	40.6	23.2
"CHILD MORTALITY HAS DECLINED" Percentage of women who are of the opinion that children are less likely to die these days than in the past	*Hosp.	27.0	23.0	73.2	66.0
	Home	24.0	24.0	81.3	62.0
N		78	60	114	102

*Expected to be the larger value, based on hypothesized relationship with dependent variable, Delivery.

were Christians in the two Lushoto areas, and in both areas Christian women were more likely to give birth in a hospital than were non-Christians (most Moslems). Younger women are more likely to give birth in a hospital, although the differences are smaller than might be expected.

The data also suggest that women in better off households (as measured by quality of housing) are more likely to deliver in a hospital (except in L1 where the quality of housing was generally quite poor) and that women whose husbands have non-farm wage-paying jobs (all of these households were "rural") are more likely to have a hospital delivery. Except in M1, lower estimated cash crop earnings were associated with hospital deliveries (estimated cash crop earnings were intended to serve as a proxy for "current" income as opposed to wealth or "permanent" income), although this may reflect both the inadequacy of this particular measure of "current" income as well as the relative unimportance of current income (as compared to wealth) in influencing health-related behavior.

In general, the data presented in Table 5.12 are highly consistent with expectations. Previous results had indicated that place of delivery was positively associated with child survivorship, and the data shown on Table 5.12 suggest among other things that education, especially of women, is positively associated with the woman giving birth in a hospital rather than at home.

As a further test of these implications, these data were subjected to discriminant function analysis, the results of which are given in Table 5.13. The relationship between hospital delivery and

Table 5.13 Standardized Discriminant Function Coefficients and Selected Indicators of the Discriminating Power of the Resulting Functions, for the Independent Variables given in Table 5.9 (the Dependent Variable is "Delivery").

Variable	Expected Sign	Standardized Discriminant Function Coefficients			
		L1	L2	M1	M2
(1)	(2)	(3)	(4)	(5)	(6)
WOMAN'S EDUCATION: Number of years of formal schooling	+	--	--	+ 0.577	+ 0.744
HUSBAND'S EDUCATION: Husband's number of years of formal schooling	+	+ 0.647	+ 0.734	--	--
WOMAN'S RELIGION: Percentage of women who are Christian	+	--	--	--	--
WOMAN'S CURRENT AGE	-	- 0.414	--	- 0.544	--
BUILDING QUALITY: An index of the quality and value of the woman's house (values range from 0 to 6)	+	- 0.455	--	+ 0.591	--
CASH CROP EARNINGS: Estimated cash earnings from sale of home-groan crops, in Tanzanian Shillings (Sh 8 = $1)	+	- 0.501	- 0.541	--	--
HUSBAND'S OCCUPATION: Percentage of husbands who also have a non-agricultural job	+	--	--	--	+ 0.522
"CHILD MORTALITY HAS DECLINED" Percentage of women who are of the opinion that children are less likely to die these days than in the past.	+	--	--	--	--
- Number in Group 1 (Hosp.delivery)		15	30	82	93
- Number in Group 2 (non-hosp. delivery)		63	80	32	69
- Group 1 as percent of total		19.8%	37.5%	71.9%	57.4%
- Percent Correct if "Random"	+	67%	53%	60%	52%
- Percent Correctly Classified		79.5%	68.8%	74.9%	63.0%

Notes: -- + Excluded from the analysis because tolerance level is too low.

women's education is positive and significant in the two Moshi areas, and the relationship with men's education is positive and significant in the two Lushoto areas.

An alternative indicator of utilization of health care services was attendance at a hospital (or clinic) for prenatal medical care during the woman's most recent pregnancy.7/ The percentages of women (ages 25-44, currently married and married once only) in each of the study areas who reported having attended a hospital or clinic at least once during their most recent pregnancy, for prenatal medical care, are as follows: L1, 53 percent; L2, 42 percent; M1, 83 percent; M2, 81 percent.

Table 5.14 presents results of a standardized discriminant function analysis using prenatal care as the dependent variable. Woman's education is positively related to prenatal care in both Moshi areas; in M1 building quality and in M2 husband's occupation are positively related to prenatal care. These results are roughly similar to those shown in Table 5.13 for delivery place. Table 5.14 shows little of interest for the two Lushoto areas.

5.5 What determines fertility?

In chapter 4, it was shown that among the four study areas, on the average women in M2 marry and begin childbearing somewhat later

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7/ Preliminary analyses suggested that prenatal care was a slightly weaker proxy for utilization of health care services than was hospital delivery, and the latter was therefore employed in the preceding analyses.

Table 5.11 Standardized Discriminant Function Coefficients and Selected Indicators of the Discriminating Power of the Resulting Functions, for the independent Variables given in Table 5.5, but with "Received Pre-natal Medical Care" as the Dependent Variable

Variable	Expected Sign	Standardized Discriminant Function Coefficients			
		L1	L2	M1	M2
(1)	(2)	(3)	(4)	(5)	(6)
WOMAN'S EDUCATION: Number of years of formal schooling	+	--	--	+ 0.527	+ 0.440
HUSBAND'S EDUCATION: Husband's number of years of formal schooling	+	--	- 0.348	--	--
WOMAN'S RELIGION: Percentage of women who are Christian	+	--	+ 1.241	--	--
WOMAN'S CURRENT AGE	-	- 1.000	--	--	--
BUILDING QUALITY: An index of the quality and value of the woman's house (values range from 0 to 6)	+	--	+ 0.560	+ 0.738	--
CASH CROP EARNINGS: Estimated cash earnings from sale of home-grown crops, in Tanzanian Shillings (Sh 8 = $1)	+	--	--	- 0.543	- 0.506
HUSBAND'S OCCUPATION: Percentage of husbands who also have a non-agricultural job.	+	--	--	--	+ 0.480
"CHILD MORTALITY HAS DECLINED" Percentage of women who are of the opinion that children are less likely to die these days than in the past	+	--	--	--	--
- Number in Group 1 (Pre-natal care)		27	14	15	112
- Number in Group 2 (no pre-natal care)		24	19	18	26
- Group 1 as percent of total		52.9%	42.4%	82.5%	81.2%
- Percent correct if "Random"		50%	52%	68%	68%
- Percent correctly classified		62.8%	72.7%	82.5%	81.2%

Notes: -- = Excluded from the analysis because tolerance level is too low

$R^2 = \frac{\phi}{1+\phi}$ where $\phi = \left[\frac{(n_1 n_2)}{(n_1+n_2)(n_1+n_2-2)}\right] D^2$

n_1 = Group 1
n_2 = Group 2

than in the other three areas, but by the time M2 women reach their mid- to late 30's their total numbers of births equal or exceed those of women in the other areas. For currently married women (married once only), ages 20-34, the (imputed) average birth interval is 2.20 years in M2, 2.30 in M1, 2.51 in L1 and 2.55 in L2 (i.e., average birth intervals are about 10 to 15 percent shorter in the Moshi areas than in the Lushoto areas).

The analyses reported in this section attempt to identify the factors associated with fertility differences among the four areas. Previous analysis had attempted to assess the relative extent to which various characteristics of the woman and her household were associated with her total number of livebirths. This analysis was approached utilizing the theoretical framework given in Figure 3.1, which attempts to distinguish between demand-affecting characteristics (incomes, relative prices and preferences) and supply-affecting characteristics (abstinence, lactation, infant/child mortality, etc.) as determinants of birth intervals and numbers of surviving children. Results from this earlier analysis of the relationships between fertility and various supply and demand characteristics are reproduced in Table 5.15.

To briefly summarize these earlier findings: The so-called demand variables generally showed little or no relationship to number of livebirths. Two exceptions are for women ages 20-29 where the building quality index (a proxy for household wealth) is positively and statistically significantly related to fertility, and the woman's level of education which is negatively and statistically significantly related

Table 5.15. Regression Results for Supply and Demand Models of Number of Children Ever Born (to women currently married and married only once) for the Four Rural Areas Combined.

Independent Variables	Age Group			
	20-29	20-29	30-39	30-39
(1)	(2)	(3)	(4)	(5)
SUPPLY VARIABLES				
- Number of Years the Woman was Married		0.278* (16.94)		0.221* (11.03)
- Woman's Reported Number of Deceased Children		0.678* (7.870)		9.691* (8.245)
- Breastfeeding: Number of months the Woman breastfed her last baby which was weaned		-.024* (4.[illegible])		-.037* (4.186)
- Husband is Polygynous: (Dummy Variable)		0.0[illegible] (0.[illegible])		-.753* (3.592)
DEMAND VARIABLES				
- Estimated value of Household crops sold (proxy for current income)	-.001 (0.119)		0.000 (0.120)	
- Building quality index (proxy for wealth)	0.127* (2.628)		0.002 (1.307)	
- Husband held a non-agricultural Wage-paying job (dummy variable)	-.317 (1.709)		-.000 (0.307)	
- The Woman thinks there are advantages to large family	-.001 (0.367)		-.006 (0.026)	
- The Woman's religion is Christian	-.120 (0.603)		0.200 (1.072)	
- Woman's Education: Number of years of formal schooling	-.102 (2.655)		-.026 (0.513)	
Constant	3.060 (16.57)*	1.[illegible] (8.970)	5.[illegible]* (20.42)	2.872* (7.799)
R^2	.035	.558	.013	.149

Notes: Regression coefficients are outside parentheses; t-ratios are inside parentheses.

* = significant t-ratio at .01 level
θ = significant t-ratio at .05 level
† = significant t-ratio at .10 level

Source: Kocher, 1977:65; and Kocher, 1979:58.

to fertility. In contrast to this, with one exception (polygynous marriage for women ages 20-29) the so-called supply variables are all significant statistically and in the directions hypothesized.[8/] Even the exception is not surprising, since it is to be expected that if polygyny typically reduces average birth intervals (due, for example, to longer periods of sexual abstinence or less frequent coitus), the effects are likely to be greater among older women than among younger women. (Indeed, younger women of polygynous husbands are likely to be the "newest" wives, and it is plausible that they have not yet experienced reduced frequency of coitus and/or longer periods of sexual abstinence.)

Thus, although the nature of the data imposed limits on this supply-demand approach to the analysis, the results were both striking and consistent with expectations.

These earlier results suggested that, aside from delayed age at marriage (the fertility-depressing effects of which appeared to be fully-compensated for within 10 to 15 years or so after marriage), birth intervals were the main direct determinant of fertility. (As noted earlier, among women ages 20-34, the imputed average birth interval was about 10-15 percent longer in the two Lushoto areas than in the two Moshi areas.)

Hence, in the present study an attempt is made to assess the relative importance of characteristics of women and their households which

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8/ For further discussion of these results, see Kocher, 1977, 1979.

might be associated with differences in average birth intervals. Table 5.16 presents the results of a regression analysis of eleven independent variables regressed against average closed birth interval (in years), for women ages 20-34, with the results of each study area presented separately. Table 5.17 presents average values and standard deviations for each of the independent variables shown in Table 5.16 as well as for the dependent variable (average birth interval).

For some of the independent variables shown in Table 5.16 appropriate hypotheses concerning their relationships with average birth interval could be offered. For others there was an inadequate theoretical basis for offering hypotheses, but they were included in the analysis because there was sufficient grounds for presuming possible relationships.

The relationships between the dependent variable -- average birth interval in years -- and each of the independent variables in Table 5.16, is hypothesized to be as follows:

- positive, for duration of breastfeeding (possibly serving in part as a proxy for duration of sexual abstinence),
- negative, for the woman's number of deceased children,
- positive, for woman's current age,
- uncertain, for building quality (as a proxy for household wealth),
- uncertain, for estimated value of household cash crops sold (proxy for current income),
- uncertain, for woman's level of education,
- uncertain, for husband's level of education,

- uncertain, for hospital delivery.

- positive, for women who are of the opinion that child survival prospects have improved,

- negative, for women who believe that it is advantageous to have a large family, and

- positive, for women whose husbands are polygynous.

Comparison of the expected results with the actual results (Table 5.16) shows a mixed picture, as follows:

- the expected positive relationship between duration of breastfeeding and average birth interval is confirmed (in all areas but L1), and, particularly in the two Moshi areas, the relationship is statistically quite strong and the coefficients are of plausible sizes. For example, the results suggest that in M1 on average an additional approximately 2 months in duration of breastfeeding is associated with an additional one month in birth interval, and in M2 an additional 3 months of breastfeeding is associated with an additional month in birth interval. (Note that in Table 5.16 average birth interval is expressed in <u>years</u> and duration of breastfeeding is given in <u>months</u>.)

- the expected negative relationship between number of deceased children and birth intervals also shows up in all four areas, but the relationship is both statistically significant and reasonably close only in M2 (where the death of one child is associated with a reduction in average birth interval by one fourth of a year).

- the expected positive relationship between woman's age and her average birth interval shows up only in M2, where an additional year of age is associated with a little less than one additional month in average birth interval. One plausible explanation for this relationship being either very weak or reversed in the other three areas is that here the widely observed relationship between age and lengthening birth interval may be substantially accounted for by longer duration of breast-feeding among older women. This may in turn be a proxy for declining fecundity and/or longer sexual abstinence among older women. That is, if older women sexually abstain for a longer period of time, they (probably) also breastfeed for that longer period when they are abstaining, and thus the "breastfeeding" variable is in this case serving as a direct proxy for duration of sexual abstinence. A somewhat less likely but still plausible explanation is that women breastfeed until they realize they are pregnant, and if older women require (on the average) a longer amount of sexual exposure to become pregnant -- because of declining fecundity, again the breastfeeding variable would be serving as a proxy for fecundity.

- birth intervals and household building quality are unrelated except in M2 where the relationship is negative and statistically significant. That is, in M2 household wealth is associated with shorter birth intervals and higher fertility.

- there are no relationships of significance between average birth interval and the proxy for current income (estimated value of the

Table 5.16: Regression Results with Average Closed Birth Interval (expressed in years) as the Dependent Variable, for Women ages 20-34 (currently married, married once only).*

Independent Variables	Expected Sign	Areas			
		1.1	1.2	2.1	2.2
(1)	(2)	(3)	(4)	(5)	(6)
Breastfeeding: Number of months the woman breastfed her last baby which was weaned	+	.01 (.20)	.05* (4.41)	.05* (23.8)	.05* (20.81)
Woman's Reported Number of Deceased Children (proxy for presumption of fecundity following the death of a child)		-.24 (1.66)	-.20 (1.13)	-.04 (.53)	-.25* (12.34)
Woman's current age	+	.04 (.74)	.08 (1.77)	-.03 (1.40)	.06* (12.50)
Building quality index (proxy for household wealth)	?	-.07 (.11)	-	-.01 (.04)	-.068 (6.48)
Estimated value of home-grown crops sold (proxy for current income)	?	.02 (.04)	.06 (.46)	-.02 (.12)	-.03 (1.25)
Woman's Education: Number of years of formal schooling	-	-.07 (.46)	-.03 (.11)	-	- (.03)
Husband's Education: Husband's number of years of formal schooling	?	.10 (.3[illegible])	-.24 (2.71)	-.06 (.99)	-.04 (1.36)
Delivery: Woman's last baby was born in a hospital (dummy variable used as proxy for quality of health care received	?	-.23 (.24)	-.63 (1.62)	.37/ (3.25)	.09 (.81)
"Child Mortality Has Declined": A dummy variable indicating that the woman thinks children are less likely to die these days than in the past	+	-.07 (.03)	-.14 (.06)	-.21 (1.46)	.11 (1.08)
"Large Families Have Advantages": A dummy variable indicating that the woman thinks there are advantages to having a large number of children	-	-.53 (2.48)	-.01/ (3.87)	-.04 (0.0[illegible])	.02 (.0[illegible])
Husband is Polygynous: (dummy variable)	-	-.9[illegible] (6.10)	-.31 (.38)	-.46 (1.93)	-.13 (.07)
Constant		1.52	-.06	.54	.56
R^2		.247	.254	.312	.427
N		43	53	92	69

Notes: * For women reporting two or more births. Average closed birth interval is calculated as follows:

$$\frac{\text{(Reported age at most recent birth)} - \text{(Reported age at first birth)}}{\text{(Total reported births} - 1)}$$

Regression coefficients are outside the parentheses; F-ratios are inside the parentheses

* = Significant F-ratio at .01 level
\# = Significant F-ratio at .05 level
/ = Significant F-ratio at .10 level

Table 5.17. Average Values and Standard Deviations for the Dependent Variable (average closed birth interval in years) and the Independent Variables in Table 5.13 for women ages 20-34 (currently married, married once only).*

Variables	Areas			
	T1	T2	M1	M2
(1)	(2)	(3)	(4)	(5)
Average Closed Birth Interval (in years)	2.51	2.55	2.30	2.20
	(1.31)	(1.70)	(0.90)	(0.60)
Breastfeeding: Reported number of months the woman breastfed her last baby which was weaned	33.7	26.3	23.7	21.2
	(9.6)	(8.9)	(9.8)	(10.2)
Child Deaths: Reported number of the woman's children who have died	0.36	0.42	0.41	0.30
	(0.66)	(0.91)	(0.79)	(0.76)
Woman's current age (in years)	27.7	27.1	26.0	27.8
	(3.5)	(3.5)	(3.8)	(3.6)
Building quality index (values range from 0 to 6)	0.70	0.66	1.97	2.82
	(0.90)	(1.28)	(2.11)	(2.14)
Estimated value of home-grown crops sold, in Tanzanian Shillings (Sh 8 = $1)	428	525	572	556
	(240)	(240)	(183)	(184)
Woman's Education: Number of years of formal schooling	0.85	1.22	2.24	2.46
	(1.77)	(2.00)	(2.51)	(2.43)
Husband's Education: Husband's number of years of formal schooling	4.20	4.59	4.73	4.49
	(1.50)	(1.49)	(1.59)	(1.76)
Delivery: Percentage of women whose last babies were born in a hospital	18.0	40.6	72.8	60.0
	(38.8)	(49.5)	(44.7)	(49.2)
"Child Mortality has Declined": Percentage of women who are of the opinion that children are less likely to die these days than in the past	23.0	21.9	72.8	61.0
	(42.4)	(41.7)	(44.7)	(49.0)
"Large Families Have Advantages": Percentage of women who are of the opinion that there are advantages to having a large number of children	62.3	54.7	31.1	52.0
	(48.9)	(50.2)	(46.5)	(50.2)
Husband is Polygynous: Percentage of women who are married to polygynous husbands	31.2	20.3	7.8	1.0
	(46.7)	(40.6)	(26.9)	(10.0)
N	61	64	103	100

Notes: Average values are outside the parentheses; standard deviations are inside the parentheses.

* For women reporting two or more births.

** Calculated as follows:

$$\frac{\text{(Reported age at most recent birth)} - \text{(Reported age at first birth)}}{\text{(Total reported births} - 1)}$$

household's cash crops sold), the woman's education, or husband's education.[9/]

Of the remaining independent variables, with one exception, the results are mostly insignificant and contradictory. The exception is marriage to a polygynous husband where the relationship with average birth interval was expected to be positive, for two reasons. First, it is presumed that marriage to a polygynous husband serves partly as a proxy for duration of sexual abstinence and/or frequency of coitus, and polygyny would therefore be associated with longer average birth intervals. Second, the results of analysis described earlier (e.g., see Table 5.15) were generally consistent with this expectation. However, in Table 5.16 the relationship is consistently negative although quite weak in all areas except L1 where it is significant at the .05 level. The coefficient of 0.91 implies that

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9/ So-called demand models of the determinants of fertility usually hypothesize that education will be negatively related to fertility, on the grounds that education is a proxy for preferences, or for relative costs of children (educated parents being presumed to desire higher "quality" children which requires incurring more child-related expenses), or because education, by raising one's income-earning potential, increases the opportunity cost of time spent in bearing and rearing children. Indeed, this negative relationship between woman's education and fertility showed up in the demand-variables regression shown in Table 5.15 (for women ages 20-29). The results on Table 5.16, however, now suggest that this negative relationship probably operates entirely through later age at marriage and not through longer birth intervals. Indeed, it is quite plausible that education indirectly reduces birth intervals by being associated with reduced duration of breast-feeding (shown in earlier evidence given in chapter 4); again, breastfeeding may be serving as a proxy for duration of sexual abstinence.

polygynous women ages 20-34 in L1 on average have a birth interval of nearly one year less than non-polygynous women when controlling for all the other variables in the table (including age).10/

In summary, this analysis offers some useful additional insights into the relative importance of various factors associated with fertility. The negative relationship (observed in the earlier analysis) between duration of lactation and fertility is confirmed. Moreover, these results suggest that the relationship is a rather close one: in 3 of the 4 study areas an increase of six months in breastfeeding is associated with an increase of 2 to 3 months in birth interval. However, the positive relationship between child mortality and fertility is statistically significant only in M2.

10/ Reasons for this can be conjectured although it was not possible to test them here. For example, it is possible that the hypothesized "polygyny" effect of larger birth intervals and lower fertility is only operative among older women (i.e., women 30 and older or even only women 35 and older) as the results shown in Table 5.16 suggest. It is sometimes contended that women in traditional East African societies are able to achieve social status primarily by producing children. It might therefore be expected that younger women would be particularly desirous of having their first few children as quickly as possible. Young second (or third) wives of polygynous husbands might be expected to be particularly desirous of producing children quickly, since a younger wife is competing with the elder wife for the affection and favor of the husband, and this could then result in slightly shorter birth intervals for young wives of polygynous husbands than for young wives of monogamous husbands. This would then be consistent with the slight negative relationship between polygyny and average birth interval for women ages 20-34 (as shown in Table 5.16) when such other characteristics as current age, duration of breastfeeding, woman's number of deceased children, and her education are controlled for.

In this set of regressions, household economic status, and education of both the woman and her husband do not appear to be related to birth intervals. This further strengthens the conclusion from the earlier analysis that fertility in rural East Africa is determined largely by so-called "supply" factors, and is essentially unrelated to conventional "demand" characteristics.

5.6 The desire for fewer births

The previous section showed that actual fertility appears to be essentially unrelated to factors conventionally associated with "demand" for children (or desired number of children), such as educational or economic status of parents. In these study areas, fertility appears to be primarily determined by age at marriage and duration of breastfeeding (which may also be serving as a proxy for sexual abstinence) and to a lesser extent infant/child mortality. (As indicated earlier, the effect of polygyny on birth intervals and fertility seems to be expressed through the breastfeeding/sexual abstinence variable.) These results are consistent with the theoretical formulations illustrated by Figures 3.1 and 3.2.

However, these theoretical formulations also illustrate the hypothesis that if individual parents eventually achieve a sufficiently large number of surviving children, some of them may find themselves in an "excess" supply situation -- i.e., the actual number of surviving children exceeds the desired number. There was no evidence in any of these study areas that any parents were deliberately attempting to prevent

additional births (for example, by using contraceptives or seeking abortions). Nevertheless, in response to a direct question as to whether they wanted more children, or whether they did not want more children, a substantial number of respondents who already had several surviving children said they wanted no more.

The top entries on Table 5.18 show that among currently married women, married once only, under age 45 with five or more living children, the percentages who said they wanted no more children were 36 in L1, 34 in L2, 51 in M1 and 37 in M2. The top entries on Table 5.19 show that among husbands under age 55, with at least one wife under age 45 and with at least 5 living children, the percentages who said they wanted no more children were 22 in L1, 26 in L2, 49 in M1 and 34 in M2.[11/]

Tables 5.18 and 5.19 also give average values for several variables hypothesized to influence parents' desires for either more children or no more children. These variables are then included in a discriminant function analysis, with the results shown in Tables 5.20 and 5.21. In brief, the direction of the association between each of the variables shown in these tables and the stated desire by the

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11/ Data are restricted to these groups of respondents because only the desires of adults who are (or believe themselves to be) physiologically capable of having more children are relevant. Thus women age 45 and over are excluded as are (somewhat more arbitrarily) men age 60 and above as well as monogamous men whose wives are age 45 or older.

respondent for more children is expected to be as follows:

- positive, for household economic status (proxies for both "current" income and wealth),

- negatively related to non-agricultural wage-paying employment by the husband,

- negatively related to the respondent's education level,

- negative, if the respondent's religion is Christian,

- negatively with the survival rate among the respondent's children (i.e., the greater the mortality among her/his children, the greater her/his desire for more births),

- negatively, if the respondent believes that children are less likely to die these days in th past,

- positively, if the respondent believes "there are advantages to having a large family",

- negatively, if the respondent believes "there are advantages to having a small family",

- negatively, with the respondent's number of surviving children,

- negatively, with the respondent's current age, and

- for women, positively with the woman's age at the time of marriage.

Among both women and their husbands, there was only one independent variable which consistently showed the hypothesized relationship with the desire for more children. That is the respondent's current number of surviving children. For both women and their husbands

Table 5. [illegible] Average values for independent variables by [illegible] size to influence whether a woman wants more children, for women currently married and married only once, ages 25-44, with at least 5 surviving children

Variables	Opinion	L1	L2		M2
(1)	(2)	(3)	(4)	(5)	(6)
- Percentage of women who say they want more children	No More	36.4	34.4	51.1	36.5
	More	63.6	65.6	48.9	63.5
- Cash crop value: Estimated value of cash crops produced in 1973 by the respondent's household, in Tanzanian shillings	No More	590	1450	1060	1170
	*More	1060	920	1100	970
- Building quality index (values from 0 to 6)	No More	0.54	0.59	2.54	2.65
	*More	0.31	0.69	2.15	2.68
- Husband's employment: Percentage of husbands who hold a non-agricultural wage-paying job	*No More	0.0	5.0	17.0	2.0
	More	0.0	10.0	7.0	5.0
- Woman's education: Number of years of formal schooling	*No More	0.50	0.37	1.40	0.93
	More	0.17	0.74	1.50	1.35
- Woman's religion: Percentage of women whose religion is Christian	*No More	17.0	37.0	85.0	100.0
	More	10.0	21.0	91.0	100.0
- Percentage of woman's children who are still alive	*No More	88.7	90.2	87.9	88.8
	More	92.0	93.9	91.9	92.2
- Percentage of women who are of the opinion that children are less likely to die these days than in the past	*No More	8.0	18.0	79.0	57.0
	More	20.0	19.0	80.0	65.0
- Percentage of women who believe there are advantages to having a large family	No More	71.0	41.0	21.0	48.0
	More	79.0	64.0	56.0	61.0
- Percentage of women who believe there are advantages to having a small family	*No More	29.0	50.0	65.0	50.0
	More	10.0	31.0	54.0	31.0
- Average number of surviving children (per woman)	*No More	6.15	6.55	6.77	6.65
	More	5.79	6.29	5.76	6.16
- Woman's current age	*No More	35.7	30.3	37.0	36.8
	More	36.3	35.4	33.7	35.1
- Woman's age at the time of marriage	No more	16.5	17.0	17.3	17.0
	*More	17.4	17.1	17.6	18.5
N		66	64	94	124

* Expected to be the larger value, based on hypothesized relationship with the dependent variable (whether or not the woman said she wanted more children).

Table 5. 1: Average values for independent variables hypothesized to influence whether a woman's husband wants more children, for husbands ages 25-54 (with at least one wife under age 45), and with at least 3 surviving children

Variables	Opinion	L1	L2	M1	M2
(1)	(2)	(3)	(4)	(5)	(6)
- Percentage of husbands who say they want more children	No More	22.4	26.3	48.8	34.0
	More	77.6	73.7	51.2	66.0
- Cash crop value: Estimated value of cash crops produced in 1973 by the respondent's household, in Tanzanian shillings	No More	600	1360	900	1160
	*More	780	1280	1180	1200
- Building quality index (values from 0 to 6)	No More	0.60	1.07	2.20	2.82
	*More	0.29	0.86	1.98	2.47
- Husband's employment: Percentage of husbands who held a non-agricultural wage-paying job	*No More	7	40	29	18
	More	8	29	14	6
- Husband's education: Number of years of formal schooling	*No More	2.53	2.53	2.56	2.94
	More	2.31	2.69	2.56	2.45
- Husband's religion: Percentage of husbands whose religion is Christian	*No More	7	20	76	100
	More	17	26	84	100
- Husband is a polygynist: Percentage of husbands who are plygynists	No More	47	53	17	6
	*More	35	41	16	8
- Percentage of husband's children who are still alive	*No More	93.0	88.1	84.3	89.1
	More	94.1	90.7	87.1	90.3
- Percentage of husbands who are of the opinion that children are less likely to die these days than in the past	*No More	40	41	83	85
	More	33	40	91	84
- Percentage of husbands who believe there are advantages to having a large family	No More	47	47	39	52
	*More	81	81	81	72
- Percentage of husbands who believe there are advantages to having a small family	*No More	53	53	61	52
	More	23	21	42	34
- Average number of surviving children (per husband)	*No More	8.33	10.47	7.27	7.12
	More	6.83	8.43	6.88	6.30
- Husband's current age	*No More	43.0	44.9	44.8	43.9
	More	43.8	40.4	43.7	40.1
N		77	57	84	97

*Expected to be the larger value, based on hypothesized relationship with the dependent variable (whether or not the husband said he wanted more children).

Table 5. 20 Standardized Discriminant Function Coefficients and Selected Indicators of the Discriminating Power of the Resulting Functions, for the independent variables given in Table 5. 15 (dependent variable is woman wants more children, for women ages 25-44 (currently married, married once only) with at least 5 surviving children.

Independent Variables	Expected Sign	L1	L2	M1	M2
(1)	(2)	(3)	(4)	(5)	(6)
- Cash Crop Value: Estimated value cash crops produced in 1973 by the respondent's household (in Tanzanian Shillings)	+	.391	-.243	.136	-.101
- Building Quality Index	+	-.322	-.280	-.109	-.086
- Husband's Employment: A dummy variable indicating that the husband has a non-agricultural wage-paying job	-	--	.144	-.251	.086
- Women's Education: Number of years of formal schooling	-	-.100	.611	-.224	.103
- Woman's Religion: A dummy variable indicating that the woman's religion is Christian	-	-.186	-.823	.285	--
- Survival rate among the women's children	-	.361	.413	.135	.176
- "Child Mortality has Declined": A dummy variable indicating that the woman thinks children are less likely to die these days than in the past	-	.695	.212	.260	.143
- "Large Families have Advantages": A dummy variable indicating that the woman thinks there are advantages to having a large family	+	.050	.582	.017	.054
- "Small Families Have Advantages": A dummy variable indicating that the woman thinks there are advantages to having a small family	-	-.452	-.131	.078	-.399
- The Woman's number of surviving children	-	-.570	-.142	-.496	-.346
- Woman's current age	-	.311	-.159	-.666	-.545
- Woman's age when married	+	.185	-.121	.452	.715
- Number "Yes" (more)	**	42	42	46	80
- Number "No" (no more)		24	22	48	46
- "Yes" as % of total		63.6%	65.6%	48.9%	63.5%
- % Correct if "random"		54%	65%	50%	54%
- % Correctly classified	**	69.7%	71.9%	73.4%	73.8%

Note: -- = Excluded from the analysis because tolerance level too low.

Table 5.21. Standardized Discriminant Function Coefficients and Selected Indicators of the Discriminating Power of the Resulting Functions, for the independent variables given in Table 5.16 (dependent variable is husband wants more children, for husbands ages 25-59 (and wife less than age 45 if monogamous), and at least 5 surviving children.

Independent Variables	Expected Sign	L1	L2	M1	M2
(1)	(2)	(3)	(4)	(5)	(6)
- Cash crop value: Estimated value of crops produced in 1973 by the respondent's household (Tanzanian Shillings)	+	.256	.118	.670	.090
- Building Quality Index	+	-.425	--	-.336	-.240
- Husband's Employment: A dummy variable indicating that the husband has a non-agricultural wage-paying job	-	-.177	-.272	-.512	-.331
- Husband's Education: number of years of formal schooling	-	.095	-.320	-.124	--
- Husband's Religion: A dummy variable indicating that the husband's religion is Christian	-	.273	.374	.456	--
- Husband is a Polygynist: A dummy variable	+	-.039	-.117	.236	.313
- Survival rate among the husband's children	-	.132	.130	.219	.381
- "Child Mortality has Declined": A dummy variable indicating that the husband thinks that children are less likely to die these days than in the past	-	--	-.308	.417	-.380
- "Large Families have Advantages": A dummy variable indicating that the husband is of the opinion that there are advantages to having a large family	+	.769	.549	-.243	.294
- "Small Families have Advantages": A dummy variable indicating that the husband is of the opinion that there are advantages to having a small family	-	-.197	-.441	-.941	-.135
- The husband's number of surviving children	-	-.689	-.374	-.263	-.293
- Husband's current age		+.322	-.610	-.320	-.495
- Number "Yes" (more)		52	42	43	64
- Number "No" (no more)		15	15	41	33
- "Yes" as % of total		77.6%	73.7%	51.2%	66.0%
- % Correct if "random"	**	65%	61%	50%	55
- % correctly classified		85.1%	84.2%	69.0%	75.3%

** Note: -- Excluded from the analysis because tolerance level too low

in all four study areas, the larger the number of surviving children, the greater the likelihood that the respondent would want no more children.

Two other variables which were nearly always related as hypothesized to the response, "wants more children", are the respondent's opinions as to whether "there are advantages to having a large number of children" and "there are advantages to having a small number of children".[12/] This relationship is really more a test of internal consistency in the attitudes of the respondents than a demonstration of possible cause-effect relationships since presumably attitudes regarding both "advantages" (of large or small numbers of children) and whether or not more children are wanted are both derived from similar, more fundamental values and perspectives on the benefits and/or burdens from given numbers of children. Nevertheless, the substantial consistency shown between these responses suggests that respondents are by and large consistent in their attitudes. For women, 7 of the 8 relationships (between "advantages" and "wants more") are in the expected direction; 7 of 8 relationships are also in the expected direction for husbands.

12/ Each of these was obtained in response to a separate set of questions to the respondent. Each question included the follow-up question, "why do you think there are advantages (or disadvantages) to having a large (or small) number of children?" Some respondents said there were advantages to having a large number of children, and then also said there were advantages to having a small number of children (and usually gave sensible reasons).

The economic and employment status variables are of some interest. For women and husbands together, in 7 of 8 cases the relationship between the proxy for household wealth (building quality index) and "wants more children" is negative, although it was hypothesized to be positive. (In the 8th case -- husbands in L2 -- there is no relationship.) In most of the demand for children literature, it is generally hypothesized that the independent relationship between household (permanent) income and demand for children will be positive (ceteris paribus). However, for estimated current income (the proxy is estimated value of cash crops produced by the household), for husbands the relationship with the desire for more children is consistently positive. Finally, for husbands, holding a non-agricultural wage-paying job is consistently related with the desire for no more children (as hypotnesized).

Education, religion and polygyny are not related to desire for more children in any consistent way.

Finally, the respondent's opinion as to whether children are less likely to die these days than in the past is something of a mystery. It was hypothesized to be negatively related to the desire for more children; that is, if the respondent believes that child survival prospects have been improving, presumably the respondent would also think that prospects for continued survival of her/his currently living children are pretty good, and hence this would

encourage a desire not to feel a need for more births as insurance or hedge against possible future child deaths. However, among the women, the relationship was consistently opposite to that hypothesized. Among men, in both L2 and M2 the relationship was as hypothesized.

In summary, these results suggest that at rather large numbers of surviving children (5 or more), a substantial (though generally minority) share of parents would prefer to have no more children, but that with the exception of the current number of surviving children, for the most part the statistical associations with other plausible characteristics of the respondent or her/his household are generally inconsistent or even contrary to the hypothesized relationship.

This chapter has presented the results of the analysis of the data from the four rural areas of Northeastern Tanzania. The next chapter will summarize the conclusions from this analysis and offer a few recommendations.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

These results show that the two single most important variables which -- in various ways -- influence both infant/young child mortality and fertility, are parental education and access to and utilization of (as analyzed in this study) pregnancy-related medical care. This does not appear surprising, yet there are surpirses.

This analysis did not show a direct relationship between parental education and child survivorship. That is, after controlling for duration of breastfeeding, use of (pregnancy-related) medical care, household economic status, age, and other variables, no significant education-child survivorship relationship is evident. Nevertheless, there is strong evidence that parental education indirectly contributes to better health and lower infant/child mortality. The variable most strongly associated with higher survivorship among children was the mother's giving birth in a hospital. And the variable most closely associated with this was education; mothers with a few years of formal schooling were much more likely to go to a hospital to deliver than were mothers without formal schooling (even when controlled by age).

Similarly, for the most part no direct relationship was evident between education and either actual fertility (including birth intervals) or fertility desires (as measured in this study). Nevertheless, the single variable most strongly and consistently related with the desire for no more children was number of surviving children. As indicated above,

by favorably influencing health-related behaviors, education appears to contribute to improved survivorship among children. (Education is also associated with shorter birth intervals, as well as with later marriage among women. Although later marriage delays the onset of childbearing, both increased child survivorship and shorter birth intervals contribute to larger numbers of surviving children per woman, which in turn is apparently the major factor causing parents to want to terminate childbearing.)

Finally, education is also the most important variable associated with parental perception that child survival prospects have been improving. However, there is no evidence from this data that parents in these study areas (yet) deliberately adjust their fertility to mortality experiences among their children. There are substantial differences in perceptions about improving child survivorship. It is plausible that there is a substantial (perhaps inter-generational) lag between perceptions of substantially improved child survivorship and efforts by parents to curtail fertility in response.

This analysis consistently showed that the single most important variable associated with child survivorship was that mothers delivered their babies in a hospital rather than at home. (There was a similar positive relationship between prenatal medical care and child survivorship, although because such a large proportion of women availed themselves of such care, this variable was a weaker discriminator.)

The analyses presented here reconfirm and strengthen the conclusions from earlier studies of determinants of fertility in rural Africa that by and large fertility is determined (or constrained) by biological and health characteristics together with socio-cultural practices which combine to limit the number of pregnancies and births, and that fertility desires are of relatively little significance. The characteristics most closely related to length of birth interval is duration of breastfeeding (which is probably in part a proxy for fecundity and/or duration of sexual abstinence). "Replacement effects" appear to be weak at best. As Preston (1978) suggests, however, this is to be expected in such populations.

At the time the data were collected (late 1973), these study areas had, by tropical African standards, relatively low infant and child mortality rates. Although not documentable, it is highly probable that infant and child mortality rates had declined substantially in the decades preceeding this survey. The analyses presented in chapter 5 shows that differences in parental education and in utilization of health services are associated with differences in child survivorship, while differences in economic levels and breastfeeding by and large are not.

One question which this anslysis is not able to answer is why has the general (or community-) level of mortality apparently declined so much in recent decades?[1/] Although medical services have

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1/ This apparent substantial decline in infant/child mortality rates has occurred concurrently with dramatically increased population densities. Total population in the study areas is estimated to have increased 3- to 5-fold during the period 1900-1973. During this period there has also been considerable net out-migration, especially in the Moshi areas (otherwise, increases in total populations and population densities would have been even greater).

become widely available during this period as has primary education (for males initially a few decades ago, for females more recently), the relationships between these two factors and child survivorship differentials are insufficiently strong to warrant attributing to them the entire decline in infant/child mortality in these communities. (Afterall, the study data suggest that uneducated women in these study areas who have not used health facilities by and large have also experienced lower mortality among their children.) Why?

There are several plausible answers. One is that these have long (or always) been relatively healthy areas, due to their favorable elevations (1050 to 1650 meters above sea level) and the fertile and highly productive land. It is probably true that residents of these highland areas have always enjoyed better health than their neighbors on the plains, but it seems unlikely that these areas had infant mortality rates well below 100 (per thousand births) a century ago. (There are many equally favorable ecological zones elsewhere in Africa where infant/child mortality rates are still at relatively high levels.)

Assuming that child survivorship has improved substantially in these areas during recent decades, some plausible causes (in addition to education and medical care) are the following: (a) generally more stable food supplies (e.g., food production and consumption less disrupted by local strife) and better general nutrition, (b) a reduction in life-threatening communicable diseases, and (c) learned health-enhancing behaviors (such as utilization of latrines).

There is one additional point: To a largent extent, infant and young child deaths are no doubt random events, regardless of the prevailing community mortality levels/rates. Certainly a large proportion of deaths occur to "at risk" or vulnerable children -- e.g., first parity or high parity births; children with low birth weights, uneducated mothers, or from poverty-stricken households, etc. But data from this study (and many others) suggest that a substantial proportion of all deaths occur where such indicators are absent, and that other households with similar "at risk" mothers or babies do not experience an infant/child death.

In these study areas, the process of socioeconomic development and modernization is resulting in more modern (Western?) attitudes towards children, and towards child-bearing and rearing. These experiences appear to be consistent with the conceptual and theoretical frameworks described and illustrated in chapter 3. They suggest that the initial demographic consequences include rising child survivorship, rising average numbers of surviving children (per parent), shorter birth intervals, and probably rising fertility. Simultaneously, parental perspectives regarding child roles and the desired number of surviving children begin to change. Eventually feelings begin to crystalize that they have, or are likely to have, more surviving children (and hence more births) than they would really prefer. Over time this process is likely to "spread" within the population, and gain momentum so that the absolute numbers of children desired decline, creating a setting

favorable to the introduction, adoption, and utilization of modern methods to limit fertility.

6.2 Recommendations

The analysis of the experiences of these populations in Northeastern Tanzania suggests that substantial and widely-shared socioeconomic development together with greatly improved health and child survivorship is likely to result in the desire for lower fertility -- and receptive attitudes towards utilization of family planning services. These experiences suggest that general socioeconomic development is probably necessary to facilitate this process.

Most important, however, is basic education, especially for girls, as well as easy access to basic medical services. It seems unlikely that "demographic modernization" (particularly low fertility) can be achieved in the absence of near universal education of women, and widespread utilization of basic health care services.

Thus, while increases in agricultural productivity, employment, and family incomes are all important to this process -- and should be priority objectives of any rural development strategy in tropical Africa, provision of basic education (e.g., at least four years and preferably up to 6 to 8 years of formal schooling) for all, and access to basic health care for all (as stressed in the 1978 Alma Atta Declaration) must be top priority objectives of any strategy designed to achieve good health, low mortality, and low fertility. Provision of family

planning services certainly must be an essential component of such a strategy. Family planning services are only one component of a total population policy which might include population education in schools (and perhaps also through non-formal channels), efforts to mobilize local opinion leaders, etc. Health education, including the importance of immediate and prolonged breastfeeding (for the health of mother and children), should be an important component of both the formal school curricula and any non-formal education program.

Although this study did not specifically address the issue of provision and utilization of family planning services, experiences in Africa (and to some extent elsewhere) to date suggest that family planning services should be incorporated into basic health care services. Contraceptives should be promoted in order to both prevent unwanted pregnancies (for women who already have as many children as they want) as well as to achieve better (longer) birth-spacing, so as to improve the health of the mother and her children. The promotion of family planning for child-spacing as part of basic health care services, directed particularly at mothers and children, is likely to find increasing acceptance in tropical Africa. Efforts should initially concentrate particularly in those areas of tropical Africa where in recent years there has been substantial educational and socioeconomic change.

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