AGRICULTURAL DEVELOPMENT AND FERTILITY PATTERNS IN THE DRY ZONE OF SRI LANKA: 1946-1971

by

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Abstract

The main objective of this study is to determine whether 1971 fertility differentials in Sri Lanka's dry zone can be explained in terms of agricultural development. It is hypothesized that agricultural development might be associated with low fertility due to the effects of agricultural development on intermediate variables found to be closely related to fertility in other studies. Yotopoulos work on the relation between economic development and fertility provides a useful theoretical frame. The methodology employed is path analysis. Findings indicate that agricultural development is not related to fertility differentials in Sri Lanka's dry zone. Differentials in fertility are explained primarily in terms of cultural factors, female education, female age at marriage, and family planning.

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Chapter I

1. Introduction

The primary objective of this study is to determine whether 1971 fertility differentials in the dry zone of Sri Lanka can be explained in terms of agricultural development.[1] It is hypothesized that agricultural development might be associated with low fertility due to its effects on various intermediate variables shown to be closely associated with fertility in other studies. In the event that the link between agricultural development and fertility is found to be weak, provision is made so that an alternative explanation of fertility differentials can be provided.

The focus of the analysis is 1971 because data for earlier time periods are not complete.[2] In order to provide historical perspective, trends in agricultural development, relevant intermediate variables, and fertility during the period from 1946 to 1971 will be discussed. By taking available historical evidence into consideration, it becomes possible to broaden the analysis and come to some conclusions with respect

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[1] Formerly Ceylon

[2] For instance, data on age of marriage were not reported in some census years while income data available for 1971 were not comparable with data available for earlier periods.

to the implications of agricultural development for fertility decline in the dry zone during the period from 1946 to 1971. As changes levels of mortality, education, and fertility are to a large extent attributable to various GOSL programmes, the implications of government policy for fertility are also considered.

Findings from this study indicate that agricultural development does not provide much explanation for 1971 fertility differentials. High female literacy provides the best explanation for low fertility in 1971, primarily because increased schooling results in deferral of marriage. Differentials in female literacy can be largely explained in terms of cultural factors, and are not strongly related with either agricultural development or income. It is concluded that significant declines in fertility would probably have occurred in the dry zone, during the period from 1946 to 1971, regardless of achievements in agricultural development. In situations where economic conditions are poor, education is low and fertility is high, increased female education may be the key to fertility decline. Government policies which contribute to higher levels of women's education and which promote family planning contribute significantly to fertility decline.

2. Theoretical Justification and Base

The nature of the relationship between economic development and fertility has been a matter of theoretical interest for some time. The view that economic development and

modernization are connected, and contain forces which lead to fertility decline, was first advanced during the latter part of the nineteenth century by writers such as Dumont and Leroy-Beaulieu.[3] Theories advanced by these writers were systematized by Frank Notestein during the 1940's and 1950's, and are integral to the theory of demographic transition.[4]

The original theory of demographic transition, as formulated by Notestein, suggests that fertility decline is part of a wider process of modernization which occurs in three stages: high mortality and high fertility (stage 1), low mortality and high fertility (stage 2), and low mortality and low fertility (stage 3). The Notestein theory provides an explanation of fertility trends in Europe, America, and Australia, and the transition from stage 1 to stage 2, and from stage 2 to stage 3, is understood in terms of "principles drawn from the European analysis".[5] Fertility decline is considered to be a response to economic development which leads to increased levels of industrialization and urbanization: "changes in economic structures, which are associated with

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[3] Ansley J. Coale, "The Demographic Transition: A Summary, Some Lessons, and Some Observations", in Lee-Jay Cho and Kobayashi Kazumasa, Fertility Transition in the East Asian Populations, The University Press of Hawaii, Honolulu, 1979, pp.10-11

[4] Ibid., p.11

[5] Frank W. Notestein, "Economic Problems of Population Change", in Proceedings of the Eighth International Conference of Agricultural Economists , Oxford University Press, London, 1953

industrialization, bring about an improved standard of living which, firstly affects mortality and, secondly, leads to rural-urban migration, urbanization and the creation of an urban society which in turn establishes incentives for the introduction of direct controls on fertility".[6]

In its classical form, the theory of demographic transition is not useful for the analysis of fertility patterns in Sri Lanka, due to the absence of significant urbanization.[7] Notestein recognized that industrial-urban transformation is neither a guarantee of fertility decline nor essential to it.[8] Furthermore, the concept 'urbanization' is far too general to have much explanatory value. What is needed is to isolate the individual mechanisms of fertility decline, many of which are reflected within the wider process of urbanization:

> It is evident that urbanization provides no mystical means for the reduction of fertility. The small family ideal and strong motivation for the reproduction of births have arisen in a variety of conditions. At present, we cannot either list all of the factors involved or attach precise weights to the factors we can list.

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[6] Robert Woods, Theoretical Population Geography, Longman Group Ltd., New York, 1982, p.161

[7] In 1946 only 15.4% of Sri Lanka's population was classified as urban; in 1971 the percentage of urban population had risen only slightly to 22.4%. In the dry zone, only 11.9% of the population was urban in 1971. All island figures are higher, primarily due to the large urban population (55%) in the district of Colombo.

[8] See Notestein, Op. Cit., pp.17-18.

> There is, however, good reason to believe that among the important factors are: the growing importance of the individual rather than the family, and particularly the extended family group; the development of a rational and secular point of view; the growing awareness of the world and modern techniques through popular education; improved health; and the appearance of alternatives to early marriage and childbearing as a means of livelihood and prestige for women.

Yotopoulos provides a comprehensive overview of factors known to influence fertility, either directly or indirectly, and his work is a logical extension of Notestein's.[9]

Equally important, Yotopoulos has grappled with various questions concerning the application of transition theory in empirical analysis.[10] He suggests that for purposes of research, "it would be convenient if one approached demographic transition by starting with economic change. Social and cultural variables could than be brought in as supplemental and intermediate variables to round out the causal links and to improve the explanation".[11] On the basis of this view, Yotopoulos has devised a conceptual framework which "provides a broad idea of the causality which runs from development to

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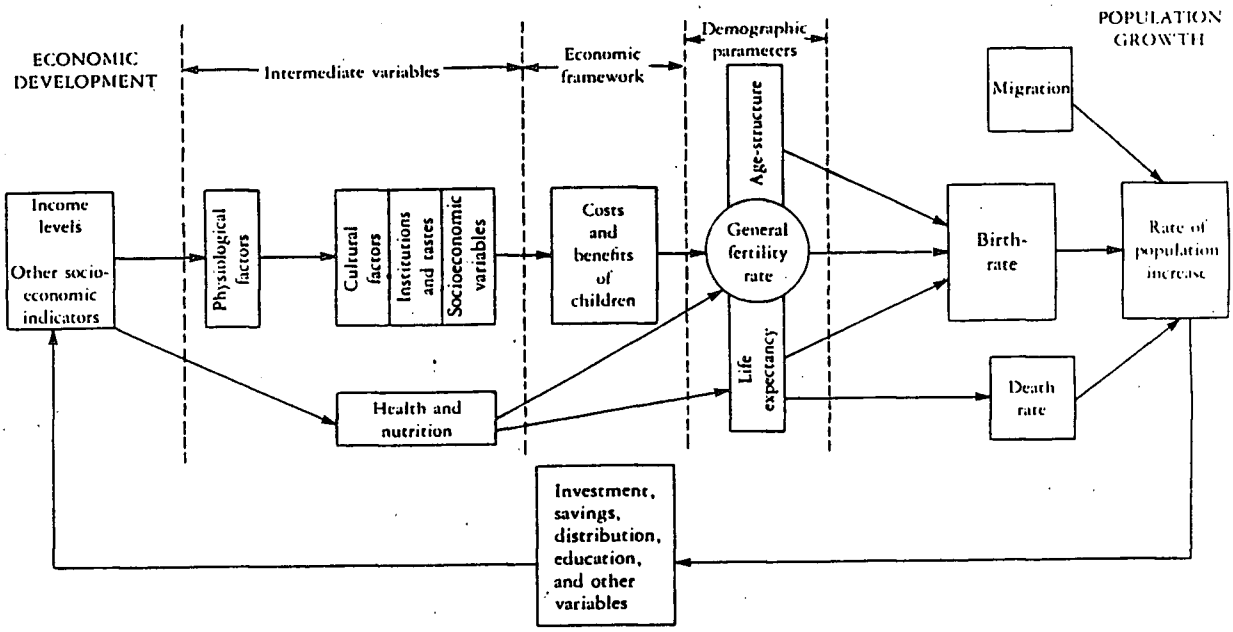
[9] Pan A. Yotopoulos, "The Population Problem and the Development Solution", in Food Research Institute Studies, Vol. XVI, No. 1, 1977

[10] Ibid.

[11] Ibid., p.9

population and conversely from population to development".[12] This conceptual framework is the foundation upon which the following study is based, and is reproduced in Diagram 1.[13]

Diagram 1
Yotopoulos' Conceptual Frame



For purposes of this study, only forward linkages in the framework are considered, and only the first four 'sections'

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[12] Ibid., p.23

[13] Ibid., p.24

are relevant.[14]

Yotopoulos' framework, and some of the hypotheses which underly it, provide a starting point on the basis of which it is possible to develop a model that facilitates an analysis of the relation between agricultural development and fertility in the dry zone of Sri Lanka. It is clear from Yotopoulos' diagram that economic development, of which agricultural development is a component, might theoretically influence fertility due to a number of mechanisms. This process would be reflected not only be changes in economic indicators and fertility rates, but also by changes in intermediate variables. It will be illustrated in the following section that the Sri Lanka dry zone provides an ideal laboratory for the study of links between agricultural development and fertility, and that conditions and trends in the dry zone during the period from 1946 to 1971 naturally invite the application of a model based on Yotopoulos' work.

3. Sri Lanka's Dry Zone: A Natural Laboratory for the Study of the relation between Agricultural Development and Fertility

Following the GOSL Department of Census and Statistics report for 1971, twelve of Sri Lanka's twenty-two districts are categorized as dry zone: Jaffna, Mannar, Vavuniya, Batticaloa, Amparai, Trincomalee, Kurunegala,

[14] Questions relating to the fact that the model employed has only forward linkages are discussed in the methodological section (Chapter II). The dependent variable in the model is general fertility rate, and not rate of population increase, as in Yotopoulos' diagram.

Puttalam, Anuradhapura, Polonnaruwa, and Moneragala.[15] These districts lie roughly within the area designated by Farmer as 'lowland' dry zone, which is differentiated from the wet zone on the basis of vegetational characteristics.[16] Some writers have defined the dry zone in terms of the 75-inch isohyet. However, as the area defined by Farmer as lowland dry zone is larger than the area circumscribed by the 75-inch annual isohyet, this definition is most useful since it permits the inclusion of a larger number of districts into the sample. The dry zone covers the northern two-thirds of Sri Lanka, and extends down the east coast and around the southern perimeter of the island. The geographical locations of districts designated as dry zone are illustrated in Map 1-A.[17]

The dry zone, during the period from 1946 to 1971, provides an ideal laboratory for the study of relations between agricultural development and fertility. This was a period of rapid agricultural development, and a period during which fertility trends shifted from increase to decline. It is also a

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[15] See Neville Edirisinghe and Thomas T. Poleman, "Rice Economy of Sri Lanka: Consumption Characteristics and Production Trends", in Marga , Vol.4, No.3, 1977, p.57. Robert Chamber, Op. Cit., also classifies these twelve districts as dry zone. Robert Chambers, "Water Management and Paddy Production in the Dry Zone of Sri Lanka", Occassional Publication No.8, Agrarian Research and Training Institute, Colombo, Dec. 1978

[16] B.H. Farmer, Pioneer Peasant Colonization in Ceylon, Oxford University Press, 1957, pp.1-6

[17] See Appendix I

period marked by changes in intermediate variables; variables which Yotopoulos suggests may be mechanisms through which agricultural development influences fertility. Before proceeding, it will be worthwhile to document some of these trends.

Progress in dry zone agriculture during the period from 1946 to 1971 occurred almost exclusively within the paddy sector, and was due primarily to increases in both the area under cultivation and per acre yields. During the 1946-47 maha season, 340,402 acres of paddy were cultivated in the dry zone.[18] The corresponding figure for the 1970-71 maha season is 770,651 acres, indicating that the area under paddy more than doubled during the period under study.[19] Yields more than tripled during the same period. The average yield per acre during the 1946-47 maha season was 13.6 bushels, while 41.6 bushels per acre were obtained during the 1970-71 maha season. All Sri Lanka trends in area cultivated and yield per acre are illustrated in Chart 1 and Chart 2.[20]

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[18] Department of Census and Statistics, "Statistical Abstract of Ceylon, 1949", 'Major Irrigation Schemes and other Paddy Lands', Table 104, p.137.

[19] Department of Census and Statistics, "Statistical Abstract of Sri Lanka, 1973", Table 63, 'Paddy: Extent Cultivated and Yield', p.109

[20] Neville Edirisinghe and Thomas T. Poleman, "Rice Economy in Sri Lanka: Consumption Characteristics and Production Trends", in Marga, Vol.4, No.3, 1977. See Chart 14, p.41 and Chart 17, p.45.

Chart 1: Actual and Trend in Area Sown to Paddy (All Sri Lanka) 1952-1972

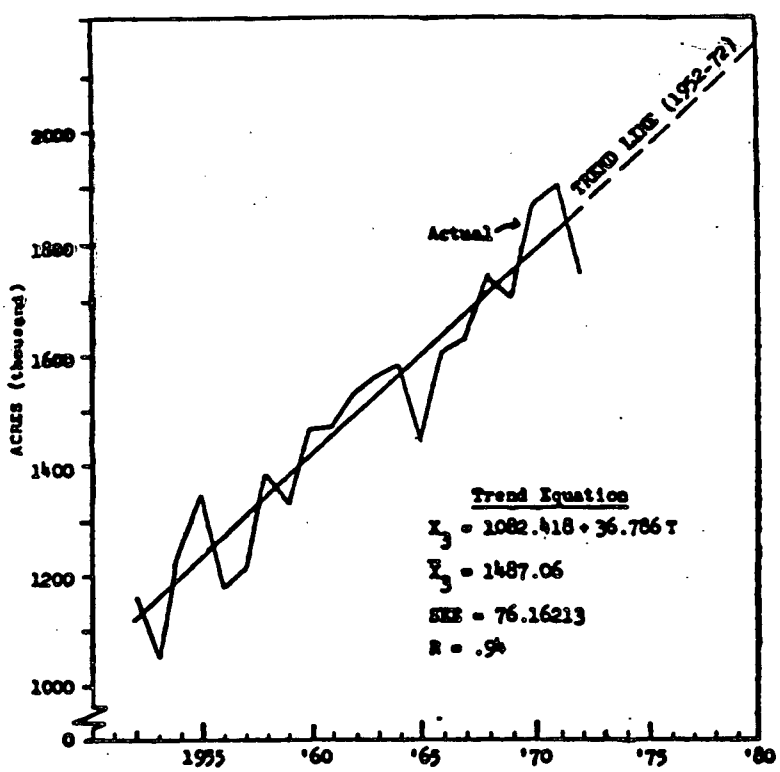
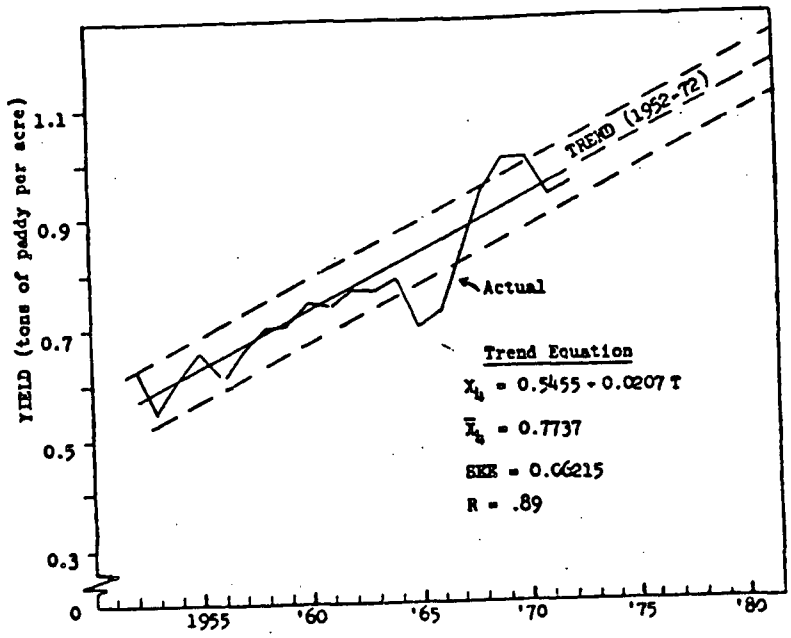


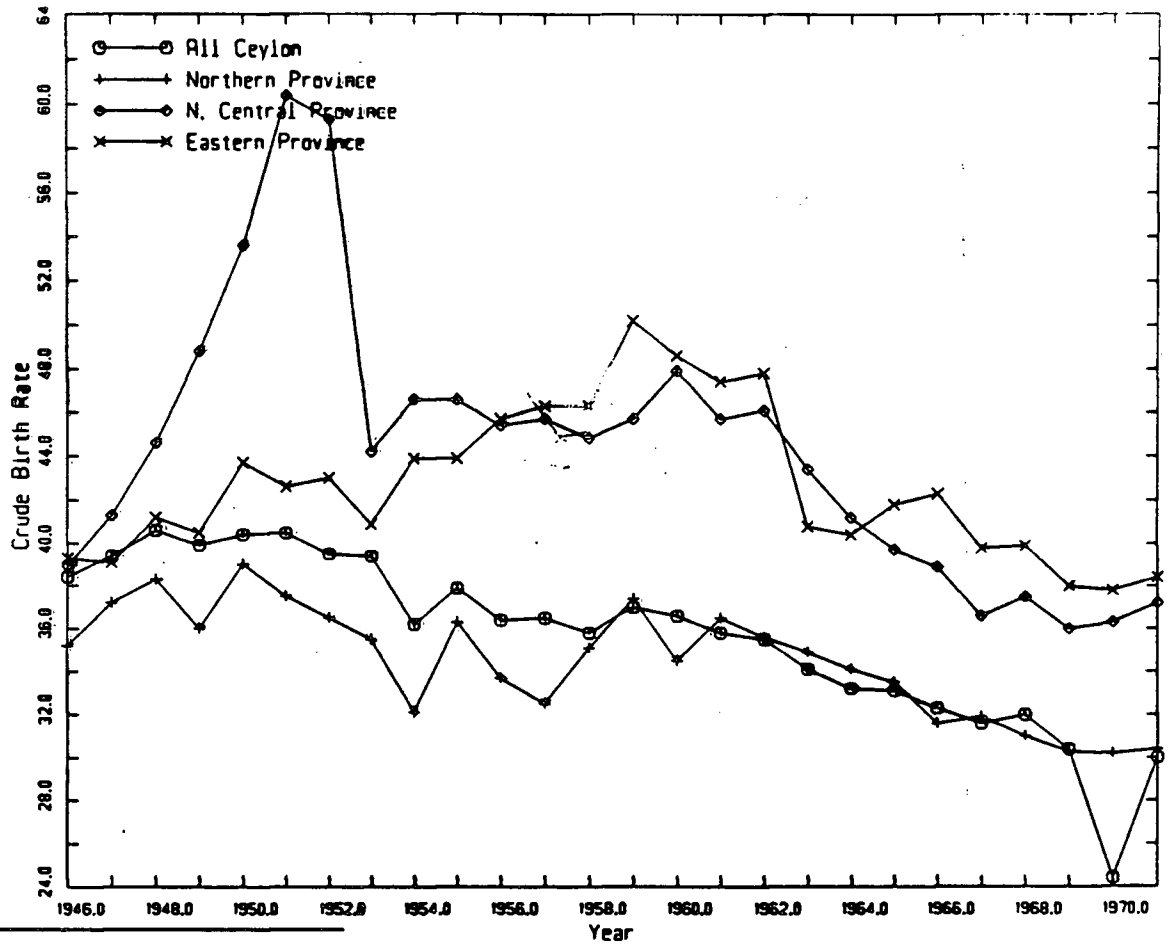
Chart 2: Actual and Trend in Paddy Yield (Tons/Acre) (All Sri Lanka) 1952-1972



While annual birth rates tend to fluctuate, the overall trend in the dry zone was a slight increase from 1946 to 1960 (37 to 44). CBR's declined fairly steadily during the period from 1960 to 1971 (44 to 34). Chart 3 illustrates trends in crude birth rates during the period from 1946 to 1971 in Sri

Lanka and three regions of the dry zone.[21]

Chart 3: Crude Birth Rates for Sri Lanka and Three Regions in the Dryzone: 1946-1971



[21] Figures for the period from 1946 to 1960 were obtained from data provided in Abayaratne and Jayawardene, Op. Cit. See Table 22, 'Crude Birth Rates by Province and District, 1900 to 1960'. All Sri Lanka figures for the period from 1961 to 1971 were obtained from Statistical Abstract for Sri Lanka, 1973, Table 32, 'Births in Sri Lanka', p.61. Figures for the Northern Province (Jaffna, Mannar, Vavuniya), the North Central Province (Anuradhapura, Polonnaruwa) and the Eastern Province (Batticaloa, Tricomalie, Amparai) for the period from 1965 to 1971 were also obtained from Statistical Abstract for Sri Lanka, 1973. See Table 33, 'Births in Sri Lanka-by districts', and Table 10, 'Estimated Mid-Year Population-By District'. Figures for specific regions of the dry zone were unavailable for the 1961 to 1964 period, and these figures were estimated.

The dry zone, during the period from 1946 to 1971, shows interesting trends in some intermediate variables depicted in Yotopoulos' theoretical frame. These are average age of females at marriage, female literacy, and mortality.[22] The first of these is dealt with by Yotopoulos under the heading 'cultural factors'. Cultural factors are "a complex of ideological factors...which has been formed around the institution of the family".[23] Following Davis and Blake, Yotopoulos classifies these factors in three groups:[24]

> 1) factors affecting exposure to intercourse, such as age of entry into marriage, minimum interval between unions when a marriage was terminated by divorce or death (often prescribed by law), or voluntary abstinance (occasionally determined by social taboos on sexual intercourse); 2) factors affecting exposure to conception, such as the availability and dissemination of contraceptive technology and sterilization (often sanctioned or precluded by law or social systems); and 3) factors affecting gestation and successful parturition, such as abortion laws or health services provided to pregnant women.

Many of these factors will be discussed with specific reference to fertility trends in the dry zone latter on. For now, it is sufficient to point out that the average age of marriage

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[22] Yotopoulos classifies mortality as a 'demographic parameter', even though it clearly functions as an intermediate variable.

[23] Pan Yotopoulos, Op. Cit., p.28

[24] Ibid., pp.27-28

steadily increased in the dry zone during the period under study. As is clear from the following table, the average age of marriage has risen more rapidly for females than males:[25]

Table 1: Mean Age at Marriage 1946, 1953, 1963, and 1971

	Average age at marriage (years)		
Census Year	Males	Females	Difference
1946	27.0	20.7	6.3
1953	27.2	20.9	6.3
1963	27.9	22.1	5.8
1971	28.0	23.5	4.5

Yotopoulos deals with education under the heading 'socio-economic', and contends that "as a by-product of develpment, literacy rates and educational levels are likely be increase for both males and females".[26] It is important to note that "education consistently appears as one of the crucial variables associated with fertility declines".[27] Literacy rates increased dramatically both in the dry zone and Sri Lanka as a whole during the period

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[25] Department of Census and Statistics, "Census of Population, 1971, Sri Lanka", Table 7:1, 'Mean Age at Marriage 1946, 1953, 1963, and 1971', p.99

[26] Yotopoulos, Op. Cit., p.33

[27] Ibid., p.32

under study, as illustrated in the following table:[28]

Table 2:Literacy Rates of the Population aged 10 Years and over
[Number of Literates per 1000 Persons]

	ALL CEYLON			DRY ZONE		
Year	Male	Female	Difference	Male	Female	Difference
1946	765	468	297	726	436	290
1953	807	555	252	789	545	244
1963	858	675	183	773	624	149
1971	856	709	147	833	689	144

It is clear from the above table that while substantial increases in both male and female literacy have been achieved, it is the increase in female literacy which has been most dramatic. In the dry zone, the female literacy rate increased from 436 in 1946 to 689 in 1971. During the same period, the gap between male literacy and female literacy decreased by over 50%. The figures indicate that literacy is lower in the dry zone than in Sri Lanka as a whole, although an examination of

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[28] National figures were obtained from Census of Population, 1971, Sri Lanka, Table 8.2, 'Literacy Rates of the Population Aged 10 years or older (Number of Literates per 1000 Persons). Literacy rates for the dry zone were calculated from census data. It should be noted that the 1946, 1953 and 1963 dry zone figures represent literacy for the population aged 5 years and older. It was not possible to calculate the literacy of the population aged 10 and older in the dry zone for these years from published census material, due to lack of information on age structure and literacy.

literacy levels for individual districts reveals that in some cases, both male and female literacy is higher than the national figure in some dry zone districts; notably Jaffna (863,792), Kurunegala (880,740) and Puttalam (880,791).[29]

The relation between mortality and fertility is generally considered to be positive, although as Yotopoulos points out, there is often "a lag in the response of fertility declines to mortality declines".[30] Chart 4 indicates that this is true for Sri Lanka.[31]

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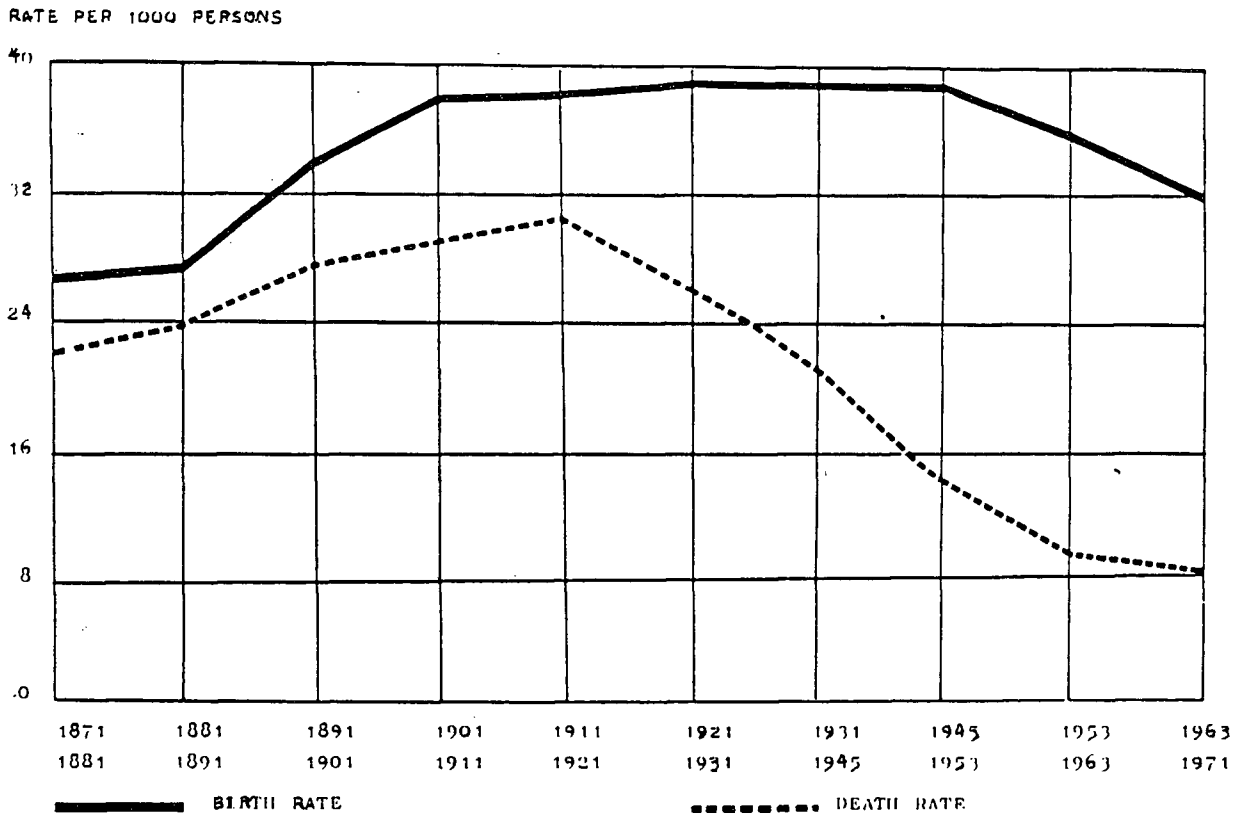
[29] See Census of Population, 1971, Sri Lanka, Table 8.5, 'Literacy Rates of the Population Aged 10 years and over by Districts 1963 and 1971', p.116.

[30] Yotopoulos, Op. Cit., p.42

[31] Department of Census and Statistics, "Census of Population, 1971, Sri Lanka", Chart 2.3, 'Variations in the Birth and Death Rates, 1871 to 1971, p.23

Chart 4: Variations in Birth and Death Rates in Sri Lanka: 1871-1971



Sri Lanka's crude death rate fell from 20.3 in 1946 to 12.6 in 1949. The infant mortality rate, which was 141 per thousand in 1946, fell to 87 per 1000 in 1949.[32] Both the crude death rate and the infant mortality rate were halved during the period

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[32] S.A. Meegama, "Malaria Eradication and its Effect on Mortality Levels", in Population Studies, No. 21, Nov. 1967, p.207

[33] International Statistical Institute, "The Sri Lanka Fertility Survey, 1975, A summary of Findings", Voorburg (Netherlands), 1978, p.1

from 1946 to 1960.[33] These achievements were largely due to the introduction of successful malaria control measures in the late 1940's and the expansion of health services.[34] In some dry zone districts, crude death rates were as high as 35 or 40 per thousand just prior to the introduction of malaria control measures in 1946. By 1950, crude death rates had fallen to between 9 and 17 per thousand in these districts.[35]

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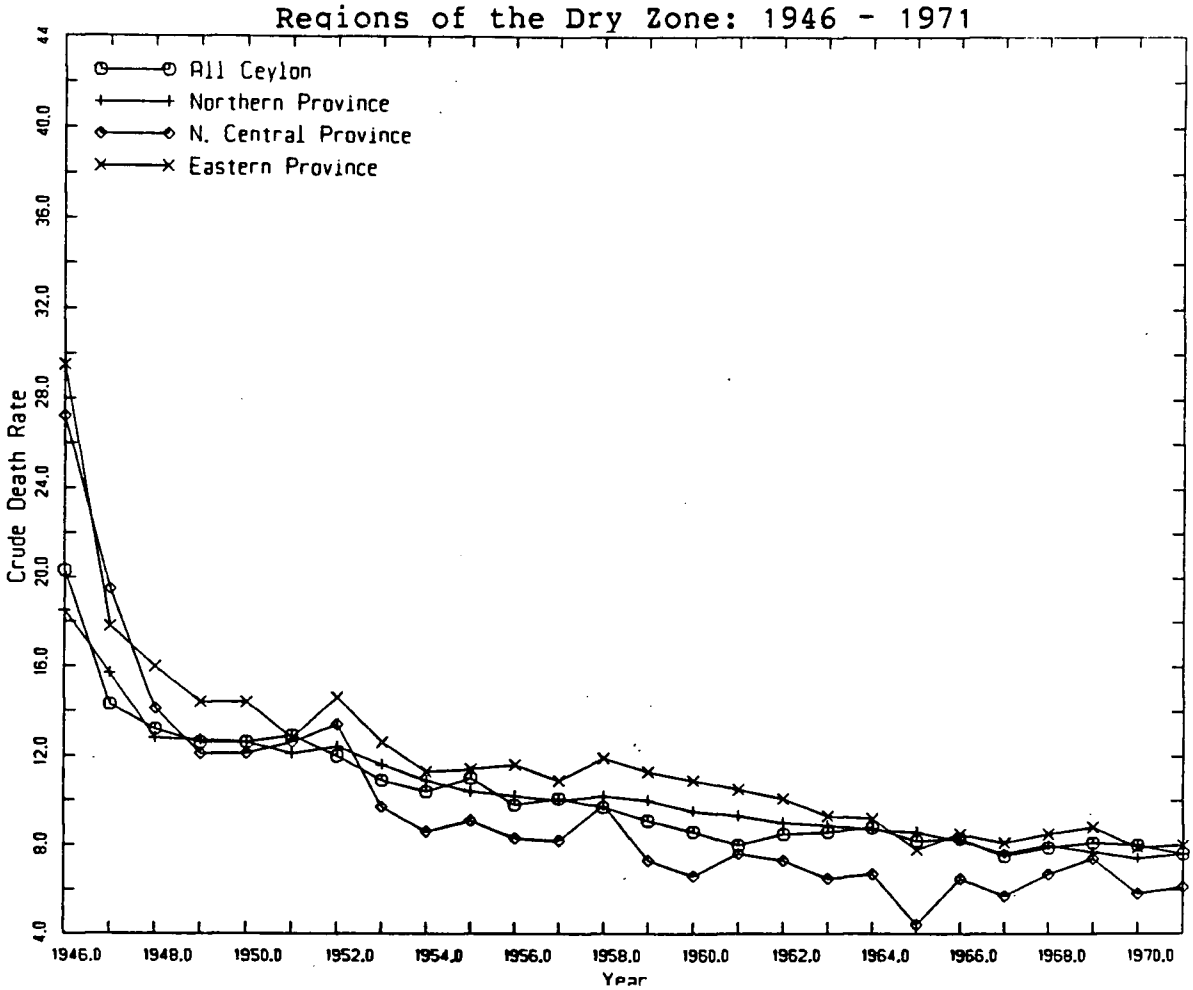
[34] See, for instance, S.A. Meegama, Op. Cit.; Peter Newman, "Malaria Eradication and its Effect on Mortality Levels: A Comment", in Population Studies, No.23, 1979, Part II; R.H. Gray, "The Decline of Mortality in Ceylon", in Population Studies, Vol.XXVIII, No.2, 1974.

[35] B.H. Farmer, Op. Cit., pp.20-22

Chart 5 illustrates trends in crude death rates for Sri Lanka and three regions of the dry zone during the period from 1946 to 1971.[36]

Chart 5: Crude Death Rates in Sri Lanka and Selected Regions of the Dry Zone: 1946 - 1971



There are also some practical reasons for selecting

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[36] Data for the period from 1946 to 1960 were obtained from Abayaratne and Jayawardene, Op. Cit. See Table 24, 'Crude Death Rates by Districts 1900-1960', pp.69-73. All Sri Lanka figures for the period from 1961 to 1971 were obtained from Statistical Abstract of Sri Lanka, 1973. Figures for the three dry zone regions for the period from 1965 to 1971 were calculated from Table 35, 'Deaths in Sri Lanka - By District', and Table 10, 'Estimated Mid-Year Population - By District' in Statistical Abstract of Sri Lanka, 1975.

Sri Lanka's dry zone as the area of study. First, relatively good statistical information is available for the period from 1946 to 1971. Second, a number of studies have been conducted in Sri Lanka and the dry zone which focus on subjects that are of direct relevance here, and a considerable amount of qualitative information can therefore be obtained.

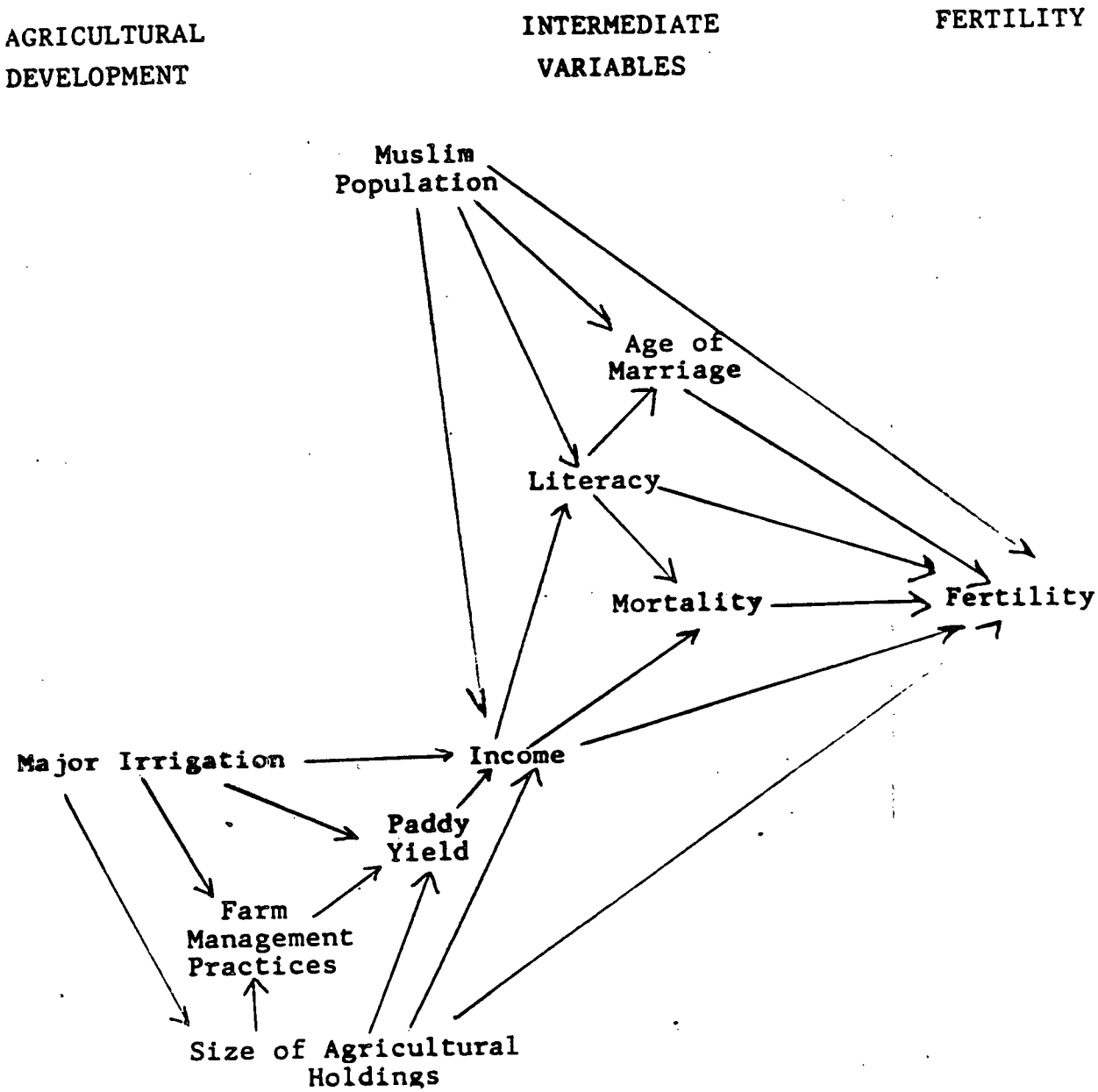
Chapter II

1. Introduction

Diagram II is a truncated version of Yotopoulos' theoretical frame and provides adequate scope for an inquiry into the relation between agricultural development and fertility in the dry zone of Sri Lanka:

Diagram II

Modified Conceptual Frame



Relationships depicted in Diagram II reflect a number of hypotheses, many of which have been briefly summarized by Yotopoulos.[37] Some of the hypotheses which underly the diagram have been formulated on the basis of findings in case studies which deal with questions concerning agricultural development or fertility in Sri Lanka. For instance, most of the hypotheses which involve agriculture-specific variables have been formulated on the basis of studies conducted by the Agrarian Research and Training Institute which explore the 'agrarian situation' in the dry zone.[38] It is the purpose of this chapter to present individual hypotheses which underly Diagram II and provide a basis for the statistical model presented in the next chapter.

According to Diagram II, fertility in the dry zone is directly influenced by age of marriage, mortality, literacy, cultural factors, income, and size of agricultural holdings. All of these variables, with the exception of cultural factors, are directly or indirectly influenced by agricultural development.[39] Hypothetical relations depicted in diagram II

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[37] Yotopoulos, Op. Cit.

[38] See "The Agrarian Situation Relating to Paddy Cultivation in Five Selected Districts of Sri Lanka", Agrarian Research and Training Institute, Pts. III,IV, and V, Colombo, 1975.

[39] Note that at this point, the discussion is in terms of variables and not indicators. The subject of statistical indicators, and why some indicators were selected over others, is dealt with in chapter III.

are dealt with individually under a number of headings. Supporting evidence from cross-national and case studies is provided.

2. Age at Marriage and Fertility

Rising age at marriage can influence fertility since it reduces exposure to sexual intercourse and reduces the number of a woman's childbearing years. A number of empirical studies indicate that "the age of marriage has the closest association with completed family size in high-fertility countries".[40] Yotopoulos estimates that if a marriage is postponed three years from age 15 to age 18 due to school attendance at least one conception will be averted.[41] It is interesting that the mean age at marriage for females in Sri Lanka rose by almost three years during the period from 1950 to 1971, and there is good reason to believe that rising age at marriage might be the primary cause of fertility decline in Sri Lanka during the period from 1960 to 1970.[42]

3. Mortality and Fertility

The notion that mortality is linked with fertility is

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[40] Yotopoulos, Op. Cit., p.28

[41] Ibid., p.28

[42] International Statistical Institute, Op. Cit., p.1; W. Parker Maudlin, "Patterns of Fertility Decline in Developing Countries,1950-1975", in Fertility Decline in Less Developed Countries, Nick Eberstadt (ed.), Op. Cit., p.89

central to the theory of demographic transition, upon which Yotopoulos' work is loosely based.[43] Insofar as fertility is concerned, it is evident that Yotopoulos considers infant and child mortality to be crucial.[44]

It is generally accepted that high levels of infant and child mortality are associated with high levels of fertility, although there is some disagreement as to the reasons for this.[45] The classical view is that high infant and child mortality can lead to high fertility due to a supposed need of parents to insure the survival of some minimum number of children desired. More recently, analysts have explained the phenomenom by means of the child-survival and child-replacement hypotheses:[46]

> "The former relates to parent's perceptions of mortality conditions in their social setting; the belief that children will survive to adult-hood is assumed to be prerequisite for acceptance of fertility regulation...the latter relates to parent's responses to mortality incidence in their own family; when a child dies, it is

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[43] This theory is briefly reviewed in chapter I.

[44] Yotopoulos, Op. Cit., pp.41-42

[45] For a discussion of the ideas relevant to this subject, see Samual Preston, The Effects of Infant and Child Mortality on Fertility, Academic Press, Inc., New York, 1978, pp.1-5, who also provides an historical bibliography.

[46] Susan C.M.Scrimshaw, "Infant Mortality and Behavior in the Regulation of Family Size", in Fertility Decline in Less developed Countries, Op. Cit., p.296

> hypothesized, a couple will replace it as quickly as possible."

It has been suggested that the child-survival response is the product of sub-conscious and unverbalized notions of mortality risks.[47] It is equally likely, however, that the phenomenom reflects conscious decision-making on the part of parents.[48]

The child-survival and child-replacement hypotheses explain the observed association between mortality and fertility in terms of behavioral mechanisms. Recent work suggests that biological mechanisms might be equally if not more important.[49] Proponents of the biological approach point out that post-partum lactational amenorrhea is associated with longer birth intervals:[50]

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[47] Taylor draws this conclusion because only 8% of the respondents in a study he conducted indicated that they took mortality risk into consideration when making family size decisions. See Carl E. Taylor, Jeanne S. Newman, and Narinder U. Kelly, "The Child Survival Hypothesis", in Population Studies, Vol.30, No.2, July 1976, p.266.

[48] Heer and Smith suggest that parents in Third World countries will have children until they can be 95% certain that at least one son will survive until the father reaches the age of 65. See David M. Heer and Dean O. Smith, "Mortality Levels, Desired Family Size, and Population Increase", in Demography, Vol.5, No.1, 1968, p.107

[49] A.K.M. Alauddin Chowdhury et. al., "Experience in Pakistan and Bangladesh", in Samuel H. Preston (ed.), The Effects of Infant and Child Mortality on Fertility, Academic Press, Inc., New York, 1978, p.129

[50] Ibid., p.116

> A birth interval is simply the time between successive births. After a pregnancy termination a woman typically experiences a period of temporary sterility, characterized by post-partum amenorrhea. With the onset of post-partum menses and ovulation, the woman again becomes at risk to pregnancy...The length of an average birth interval is important because it is a direct measure of fertility; long intervals are associated with low fertility and vice versa.

Infant death results in the interruption of lactation and the onset of menstrual cycles. This means that, in the absence of contraceptive measures, birth intervals will be significantly shortened.[51] The corollary to this is that, as infant death rates decline, birth intervals become longer. There is some evidence that crude birth rates may have declined in Mysore State during the period from 1921 to 1941.[52] Caldwell suggests that if such a decline did occur, it was due "solely to an extension of the average length of the interval between births arising from declining infant and child mortality and hence to a reduction of the number of periods of breastfeeding cut short

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[51] A.K.M. Alauddin Chowdhury et. al. report that birth intervals were shortened, on average, by 13.1 months in Bangladesh during the period of their study. Ibid., pp.126-127. Cantrelle, Ferry, and Mondot find similar trends in various African countries. P. Cantrelle, B. Ferry, and J. Mondot, "Relationship between Fertility and Mortality in Tropical Africa", in Ibid., p.116. Both studies report that the mean length of post-partum amenorrhea is about 60 days in the case of women who do not breastfeed.

[52] See Kingsley Davis, The Population of India and Pakistan, Princeton University Press, Princeton, 1951

by the death of a child".[53]

The relative explanatory value of behavioral and biological theories no doubt varies from one case to another. Unfortunately, it is often impossible to differentiate the biological and behavioral effects of infant mortality on fertility empirically.[54] No attempt is made to assess the relative predictive value of behavioral and biological theories in this study, due to lack of qualitative information. It is not essential to do so, since it is generally accepted that the effect of high infant mortality on fertility will be positive, regardless of whether behavioral or biological mechanisms are most operative.[55]

4. Education and Fertility

Education has consistently been one of the best

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[53] John C. Caldwell, P.H. Reddy, and Pat Caldwell, "The Causes of Demographic Change in Rural South India", in Population and Development Review, Vol.8., No.4, Dec., 1982

[54] This is due to problems in modelling, as well as to lack of data. See Chowdhury et. al., Op. Cit., p.114. For a detailed discussion of problems in modelling these effects, see T. Paul Schultz,"Interrelationships Between Mortality and Fertility", in Population and Development: The Search for Selective Interventions, Ronald G. Ridker (ed.), The Johns Hopkins University Press, Balitmore, 1976, pp.255-263.

[55] T. Paul Schultz, Op. Cit., p.288. It is of interest that fertility increased suddenly in districts which experienced rapid mortality decline following the introduction of malaria control. This suggests that the child-survival response was in operation prior to malaria control, and that there was a lag in the adjustment of the response to a condition of low mortality. See R.H. Gray, Op. Cit., p.227.

predictors of low fertility.[56] As people become more educated and have wider access to salaried employment, they are exposed to 'modern' ideas and values.[57] Education generally increases aspirations for upward mobility and material wealth, and this tends to reduce the desirability of having large numbers of children.[58] It has been shown that formal schooling has a strong effect on traditional attitudes toward family size and family planning; as levels of formal schooling increase, there is a higher probability that couples will desire small families and will be favourably disposed to practice contraception.[59]

Female education can affect fertility by virtue of any of several mechanisms, either singly or in combination, and may be particularly crucial to fertility.[60] It has been suggested that high female education has the effect of lowering fertility, due to supposed links between female education, levels of child care, and infant and child mortality. Women who

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[56] Pan A. Yotopoulos, Op. Cit., p.32

[57] Ibid., p.164

[58] Ibid., pp.160-161; O.E.R. Abhayaratne and C.H.S. Jayewardene, Fertility Trends in Ceylon, The Colombo Apothecaries' Co., Ltd., Colombo, 1967, pp.319-335

[59] Donald B. Holsinger and John D. Kasarda, "Education and Human Fertility: Sociological Perspectives", in Ronald G. Ridker (ed.), Op. Cit., p.166; Repetto, Op. Cit., p.93

[60] Yotopoulos, Op. Cit., p.33

are more highly educated are generally more cognizant of factors affecting the health of their offspring, and may have wider knowledge of, and access to, medical services: "in the less developed countries the schooled citizen is more likely to be immunized, to live under improved sanitary conditions, and to buy antibiotics for the control of disease (hence)...infant and child mortality rates are much lower among families where formal education is present than where the parents and children are unschooled".[61] Breastfeeding greatly benefits infant health, since it not only provides a source of adequate nutrition, but also because it provides natural immunization against disease.[62] This is particularly true with respect to intestinal diseases, which are a major cause of infant and child mortality in developing countries.[63] Evidence from cross-national studies suggests that the relationship between female education and breastfeeding is negative, although breastfeeding may not be as vitally important in the case of higher socio-

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[61] Holsinger and Kasarda, Op. Cit., p.163

[62] For comment on the advantages of breastfeeding for nutrition, see R.N. Gross, "Interrelation Between Health and Population:Observations from Derived from Field Experiences", in Social Science and Medicine, Vol.14C, No.2, June 1980, p.104, and Ruth Rice Puffer and Carlos V. Serrano, "Patterns of Mortality in Childhood", Pan American Health Organization, World Health Organization, Washington D.C., 1973, pp.267-271. For a discussion of the immunological mechanisms associated with breastfeeding see Gross, pp.104-105, and Puffer and Serrano, p.265.

[63] See Puffer and Serrano, Op. Cit., p.264.

economic groups.[64] This general pattern is not necessarily characteristic of Sri Lanka however, where there is evidence of strong and positive associations between female literacy and the incidence of breastfeeding, and female literacy and the duration of breastfeeding:[65]

> ...more educated women are more likely to ever breastfeed (and)...those who do breastfeed are more likely to continue breastfeeding to recommended ages if they are more educated. More educated women in Sri Lanka thus appear to better understand the value of breastfeeding for five or more months of the infant's life.

Education also affects fertility by raising the average age of females at marriage.[66] Men and women typically defer marriage while in high school and university, and it has been shown that this reduces the number of children ever born.[67] It has been determined, with respect to recent fertility declines in Kerala, that "increased age at marriage due to increased school attendance was...a significant factor".[68] Evidence that rising age at marriage is the primary

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[64] Ibid., p.264

[65] John Akin et. al., "The Determinants of Breastfeeding in Sri Lanka", in Demography, Vol.18, No.3, 1981, p.159

[66] See Pan A. Yotopoulos, Op. Cit., p.32, and Holsinger and Kasarda, Op. Cit., p.159.

[67] Holsinger and Kasarda, Op. Cit., p.159

[68] See Yotopoulos, Op. Cit., p.33.

cause of fertility decline in Sri Lanka during the period from 1960 to 1970 has already been discussed. Higher age at marriage is almost entirely due to increased school enrolment.[69]

Several studies have shown that there is an inverse relationship between female employment and fertility.[70] Increases in the level of female education can lead to greater participation of women in the workforce. As Kasarda, who has analyzed the relationships between female education, female employment, and fertility using data from 49 countries concludes: "The level of education in each nation was found to have a large effect on the proportion of females employed for wages and salaries, which in turn had a strong negative association with fertility".[71] According to Kasarda, fertility is influenced both by the opportunities of women to obtain salaried employment and the economic role of women in society.[72] However, there is evidence that there is no relation between female employment and fertility in Sri Lanka: "It will be a disappointment to some readers to observe that women who

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[69] "Census of Population 1971, Summary Report", Department of Census and Statistics, 1978, p.154

[70] For a summary of these, see John D. Kasarda, "Economic Structure and Fertility: A Comparative Analysis," in Demography, Vol.8, No.3, Aug. 1971, pp.308-309

[71] Cited from Hosinger and Kasarda, Op. Cit., p.161.

[72] Kasarda, Op. Cit., p.314

work during their first years of marriage do not seem to have lower fertility".[73] While there is evidence that some women who work before marriage exhibit slightly lower fertility than women who do not, this trend is really only characteristic of estate workers living in the wet zone.[74] The number of females employed for wages in the dry zone is quite small, and the number of women employed in positions which require higher education is almost negligible.[75] The relation between female employment and fertility will not be subjected to statistical analysis in this study.[76]

Women who are educated or who have obtained salaried employment tend to be more independent than their counterparts. One result of this is that the balance of power within marriage can shift, so that women have more input into marital decisions which affect fertility.[77] Fertility surveys indicate that women

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[73] International Statistical Institute, Op. Cit., p.91

[74] Ibid., p.91

[75] For instance, in Anuradhapura District only 1.1% of females employed are employed as professional, technical and related workers.

[76] The correlation between females employed and the fertility indicator used in the study (GFR) is negative as might be expected, but very weak (-.29).

[77] Eberstadt, Op. Cit., pp.58-59

generally desire smaller families than men.[78] Education also facilitates the diffusion of knowledge of contraceptive techniques.[79]

There is some evidence that a breakdown in traditional attitudes toward family size and family planning may have occurred in Sri Lanka during the period from 1950 to 1970, and that this might be associated with increases in the level of female education which occurred during the same period. Prior to 1950, most village women probably regarded childbearing as their inalterable fate. Even if they might have preferred to limit the size of their families by one means or other, they probably would not have done so because of their religious beliefs and their desire to avoid social stigma. Ryan suggests that the attitudes of most rural women toward the use of contraceptive devices, during the 1940's and early 1950's, might be summarized as follows:[80]

> If a dead 'soul' wishes to be born into your family, it would be a terrible sin to prevent its birth. We will pay for such acts in our next life. Children that are to be born to you must be allowed to be born. That is how life goes on. We cannot and should not prevent this.

Ryan's interviews were conducted in Sinhalese villages where Buddhism was the dominant religion. Whether such attitudes

[78] Ibid., p.58

[79] Repetto, Op. Cit., p.85

[80] Bryce Ryan, Institutional Factors in Sinhalese Fertility, Milbank Memorial Fund Quarterly, Vol.30, p.371, 1952

might have been common among Hindus, who also subscribe to the doctrine of transmigration of souls, is not clear from Ryan's study. Dr. G.P. Malalasekera, President of the All Ceylon Buddhist Congress, officially sanctioned the use of contraceptive techniques by Buddhists in 1968. He noted that while Buddhism traditionally encouraged the birth of children, it was in the national interest to control population growth.[81] Religious beliefs had largely ceased to be an obstruction to family planning by 1970.[82]

Ryan did find some evidence that women might prefer to limit the size of their families if they knew of a discreet and moral way of doing so. As one married female respondent stated:[83]

> We consider it a misfortune to have too many children. Provided one is not destroying life she is quite justified in preventing pregnancy. Women would be thankful if they knew of such a device (birth control) for although they dare not confess it in public, individually women would not like to have more than three children.

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[81] Mary Bishop, From Left to Right: A Perspective on the Role of the Volunteers in Family Planning in the West and in South Asia, Masters Thesis, University of B.C., 1971, p.181

[82] Ibid., p.178. At least this was probably true for Buddhists and Hindus. Abhayaratne and Jayewardene found that "a large proportion of persons opposed to family planning was opposed to it because they thought it contravened religious principles" when they conducted their study in 1965. See Abhayaratne and Jayewardene, Op. Cit., p.282.

[83] Ryan, Op. Cit., p.371

However, regardless of what women's attitudes toward family planning might have been, fertility decisions were largely a matter of male prerogative. Married women were expected to be obedient and subservient to their husbands, both in sexual as well as other matters.[84] As Ryan suggests: "The husband's sexual authority is the most important single element for an understanding of fertility".[85] Men were disposed to have large families for a number of cultural reasons:[86]

> Men sincerely want large families, and especially many sons: children are prosperity. Not once in the extensive discussions with village men was there a mention of the burden of child care and the difficulties of rearing. The personal trials and burdens of parenthood are almost wholly the mother's. Father is proud parent toward his neighbours, a caresser of infants in the home, and contributer to his kin status through well-calculated marriages. He is served by his household, and the larger his small kingdom the greater his dignity and glory. Through children, especially sons, he gains status as a man, is assured that his responsibilies will be inherited by others and that he himself will have security in old age.

There is some evidence that levels of feminine self-determination had increased by 1970, and that women had more

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[84] Ibid., pp.375-377

[85] Ibid., p.372

[86] Ibid., p.373

influence over their own fertility.[87] This is consistent with the theory that women might have more input into family planning as the level of their education increases.

Abhayaratne and Jayewardene have shown that in Sri Lanka, education increases aspirations for social mobility and leads to a desire for small families:[88]

> The most potent factor controlling the use of contraceptives appears to be the attitude of the parents to the future of their children...Those who had specific plans for their children - what occupation they should do in later life - had the lowest fertility while those who had no such plans had the highest...In short, those who were future oriented, who planned for the future of their cildren, were the people who had the lowest fertility and had used contraceptives to achieve this end. These people do not come mainly from the upper classes nor do they come from the lower. They are usually educated people with a limited income, in the public service doing clerical jobs. Their wives are also educated and employed gainfully outside the home.

This is consistent with theories which suggest that parents with higher levels of education might prefer to have small numbers of children of high quality.[89]

5. Income and Fertility

It is possible that income affects fertility in

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[87] Mary Bishop, Op. Cit., p.181

[88] Abhayaratne and Jayewardene, Op. Cit., p.341

[89] See Holsinger and Kasarda, Op. Cit., pp.160-162

several ways, and analysts invariably take income into consideration when studying fertility.[90] There is however, much disagreement as to what the mechanisms of the relationship might be, how income should be measured, and whether the effect of higher income on fertility is negative or positive.[91] Yotopoulos suggests that low income can inflate fertility in three ways:[92]

> First, poverty, through poor nutrition and health, leads to higher mortality rates. Parents tend to overcompensate for the expected loss of a child by higher fertility rates. Second, poverty lowers the relative cost of children, since the ambition of the poor is survival. The cost of children at higher levels of income is measured in terms of opportunities foregone and educational expenditures. Third, the benefits from children may be higher at lower levels of living. A child is a source of pleasure for every parent, but a poor farmer's child is also part of the family's working capital and a potential source of profit.

Most writers would accept that income can affect fertility indirectly by virtue of a link between income and nutrition. Maternal nutrition affects foetal wastage, and malnourished women experience higher levels of foetal wastage than their

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[90] Yotopoulos, Op. Cit., p.31

[91] Ibid., p.31

[92] Ibid., p.31

counterparts.[93] Well nourished mothers tend to have heavier babies, and there is statistical evidence to suggest that low birth weight is positively associated with infant death.[94] Furthermore, malnutrition is clearly linked with respiratory and intestinal diseases in weaned infants and young children, and influences the level of infant and child mortality in many developing countries.[95] Yotopoulos' last two points require elaboration. Since these points reflect the application of Hicksian micro-theory in the analysis of fertility behavior, they may be considered together.

Becker is generally credited with being the first to recognize that, for the purpose of analyzing household fertility patterns, children might be viewed as both consumer

[93] Rose E. Frisch, "Population, Nutrition, and Fecundity: Significance for Interpretation of Changes in Fertility", in Nick Eberstadt (ed.), Op. Cit., p.324

[94] For a discussion of the relationship between birthweight and mortality, see Grosse, Op. Cit., p.105, who provides cross-national information. For an in depth theoretical discussion of this subject, see Puffer and Serrano, Op. Cit., chapter 3.

[95] Repetto, Op. Cit., p.26; Akin et. al., Op. Cit., p.288. For a broader discussion, see "Nutrition and Infection", WHO Technical Report Series, 314, Geneva, 1964; Jelliff, D.B. "Child Nutrition in Developing Countries", Agency for International Development, 1969, and M.C. Latham, "Nutrition and and Infection in National Development", in Philip H. Abelson, Food: Politics Economics, Nutrition, and Research, American Association for the Advancement of Science, Washington, D.C., 1975.

[96] See Gary S. Becker, "An Economic Analysis of Fertility," in Ansley Coale (ed.) Demographic and Economic Change in Developed Countries, Universities-National Bureau Conference Series 11, Princeton University Press, Princeton, 1960, pp.210-211.

and producer goods.[96] According to Becker, an increase in family income should have a positive effect on both the amount invested in children (child quality) and the number of children produced (child quantity). Cross-national data indicate that Becker's conclusion with respect to the effect of income on the demand for children might be correct, but only in the short-term:[97]

> The immediate effect of a rise in income at the beginning of a secular rise in a traditional subsistence-agriculture setting is to increase fertility. This is the classic case in economic theory of the effect of income on fertility, tastes in the short run remaining unchanged while people find they can afford to raise more children.

The main fault in Becker's theory, insofar as the prediction of long-term fertility trends is concerned, is that it assumes the existence of a stable utility function common to all households; changes in household tastes are assumed away.[98] Cross-national studies indicate that over the long-term, the effect of income on fertility is negative.[99] One possible reason for this is that taste generally varies according to

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[97] Julian Simon, "Income, Wealth, and Their Distribution as Policy Tools in Fertility Control," in Ronald R. Ridker (ed.), Op. Cit., p.53

[98] Ibid., p.41; Yotopolous, Op. Cit., p.53

[99] Julian Simon, Op. Cit., p.56

income, as has been suggested by Leibenstein:[100]

> ...populations are divided into social status groups that have different tastes, who may to some degree have different desires for children (but not simply because of an economic difference), and who especially see the whole cost structure of their expenditures, including expenditures for children, from a viewpoint of vastly different preference structures.

Furthermore, cross-national studies indicate that there is an inverse relationship between child quality and child quantity.[101] While this may be partly due to the fact that different social status groups exhibit different tastes, it also reflects purely economic factors: "an increase in quality is more expensive if there are more children because the increase has to apply to more units; similarly, an increase in quantity is more expensive if the children are of higher quality, because higher-quality children cost more".[102]

Quantitative data show that, in Sri Lanka, high income is negatively associated with family size.[103] There is

[100] Harvey Leibenstein, "The Economic Theory of Fertility Decline", Quarterly Journal of Economics, Vol.89, 1975, p.3

[101] Becker and Lewis, "On the Interaction between Quantity and Quality of Children", Journal of Political Economy, Vol.81, No.2, Pt.II, March/April 1973, p.s279

[102] Ibid., p.65; This theory assumes that parent's will invest in all off-spring equally. In many cases, this assumption may be unreasonable, since it is known that parents in developing countries may spend more for the education of sons than for daughters.

[103] Abhayaratne and Jayewardene, Op. Cit., p.296

however, little qualitative information to suggest why this should be the case. Recent information suggests that poverty is increasingly becoming a positive factor in fertility:[104]

> ...it is also clear that the pressures of poverty, with increasing food shortages and spreading malnutrition, are themselves leading more and more couples to search for a more effective means of limiting their families than the traditional rhythm method.

There is also evidence that unemployment and low income often result in deferment of marriage, which also has the effect of reducing fertility.[105]

6. Size of Agricultural Holdings and Fertility

It is difficult to speculate on what the overall effect of high income on fertility might be in the dry zone. This is partly because of the large proportion of the population which is engaged in agriculture. It is generally accepted that the dynamics of family planning are somewhat different in farm households than in non-farm households, since the cost of raising children is generally less for farmers than for members of other occupational groups. The association between size of agricultural holdings and fertility tends to be

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[104] See John Rowley, "Joy, Happiness, and a Woman's Friend", in Vol.2, No.4, People, 1975, p.16. This view is also advanced by Mary Bishop, Op. Cit., p.186

[105] Badrud Duza, "Determinants of Marital Postponement in Sri Lanka" in Nuptiality and Population Policy, Population Council, New York, 1977

positive because labour requirements are greater on large farms than on small farms, and children are an ideal source of labour. An additional factor is that farmers with small holdings may limit the size of their families to avoid land fragmentation.[106] It is hypothesized that the direct effect of farm size on fertility will be positive.

It is hypothesized that farm size influences fertility indirectly due to linkages between farm size, agricultural productivity, and income. Evidence from various studies indicates that the relation between farm size and agricultural productivity can be positive or negative, depending upon a number of factors. It is generally accepted that in industrialized countries large holdings are more productive than small holdings due to economies of scale.[107] As Cline points out, "the primary reason to expect possible scale economies would be the argument that minimum areas are required to utilize certain farm machines (such as tractors and self-

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[106] For a more extensive discussion of the relationship between size of agricultural holdings and fertility, see W. Whitney Hicks, "Economic Development and Fertility Change in Mexico, 1950-1970", in Demography, Vol.11, No.3, August 1974, pp.407-421.

[107] Doreen Warriner, 'Relation Between Land Reform and Development', in Gerald M. Meier (ed.), Leading Issues in Economic Development, Oxford University Press, New York, 1976, pp.607-612, p.609

propelled combines)".[108] However, "in a labor surplus context these machines are not likely to be profitable at appropriate capital, exchange rate, and product prices, and a fortiori are not likely to be socially profitable if labor is shadow-priced".[109] Furthermore, even if such machines are profitable in developing countries, they can "in principle be supplied on a custom service basis, so that their availability need not depend on farm size. The economies of scale argument is not necessarily relevant insofar as agricultural in developing countries is concerned."[110]

During the 1971-72 maha season, over 70% of paddy fields in Anuradhapura were prepared with 4-wheel tractors.[111] Dry zone farmers relied on tractors because of an acute shortage of draught animals and because of a need to prepare agricultural land quickly, particularly in areas where water supply was uncertain.[112] It is of interest that field

[108] William R. Cline, 'Agricultural Strategy and Rural Income Distribution', in Gerald M. Meier (ed.), Op. Cit., pp.612-616, p.613

[109] Ibid., p.613

[110] Ibid., p.613

[111] 'The Agrarian Situation Relating to Paddy Cultivation in Five Selected Districts of Sri Lanka', Part 4-Anuradhapura District, Research Study Series No.9, Agrarian Research and Training Institute, Colombo, 1975, p.89

[112] 'The Agrarian Situation Relating to Paddy Cultivation in Five Selected Districts of Sri Lanka', Part 6-Comparative Analysis, Research Studie Series No.11, Agrarian Research and Training Institute, Colombo, 1975, p.26

preparation, sowing, and overall agricultural productivity were at least partially dependent upon patterns of ownership of farm machinery:[113]

> In both Anuradhapura and Hambantota where tractor is the main source of draught power, over 90% of the tractor users hire their machines mostly from non-cultivators, viz. merchants, millers, Gambarayas and landlords. In view of the general shortage of machinery in the country and the tractor users being heavily dependent on hired machines farmers often fail to complete sowing according to stipulated time schedules...The time of sowing is a crucial factor from the point of view of productivity. Crops sown in the peak period in November have given higher acre yields both in Hambantota and Polonnaruwa than those sown later in the season, indicating the influence of time of sowing on yields.

While increased oil prices resulted in widespread use of 2-wheel tractors and buffalos for draught power during the middle 1970's, it is clear that some dry zone farmers may have benefited from economies of scale during the period under study.

Whether or not levels of agricultural production are dependent upon economies of scale, evidence from field studies indicates that farm size and agricultural productivity are inversely related in the dry zone. It is evident from the following table that paddy yields in Polonnaruwa, Hambantota, and Anuradhapura were highest where holdings were less than 6

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[113] Ibid., pp.26-27

acres.[114]

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[114] Ibid., Table 4-II, 'Average yields per acre in relation to size of holding (bushels), Maha 1971/72', p.22

Table 3: Average Yields per Acre in Relation to Size of Holding in Bushels (Maha 1971/72)

	Upto 2.00	2.00-4.00	4.00-6.00	6.00-8.00	8.00-10.00	Over 10.00	Average
Maha 1971/72							
Polonnaruwa	49	69	71	59	50	50	62
Hambantota	37	40	35	29*			34
Anuradhapura	46	43	41	36	49	37	40
Yala 1972							
Polonnaruwa	41	58	47	49	49	54	50
Hambantota	29	32	21	19*			24
Anuradhapura	38	48	50	35	74	27	38

*6 acres and over

It is hypothesized that the farm size has a direct effect on income because agriculture is the primary source of income in the dry zone.[115]

7. Cultural Factors and Fertility

Yotopoulos defines cultural factors as "a complex of ideological factors...which has been formed around the institution of the family".[116] Knodel and van de Walle point

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[115] ARTI, Op. Cit., Part 4-Anuradhapura District, p.80

[116] Yotopoulos, Op. Cit., p.27

out that the status of women is a cultural characteristic, and that cultural values which define women's roles may have a strong influence on fertility.[117]

> One cultural feature that we believe the historical record suggests is particularly important is the status of women. We regard this more as a cultural characteristic than a socioeconomic or structural one since the extent to which women participate in the broader socioeconomic system beyond the home and extended family appears to be determined more by religious and other cultural values than by socioeconomic development per se. Of course the two are related, but the point is that the success of both family planning programs and more general development efforts designed to affect fertility may be quite dependent on the cultural beliefs regarding the appropriate role of women. This implication is consistent with the evidence suggesting that women may be more receptive than men to the limitation of family size, at least in circumstances where fertility is quite high. In cultural settings where the female role is subordinate to the extreme and where women are isolated from the broader communication network, policies designed to alter the status of women may be more conducive to reduced fertility than either family planning or more general development efforts.

As will be clear from discussion in chapter III, in the dry zone, the effect of culture on fertility appears to be stronger in the Muslim community than in other communities. This is primarily due to the influence of Muslim culture on the role of women. The Muslim population is very substantial in some

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[117] John Knodel and Etienne van de Walle, "Lessons from the Past: Policy Implications of Historical Fertility Studies", in Population and Development Review, Vol.5, No.2, June 1979, pp.217-245, p.238

districts and almost negligible in others, and there is reason to believe that this might provide some explanation for district-wise variation in both age at marriage and education.[118]

Diagram II indicates that cultural factors influence fertility indirectly, due to their effects on age at marriage, literacy, and income, as well as directly. It is hypothesized that culture influences fertility directly since there is evidence to suggest Muslim women desire larger families than women from other religious communities. This is clear from the following table:[119]

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[118] For instance, the percentage of the population which is Muslim in Amparai, Trincomolee, and Mannar is 46%, 32%, and 28% respectively. Muslims account for only about 2% of the population in Hambantota and Jaffna, and less than 5% of the population of Kurunegala.

[119] "World Fertility Survey, Sri Lanka, 1975, First Report". Department of Census and Statistics, Sri Lanka, March 1978. See Table 6.6, p.117.

Table 4: Mean Total Number of Children Desired by Currently Married Women Aged 25-34, by Background Variables

A: Observed, and B: Standardized on the Cohort's Distribution of Family Size (Categories 0-1,3,4,5+)
(Overall mean is 3.5)

	RELIGION			
	Buddhist	Hindu	Muslim	Christian
A	3.4	3.5	4.3	3.3
B	3.5	3.6	3.8	3.3

It is hypothesized that culture influences fertility indirectly, due to its effect on education, since Muslims; particularly Muslim women, tend to have less schooling than members of other cultural groups. Throughout the colonial period the Sri Lanka Muslims assiduously refrained from sending their children to schools which provided Western education, since these were justifiably perceived to be vehicles of Christian proselytization. This was particularly true during the period that Ceylon was under the British:[120]

> They repudiated the Macaulayan conception of education. (That is they wanted to preserve their religion and culture at the cost of an English education.) Hence there

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[120] K.H.M. Sumathipala, History of Education in Ceylon: 1796-1965 Dehiwala, Ceylon, 1968, p.36; citation is from A.M.A. Azeez, Reprints of Articles and Speeches, Vol.I

> was a period of non-co-operation with modern education. English education became closely associated with Christianity and quite naturally the spirit of non-co-operation hardened among Muslims. They were not prepared to endanger the faith of their children even though they were fully conscious that thereby they were sacrificing their chances of obtaining government jobs.

The Muslims continued to show some reluctance to enrol their children in non-Muslim schools even after Independence. This is in spite of the fact that the Education Ordinance of 1947 contained a provision intended to insure that "instruction in the religion of the parent of each pupil would be given to the pupil as part of his course of studies" in government schools.[121] As there are not enough Muslim schools to adequately meet the needs of the Muslim population, levels of enrolment are not as high as they might otherwise be.[122] Furthermore, Muslims generally prefer that school children be segregated according to sex. Children are not segregated in public schools, and this is probably one reason why literacy is particularly low for Muslim women.

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[121] J.E. Jayasurya, Educational Policies and Progress During the British Rule in Ceylon (Sri Lanka) 1796-1948 Associated Educational Publishers, Colombo, p.523

[122] After 1971, SLFP Minister of Education Badiudin Mohamed provided the Muslim community with additional all-Muslim schools and upgraded many of the previously existing ones in an attempt to overcome this problem. I am indebted to S.H. Hasbullah for this, and other information, concerning the Muslim community in Sri Lanka.

Traditionally, Muslim culture does not place much value on the education of women. Hindus and Buddhists value female education as a means of reducing dowry payments. If a women is educated she is likely to find employment, and therefore requires a smaller dowry. Muslims do not have a dowry system, and there is no stimulus toward female education on that account. Similarly, Muslim women do not require secular education since it is not customary for Muslim women to seek employment after they are married. As is evident from the following national table, Muslim women have relatively low education and are less likely to be employed after marriage than women with other religious affiliations:[123]

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[123] Department of Census and Statistics, 1978, Op. Cit., Table 3.4, 'Association of other explanatory variables with religion', p.53

Table 5: Association of Various Explanatory Variables with Religion [women only]

Religion	Education more than 5 years	Husband's Occupation farming	Pattern of Work Never Worked	Pattern of Work Worked "away" after marriage
	%	%	%	%
Buddhist	42	39	47	19
Hindu	25	61	39	49
Muslim	21	29	79	12
Christian	59	27	50	25
ALL	38	42	48	25

Given that one of the main reasons for deferral of marriage in Sri Lanka during recent years has been schooling, it is not surprising that Muslims, and Muslim women in particular, tend to marry earlier than members of other cultural groups. The mean age at marriage for women is provided in the following table according to religious affiliation and ethnic background.[124]

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[124] "World Fertility Survey, Sri Lanka, 1975", Department of Census and Statistics, Op. Cit., p.62. See Table 4.4.

Table 6: Mean Age at Marriage of Women who Married Before Age 25, by Religion and Ethnicity

A: For Women with Current Age 25-49
B: For Women with Current Age 25-29

(The overall mean age at marriage is 18.2 for women aged 25-49 and 18.9 for women aged 25-29)

	RELIGION			
	Buddhist	Hindu	Muslim	Christian
A	18.5	17.3	16.6	18.6
B	19.5	18.0	16.6	19.4

	ETHNIC GROUP			
	Sinhalese	Sri Lanka Tamil	Indian Tamil	Sri Lanka Moor
A	18.6	17.5	17.2	16.5
B	19.5	18.0	18.2	16.5

As suggested in the World Fertility Survey, "the high fertility of Muslims is due mainly to their early age at marriage".[125]

It is also hypothesized that cultural factors might indirectly influence fertility by virtue of some relationship between culture and income, although there is no evidence in the literature to suggest whether or not this relationship might be positive or negative.

It is also possible that cultural factors influence fertility directly, since communal rivalries may have some

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[125] Ibid., p. 154

influence on fertility. For instance, Buddhist religious leaders have been particularly concerned that family planning might jeopardize the majority position enjoyed by the Sinhalese population:[126]

> A sustained attack on family planning campaigns was set in motion by members of the Buddhist clergy, led by the Mahanayake Theras of Malwatte and Asgiriya and the Reverend Madihe Pannasha, a redoubtable champion of the cause of Sihnalla Buddhists. Not long after it had been made a national programme in Ceylon, the Mahanayake of Malwatte declared family planning to be inimical to the Sinhalese people and called upon Sinhalese women to abstain from using family planning methods. In a series of articles to the press written in 1969 and 1970, the Reverend Madihe Pannasiha pointed to the inexorable and inevitable effect which family planning would have of undermining the ethnic constitution of the population of the country, to the disadvantage of Sinhala Buddhists. Pannasiha Thero used statistics to argue that the majority community of Ceylon would eventually be transformed into a minority community as a result of the family planning movement.

The question of family planning and communal interests has been a matter of considerable interest in the press, and no doubt influenced the rate of implementation of family planning in Sri Lanka.[127] It is questionable, however, that communal sentiments have been a factor in the fertility decisions of families.

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[126] S.U. Kodikara, "Family Planning in Ceylon", in T.E. Smith, The Politics of Family Planning in the Third World, George, Allan & Unwin Ltd., London, 1973, p.311

[127] Ibid., p.312 and pp.326-329

While both the Tamil and Sinhalese segments of the population fear that their relative numbers might diminish, there is nothing in the literature which suggests that such fear provides a motivation for increased fertility.[128] The question of whether communal rivalries might provide an explanation for high fertility is dealt with in chapter III, where it will be shown that cultural factors, insofar as Hindus and Buddhists are concerned, do not provide much explanation for fertility differentials in the dry zone.

8. Irrigation, Paddy Yield, Farm Management Practices and Income

In the case of Sri Lanka's dry zone, it is convenient to consider agricultural development in terms of water supply conditions, farm managment practices, and paddy yield. It is hypothesized that, in the districts under study, major irrigation leads to improved farm management practices and to higher agricultural productivity. Areas under major irrigation should therefore have higher yields than areas which are characterized by minor and rainfed irrigation systems. As paddy provides the main source of income for farm families living in the dry zone, particularly in areas under major schemes, paddy

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[128] For instance, it is not suggested that communal rivalries are a factor in fertility decision-making in either the World Fertility Survey or Abayaratne and Jayawardene's Fertility in Ceylon, both of which investigate factors which influence fertility decisions.

yield should be positively associated with income.[129]

The hypothesis that major irrigation contributes to agricultural productivity is strongly supported by field studies conducted by the Agrarian Research and Training Institute.[130] Studies of the agrarian situation with respect to paddy production are available for three of the twelve dry zone districts. These are Hambantota, Anuradhapura, and Polonnaruwa. The studies indicate that major irrigation leads to increased paddy production for several reasons.

Uncertainty of water supply is a major reason for crop failure in areas which are serviced by minor and rainfed irrigation systems, as findings from the Anuradhapura study indicate:[131]

> This data presented shows a relatively close relationship between the quality of irrigation experienced particularly during the flowering stage of paddy and the acre yields harvested. 80% of the operators in the lowest yield group (less than 20 bushels) have had a poor water supply at flowering whilst only 8% of those who had reported yields of over 60 bushels per acre had experienced similar conditions...given the uncertainty of rain, irrigation remains a critical factor in determining acre yields.

[129] Over 75% of gross farm income was derived from paddy cultivation in the three dry zone districts studied by the Agrarian Research and Training Institute (ARTI). See "The Agrarian Situation Relating to Paddy Cultivation in Five Selected Districts of Sri Lanka", ARTI, Research Study Series #11, Part 6, p.30.

[130] Ibid., Parts 1, 3, and 4

[131] Ibid., Part 4

The risk of crop failure is much higher in areas under minor and rainfed schemes than it is in areas under major schemes, where water supply is more assured. Farmers whose fields are supplied by minor and rainfed irrigation are therefore considerably more reluctant to invest in the new, high yielding but capital-intensive seed technologies, than their counterparts. It is well known that 'high yielding' varieties of seed do not perform well without the application of large quantities of fertilizers and insecticides. Costs relating to field preparation, transplanting as opposed to broadcasting by traditional methods, and harvesting must be taken into consideration by farmers before they adopt higher yielding seed technologies. The following table shows that in Anuradhapura the average cash outlay by farmers with major irrigation is more than double the cash outlay by farmers with minor irrigation.[132] The pattern is similar for both Hambantota and Polonnaruwa, and for both the maha as well as the yala season.[133]

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[132] Ibid., p.84. See Table 7-XVIII, 'Cash Outlay per acre for Paddy Cultivation according to Water Supply - Yala 1972'.

[133] Ibid., Parts 1 and 3, pp. 134 and 106 respectively

Table 7: Cash Outlay per acre for Paddy Cultivation according to Source of Water Supply Yala 1972

	Source of Water Supply			
	Major		Minor	
No. of Farmers.....	48		21	
Extent Cultivated (acres)	214.06		43.25	
	Expenses			
Items of Expenditure	Amount		Amount	
	Rs.	%	Rs.	%
1. Field Operations	253	74	123	82
i. Tractor including fuel costs	93	27	79	53
ii. Buffalo	13	4	11	7
iii. Hired Labour				
(a) Wages	105	31	19	13
(b) Food	42	12	14	9
2. Inputs	49	14	17	11
3. Miscellaneous				
i. Land Acreage Tax & Land Rent	32	9	6	4
ii. Transport	6	2	3	2
Total	340	100	149	100

In Anuradhapura, per acre expenditures on hired labour are over 5 times greater in areas under major schemes. The amount spent on hired labour is the greatest category of differential expenditure in all three districts. Much of the

difference in labour costs is due to the use of transplanting techniques by farmers whose fields are supplied by major irrigation.[134] Transplanting is clearly associated with both major irrigation and the use of high yielding varieties.[135]

> In Polonnaruwa under major schemes transplanted crops have significantly out-yielded the broadcast crops, the difference in yield being 28 bushels for NHYV's and 20 bushels for OHYV's per acre. The very small proportion of the area transplanted under minor schemes in the dry zone... shows the reluctance of farmers to adopt techniques that are associated with high expenses under less favourable environmental conditions.

That water supply conditions influence the type of seed which is sown is evident from the following tables:[136]

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[134] This was true for all three districts.

[135] Ibid., Part 6, Comparative Analysis, pp. 25-26

[136] Ibid., Part 4, Tables 5-VIII and 5-IX, p.56. The terms NHYV, OHYV, and TV stand for new high yielding varieties, old high yielding varieties, and traditional varieties respectively.

Table 8: Distribution of Varieties according to Water Supply during Maha 1971/72

Water Supply	NHYV (acres)	OHYV (acres)	TV (acres)	Total (acres)
Major Irrigation	83.00	324.31	71.75	479.06
%	17	68	15	100
Minor Irrigation	33.75	531.51	67.75	633.01
%	5	84	11	100
Total	116.75	855.82	139.50	1112.07
%	10	77	13	100

Table 9: Distribution of Varieties according to Water Supply during Yala 1972

Water Supply	NHYV (acres)	OHYV (acres)	TV (acres)	Total (acres)
Major Irrigation	66.50	14.00	160.56	241.06
%	28	6	67	100
Minor Irrigation	2.00	9.75	47.88	59.63
%	3	16	80	100
Total	68.50	23.75	208.44	300.69
%	23	8	69	100

NHYV's are most common in areas characterized by major schemes. OHYV's and TV's are associated with minor schemes. In Polonnaruwa, the average yield for NHYV's was 84 bushels per acre; for OHYV's the average yield was only 56 bushels per acre.[137] Major irrigation contributes to higher yields since it

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[137] Ibid., Part 4, p.25

facilitates the spread of new varieties.

Results from the ARTI studies indicate that "different situations relating to water supply...give rise to income disparities" and that operators under assured water supply schemes are in a better position to adopt a package of improved farm practices.[138] Gross incomes from paddy sales are invariably highest in areas which benefit from major irrigation, although evidence that real income increases in relation to paddy yield is not strong. In Hambantota, farmers whose fields were supplied by major irrigation obtained 65% more net income per acre than farmers whose fields were dependent upon minor schemes.[139] However, findings for Anuradhapura show that yield advantages associated with major irrigation and the use of new seed technologies were more than offset by higher production expenses.[140] In this district, farmers whose fields were supplied by minor irrigation received 11% more net income per acre than farmers under major schemes. Information on the net incomes of farmers according to water supply is not provided for Polonnaruwa, due to the fact that the number of farmers under minor schemes in the sample was

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[138] Ibid., Part 6, Comparative Analysis, P.32

[139] Ibid., Part 1, Hambantota District, p.138. Findings are for the yala season only.

[140] Ibid., Part 4, Anuradhapura District, p.84

small.[141] It might be noted however, that the average net income per acre was 25% higher in Polonnaruwa than that obtained by farmers under minor irrigation in Anuradhapura. Overall, the evidence from field studies seems to support the hypothesis that increases in paddy yield have a positive effect on income.

9. Contraception and Fertility

It is generally accepted that "contraceptive practice is the...variable primarily responsible for the wide range in the levels of fertility within marriage among populations today."[142] Marital fertility is of particular interest in the case of Sri Lanka,, since practically all births in that country occur within marriage.[143] The relation between age at marriage and fertility has already been discussed in some detail, and is subjected to a statistical analysis in the following chapters. Unfortunately, district-wise data on marital fertility rates and contraceptive use are unavailable and it will not be possible to measure the effect of family planning on fertility in this study. Still, the subject of family planning cannot be overlooked. Sufficient information is available from other studies to give some insight with respect

[141] Ibid., Part 3, Polonnaruwa District, p.106

[142] John Bongaarts, "A Framework for Analyzing the Proximate Determinants of Fertility", in Population and Development Review, Vol.4, No.1, March 1978, p.110.

[143] Figures for 1975 indicate that only 2% of women experienced a birth prior to their first marriage. See International Statistical Institute, Op. Cit., p.90.

to the relative importance of family planning to fertility in Sri Lanka and the dry zone.

The GOSL launched the Family Planning Programme late in 1965, and all-island coverage of the programme was achieved in 1968.[144] Age-specific marital fertility rates declined during the period from 1963 to 1971 and there is some evidence that this trend is due to higher levels of contraceptive use by married couples.[145] The change in marital fertility during this period has been greatest for women above the age of twenty-five years, which suggests that older women may be using family planning techniques in order to prevent further births.

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[144] Ibid., pp.8-9

[145] "Census of Population 1971 Sri Lanka, General Report", Department of Census and Statistics, Colombo, p.26

This is evident from the following table.[146]

Table 10: Age Specific Marital Fertility Rates for Sri Lanka: 1963-1972

Age Group	Age Specific Marital Fertility Rates		Percentage Change
	1963	1971	
15-19	354	418	+ 18.1
20-24	396	388	- 2.0
25-29	344	313	- 9.0
30-34	270	237	- 12.2
35-39	175	157	- 10.3
40-44	53	49	- 7.5
45-49	8	8	0.0

Fernando has shown that during the period from 1963 to 1970, the "all-island pattern of marital fertility decline among older women (30-44) is noticed in all four zones", and that the decline was most pronounced in zones II and IV.[147] Zone II corresponds to the dry zone districts Hambantota, Moneragala, Amparai, Polonnaruwa, Anuradhapura, and Puttalam. The most dramatic decline in marital fertility among younger women (15-

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[146] Ibid., Table 2.6, 'Changes in Age Specific Marital Fertility Rates in Sri Lanka: 1963-1971', p.26

[147] Dallas F. Fernando, "A Note on Differential Fertility in Sri Lanka", Demography, Vol. 11, No.3, August 1974, p.447

29) occurred in zone III, which corresponds to Jaffna, Mannar, Vavuniya, Trincomalee, and Batticaloa.[148]

The all-island decline in marital fertility which occurred between 1963 and 1971 is primarily due to increased levels of contraceptive use, both within and outside the Family Planning Programme, and illegal abortions.[149] Fernando reports that family planning activity "seems to have intensified considerably in 1973", and that it is very likely that increased contraceptive use will have a dramatic impact on fertility in the future.[150] However, it is important to note that the main factors in the decline in crude birth rate during the period from 1963 to 1971 were changes in marital composition and rising age at marriage, even though decline in marital fertility was important.[151]

Detailed information on contraceptive methods in Sri Lanka is of particular interest, in that it indicates that the responsibility for family planning has fallen largely on women.

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[148] Ibid., p.447

[149] Ibid., p.9 It has been suggested that illegal abortions have "assumed epidemic proportions" in Sri Lanka. See Ralph Pieris, "Motivations Relating to Family Planning", in Marga, Vol.5, No.1, 1978, p.80.

[150] Dallas F.S. Fernando, "Fertility Trends in Sri Lanka and Future Prospects", in Journal of Biosocial Science, No.8, 1976, p.38

[151] Ibid., p.35, and Census of Population, 1971, General Report, p.26

Information with respect to contraceptive use by new acceptors in 1971 is presented in the following table.[152]

Table 11: New Acceptors of Family Planning at Government, Municipality, and Family Planning Clinics, in Sri Lanka: 1971

Contraceptive Method	Total	%
Loop	11,446	23.2
Pill	25,828	52.4
Condom	6,945	14.1
Foam Tablets	361	0.7
Sterilization - male	245	0.5
Sterilization - female	4,090	8.3
Other	408	0.8

It is clear from the above table that the pill and the loop are the most commonly adopted forms of birth control adopted by new acceptors in 1971. Over 75% of new acceptors adopted one of these two methods of birth control, indicating that family planning is very much the prerogative of women. The number of women opting for sterilization is also of interest.

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[152] Fernando, 1976, Op. Cit., Table 4, 'New acceptors of family planning at government, municipality and family planning association clinics, by methods, Sri Lanka, 1967-72', p.39

Chapter III

1. Introduction

It is the purpose of this chapter to provide details of the methodology employed, and to deal with questions which are of methodological interest. The discussion is divided into three parts. First, path analysis is introduced in section 2, since this is the methodology employed. Procedural steps taken are briefly outlined in section 3. The problem of ecological correlation, which must be considered since statistical results are based on aggregate figures and represent district trends rather than the behavior of individuals, is dealt with in section 4. The final section provides details concerning the statistical model employed.

2. Path Analysis: A Brief Description and some Caveats

The most useful application of path analysis is to test the relative strength of alternative hypotheses.[153] Each path in Yotopoulos' diagram is based upon, and is representative of, one or more hypotheses. In order to model some of the relationships depicted in this diagram, and to determine which hypotheses provide the best explanation for

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[153] Fred N. Kerlinger and Elazer J. Pedhazur, Multiple Regression in Behavioral Research, Holt, Rinehart, and Winston, Inc., New York, 1973, p.305

district-wise differentials in fertility, path analysis is employed. Hypothesized relationships between or amongst variables must be clearly specified before a path model can be constructed, and statistical findings must be judiciously interpreted with reference to available qualitative information:[154]

> The method of path coefficients is not intended to accomplish the impossible task of deducing causal relations from the values of correlation coefficients. It is intended to combine the quantitative information given by the correlations with such qualitative information as may be on hand on causal relations to give a quantitative interpretation.

Insofar as the use of path analysis in this study is concerned, two considerations are in order. First, the interrelationships amongst economic, intermediate, and demographic variables are highly complex, and questions pertinent to the understanding of many fundamental relationships are still unclear and open to divergent interpretations. In cases where a path is based upon more than one plausible hypothesis, it will not necessarily be possible to determine which hypothesis has the best explanatory power even if good statistical results are obtained.[155] Second, statistical correlation is no proof of cause-and-effect, and

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[154] Ibid., p.305

[155] Nick Eberstadt, Fertility Decline in the Less Developed Countries, Praeger Publishers, New York, 1981, p.3

when reciprocal cause-and-effect relationships between or amongst variables are expected, the interpretation of statistical results becomes even more difficult. One of the greatest problems with path analysis is the fact that path models are recursive: "the causal flow of the model is unidirectional...at a given point in time a variable cannot be both a cause and an effect of another variable".[156] As DeWalt suggests, "simple recursive path analysis...does not allow for any feedback in the system".[157] This problem is particularly acute in cases where data for only one time period are available, and amplifies the importance of any qualitative information which might be available from field studies. In developing a model designed to capture the effects of agricultural development on fertility in the dry zone, only the forward effects of one variable on another are considered. This is a viable approach, since quantitative and qualitative information which reflects historical trends is taken into consideration.

3. A Brief Note on Procedure

In order to construct a path model and proceed toward an analysis, several steps were necessary. First, a number of

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[156] Kerlinger and Pedhazur, Op. Cit., p.308

[157] Billie R. DeWalt, Modernization in a Mexican Ejido: A Study in Economic Adaptation, Cambridge University Press, Cambridge, 1979, p.283

hypotheses concerning the relationship between agricultural development and fertility were constructed. This was accomplished following a survey of the literature, and on the basis of findings in relevant case studies conducted in Sri Lanka and the dry zone. Once it was determined which hypotheses were to be tested, variables to be included in the model were identified and their relationships were established. Following this, the regression equations which comprise the model were written.[158] It must be remembered that many of the hypotheses upon which the model is based involve variables which are not easily quantified or for which data are otherwise not available, and the model is only as detailed as data will permit.

The next step was to select appropriate indicators for variables specified in the model. In many cases it was necessary to choose between two or more indicators from within the same variable domain, and the most appropriate indicator was determined from a correlation matrix derived from data representing the twelve dry zone districts. For instance, either of two mortality indicators might have been selected, since both crude death rate and infant mortality rate are presumed to influence fertility.[159] As the correlation between the infant mortality rate and fertility is +.62, and the

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[158] See Chapter III, section 5.

[159] District-wise child mortality rates were unavailable.

correlation between the crude death rate and fertility is only +.14, infant mortality rate was selected for use in the model.

Once all of the indicators had been chosen, regression equations contained in the model were run using the SPSS programme. An even level of inclusion was specified, and the direct effects of the independent variables on the dependent variables were obtained. It was then possible to construct a path diagram, and to illustrate relationships depicted by the model in terms of path coefficients (beta values). Following this, the indirect effects of the independent variables were calculated, and a general decomposition table illustrating direct, indirect, and total 'causal' relations between different variable pairs was constructed. The numerical results contained in this table provide much of the quantitative information upon which further analysis is based.

4. Ecological Correlation: The Problem and Some Precautions

As analysis is based on statistical results derived from aggregate figures which represent entire districts, this study is ecologic in nature. In introducing the subject of ecologic studies, Morgenstern makes the following observations:[160]

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[160] Hal Morgenstern, "Uses of Ecologic Analysis in Epidemiologic Research", American Journal of Public Health", No.72, pp.1336-1344, 1972

> Ecologic studies are empirical investigations involving the group as the unit of analysis. Typically, the group is a geographically defined area, such as a state, county, or census tract. Because they can often be done by combining existing data files on large populations, ecologic studies are generally less expensive and take less time than studies involving the individual as the unit of analysis; ecologic studies can also achieve certain objectives generally not met with nonecologic designs. On the other hand, data on many variables (e.g. behaviors, attitudes, and medical histories) may not be available at the ecologic level, and the results of ecologic analyses are subject to certain limitations not applicable to many other study designs.

Insofar as this particular study is concerned, an ecologic approach was adopted from necessity: fieldwork was not possible, yet much district-wise data were available from government censuses and other publications.

The main limitation of ecologic analysis is the problem of ecological correlation.[161] This results "from making a causal inference about individual phenomena on the basis of observations of groups".[162] For instance, if districts with high Muslim populations show high fertility, it cannot necessarily be concluded that Muslims have higher fertility rates than non-Muslims. Statistical results based on disaggregate data generally differ from results which are based

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[161] This phenomena is referred to as ecological fallicy in some texts.

[162] Hal Morgenstern, Op. Cit., p.1339

on aggregate data. Levels of correlation will usually be higher when aggregate figures are used, due to the phenomenom of 'cross-level bias'.[163]

There are several ways to deal with ecological correlation. One method suggested by Morgenstern is to use regression rather than simple correlation: "in the situation where groups tend to be homogeneous with respect to one of the independent variables, ecologic regression coefficients, but not ecologic correlation coefficients, will result in unbiased estimates of their corresponding individual measures".[164] Another way is to verify results obtained in ecologic studies by comparing them with findings from studies which use the individual as the unit of analysis.[165]

Both of the above mentioned methods of dealing with ecological correlation are employed in this study. Although some statistical indicators are selected on the basis of correlation coefficients, the bulk of analysis is based on results obtained from regression equations. There are several studies which use the individual as the unit of analysis, on the basis of which it is possible to corroborate findings based on district data. Abayaratne and Jayawardene's study of

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[163] Ibid., pp.1339-1340

[164] Ibid., p.1342

[165] Ibid., p.1342

fertility trends in Sri Lanka incorporates an ecological approach (Part I) as well as a case study approach (Part II).[166] Part II is of particular interest, both for its content as well as its methodology:[167]

> In the choice of the villagers to be studied, each demographic area has been divided into strata on the basis of their ethno-religious or socio-economic characteristics and the villages have been chosen from strata so that the different groups would find representation in the sample. The method was essentially one of case study and consequently the possibility exists that the villages chosen and studied would not present a sample that was statistically representative of the demographic area into which they fell. As has been already pointed out, in the choice of the sample the main consideration was not that the villages studied should constitute a statistically representative sample of the demographic area but that all groups in a demographic area should find adequate representation in the sample so that fertility similarities and dissimilarities in the different groups could be studied.

Abhayaratne and Jayawardene's findings with respect to the fertility patterns of individual members in different socio-economic and ethno-religious groups are consistent with district patterns illustrated in the decomposition table. Similarly, findings in the World Fertility Survey are also based on a case study approach, and help to verify results from

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[166] Abhayaratne, O.E.R., and Jayawardene, C.H.S., Fertility Trends in Ceylon, The Colombo Apothecaries' Co., Ltd., Colombo, 1967

[167] Ibid., p.186

my own ecological analysis.[168]

5. Statistical Model Employed

Statistical information necessary for path analysis has been obtained through the use of the following model, which is based on the path diagram presented in chapter II:[169]

GFR = f[IMR,FLIT,I,CF,ASSH,AM]

IMR = f[FLIT,I]

AM = f[FLIT,CF]

FLIT = f[CF,I]

I = f[CF,ASSH,PY,MI]

PY = f[ASSH,MI,T]

T = f[ASSH,MI]

ASSH = f[MI].

The above model comprises seven regression equations. Equation 1 indicates that general fertility rate (GFR) is a function of infant mortality rate (IMR), female literacy (FLIT), income (I), cultural factors (CF), average size of small holdings (ASSH), and age of females at marriage (AM). Equations 2 and 3 are self explanatory. Equation 4 indicates that income is a function of cultural factors, average size of small holdings, paddy yield (PY), and major irrigation (MI).

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[168] Department of Census and Statistics, "World Fertility Survey, Sri Lanka, 1975, First Report", Ministry of Plan Implementation, Colombo, 1978

[169] See Diagram II.

Equation 5 indicates that paddy yield is a function of average size of small holdings, major irrigation, and transplanting (T). Equations 6 and 7 are self explanatory.

Measure of Fertility - the dependent variable

General fertility rate (GFR) is employed as a measure of fertility in this study. The general fertility rate is calculated by dividing the annual number of live births in each district by the number of women aged from 15 to 44 years in a given year.[170] This measure is superior to crude birth rate because fertility is defined in terms of women of childbearing age rather than in terms of the general population. The number of women of childbearing age in each district was obtained from the 1971 Census of Population.[171] These data are probably quite reliable, since it is reported that the registration of births was 98.7% complete by 1967.[172]

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[170] Robert Repetto, Economic Equality and Fertility in Developing Countries, Resources for the Future, Inc., Washington, 1979, p.31

[171] Table Six, Population by Sex and Five-Year age groups for Districts by Urban and Rural Areas, Census of Population, 1971

[172] Ibid., p.99

Measures of explanatory variables[173]

Reasons for selecting infant mortality over other mortality indicators have already been discussed. Infant mortality rates for individual districts; specifically, the number of infant deaths per 1000 live births in 1971, were also obtained from the 1971 GOSL District Censuses.[174]

The percentage of women currently married aged 15 to 19 was used as a measure for age of females at marriage. These data were not available in the Census of Population, but are provided by Dallas Fernando.[175] These data were no doubt obtained directly from the Department of Census and Statistics and are reasonably accurate.

Yotopoulos points out that, "as a byproduct of development, literacy rates and educational levels are likely to increase for both males and females", but notes that "the increase in female education is more likely to affect fertility rates".[176] Female literacy was selected for use in the model,

[173] The term explanatory variables is used rather than the term independent variables in order to avoid confusion. Technically speaking, each individual equation in the statistical model employed has one dependent variable and several independent variables. Viewed in this manner, many variables which are depicted as intermediate between major irrigation and fertility in Diagram II and Diagram III are both independent and dependent, depending upon which equation one is looking at.

[174] Census of population, 1971, General Report

[175] Dallas F.S. Fernando, "Nuptiality, Education, Infant Mortality and Fertility in Sri Lanka", Journal of Biosocial Science, No.11, 1977

[176] Pan Yotopoulos, Op. Cit., p.33

rather than male literacy , on the basis of correlation coefficients. The correlation between female literacy and general fertility rate, and male literacy and general fertility rate, is -.81 and -.78 respectively. Another reason for selecting female literacy instead of male literacy was that female literacy was more strongly correlated with independent variables in equation 2. For instance, the correlation between female literacy and infant mortality is -.74, while the correlation between male literacy and infant mortality is -.68. Female literacy is the number of females aged ten years or over who could read and write a short statement on everyday life. While no objective test was given in order to determine literacy, and it is possible that some respondents may have exaggerated their abilities to enumerators, these data are considered by the GOSL Department of Census and Statistics to be reasonably accurate.[177]

Female literacy is employed in this study, rather than any of a number of possible measures of educational attainment, primarily for theoretical reasons. For instance, while it is clear that the best way to capture the effect of marriage deferral on fertility would be to employ an indicator such as number of school-aged females 15 to 19 in school, the use of this indicator would significantly narrow the scope of analysis. GFR is conceived to be a a function of marital

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[177] For a more detailed comment on this particular data, see Census of Population General Report, pp.111-113.

fertility as well as age at marriage, and it is very likely that anyone who has achieved basic literacy can understand various advertisements and/or written information pertaining to the use of birth control. Furthermore, while it is clear that higher education is associated with higher levels of health care, it is anticipated that between the literate and the illiterate, there is a broad division in terms of health care.

In order to obtain a measure for income, three indicators were tested; income per capita, % total income going to the bottom two quintiles of the population, and income per capita for the bottom two quintiles. Income per capita is commonly used as a measure for income in cross-national studies. The other income indicators were tested since there is some evidence that the income of the poor is more closely associated with fertility than the income of the total population:[178]

> By now it is clear that both levels and rates of growth in economics have relatively little association with levels or rates of change in fertility. Some researchers have suggested that the lack of association is due to the fact that income changes for the poor majority, who bear the large majority of children, are muffled out of in national aggregates by income changes for the minority of the population with the majority of purchasing power. Correlations between changes in income levels of the poorest 40 per cent of a population and national fertility are reasonably close.

The level of correlation between income per capita of the

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[178] Nick Eberstadt, Op. Cit.

bottom two deciles and general fertility rate is +.18, and the correlation between income per capita and general fertility rate and % income going to the bottom two quintiles and general fertility is +.11 and +.15 respectively. These data are available for individual districts from the Central Bank of Sri Lanka.[179] Unfortunately, these data were compiled over a two-month period and may contain distortions due to the fact that farm incomes fluctuate seasonally.[180] Furthermore, there is no way of knowing the extent to which these data represent farm incomes. As better than 50% of the population employed in the dry zone derives its income from agriculture, it is probably likely that the Bank of Sri Lanka data reflects farm incomes to some extent, but this is not certain. It is important to note that these data provide a measure of gross incomes rather than net incomes. Field studies indicate that yield is more closely related to gross income than net income.[181] Even if a high correlation is obtained, it is likely that the relationship

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[179] Unpublished data obtained from the Central Bank of Sri Lanka by Dr. Barrie M. Morrison

[180] If all districts had the same farm population, this might not pose a problem. However, the population which is employed in agriculture varies from a low of 33% in Jaffna to a high of 78% in Polonnaruwa.

[181] For instance, in Anuradhapura, operators under minor schemes obtained higher net income than farmers under major schemes, even though farmers under major schemes had higher yields and higher gross income. This is because farmers under minor schemes incurred less expenses. See ARTI, Op. Cit., p.92.

between agricultural development and net disposable income is not so strong as the data might suggest. Particularly where equation 4 is concerned, statistical results based upon the income data must be accepted with considerable caution.

There are several ways in which cultural factors might influence fertility, and six different indicators were tested: %Tamil, %Moor, %Sinhalese, %Hindu, %Muslim, and %Buddhist. While each ethnic group showed a strong correlation with its corresponding religion, only two of the above six indicators were highly correlated with general fertility rate.[182] The correlation between %Muslim and general fertility rate is +.6541, and the correlation between %Moor and general fertility rate is +.6530.[183] In order to measure cultural factors, % Muslim is used. In the districts under study, Muslims account for just under 16% of the total population. Hindus and Buddhists comprise an additional 74% of the population, and the remaining 10% is predominantly Christian. These data are available from the Department of Census and Statistics, and are well reported.[184]

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[182] Tamils are almost invariably Hindus, Sinhalese are almost invariably Buddhists, and Moors are almost invariably Muslims.

[183] Correlation coefficients for the other indicators are provided in Table 11.

[184] Statistical Abstract of Sri Lanka, 1973 Table 21, Percentage Distribution of the Population by District and Religion - Census 1971, Department of Census and Statistics, Colombo, 1975, p.38 + Table for Ethnic Comp.

Average size of small holdings (ASSH) is used as a measure for the size distribution of agricultural holdings within the paddy sector. Average size of small holdings is used rather than average size of holdings, since paddy is a small holders crop. All holdings less than 50 acres were classified as small holdings, a figure which includes larger paddy holdings found in some districts but excludes most commercial estates. The average size of small holdings ranged from 1.3 acres to 5.8 acres in the districts under study.

The percentage of paddy transplanted in each district, and the percentage of major irrigation in each district, are available from the Statistical Abstract for Sri Lanka.[185]

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[185] See Table 67, 'Paddy: Cultivation Details - Maha 1970-71' and Table 63, 'Paddy: Extent Cultivated and Yield - Maha 1970-71'. Agricultural data may be subject to reporting error, although data on water supply conditions is probably fairly accurate.

Table 12: Correlations Between Alternative Indicators and General Fertility Rate

Variable	Indicators	Correlation Coefficient
Mortality	CDR	+.1383
	IMR	+.6167
Literacy	FLIT	-.8084
	MLIT	-.7822
Income	I/capita	+.1108
	I/capita (lower 2 deciles)	+.1845
	% Total I (to lower 2 deciles)	+.1485
Culture	% Moor	+.6530
	% Muslim	+.6541
	% Tamil	+.0898
	% Hindu	+.0712
	% Sinhalese	-.3300
	% Buddhist	-.2816

Chapter IV

1. Introduction

The primary objective of this study is to determine whether agricultural development provides some explanation for fertility differentials in the dry zone of Sri Lanka in 1971. Diagram II, which is based on Yotopoulos' scheme for economic and demographic interactions, provides a useful frame of analysis since it envisages possible linkages between agricultural development, various economic and social indicators, and fertility. The relative strength of different hypotheses underlying diagram II were tested, using path analysis as described in chapter III. It is the purpose of chapter IV to present the statistical findings obtained, and to provide an analysis. The analysis is not based solely on the numerical results obtained, which are based on aggregate data representing the twelve dry zone districts, but takes into account quantitative and qualitative information available from case studies. Wider implications of the findings are presented in a separate section, which appears at the end of this chapter.

2. Statistical Results and Conclusions

Statistical results obtained from the regression equations presented in the previous chapter included path coefficients (beta values) representing the 'direct causal'

effects in model 1.[186] These coefficients are represented in the following path diagram:

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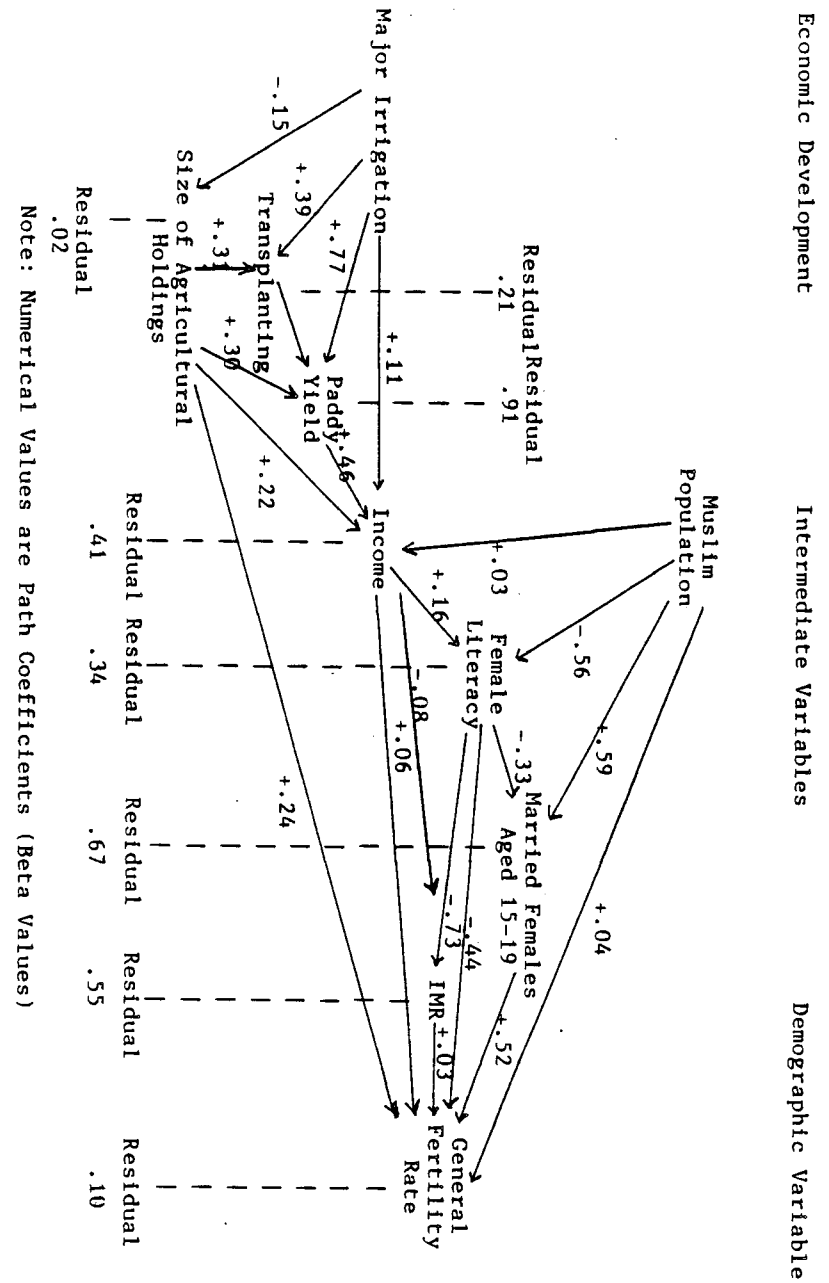
[186] See Chapter III.

Diagram III

Path Diagram Depicting the Relative Strength of Relationships Among Different Variables and Fertility



In order to calculate the 'indirect causal' effects between variables represented in path diagram I, and to discriminate between causal and non-causal effects, the following decomposition table was constructed following procedures outlined in the SPSS manual:[187]

Table 13: General Decomposition Table for Path Model I

Bivariate Relationship	Total Covariance (A)	Direct (B)	Causal Indirect (C)	Total (D) (B+C)	Non-Causal (E) (A-D)
GFR,IMR	.62	.03	-	.03	.59
GFR,FLIT	-.81	-.44	-.19	-.63	-.17
GFR,I	.18	.06	-.10	-.04	.23
GFR,M	.65	.04	.26	.30	.35
GFR,ASSH	.30	.24	-.02	.23	.07
GFR,AM	.91	.52	-	.52	.39
IMR,FLIT	-.74	-.73	-	-.73	-.01
IMR,I	-.19	-.08	-.11	-.19	.01
AM,FLIT	-.66	-.33	-	-.33	-.33
AM,M	.77	.59	.18	.77	.00
FLIT,M	-.56	-.56	.00	-.56	.00
FLIT,I	.14	.16	-	.16	-.02
I,M	.03	.03	-	.03	.00
I,MI	.47	.11	.35	.46	.01
I,PY	.61	.46	-	.46	.15
I,ASSH	.32	.22	.18	.40	-.08
PY,T	.64	.30	-	.30	.34
PY,MI	.83	.77	.06	.83	.00
PY,ASSH	.26	.30	.09	.39	-.13
T,ASSH	.25	.31	-	.31	-.05
T,MI	.34	.39	-.05	.34	.00
ASSH,WSC	-.15	-.15	-	-.15	.00

It is clear from column B of the above table that the best predictor of general fertility rate is %married females

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[187] Norman Nie, et. al., SPSS, Second Edition, McGraw-Hill, New York, 1975, pp.287-289

aged 15-19 years (+.52). This finding supports the hypothesis that high age at marriage influences fertility because it reduces exposure to sexual intercourse and effectively shortens the number of childbearing years which a woman has. The hypothesis appears to have considerable explanatory power insofar as the explanation of 1971 fertility differentials in the dry zone is concerned. Findings in the World Fertility Survey which indicate that rising age of marriage was the main cause of fertility decline in Sri Lanka during the period from 1960 to 1970 support this conclusion.[188]

The next best predictor of general fertility rate is female literacy (-.44). As mentioned previously, female literacy is employed as an indicator rather than some measure of female education in order to broaden the scope of analysis. The use of this indicator has one major drawback, in that it is not possible to discriminate the mechanism(s) which account for many of the statistical associations found. For instance, the indicator female literacy takes into account all of the female population with formal education. It is therefore not possible, on the basis of the statistical results obtained, to come to precise conclusions with respect to such things as whether or not the relation between female literacy and female age at marriage is primarily due to the relation between higher education and marriage postponement. Such extrapolations must

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[188] See the discussion on age and marriage and fertility in Chapter II of this thesis.

be made on the basis of findings in other studies and various theoretical considerations, and cannot be concluded directly from the statistical results. It was suggested in chapter II that high female literacy should lead to low fertility due to a number of mechanisms. The above statistical result lends support to several of the hypotheses presented in chapter II: 1) educated women have lower fertility because women generally desire less children than men, and as women become more highly educated their control over family planning decisions increases; 2) traditional attitudes toward family size and family planning change as levels of education increase, and 3) higher education often facilitates increased knowledge of birth control techniques.[189] This conclusion is consistent with Mary Bishop's evidence that feminine self-determination had become a real force in marital fertility decisions in Sri Lanka by 1970. Abayaratne and Jayawardene's evidence that high education in Sri Lanka leads to increased aspirations for social mobility and a desire for small families provides another possible reason for the strong statistical relation between female literacy and fertility. It is clear from the evidence presented in the discussion on contraception and fertility that the use of family planning methods by Sri Lankan women has greatly increased since the 1950's, and that this may provided one of the best explanations for the strong direct effect between

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[189] See discussion on the relation between education and fertility in chapter II.

female literacy and fertility.

The results reported in the previous two paragraphs indicate that fertility is directly influenced more by age of marriage than female literacy. However, as is clear from column D, when both direct and indirect effects are taken into consideration female literacy has a greater influence on general fertility rate (-.63) than %married females aged 15-19 (+.52). This is due primarily to the effect of female literacy on %married females aged 15-19 (-.33). Given that prior to 1971 in Sri Lanka, increased age at marriage was almost entirely due to an increase in the number of females obtaining higher education, this finding is not surprising.[190]

It was hypothesized in chapter II that high female literacy should be associated with low fertility due to a link between female literacy and infant mortality. The statistical results obtained indicate that the relationship between female literacy and infant mortality is relatively strong (-.73), and provide support for the hypothesis that quality of child care is positively related with high female literacy. The extent to which literacy, breastfeeding, and infant mortality are related cannot be determined on the basis of these results. It must be concluded however, that even though high female literacy is associated with high levels of child care and low infant mortality, this does not have an appreciable effect on

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[190] See the discussion on education and fertility in chapter II.

fertility. The relationship between infant mortality and general fertility rate proved to be very weak (+.03). It is evident that the child-survival and child-replacement hypotheses do not provide much explanation for fertility differentials in this particular case. Evidently infant mortality has fallen below some critical level prior to 1971, and has ceased to be a major cause of high fertility in the dry zone.

It is important to note that in terms of total causal effect, %Muslim has the third strongest influence on general fertility rate (+.30). While %Muslim does not have a strong direct effect on general fertility rate (+.04), its indirect effects are relatively strong (+.26). This is primarily due to the effect of %Muslim on %married females aged 15-19 and female literacy. The total causal effect of %Muslim on these indicators is +.77 and -.56 respectively. These findings support the hypothesis that levels of schooling are relatively low for Muslim girls, and that this is likely due to various socio-economic and religious factors peculiar to the Muslim community.[191] The net result is that Muslim women tend to marry earlier than women from other religious communities.[192] This, probably more than any other factor, accounts for the high

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[191] See discussion on cultural factors and fertility in chapter II.

[192] Department of Census and Statistics, 1978, Op. Cit., p.79

levels of fertility in districts with large Muslim populations:[193]

> Differentials in fertility are most affected by differentials in age at marriage. For example, fertility declines with increasing levels of education, almost entirely because better-educated women marry later. The high fertility of the Muslims is due mainly to their early age at marriage...

The hypothesis that culture influences fertility by virtue of its effect on income proved to be weak, since the total effect of culture on income was negligible (+.03), and because the total effect of income on fertility was also negligible (-.04).

It is evident from the path diagram as well as from the general decomposition table that those hypotheses concerning the relationship between water supply conditions, farm management practices and yield are probably valid. There is also some support for the hypothesis that paddy yield might be positively associated with income, since the direct effect of paddy yield on income is +.46. The total causal effect of water supply conditions on income is also +.46, largely due to the effects of water supply conditions on transplanting and yield.

The information provided in the decomposition table indicates that there is little support for any of the

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[193] Ibid., p.154

hypotheses linking agricultural development with fertility, particularly those hypotheses which suggest that agricultural development might influence fertility by virtue of its effects on income. While there is some evidence that agricultural development is associated with high income, there is nothing to suggest that income has much influence on fertility either directly or indirectly. The total effect of major irrigation on paddy yield is very strong (+.83), while the total effect of major irrigation on income is somewhat weaker (+.46). The relation between major irrigation and income is due almost solely to the direct effect of paddy yield on income (+.46). The relation between high income and female literacy was positive, as hypothesized, but relatively weak (+.16), and the total causal effect of income on general fertility rate is only -.04. It is of interest that the total effect of female literacy on infant mortality (-.73) proved to be greater than the total effect of income on infant mortality (-.19). The effect of high income on infant mortality might be greater if it were not for the existence of the Government food subsidies, which diminish the importance of income to nutrition. It has been estimated that food subsidies increase the real income of poor families in Sri Lanka by about 20%.[194] Even so, it is unlikely that income would be a better predictor of infant mortality than female literacy, given the results obtained in

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[194] Isenman, Op. Cit., p.240

other studies:[195]

> Many observers argue, in fact, that ignorance is a more deadly foe of young children than poverty is - though the two so often go together that it is difficult to separate their effects. But the evidence seems to support their contention...In Sri Lanka, more than 44 percent of the adult women have completed primary school, and virtually everyone in the younger age-groups learns at least to read and write. In Pakistan and Bangladesh in the mid-seventies, by contrast, only about 10 percent of the girls finished primary school. The difference is reflected in their infant mortality rates of 142 and 139 respectively, compared with Sri Lanka's of 42. On the other side of the coin are wealthy countries such as Libya and Gabon where illiteracy is still widespread and infant mortality, not surprisingly, remains high.

There is some support for the hypothesis that fertility in the dry zone is at least partly a function of farm size.[196] The direct causal effect of size of agricultural holdings on fertility is +.24, indicating that fertility increases as farm size increases. This finding supports the hypothesis that levels of fertility should be positively associated with farm size because: 1) labour requirements increase as farm size increases and children are a major source of farm labour in traditional societies, 2) children provide security for heads of farm families when they reach old age,

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[195] Kathleen Newland, "Infant Mortality and Health in Societies", WorldWatch Paper No. 47, Dec. 1981, pp.26-27

[196] See discussion in chapter II.

and 3) farmers with small holdings have fewer numbers of children in order to prevent fragmentation of holdings into economically unviable units. It is interesting that in Manupur, small holders will risk land fragmentation by having large numbers of children in order to avoid having to hire outside labour.[197] Also, it is believed that by having more children, farmers can increase the size of their holdings if they are lucky enough to have sons.[198] According to Mamdani, this phenomenon can be reversed providing labour saving technology becomes available to small holders.[199] In the dry zone, many of the small holdings are found in colonization schemes, where the existence of various co-operatives, and the availability of 2-wheel tractors and other labour saving devices reduces the need for children. Furthermore, it is not legally possible for farmers to increase the size of their holdings within colonization schemes, so there is no incentive to use children as a means of future land aquisition. The factors which influence the fertility patterns of small holders in Manupur are clearly different from those influencing small holders in the dry zone.

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[197] Mahmood Mamdani, The Myth of Population Control: Family Caste, and Class in an Indian Village, Monthly Review Press, New York, 1972, p.76.

[198] Ibid., p.77.

[199] Ibid., pp.77-78

The total effect of average size of small holdings on yield was +.40, which lends support to the hypothesis that agricultural productivity increases with farm size. However, the maximum figure for average size of small holdings obtained for districts in the sample was 5.8 acres. These findings are therefore quite consistent with findings reported in the ARTI studies which indicate that agricultural productivity increases until farm size reaches about six acres, from which point it begins to decline.[200] The relationship between major irrigation and farm size was negative as expected, but very weak (-.15).

It is clear that agricultural development has probably not influenced the rate of fertility decline in the dry zone during the period from 1946 to 1971. Districts with high levels of agricultural development in 1971, as measured in terms of water supply conditions and per acre yields, were the same districts which had high levels of agricultural development in 1950 and 1960, and the rate of agricultural development during the period under study has been greatest in these same districts. This is not surprising, since districts which have been beneficiaries of major irrigation projects would naturally show the most rapid increases in major irrigation over time, and the greatest increases in yield per acre over time. The net decrease in fertility in districts with high levels of agricultural development during the 1946-1971

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[200] See discussion on the relationship between farm size and agricultural productivity in chapter 2.

period has not been greater than the net decrease in fertility in districts with low levels of agricultural development. Furthermore, if agricultural development has been a factor in fertility decline, and if the rate of agricultural development varies from district to district, it might be expected that 1971 differentials in agricultural development would provide some explanation for 1971 district-wise fertility differentials. This clearly is not the case.

3. Government Policy and Fertility

It was suggested in chapter 2 that agricultural development might influence fertility through mechanisms involving income and nutrition, which lead to a reduction of mortality and by extension, a reduction of fertility. It was also suggested that increases in income associated with higher agricultural productivity might result in lower fertility, since increases in income could result in higher expenditures on schooling. However, there is considerable evidence that increases in levels of nutrition, health, and education during the period from 1946 to 1971, and decreases in mortality during the same period, are largely the product of GOSL social welfare policies, and have little to do with achievements in agricultural development. A brief overview of GOSL social welfare policies is therefore in order.

The GOSL has been committed to a high level of social welfare expenditure since Independence. As Minister of Finance J.R. Jayawardene stated in 1948: "We are spending both from

current revenue as well as from loan funds a sum of Rs. 270.6 million, or about 40% of our total expenditure, on welfare services".[201] From 1950 through to the mid-1960's approximately 30% of total annual Government expenditure was allocated to transfer payments.[202] The bulk of these funds went toward food subsidies (rice and sugar) and the expansion of health and educational services.[203]

The effectiveness of the GOSL's malaria control programme, first introduced in 1946, has already been discussed. There is evidence, however, that the rapid decline in crude death rates which occurred during the late 1940's was at least partly due to the development of health care facilities in rural areas.[204] A policy of spreading health care facilities in rural areas rather than concentrating them in urban centres was adopted in the middle 1940's, and considerable emphasis was placed on the construction of maternity centres. The expansion of medical and para-medical

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[201] Godfrey Gunatilleke, Welfare and Growth in Sri Lanka, Marga Institute, Marga Research Study Series-2, Colombo, 1974, p.6

[202] Ibid., p.17 and p.24

[203] For a brief overview of the GOSL development strategy from about 1940 onwards, see Ibid. Similar information is provided by Carr-Gregg. See John R.E. Carr-Gregg, "The Colombo Plan: A Commonwealth Program for Southeast Asia", in International Conciliation, No. 467, Jan. 1951, pp.42-43.

[204] See R.H. Gray, Op. Cit., pp.217-221.

services continued during the 1950's and 1960's in accordance with the GOSL's committment under the Colombo Plan. Isenman reports that maternal mortality declined from 16/1000 in 1946 to 1.2/1000 in 1970, and notes that this decline was at least partly due to the spread of maternity care. By 1980, more than two-thirds of all births took place in hospitals or maternity centres.[205] Medical services have been free of charge in Sri Lanka since the 1940's and there can be little doubt that Government policies have had considerable impact on levels of health and mortality in general, and on levels of maternal and infant mortality in particular.

The food subsidization scheme has generally been the most expensive component of the GOSL's social welfare strategy. In 1948/49, food subsidies accounted for 35% of total transfer payments, and in 1951/52 this figure rose to 65%.[206] Even during the late 1960's food subsidies accounted for about 20% of total current expenditure by the Government.[207] In 1952 the UNP Government (United National Party) faced a major financial crisis due to serious reverse in the terms of trade, and in order to balance accounts the food subsidies were drastically

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[205] Paul Isenman, "Basic Needs: The Case of Sri Lanka", in World Development, Vol.8, No.3, March 1980, p.240

[206] Godfrey Gunatilleke, Op. Cit., p.15

[207] Paul Isenman, Op. Cit., p.240

reduced.[208] Expenditures by the Government on food subsidies in 1953/54 were only 5% of what they were in 1951/52. This resulted in violent demonstrations throughout the country, and was a major factor in the UNP's defeat by the SLFP (Sri Lanka Freedom Party) in the 1956 elections. The food subsidies were fully restored by the SLFP, and since 1956 no Government has seriously attempted to remove them because of the attendant political risks.[209] 1945 through to 1971 was therefore a period of almost uninterrupted social welfare spending.[210]

There is evidence that GOSL food subsidies have increased the nutrition of the poor and may have contributed to the decline in mortality which began in the late 1940's and continued until the early 1970's.[211] Government food rations accounted for about 20% of caloric intake for families earning less than 400 Rs./ month, and 15% of caloric intake for families earning between 600 and 1000 Rs./month in 1969/70.[212] It has been shown that increases in the level of mortality which occurred in 1974 can be directly attributed to cutbacks

[208] Godfrey Gunatilleke, Op. Cit., p.15

[209] Excepting the UNP in 1977

[210] The UNP Government realized in 1965 that there was a need to increase the funding of economic development programmes, but additional funds were obtained more from foreign aid than by a reduction of transfer payments. See Godfrey unatilleke, Op. Cit., pp.24-26.

[211] Paul Isenman, Op. Cit., pp.240-242

[212] Ibid., p.241

in the food subsidization scheme, and were not due to changes in age structure or a deterioration of health services.[213] The importance of higher agricultural productivity and income to mortality would be minimal, given the existence of the food subsidization scheme. Food has always been available to the poor, even during periods when it was necessary to import it.

Similarly, the dramatic increase in literacy which occurred between 1946 and 1971 is in large part a direct result of GOSL policies. A Bill for Free Education was introduced into State Council in 1943, and a programme which provided free education at all levels existed by 1945.[214] Table 14 shows that while 41.6% of the total population had no schooling in 1953, only 16% of the population remained without schooling in 1970:[215]

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[213] Paul Isenman, Op. Cit., p.241

[214] Godfrey Gunatilleke, Op. Cit., p.4

[215] Ibid., Table 15, p.99

Table 14: Percentage Distribution of Population by Education - 1953, 1963, and 1969/70

	1953	1963	1969/70
No Schooling	41.6	36.6	16
Primary	46.8	39.3	39
Secondary	9.8	19.6	32
Passed GCE/SSC	0.9	3.4	12
Higher and Technical	0.9	1.1	1
	100.0	100.0	100.0

While male literacy increased from 628/1000 in 1946 to 785/1000 in 1971, female literacy increased from 468/1000 to 709/1000 during the same period.[216] Table 15 illustrates the level of education according to age and sex in 1971:[217]

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[216] Census of Population, Department of Census and Statistics, Colombo, 1971, p.113

[217] Ibid., Table 8.3, p.114

Table 15: Literacy Rates by Sex and Age - 1971

Age	Literacy rates per 1000 Total	Male	Female	Ratio of male rate to female rate (percentage)
10 & over	785	856	709	120.7
10-14	830	837	823	101.7
15-19	867	883	851	103.8
20-24	871	910	831	109.5
25-29	847	910	783	116.2
30-34	824	904	738	122.5
35-39	745	863	625	138.1
40-44	749	867	613	141.4
45-49	701	840	544	154.4
50-54	687	833	513	162.4
55-59	639	791	453	174.6
60-64	605	756	410	184.4
65-69	573	735	375	196.0
70-74	532	699	318	219.8
75 & over	429	608	238	255.5

It is evident from the above table that the gap between male and female literacy has narrowed since 1946. Perhaps most interesting however, is the fact that females of childbearing age show relatively high literacy. Progress in

literacy during the period from 1946 to 1971 is mainly due to Government success in expanding educational facilities throughout the country, and the fact that education has been free and therefore accessible to the general population.[218] Clearly, most achievements with respect to improved nutrition, reduced mortality and increased literacy during the period from 1946 to 1971 were due to various government programmes and are not attributable to agricultural development.

While it has not been the main purpose of this study to explore policy issues, some of the findings have definite policy implications. It is evident that achievements in mortality and fertility decline in Sri Lanka are in large part the direct result of government programmes which provided for malaria control, the extension of health services, the supply of food subsidies to the poor, and mass education.[219] The findings in this study should be of interest to policy makers in developing countries insofar as they demonstrate the importance of mass education to development.[220]

Early advocates of free education in Sri Lanka considered mass education to be essential to the development

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[218] Census of Population, Op. Cit., p.113

[219] And to a lesser extent, the promotion of family planning.

[220] This study has not specifically addressed the ways in which education contributes to economic development. It is widely accepted that education is beneficial in this regard.

process:[221]

> "It is not difficult to see that among the objectives that would dominate national policies after the war will be the prevention of unemployment, the raising of the standard of living of the masses, increased production, a more equitable system of distribution, social security, promotion of co-operative enterprise, etc. But as none of these things can be fully realized without mass education we are of the opinion that free education must come first and foremost."

Investment in mass education is all too often regarded as a luxury only to be adopted by socialist governments interested in promoting equality of opportunity. On the contrary, mass education is a fundamental and integral part of the development process. Mass education should be a matter of serious concern in all countries where a condition of low mortality and low fertility has not been achieved. As Caldwell has suggested: "It seems probable - and has yet to be demonstrated - that any society can sustain stable high fertility beyond two generations of mass schooling".[222] Fernando concludes that "fostering marriage postponements and increasing the

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[221] As put forward by the Special Committee on Education in support of free education. Cited in K.M.H. Sumathipala, Op. Cit., p.278. It is interesting that the Special Committee advanced this view in 1943, a full twenty-one years before T.W. Schultz advanced his theories on human capital and economic development. See T.W. Schultz, Transforming Traditional Agriculture, Yale University Press, 1964. It is nowhere evident, however, that the Special Committee considered mortality and fertility decline to be integral to development.

[222] Caldwell, 1982, Op. Cit., p.305

educational attainments of women appears to be the most pragmatic approach to controlling Sri Lankan fertility".[223]

The relative importance of the GOSL's Family Planning Programme has previously been noted. While rising in age at marriage can lead to dramatic declines in fertility over the short term, the reduction of marital fertility is essential if sustained low fertility is to be achieved. There is evidence that family planning is becoming increasingly important since 1973.[224] Fernando calculates that Sri Lanka's crude birth rate will decline from 29.4 in 1976 to 27.5 in 1981 solely on the basis of decreasing marital fertility rates.

4. A Final Note

Yotopoulos' conceptual fram has proved useful insofar as an analysis of the relation between agricultural development and fertility in Sri Lanka's dry zone is concerned. However, it is clear that for the analysis of fertility differentials in the dry zone, that portion of Yotopoulos' frame which deals with economic development is unnecessary. This is largely due to the weak relation between income and fertility, which may be peculiar to Sri Lanka.[225] Similarly, mortality does not appear

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[223] Dallas F.S. Fernando, 1979, Op. Cit., p.139

[224] See Dallas F.S. Fernando, 1976, Op.Cit., p.42

[225] Food subsidies, free education, and free health care all minimize the importance of income to fertility in Sri Lanka. This distinguishes Sri Lanka from many Third World countries.

to be critical to an analysis of dry zone fertility differentials.

Components of Yotopoulos' theoretical frame which are most useful in the analysis of dry zone fertility differentials are theories concerning the relation between cultural factors, education, age at marriage, and marital fertility. While data on ethnic composition, education levels and age at marriage are available for individual districts of Sri Lanka, it is clear that village level studies are necessary before the relationship between culture, education, and other factors affecting age at marriage and marital fertility can be thoroughly analyzed. As marital fertility rates decrease, it becomes increasingly important to obtain reliable information on contraceptive practices and factors which influence the rate at which they are adopted.

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Appendix I
Map Showing Area Designated as Dry Zone