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Proximate Determinants of Fertility Decline in Athoor Block of Tamil Nadu State in India, 1959-1985

Introduction

A THOOR block in Tamil Nadu state of India has experienced remarkable decline in its fertility levels since the late 1950s. Surveys conducted in this block during different periods show that crude birth rate (CBR) in this block was 43.1 in 1959 and it declined to 25.6 by 1984-85. The decline in CBR for Tamil Nadu and for all India was much lower as it is evident from the Census- and Sample Registration Scheme (SRS)-based estimates. The CBR was 34.9 during 1951-61 and 28.4 in 1984 for Tamil Nadu, and 41.7 and 35.3, respectively, for all India. As it will be discussed later, the refined fertility measures such as total fertility rate and total marital fertility rate also indicated a similar trend in the decline of fertility in Athoor block. As Athoor block is one of the backward areas in the district and also in the state (to be discussed later), the rapid decline of fertility in this block is unprecedented. However, this block had the benefit of receiving additional inputs in terms of maternal and child health and family planning services during the 1960s and 1970s, being implemented by a few voluntary organisations located in the same block.

Though there are attempts to study the determinants or components of fertility decline at all India level (e.g. Jain and Adlakha 1982; Retherford and Rele 1989), such studies at sub-national level or for small areas are rare. Athoor block provides a unique opportunity for such a study as there exists fertility data for over a quarter century (since 1959). Hence, utilizing the available data, this paper attempts to study the trend in fertility decline and its proximate determinants in Athoor block since the late 1950s. Before going into the details of fertility decline in this block, it is worthwhile to have an account of the background characteristics and of the programmes undertaken in this block.

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Athoor Block: Background and Programmes

Athoor block is a rural community development block in the Dindigul Anna district (bifurcated from Madurai district in 1985) of Tamil Nadu state in India. This block had a population of 131 thousands in 1981, living in 3 town panchayat villages and 106 hamlet villages. The area of the block was 233 sq kms and the population density was 559 persons per sq km. A sample survey conducted in this block in 1986 showed that about 88 percent of the population in this block was Hindus, 7 percent Christians and 5 percent Muslims (Rajaretnam *et al.* 1988). The figures for the rural areas of Madurai district in 1981 were 94 percent, 4 percent and 2 percent; and for the rural areas of Tamil Nadu State were 92 percent, 5 percent and 3 percent, respectively (Director of Census Operations, Tamil Nadu 1986a). These figures indicate that the proportions of Christian and Muslim population are relatively higher in this block as compared with the rural areas of the district and also the State as a whole. The proportion of scheduled caste and scheduled tribe (SC/ST) population in this block was 31 percent in 1986, as against 16 percent in Madurai district and 19 percent in Tamil Nadu State, in 1981. The general literacy rate in this block was 24 percent in 1960 (Pilot Health Project 1961) and 55 percent in 1986 (Rajaretnam *et al.* 1988). For Madurai district it was 33 percent in 1961 and 47 percent in 1981 (Director of Census Operations, Tamil Nadu 1986b). However, a neighbouring block viz; Batlagundu showed a literacy rate as high as 61 percent in 1986 (Rajaretnam *et al.* 1988). Only about one-fourth of the households of this block in I960 owned land (Pilot Health Project 1961). The proportion of males (5+ age group) engaged in own agricultural activities in 1986 was 12 percent, whereas it was 19 percent in the neighbouring block viz; Batlagundu (Rajaretnam *et al.* 1988). These evidences indicate that Athoor block is one of the backward areas of the district and also of the State, but there are indications of a faster pace of social development as it is evident from the trend in the literacy rate.

The age structure of the population of Athoor block has undergone substantial change between 1965 and 1986. For example, the proportion of population in the 0-4 age group declined from 15 percent in 1965 to 11 percent in 1986; and that in the 0-14 age group from 39 percent to 33 percent, respectively. Correspondingly there has been an increase in the proportion of old age (60+ age group) population from 5.3 percent in 1965 to 7.5 percent in 1986 (Krishnamoorthy and Muthiah 1972a; Rajaretnam *et al.* 1988). The proportion of population in the 0-14 age group for Madurai district was 38 percent in 1961 and 36 percent in 1981, and that for Tamil Nadu State were 38 percent and 35 percent respectively (Superintendent of Census Operations, Madras 1966; Director of Census Operations, Tamil Nadu 1986b). The figures obtained from the Sample Registration Scheme for rural Tamil Nadu in 1987 was 33 percent (Registrar General, India 1990). The relatively faster decline in the 0-14 age group population of Athoor block is an indication of the faster decline in its fertility levels.

In Athoor block, a number of intensive health and family planning programmes were undertaken since the late 1950s. From 1962, with the introduction of extension approach

to family planning programme at all India level, the Gandhigram Institute of Health and Family Welfare Trust, Gandhigram (previously called the Gandhigram Institute of Rural Health and Family Planning, and during the early 1960s, it was known as Pilot Health Project) (hereafter called the 'Institute') was carrying out extensive health and family planning activities in this block. In 1965, the family planning programme in this block was integrated with maternal and child health programme with one auxiliary-nurse-midwife (ANM) for 5,000 population (in the other areas it was one ANM for 10,000 population at that time). The family planning programme in this block was implemented through the two Primary Health Centres (PHCs) of this block with the administrative and supervisory control of the whole programme being vested with the Institute (in the other areas it was with the State Government).

A number of approaches were tried in the implementation of health and family planning programme in this block. While evolving approaches, much attention was paid to developing and implementing the programme on a phased manner, placing more emphasis on extension education and making available the services nearer to the public. Training and involving of village leaders, satisfied acceptors, traditional birth attendants (dais), indigenous medical practitioners, women clubs, and voluntary workers was also given importance (Pisharoti *et at.* 1971). The experiences gained from this block were then extended to the neighbouring 6 blocks since the late 1960s by the state Government wherein the Institute provided only technical guidance. The intensive programme in Athoor block by the Institute continued'until the two PHCs were handed over to the Government in 1973. Even after handing over the PHCs, the Institute undertook a few health and family planning projects in the whole block or in selected villages, either directly or through the Government PHCs (Rajaretnam *et al.* 1988: Gandhigram Institute of Rural Health and Family Welfare Trust 1988).

Sources of Data

The first set of information on fertility in Athoor block is made available by the survey conducted in this block in 1960. This survey covered a sample of over 6,000 households, and provided selected population statistics for 1960 and fertility estimates for 1959. The second source is the prospective 'Standard Fertility Survey' conducted in this block during 1965 to 1969, which consisted of a cross-sectional survey of about 3,000 households (selected according to stratified random sampling procedure) in 1965 and a number of repeat visits to these and a sample of substitute households once in 6 months. Similar cross-sectional surveys were conducted in 1971, 1974 and 1976 with almost similar sampling design.

In 1977, under a 'Revised Family Planning Project', a complete enumeration of all (around 30,000) households in this block was made in which information on births and deaths were also recorded. As the number of households covered in this survey was very large, it was felt that a good amount of vital events might have been missed, and hence a sub-sample of about 12,000 households were selected and revisited in 1979, which

provided some estimates of fertility for 1978. Later, in 1980, besides updating the schedules canvassed during 1977 to 1979, births and deaths that occurred during January to August, 1980 were enumerated, which provided estimates of CBR for 1980. The last source is the survey conducted in this block in 1986 on a sample of over 4,000 households. This survey provided fertility estimates for 1984-1985.

Trend in Fertility

Crude Birth Rate

Table1 presents survey-based estimates of CBR for selected years between 1959 and 1985 for Athoor block. The estimated CBR for this block was 43.1 in 1959 and it progressively declined to 35.5 in 1964, 31.3 in 1971 and 23.7 in 1980. However, the rate for 1984-85 (hereafter the period will be mentioned as 1985 for convenience) was estimated at 25.6, which is higher than the figure for 1980; probably due to the intensive nature of the survey of 1986 (Rajaretnam 1992). Though the rates showed a declining _ trend at least up to 1980, the rate of decline was not uniform over periods. Between 1959 and 1964, during which period the family planning programme of this block was at its beginning, the birth rate recorded a higher rate of decline (3.8 percent per year) whereas between 1964 and 1971, during which period the family planning programme was at its intensive phase, the decline was very slow (1.9 percent per year). Also, between 1971 and 1980, there are fluctuations in the rate of decline in CBR in the intermediate periods.

The observed irregular trend in the decline in CBR of Athoor block during different periods can be attributed to the real fluctuations in the occurrence of births, or to the age-sex distribution of the population, or to the conduct of the surveys, or to a combination of these factors. So, an attempt has been made to understand the role played by the age-sex structure of the population on the estimated rates. The CBRs adjusted for the age-sex distribution of the population of Athoor block of 1965 and 1986 are also presented in Table-1. The adjusted CBRs clearly indicate that there is almost a smooth declining trend in the rates during the analysis period. The rates adjusted for the age-sex distribution of the population of 1986, showed that the CBR had declined from 41.5 in 1959 to 25.2 in 1985; 39.5 percent decline during the 25 year period. The rates adjusted for the age-sex distribution of the population of 1965 also showed that the overall decline in CBR was as much as 38.5 percent. Further, after adjustments, the differences in the rate of decline in CBR for different periods narrowed: the minimum was 1.24 percent per year during 1974-78 and the maximum was 3.58 percent per year during 1971-74. However, for the combined period 1971-78, the average rate of decline in CBR per year was 2.7 percent only. It is significant to note that after adjustments, the difference in CBR between 1959 and 1964 narrowed, and that between 1978 and 1985 widened, reflecting that the observed large decline in the rate during 1959-64 and the large increase in the rate during 1980-85 are not real. The analysis not only suggests the need for standardization of the

rates for trend and differential analysis but also confirms the smooth declining trend in CBR of Athoor block during 1959-85. The overall decline in the CBR between 1959 and 1985 is about 40 percent, and the average rate of decline per year is around 2 percent.

TABLE 1: UNADJUSTKD AND ADJUSTED CRUDE BIRTH RATES (CBRs) FOR SELECTED YEARS BETWEEN 1959 AND 1985. ATHOOR BLOCK

Year	*CBR*	*CBR adjusted for population of:*			*, % decline per year in CBR during intermediate periods*	
		Athoor 1965	*Athoor 1986*	*Unadjusted*	*Rate adjusted for*	
					Pop'65	*Pop '86*
1959	43.1	38.1	41.5	—	—	—
1964	35.5	35.5	38.1	3.81	1.40	1.70
1971	31.3	30.5	32.8	1.92	2.31	2.27
1974	27.4	27.5	29.4	4.34	3.39	3.58
1978	25.8	26.0	27.8	133	124	124
1980	23.7	—	—	4.16	—	—
1985	25.6	23.6	25.2	1.73	1.48	1 .50

Notes and data sources.

1. The unadjusted CBRs and the ASFRs and ASMFRs used for adjusting the CBRs are obtained from Kachirayan (1978) for the period up to 19;4. unpublished reports for the years 1978 and 1980 and Rajaretnam *el al.* (1988) for the year 1985.
2. The age-sex distribution of the population of Athoor 1965 and 1986 (standard populations) that are used for estimating the adjusted CBRs are derived from Krishnamoorthy and Muthiah (1972a) and Rajaretnam *etal* (1988), respectively. Adjusted rates for 1980 are not obtained due to non-availability of required data.
3. The percentage decline presented is the geometric rate of decline per year. The overall decline in the adjusted CBRs during 1959 to 1985 is worked out to 39 percent, and the weighted average decline per year is 1.9 percent.

GFR. GMFR, TFR and TMFR

Refined fertility measures such as general fertility rate (GFR), general marital fertility rate (GMFR), total fertility rate (TFR), and total marital fertility rate (TMFR) are available for all the survey years except 1980, and are presented in Table 2. The GFR which was 182 in 1959 declined to 109 by 1985; 40 percent decline during the 25 years period. The corresponding decline in GMFR was from 228 to 157, or 31 percent. While the rate of decline in GFR averages around 2 percent per year, the rate of decline in GMFR was below 1.5 percent per year. The TFR which was 4.9 in 1959 declined to 4.0 in 1971 and to 3.0 by 1985. The overall decline in TFR during 1959-85 was 38 percent, or 1.85 percent per year. However, the overall decline in TMFR was relatively low; from 6.0 to 4.2, or 29 percent during the above period, or just 1.35 percent per year.

TABLE 2: OFR, GMFR, TFR, AND TMFR AND RATF. OF DECLINE IN THE RATES DURING DIFFERENT PERIODS BETWEEN 1959 AND 1985, ATHOOR BLOCK, AND TAMIL NADU (RURAL)

Area/Period	*GFR*	*GMFR*	*TFR*	*TMFR*
Athoor block				
1959	182.3	227.9	4.85	5.98
1964	168.9	221.5	4.66	5.87
1971	145.2	200.1	4.04	5.63
1974	125.5	182.7	3.54	5.09
1978	118.4	172.5	3.40	4.76
1985	109.1	156.5	3.01	4.23
% overall decline				
1959-85	40.2	31.3	37.9	29.3
1964-85	35.4	29.3	35.4	27.9
1971-85	24.9	21.8	25.5	24.9
% decline per year				
1959-85	1.99	1.46	1.85	1.35
1964-85	2.11	1.68	2.11	1 .59
1971-85	2.02	1.74	2.08	2.02
1974-85	1.27	1.40	1.46	1.67
1978-85	1.25	1.49	1.86	1.80
Tamil Nadu (rural)				
1972	142.2	166.4	4.40	4.90
1985	96.7	134.9	3.00	4.90
% decline (72-85)				
Overall	32.0	18.9	31.8	0.0
Per year	2.82	1.54	2.80	0.00

Source: For Athoor block, as in Table 1, and for Tamil Nadu, Ministry of Health and Family Welfare (1989).

As compared to rural Tamil Nadu, the rate of decline in GFR and TFR in this block was lower and that of GMFR and TMFR was higher. For, the SRS-based estimates showed that in rural Tamil Nadu, between 1972 and 1985, both GFR and TFR declined at the rate of 2.8 percent per year, GMFR declined at the rate of 1.5 percent per year and TMFR did not show any decline at all (see Table 2). But in Athoor block, between 1971 and 1985, the rate of decline in GFR and TFR was about 2.1 percent per year and that of GMFR and TMFR was between 1.7 and 2.0 percent per year. The analysis, keeping aside the reliability and comparability of the rates as they are drawn from different sources, indicates that the fertility within marriage had declined much faster in Athoor block than in rural Tamil Nadu.

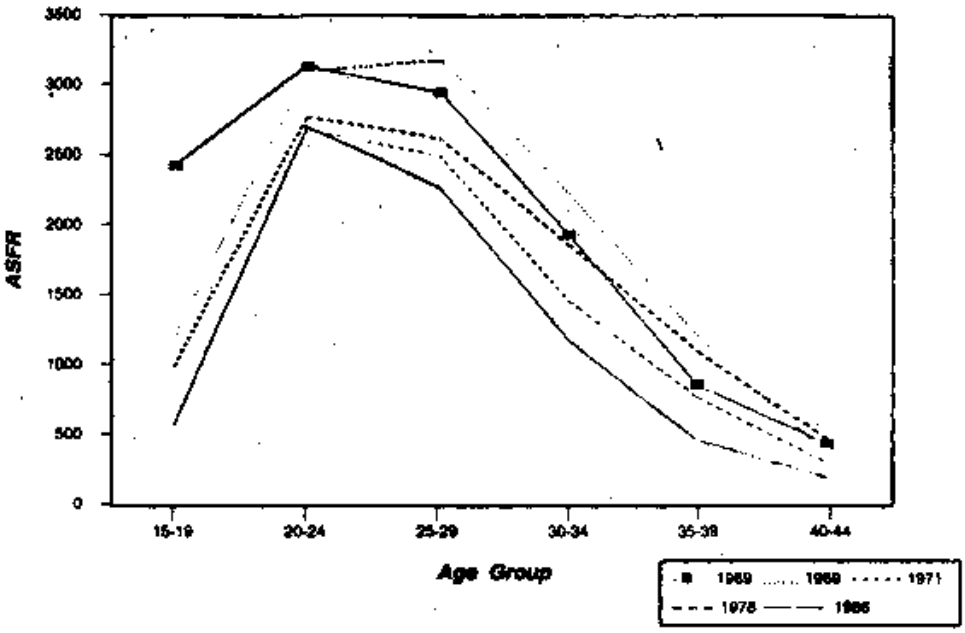

Fig. 1. ASFR for Athoor block

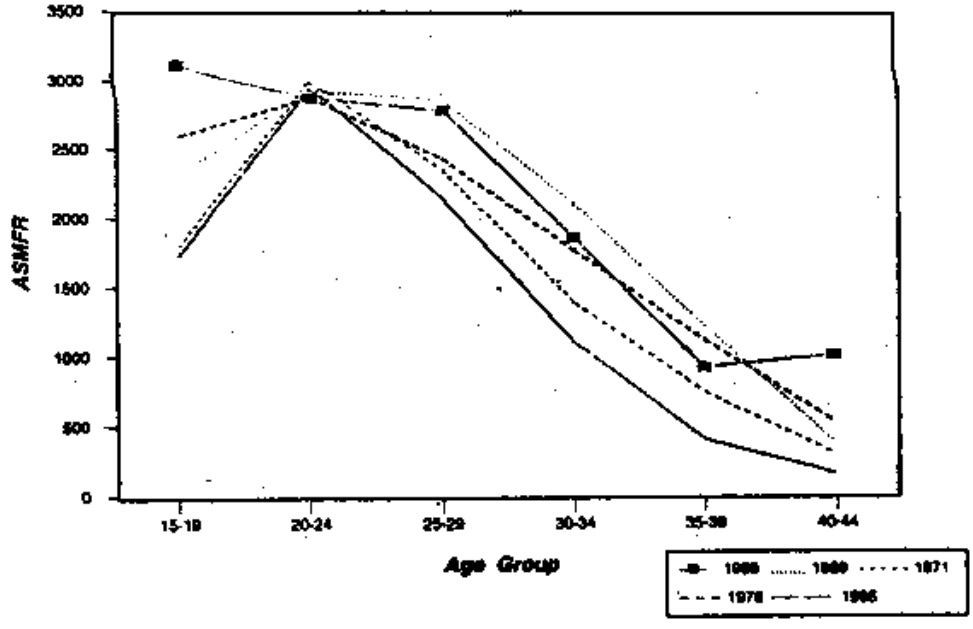

Fig. 2. ASMFR for Athoor block

An analysis of the age-specific fertility rates (ASFRs) and age-specific marital fertility rates (ASMFRs) for selected years between 1959 and 1985 showed that in general there was a declining trend in both ASFRs and ASMFRs in almost all age groups (see Figs. 1 and 2). However, the rate of decline in the rates appeared substantial in the age groups 15-19 and 30+, and moderate in the age group 25-29 and negligible in the age group 20-24. For example, the percentage decline in ASFR between 1964 and 1985 was 50 percent in the age groups 15-19 and 30+, while it was about 30 percent in the age group 25-29 and just 14 percent in the age group 20-24. During the same period, the decline in ASMFR was 50 percent or more in the age group 30+, 25 percent in the age groups 15-19 and 25-29 and no decline at all in the age group 20-24 (Table 3). That is, in Athoor block, the decline of fertility during 1959-85 is contributed largely by the decline in the fertility of women aged 30 and above.

TABLE 3: ASFRs AND ASMFRs FOR SELECTED YEARS BETWEEN 1959 AND 1985, AND PERCENT DECLINE IN THE RATES DURING 1964 TO 1985, AUTHOR BLOCK

Age group	*1959*	*1964*	*1971*	*1974*	*1978*	*1985*	*% dec. 64-85*
ASFR							
15-19	200.9	97.2	80.2	63.8	46.5	45.3	53.4
20-24	260.3	258.3	230.0	226.7	221.6	223.4	135
25-29	245.0	265.1	217.5	215.6	207.0	187.6	29.2
30-34	159.1	183.5	153.0	130.6	119.7	95.8	47.8
35-39	69.6	99.2	89.5	58.8	62.5	36.0	63.7
40-44	34.2	28.0	37.1	14.0	22.4	14.0	50.0
ASMFR							
15-19	310.7	231.1	259.0	220.0	179.6	172.3	25.4
20-24	285.4	291.1	286.0	308. 1	297.8	293.2	-0.7
25-29	275.3	283.2	241.1	250.6	232.9	212.9	24.8
30-34	183.3	208.6	175.1	148.3	138.2	109.5	47.5
35-39	91.5	120.7	110.9	73.8	73.7	41.5	65.6
40-44	99.0	383	52.9	175	30.8	174	54.6

Source: As in Table 1.

Birth Order

The percent distribution of live births by order of birth for different years is given in Table 4. The data show that over the years the proportion of births that are higher orders (especially fourth and higher orders) decreased and that of lower orders increased. The decrease in the percent of higher order births was however steeper since 1971. For

example, up to 1971, the third and lower order births accounted for only 53 to 57 percent, but by 1985, the figure went up to 75 percent. Further, the proportion of births that are sixth and higher orders was just 8 percent in 1985 as against 19 percent in 1971 and 23 percent in 1965. The data show that there is a steep decline in the higher order births during the analysis period especially since the early 1970s.

TABLE 4: PERCENT DISTRIBUTION OF LIVE BIRTHS BY BIRTH ORDER FOR 1964, 1971 AND 1985, AUTHOR BLOCK

Order of birth	*1964*	*1971*	*1985*
1	18.9	20.1	29.9
2	18.4	20.1	27.4
3	15.6	16.7	17.9
4-5	24.0	24.4	16.9
6+	23.1	18.8	7.9
All	100.0	100.0	100.0

Source: Kachirayan and Krishnamoorthy (1976) for the years 1964 and 1971 and Rajaretnam *et al.* (1988) for 1985.

Birth Intervals

Table 5 presents closed and open birth intervals (in months) by birth order/parity. It is to be noted that data on birth intervals were collected only in the surveys conducted in 1965, 1971 and 1974, but it is sufficient enough to assess the impact of the reported intensive family planning programme which was active during this period. The closed birth interval was defined in the surveys as the interval between the last and second last live births, and open birth interval as the interval since the last live birth up to the date of survey (Kachirayan and Krishnamoorthy 1976).

The data show that the mean closed birth interval which was 37 months in 1964 increased to 39 months in 1974: an increase of only two months during the 10 year period. At the same time, between 1964 and 1974 the closed birth interval for the first order births decreased by 6 months, while that for the second order births increased by about 9 months and that for the third order births increased by 3 months. For the fourth and higher order births, the interval remained the same over period. The evidences indicate that between 1964 and 1974, women were becoming more fecund or more free from the clutches of traditional taboos to give birth to their first child quicker after marriage. They were also more conscious to delay their second and third births. Further, the mean open birth interval increased from 43 months in 1964 to 52 months by 1974, and this difference was observed in all parity groups except parities 0 and I. This is an indication of the women's increased consciousness to stop childbearing after having 2 or 3 children. It is to be noted that the very high mean open interval of 56 to 60 months obtained for

the nulli-para mothers might be due to the inclusion of mothers who remained childless for very long periods (mainly due to sterility) at survey.

TABLE 5: MEAN CLOSED AND OPEN BIRTH INTERVALS (in months) HY BIRTH ORDER/ PARTY FOR 1964, 1971 AND 1974. ATHOOR BLOCK

Birlh order	*Closed birth interval*			*Parity*	*Open birth interval*		
	1964	*1971*	*1974*		*1964*	1971	1974
1	34.0	31.8	28.0	0	55.8	57.6	60.6
2	3-55	40.8	44.2	1	42.2	48.7	40.1
3	38.1	40.0	41.3	2	38.8	43.1	53.8
4	39.5	37.4	40.0	3	42.5	43.1	51.1
5-6	39.0	39.0	39.6	4-5	40.1	44.7	51.8
7+	35.9	35.8	36.0	6+	41.2	48.1	55.7
All	37.0	37.6	38.9		42.8	47.0	52.2

Source'. Kachirayan (1978).

Another survey conducted in the same block in 1983 showed that the mean live birth interval was about 28 months, and it was relatively shorter for the first order births and longer but largely constant for all the higher order births. Further, it was found that an increase in age at marriage reduced the first birth interval to some extent, but not the second and subsequent birth intervals (Rajaretnam 1986). These indicate that though the family planning programme was intensive in this block during this period, its focus was more on family size control rather than on childspacing. Kachirayan and Krishnamoorthy (1976) also arrived at the same conclusion while analysing the data for the period 1964 to 1971.

Trend in Proximate Variables

In any population, changes in the levels of fertility are determined primarily by changes in the reproductive performance of the women. Empirical findings suggest that changes in the reproductive performance of women are not uniform over period. They are conditioned by the factors related to exposure to intercourse, conception and gestation and successful parturition. Davis and Blake (1956) identified eleven 'intermediate variables' falling under the above 3 factors. In a later development, Bongaarts (1978; 1982) regrouped these intermediate variables and identified only four variables as "proximate variables,' which together explained almost all the variations in the fertility. They are: proportion married, contraceptive use, prevalence of induced abortion and duration of lactational infecundability. A brief account of the changes in the "proximate variables" that have occurred in the study population over period is presented below.

Proportion Married

Changes in the proportion of women married in the reproductive ages are primarily determined by the nuptiality factors such as age at marriage, marriage dissolution and remarriage, and permanent celibacy. For Athoor block, information on age at marriage and marital dissolution are available for select years only. Further, the available information for 1960 could not be used for trend analysis as it was not based on a representative sample. Furthermore, for the period from 1971 to 1980, information on age at marriage are not available and the data on proportion married obtained from the ASFRs and ASMFRs did not show any systematic trend and hence not used in this analysis. Otherwise, comparable information are available only for the years 1965 and 1986, and selected information compiled for these years are given in Table 6. The singulate mean age at marriage for females increased only marginally from 18.2 in 1965 to 19.9 in 1986. Further, for women who married during January, 1984 to mid-1986, the mean age at marriage was worked out to 18.5, the proportion who married before age 18 was 34 percent and the proportion who married by age 20 was 85 percent. However, the proportion who married at age IS. or earlier was only 9 percent.

TABLE 6: SELECTED INDICES OF NUPTIALITY FOR THE YEARS 1965 AND 1986, ATHOOR BLOCK.

Indices	*1965*	*1986*
Singulate mean age at marriage for females	18.2	19.9
For females who married since January 1984 to mid-1986:		
Mean age at marriage	NA	18.5
% married before age 16	NA	9.2
% married before age 18	NA	34.3
% married by age 20	NA	84.7
Percent of females married:		
15-19 age group	45.2	27.7
20-24 age group	93.6	80.5
Percent of females aged 45-49 never married	0.4	1.1
Percent of females widowed, divorced, and separated (all ages)	15.3	13.1
Percent widowed among ever married females of 15-44 age group	NA	5.2
Percent currently married among ever married females of:		
25-29 age group	93.3	93.5
30-34 age group	89.2	91.4
40-44 age group	72.1	83.5
15-44 age group	89.1	90.9
Currently married women as percentage to total population	16.0	16.1

Source: The rates are derived from relevant tables of krisrmamoorthy and Muthiah (1972a) for the year 1965. and of Rajaretnam *et al* (1988) for the year 198

Other available evidences show that the proportion of females married in the age group 15-19 declined from 45 percent in 1965 to 28 percent by 1986; 39 percent decline during the period of 21 years. The proportion of females married in the age group 20-24 also declined marginally; from 94 percent in 1965 to 81 percent in 1986, or 14 percent decline during the corresponding period. Further, the proportion of females never married in the age group 45-49 was not more than one percent throughout the comparison period. The evidences show that in the study area marriage among females is universal and early, but very early marriages (at age 15 or earlier) are rare. Further, the increase in age at marriage of females is very slow: the increase is less than one your for every 10 year period.

Over the years the proportion currently married among the ever married women of reproductive age 15-44, at least from age 30, increased: for the 40-44 age group, it was 72 percent in 1965 and 84 percent in 1986. The proportion of females widowed, divorced and separated (all ages combined) declined from 15 percent in 1965 to 13 percent in 1986. This is an indication of the declining trend in marriage dissolution among females. However, with all these changes, the proportion of currently married women in the reproductive age group 15-44 to total population remained at 16 percent between 1965 and 1986 and it may be that the observed small increase in the age at marriage of females (that tends to reduce proportion married) has been offset by the small decrease in the marriage dissolution (that tends to increase proportion married), besides the role played by the age-sex structure of the population.

Contraceptive Prevalence

Reliable information on contraception prevalence rate (CPR), defined as the percent of couples of reproductive age group 15-44 using any modern method of family planning at survey, is not available before 1974. The CPR obtained for different years since 1974 are presented in Table 7. The CPR for Athoor bock, which is expected to be nil in 1959, was 20 percent in 1974 and 34 percent in 1986. It is a big handicap that we do not have any reliable estimate of CPR for the period before 1974 that marked the "Athoor experience". However, it was reported by Pisharoti *etal.* (1971) that family planning knowledge and practice in Athoor block increased during the 1960s.

As elsewhere in India, female sterilization is the predominant method of family planning in Athoor block at least since the early 1970s. For example, the 1976 survey showed that the CPR due to tubectomy operation was 14 percent, that due to vasectomy operation was 3 percent, that due to IUD and condom use was each 1 percent and that due to all other methods (not listed) was 3 percent (Kachirayan 1978a). The 1986 survey showed that sterilization operations (mostly tubectomy and laparoscopy methods) accounted for 97 percent of all methods used by couples at survey (Rajaretnam *et al.* 1988).

Lactational Infecundability

Duration of postpartum amenorrhoea (PPA), or duration of breastfeeding, is a major component of lactational infecundability. Its importance lies in the fact that both duration

of PPA and breastfeeding are declining in the recent years, which tend to increase fertility. For Athoor block, the earliest period for which information on duration of breastfeeding and duration of PPA are available is for 1964-69. Some of the later surveys of this block also provided information on duration of breastfeeding and PPA. The available information are compiled and included in Table 7.

TABLE 7: CONTRACEPTIVE PREVALENCE RATE, MEAN DURATION OF LACTATION AND POSTPARTUM AMENORRHOEA (PPA) AND ABORTION RATE FOR SELECTED YEARS BETWEEN 1964 AND 1986. ATHOOR BLOCK

Year	*Contraceptive prevalence rale %*		*Mean duration (in months)*			*Abortion rate per 100 live births*
	All methods	*Permanent methods*	*Lactation*	*PPA (Sur)*	*PPA (Est)*	
1964-69	—	—	22.2	14.4	15.5	—
1971	—	—	—	—	—	5.47
1974	19.7@	18.6@	19.2	14.1	12.8	—
1976	21.4@	16.6@	—	—	—	—
1980	28.4	—	—	—	—	—
1983	—	—	—	—	—	5.91
1986	34.4#	333	18.4	9.6	12.1	—

Notes':

@ Excludes vasectomy cases estimated using indirect methods.

Includes 6 temporary method users detected during repeat visit to the mothers.

Sur Survey estimate.

Est Estimated from mean duration of breastfeeding, as suggested by Bongaarts (1982). *Source:* Kachirayan (I978b; 1978a); Unpublished research note; and Rajaretnam *el al.* (1988) for CPR for the years 1974, 1976, 1980 and 1986, respectively. Krishnamoorthy and Muthiah (1972b), processed from dataon punched cards, Rajaretnam *etal.(* 1988) for mean duration of lactation and PPA for the years 1974, 1976 and 1986, respectively. Abortion rates for 1971 and 1983 were derived from available data files.

In Athoor block, mean duration of breastfeeding declined from about 22 months during the late 1960s to 18 n onths by the mid-1980s, and mean duration of PPA declined from about 14 months to 10 months during this period. However, as the 1986 survey revealed, breastfeeding is universal: over 95 percent of mothers initiated breastfeeding and among those who initiated breastfeeding hardly 8 percent terminated it before 12 mon'hs of age of the child (Rajaretnam, forthcoming). Hence, though the duration of breastfeeding is declining, it is effective only after 12 months of age of the child. However, there appears to be a rapid decline in the duration of PPA as the figures indicate.

Induced Abortion

Information on induced abortion are scarce not only for Athoor block but also for other parts of India, though it has been considered as a proximate determinant of fertility.

In Athoor block, no specific survey was conducted to elicit information on the extent of induced abortion. Nevertheless some surveys did ask the mothers about their practice of induced abortion, though such information are not fully reliable. The data obtained from the 1971 and 1983 surveys, respectively, showed an induced abortion rate of 5.5 and 5.9 per 100 live births (see Table 7). The information available thus indicate that the extent of induced abortion in this block might be very low and almost constant over the analysis period.

Proximate Determinants of Fertility Decline

In order to assess the contribution of the proximate variables on the decline of fertility in Athoor block, three methods are applied. The first is the conventional direct standardisation approach. This method has been used to standardise the CBR of different periods for the age-sex and age-sex-marital status distribution of a standard population so that the contribution of the changes in age-sex structure of the population, proportion of women married in the reproductive ages and marital fertility on the decline of CBR could be assessed. The second method is the decomposition technique used by Retherford and Rele (1989), which decomposes the change in TFR during a period to the change in the nuptiality patterns and in the marital fertility during the same period. The third method is the Bongaarts' proximate variables framework (Bongaarts 1978, 1982). This method dissects the contribution of each of the proximate variables viz., proportion married, contraception, induced abortion and lactational infecundability, on the decline of fertility, not merely the components of fertility as in the above two methods.

Standardisation of CBR

In this method, first, the CBR of Athoor block for different years have been standardised for the age-sex and age-sex-marital status distribution of the population of Athoor block for the years 1965 and 1986. The differences in the unadjusted and adjusted CBRs are then attributed to the change in age-sex structure of the population, proportion married and marital fertility components. The relative contribution of change in marital fertility and proportion married components are also obtained after removing the effect of the age-sex structure of the population. The data and the methodology of estimation are presented in Table 8. It is to be noted that the Table gives the average of the figures obtained based on the two standard populations.

The results show that during the period between 1959 and 1985, the total decline in CBR was 17.5 points, and, of which, 2.1 points is attributed to the change in age-sex structure of the population, 6.4 points to the change in proportion married and the remaining 9,1 points to the change in marital fertility. The relative contribution of each of these factors is 12 percent, 36 percent and 52 percent, respectively. After removing the effect of age-sex structure of the population, the relative contribution of proportion married and marital fertility components stood at 41 percent and 59 percent, respectively. The figures imply that, during 1959-85, the relative contribution of proportion married and marital fertility components are in the ratio 2:3.

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If we consider the period 1964-85, the picture is slightly different, however. During this period, the change in age-sex structure of the population tended to increase the CBR by one-fourth. When the effect of the change in the age-sex structure of the population is removed, the relative contribution of the change in proportion married and the change in marital fertility are in the ratio 3:7. When we move further to the recent periods, it is observed that the relative contribution of proportion married decreases and that of marital fertility increases. For the most recent period, in fact, both the age-sex structure and proportion married components tended to increase fertility, while the marital fertility component did not only offset these increasing effects but also lowered the CBR level.

TABLE 8: ABSOLUTE AND RELATIVE DIFFERENCES IN CBRs AND TFRs OF DIFFLRENT PERIODS THAT ARE ATTRIBUTED TO AGE-SEX STRUCTURE. PROPORTIONS MARRIED AND MARITAL FER TILITY COMPONENTS. FOR SELECTED PERIODS BETWEEN 1959 AND 1985, ATHOOR BLOCK

Year	*Total change*	*Absolute change due to.*			*Percent change due to:*		
		Age-sex structure	*Proportion married*	*Marital fertility*	*Age-sex structure*	*Proportion married*	*Marital j'ertility*
('rude birth rate							
1959-85	-17.50	-2.05	-6.37	-9.07	11.72	36.43	51.85
1964-85	-9.90	2.49	-3.74	-8.65	-25.18	37.80	87.37
1971-85	-5.70	1.55	-0.79	-6.46	-27.16	13.91	113.25
1974-85	-1.80	2.24	0.6	-4.66	-124.33	-34.63	258.96
1978-85	-0.20	2.32	2	-2.87	*	*	*
Total fertility rate							
1959-85	-1.84	NA	-0.52	-1.32	NA	28.2	71.8
1964-85	-1.65	NA	-0.39	-1.26	NA	23.4	76.6
1971-85	-1.03	NA	-0.09	-0.93	NA	9.1	90.9
1974-85	-0.15	NA	0.02	-0.16	NA	-10.5	110.5
1978-85	-0.39	NA	0.04	-0.43	NA	-10.7	110.7

Source: As in Table I.
Notes:

1. With respect to CBR. the rates are adjusted for the age-sex and age-sex-marital status distribution of the population between the words of Athoor block in 1965 and 1986, but the Table gives the figures based on the average of the two adjusted rates.
2. The difference in the age-sex-marital-status adjusted CBRs of two periods is attributed to the change in C'BR due to the change in the marital fertility during the period, as these rates are free from the effect of the changes in age. sex and marital status distribution of the population. The difference in the difference of the age-sex adjusted CBRs and age-sex-marital-status adjusted CBRs of two periods is attributed to the change in CBR due to the change in proportion married during the period. And, the difference in the difference of the unadjusted CBRs and in age-sex adjusted CBRs of two periods is attributed to the change in CBR due to the change in the age-sex structure of the population during the comparison period.

Decomposition of Change in TFR

Table 8 also gives the result of decomposition of the change in TFR. The figures show that during the period between 1959 and 1985, the amount of decline in the TFR is shared more by the marital fertility component than by the nuptiality component, and their contribution are in the ratio 7:3 (3:2 when based on the change in CBR). According to this method also, over the years, the relative contribution of the change in the marital fertility component increases while that of the nuptiality component decreases. The relative contribution of marital fertility increases from 72 percent for the period 1959-85, to 77 percent for 1965-85, 91 percent for 1971-85, and to more than cent percent for the most recent periods.

An analysis of the change in TFR attributable to the change in proportion married and the change in marital fertility by age is also made (table not shown). Of the total change attributable to proportion married, the change in proportions married in the age groups 15-19 and 20-24 have contributed almost wholly during the earlier periods; for the recent periods, the change in proportion married in the age group 25-29 also contributed to some extent (up to 25 percent of the total change attributable to the proportion married component). On the other hand, the proportions married in the older age groups have contributed negatively (to increase TFR), though the impact was marginal in respect of the age groups 30-34 and 35-39 (around 5 percent) but substantial in respect of the age group 40-44 (10-15 percent). These indicate that the declining widowhood (discussed earlier) has tended to increase the TFR while the increasing age at marriage has contributed substantially to the decline of TFR. Though the age at marriage is increasing only slowly (discussed earlier), its contribution appears to be about 20-25 percent higher than that explained by the change in proportion married component as a whole.

As far as the change in marital fertility by age is concerned, all the age groups except the 20-24 age group have contributed to the decline of TFR. However, the major contribution was made by the 25-29, 30-34 and 35-39 age groups almost equally and their total contribution is 60 percent of that attributable to marital fertility component during 1959-85 but around 80 percent for the recent periods. The age groups 15-19 and 40-44 each contributed 10-15 percent and the age group 20-24 contributed negatively by 10-15 percent during different periods.

Proximate Variables Model

Though the Bongaarts' proximate fertility variables model has the ability to dissect the contribution of each of the proximate variables, it has certain disadvantages. This method depends purely on the estimated values of the proximate variables. The application of this method changes the contribution of each of the proximate variables considerably if the rates are not reliable, or their reliability varied across the comparison period or between the variables. In respect of Athoor block, the application of Bongaarts' model is severely affected by the non-availability of reliable estimates of contraceptive use for

the period up to 1971, and of abortion rates for the entire comparison period. Further, even the available rates cannot be treated as fully reliable. For example, the estimate of contraceptive prevalence rates for 1974 and 1976 assume that the surveys under-enumerated vasectomy acceptors. As far as abortion is concerned, it is already mentioned that only rough estimates of abortion rates are available for 1971 and 1983, and the figures are very low and same. So, its impact on fertility is assumed to be constant throughout the comparison period.

FABLE 9: INDEXES OF PROXIMATE FERTILITY VARIABLES FOR SELECTED YEARS BETWEEN 1959 AND 1985, AUTHOR BLOCK

Year	*Propn. Married*	*Non-Contraception*	Lact .infecundability	
			Esti-l	*Esti-2*
1959	0.84			
1964	0.80			
1971	0.75		0.61*	0.59*
1974	0.69	0.79	0.61	0.64
1978	0.68			
1985	0.67	0.63	0.71	0.65
Change during 1974-85	0.02	0.16	-0.10	-0.10

Source: As in Table 6.. Method: Bongaarts (1982).

* Rates refer to the period 1864-69.

Esti-l Estimated using mean duration of PPA.

Esti-2 Estimated using mean duration of breastfeeding.

Table 8 gives estimates of indexes of proximate fertility variables for selected years. The index of proportion married indicates that its contribution to fertility decline diminishes as the period advances. For, during 1959 to 1974, the index declined from 0.84 to 0.69 (0.15 points during the 15 years period), while during 1974 to 1985 the index remained almost constant. The index of non-contraception showed that it declined from 0.79 to 0.63 during 1974 to 1985; or by 16 percentage points during the 11 year period. On the other hand, the index of lactational infecundability increased from 0.61 to 0.70, or by 0.09 points when the equation involving mean duration of PPA was used, and from 0.64 to 0.65, or by just 0.01 points increase when the equation involving mean duration of breastfeeding was used. These indicate that notwithstanding the differences in the definitions and measurements of the variables, during 1974-85, the lactational infecundabil ity contributed to increase marital fertility and induced abortion rates made no impact on it. At the same time, the increase in contraceptive use contributed greatly to the decline of marital fertility and in turn to the decline of TFR and CBR.

Summary and Conclusions

In Athoor block of Tamil Nadu State in India a number of health and family welfare programmes were undertaken since the late 1950s by a few voluntary organizations including the Gandhigram Institute of Rural Health and Family Welfare Trust, located in the same block. This block is one of the backward areas of the district and also of the state. A number of fertility surveys conducted in this block between 1960 and 1986 showed that fertility in this block declined by about 40 percent, or about 2 percent per year. The decline of fertility in this block was rapid as compared to that of rural Tamil Nadu and of all India.

Over the period, there was a rapid decline in the fertility of women aged 30 and above, a large reduction in the fourth and higher order births and substantial increase in the open birth interval. A decomposition of fertility measures showed that the increase in contraceptive use and the decrease in proportion of women married (mainly due to increase in age at marriage) are the two proximate factors that have contributed to the decline of fertility in Athoor block. Further, over the years, the relative contribution of the change in the proportion married decreased and the change in the marital fertility increased. The relative contribution of proportion married and martial fertility components are approximately 30 percent and 70 percent during the period 1959 to 1985. Retherford and Rele (1989) estimated that of the total decline in TFR of India during 1960-64 to 1980-84, about one-fourth was due to change in nuptiality and three-fourths due to change in marital fertility. The present exercise also indicates a similar pattern in Athoor block.

The significant feature of the rapid decline of fertility in Athoor block is that it has occurred despite the socioeconomic backwardness of the area. Though the family planning programme was active even before 1971, the fact that the contribution of marital fertility component for the overall decline of fertility levels in this block was not substantial during this period, indicates that its effect was not sufficient enough to offset the fertility increasing forces that were strong until then. Further, the observed small increase in age at marriage of females has contributed substantially to the decline of fertility in this block. However, the largest part of the decline in fertility of this block is to be attributed to the intensive family planning programme of this block which is believed to have induced a desire for smaller family size and wider use of family planning methods among couples.

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References

Bongaarts. John, 1978. A framework for analysing the proximate determinants of fertility. *Population and Development Review*. 4(1): 105-132. Bongaarts, John, 1982. The fertility inhibiting effect of the intermediate fertility variables. *Studies in Family Planning*, 13(6/7): 179-189 Davis. K. and Blake. J., 1956. Social structure and fertility: An analytical framework. *Economic Development and Cultural Change*, 4(4): 211-235. Director of Census Operations. Tamil Nadu. I986a. *Household Population by Religion of the Head of the Household.* Census of India 1981. Paper 1 of 1986. Series 20. Tamil Nadu, Madras: Directorate of Census Operations. Director of Census Operations. Tamil Nadu. 1986b. *Social and Cultural Tables.* Census of India 1981. Part IV A, Series 20. Tamil Nadu. Madras. Directorate of Census Operations Gandhigram Institute of Rural and Family Welfare Trust. 1988. *Research Compendium: Findings and'Implications of Population and Health Studies 1964-87.* Gandhigram. India: The Gandhigram Institute of Rural Health and Family Welfare Trust. Jain. Anrudh K. and Adlakha, Arjun L. 1982, Preliminary estimates of fertility decline in India during the 1970s. *Population and Development Review*, 8(3): 589-606. Kachirayan, M., 1978a, Empirical estimates of parameters for birth averted models. *Bulletin of the Gandhigram Institute of Rural Health and Family Planning*, 13(1): 60-73. Kachirayan, M., I978b. Estimates of fertility, family planning use and growth rate in Athoor Block 1974. *Kullelin of the Gandhigram Institute of Rural Health and Family Planning*, 13(2): 1-20. Kachirayan. M.. and Krishnamoorthy, S., 1976, Athoor cross sectional fertility survey: Estimates of fertility and mortality. *Bulletin of the (jandhigram Institute of Rural Health and Family Planning*. 10(3): 39-67. Krishnamoorthy. S and Muthiah. A., 1972a. *Report on the Gandhigram Standard Fertility Survey*. Gandhigram: The Gandhigram Institute of Rural Health and Family Planning. Krishnamoorthy, Sand Muthiah, A., 1972b, Life table analysis of amenorrhoea and lactation and their relationship in a rural South Indian population. *Bulletin of the Gandhigram Institute of Rural Health and Family Planning*. 6(3): 229-244. Ministry of Health and Family Welfare, India. 1987, *Family Welfare Programme in India: Year Book 1985-86*. New Delhi: Government of India. Ministry of Health and Family Welfare, India, 1989, *Family Welfare Programme in India: Year Book 1987-88*. New Delhi: Government of India.
Pilot Health Project, 1961, *Report on the Baseline Survey,* (jandhigram, India: Pilot Health Project. Pisharoti, K. A., Renganathan, K. V., Sethu S. and Dutt, P. R.. 1971, *The Athoor Experience Implications for a State-wide Family Planning Programme.* Action Research Monograph No. 4. Gandhigram: The Gandhigram Institute of Rural Health and Family Planning. Rajaretnam, T..T986, The relationship between age at marriage and fertility: Some evidence from a rural area in Tamil Nadu. *Bulletin of the Gandhigram Institute of Rural Health and Family Welfare Trust.* 21(3): 31-55. Rajaretnam. T., 1992. On estimating fertility and mortality rates for small areas: A Held experience. *Demography India*, 22(1): 29-40. Rajaretnam, T., Forthcoming, Trends and differentials in breastfeeding and amenorrhoea patterns in a rural area in South India. *Demography India*.

Rajaretnam, T., Ramalingam, S.P., Gandhi, E., Ramasamy, R., Muthulakshmi.R.and Rajathi.C'.. 1988, *Fertility and Proximate Variables in Athoor and Batlagundu Blocks: Finding of a Household Survey in 1986.* Report-1, Determinants of Fertility in Athoor Block, Tamil Nadu, Gandhigram: The Gandhigram Institute of Rural Health and Family Welfare Trust (Mimeographed). Registrar General, India, 1990, *Sample Registration System 1987.* Vital Statistics Division. New Delhi: Office of the Registrar General, Ministry of Home Affairs. Retherford, R. D. and Rele, J. R., 1989, A decomposition of recent fertility changes in South India. *Population and Development Review,* 15(4): 739-747. Superintendent of Census Operations, Madras, 1966, *DistrictCensus Handbook, Madurai District,* Vol. I,Census of India, 1961, Vol. IX, Madras: Office of the Superintendent of Census Operations.