

AN ANALYSIS OF SOME INTERMEDIATE VARIABLES AFFECTING FERTILITY IN EGYPT USING BONGAART'S MODEL

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The rate of Population growth of Egypt is considered one of the highest in the world. Egypt has been experiencing rapid population growth since the thirties of the twentieth Century. The population of Egypt according to the latest Census of 1976 exceeded 38 millions, where as in 1897 it was only 9.7 millions. In other words, the size of the population has increased more than four times in about eighty years. The average annual rate of increase of the Egyptian population was very close to 2.3 % for the period (1966-1976).

This conspicuous increase in the size of the population of Egypt is attributable to a decline in the death rate during the last twenty years where as the birth rate remains at high levels

Two approaches may be considered to reduce the level of fertility:

The First: Through affecting indirect factors (socio-economic and cultural factors). But some studies that dealt with this subject had proved that in some cases weak relation exists and that relation differs from time to time and settings.

The Second: Through affecting direct factors (intermediate variables). Few research efforts had studied the intermediate

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variables affecting fertility where the level of fertility directly depends .

The main focus of this study is to analyse four intermediate variables affecting fertility in Egypt by using J. Bongaarts model (1978).

The following questions are posed:

- 1- How is the level of fertility affected by there intermediate variables?
- 2- are there relative differences among the various areas in the effect of intermediate variables on fertility?
- 3- What is the target needed to be achieved for the intermediate variables to reduce the level of fertility in the future?

METHODOLOGY

The study uses data of a survey carried out by The Egyptian Population & famly planning (P.F.P.B) called "Industrialization & Population in 1978. The investigation will summarize intermediate variables to estimate the index for fertility using Bongaart's Model (1978) for three socio-economis envirouments in Egypt: Urban, Rural and a special group sampled from industrial workers. Total size of the sample is 5126 Households

A THEORITICAL FRAMEWORK

In any society, fertility is affected by varioas factors operating with or against one another, among thes factors are the so-called" intermediate variables"

Davis & Blake (1956) were the first to develop a framework outlining the intermediate variables that define the proccess of reproduction and involves three neccessary steps sufficiently obvious to be generally recognized in human cultur, these are:

- (1) intercourse (2) conception and (3) gestation and parturition.

These three steps constitute eleven intermediat variables.

B. BONGAART'S MODEL (1978)

Recently, Bongaart's (1978) has presented a model which expresses the relations between the intermediate fertility variables and the level of fertility in quantitative terms. In the model, a series of indices are used to assess the importance of each intermediate variable in determining the level of fertility. He defines a set of eight intermediate fertility variables. He, however, included only four variables (proportion married, contraception use, induced abortion and lactational) as the most important.

The relationship between the level of fertility and the intermediate variables is defined as follows:

$$TFR = C_m \times C_c \times Ca \times C_i \times TF$$

where,

TFR = is the total fertility rate.

TF = is the total fecundity rate.

C_m = is the index of proportion married.

C_c = is the index of non-contraception.

Ca = is the index of induced abortion.

C_i = is the index of lactational infecundability.

Each of these indices take a value between zero and one.

C. A FRAMEWORK FOR FERTILITY ANALYSIS

The analysis of fertility is very complex when using multivariate system analysis which these variables are likely to be independent.

In order to put some structure into analysis, it is convenient to divide the variables into three groups as following:

The dependent variable, fertility measured as total fertility rate TFR.

2. Intermediate variables which have a direct bearing on fertility and these are mainly:

- a- proportions married.
- b- Contraception use.
- c- Induced abortion.
- d- Lactational Infecundability.

2. Explanatory variables which are believed to affect fertility indirectly through their bearing on intermediate variables. These include social and economic variables, and attitudes toward family size and structure.

This study is mainly concerned of analysing Egyptian fertility performance through the differential impact of there main four intermediate variables. The impact of socio-economic and cultural factors on intermediate variables, though important, is outside the scope of this study. (See Fig.1).

c- SUMMARY OF MEASURES & INDECES OF INTERMEDIATE VARIABLES
IN DIFFERENT AREAS:

Table (1), Summerizes the fertility levels of the three areas. analysed and the differential impact of the four intermediate variables as estimated.

1) The results indicate that the variations in the four factors (marriage, contraception, induced abortion and lactation), are the primary proximate causes of fertility differences among various areas. The combined effect of present levels of these variables in various areas bring down the fertility by .229,.400, and .156 The total fecundity rate for urban, rural and industrial residence areas respectively. Consequently, the difference in estimated TFR among various arease are significant. Although, the intermediate variables has a direct influence on fertility, the relative importance of these variables differ in various areas. Thus, fertility is consistently lower in urban areas. the socio-economic conditions prevailing in a community as related to the level of industrialization and urban infrastructure are more conducive to lower fertility.

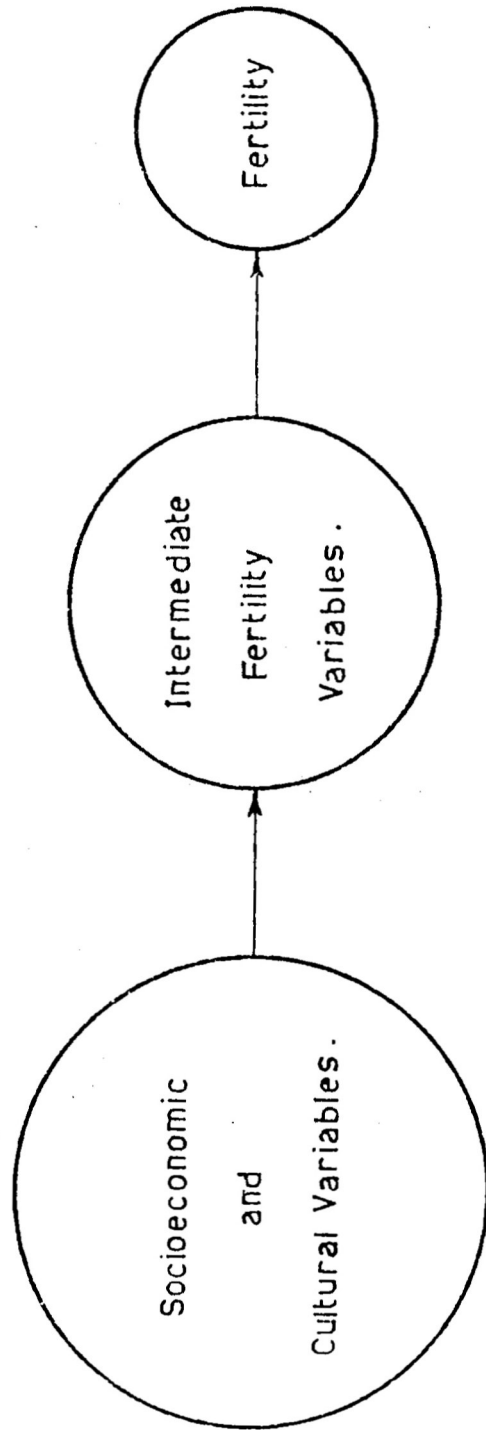


Fig (1): The Relationship Among Fertility , Intermediate Variables and Socioeconomic Variables .

Table (37)

Summary of Selected Reproductive Measures and
Indexes of Intermediate Variable for Different Areas
(Survey 1978)

Measures	Urban Areas	Rural Areas	Indust.Resid., Areas
Total Fertility Rate (TFR)	2.740	5.750	2.155
Total Marital Fertility Rate (TM)	4.520	7.44	5.270
Total Natural Marital Fert- ility Rate (TNM)	8.183	9.109	12.701
Total Fecundity Rate (TF)	11.361	14.267	17.303
Current Contraceptive Use (U)	.421	.179	.530
Contraceptive Effectiven- ess (e)	.876	.825	.876
Average Duration of Lact- ation (months) (L)	15.933	20.170	12.900
Lactational Infecund- ability (months) (I)	10.422	12.700	8.724
<u>Indexes</u>			
(Cm)	.606	.772	.408
(Cc)	.570	.820	.450
(Ca)	.963	.996	.922
(Ci)	.691	.640	.734
Cm Cc Ca Ci	.231	.403	.124

- 2) The distribution of the relative importance of intermediate variables among various areas is shown in the following diagram:

<u>INDEX</u>	<u>URBAN AREAS</u>	<u>RURAL AREAS</u>	<u>IND. RES. AREAS</u>
C_m	3	3	2
C_c	1	2	1
C_a	4	4	4
C_i	2	1	3

It is clear that, contraception use index is the first main intermediate variable controlling marital fertility in both industrial residence areas and urban areas. But lactation is still the most dominant variable controlling fertility in rural areas. The second main intermediate variable is proportion married index for for rural areas and lactation index for urban areas. the third main intermediate variable is proportion married index for both urban areas and rural areas. The fourth main intermediate variables is induced abortion index for all areas. The relative impact of these four variables on fertility is shown in figure (2).

- 3) By comparing the estimated indexes with the approximate observed range of indexes by countries that have TFR greater than 5 and countries that have TFR less than 3 as shown in table (2), we notice that:

1. Proportion married index estimated for each area lies within the range of Bongaart's expectation.
2. Contraception use index for urban areas lies outside the expected range. Contraceptive use among Egyptian Urban women is lower than expected.
3. Under the assumption used for induced abortion, the index of induced abortion lies out of the range for all areas. This may be due to the fact that induced abortion in Egypt is illegal.
4. Lactation infecundability index for urban areas lies

outside the expected range, this can give an indication that in urban areas is still dominant relative to experiences of other countries,

TABLE (3)
Approximate Observed Range For The Indices

INDEX	Countries With High Fertility (TFR Greater Than 5)	Countries With Low Fertility (TFR Less Than 3)
C _m	0.65 - 0.90	0.40 - 0.65
C _c	0.80 - 1.00	0.22 - 0.45
C _a	1.00 - n.a	1.00 - 0.50
C _i	0.50 - 0.70	0.90 - 1.00

n.a. not available

4) Table (4), compares the estimated for Egypt with other countries. From table (4), we notice that contraception use is the main variable in U.S. and Turkey, also in the industrial residence and urban areas for Egypt (Survey, 1978). The contraception use is the dominant factor controlling fertility among developed countries and regions. Proportion married is the main intermediate variables in Korea and Lebanon. It is worthwhile to notice that:

1. Lactation is not considered an impact intermediate variable controlling fertility in all countries as is the case in Egypt.
2. Induced abortion index is very high in rural North Yeman, although, Yeman is a Muslem country.

Fig (2) : Estimated TF by Differential Effect of Intermediate Variables by Different Areas .

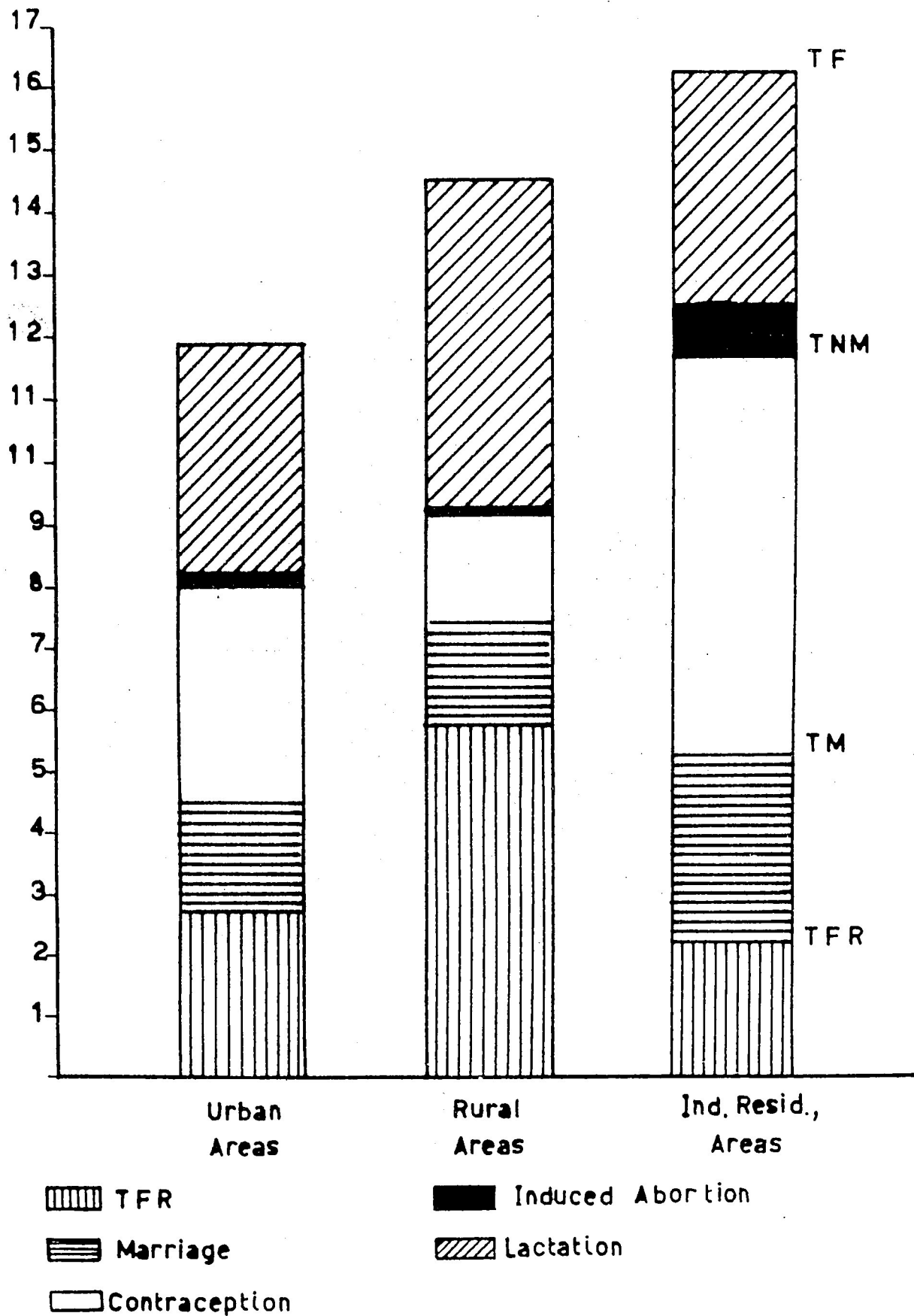


TABLE (4)

Estimates of Indexes of
Intermediate Variables

COUNTRY	Cm	Cc	Ca	Ci	Cm Cc Ca Ci
Egypt (Survey, 1978)					
Urban	0.606	.570	0.969	0.691	0.231
Rural	0.772	.820	0.996	0.690	0.103
Ind. Res.	0.408	.450	0.922	0.720	0.130
South Rural Lebanon (1976) ⁽¹⁾	0.51	0.63	0.78	1.00	0.25
Rural North Yeman (1977) ⁽²⁾	0.89	0.85	0.66	1.00	0.50
Turkey (1973) ⁽³⁾	0.74	0.62	0.75	0.98	0.34
U.S. (1973) ⁽⁴⁾	0.57	0.22	0.95	0.93	0.11
Korea (1970) ⁽⁵⁾	0.58	0.76	0.84	0.66	0.24

Sources: (1), (2), and (3) from Zurayk, 1978: p. 502,

(4), and (5) from Bongaarts, 1978: p. 125.

- e. The target needed for the intermediate variables to a specific reduction the level of fertility.

It has become very essential for any country to have the most accurate information possible about the level of fertility at a future point in time. Such information is basic for planning and policy making . Fertility projection can present the factors which may be changed within the limits by planned action.

Egypt's built-in momentum of population growth will greatly increase its future population (RAPID, 1980). Thus, great effects must be done to reduce the fertility rate. This can be seen from projections based on some alternative fertility assumptions.

The results of the analysis done in this study proved that there are differences between different areas in the TFR due to differences in one or more of intermediate variables, because they have direct effect on fertility. Consequently, any desired change in the fertility could be achieved through manipulation of these intermediate variables.

The aim of this section is to project the level of fertility of Egypt in order to estimate the target changes needed for some intermediate variables in the future to realize a suitable TFR in Year 2000.

The basic frame for projection is as follows:

- a) period: 1976-2000.
- b) Initial population: 1976 adjusted Census data of Population particularly the proportion married.
- c) Fertility rate: the initial fertility rates were estimated from 1976 census data, i.e., TFR.
- d) Total fecundity rate: (13.07), this rate was estimated from available data on Egypt.
- e) The projections include Egypt as a whole because the basic data required either for urban or rural are not available.

1. The first group:

Assumptions concerning intermediate variables are:

1. Proportion married shall decrease by 10% for every five years during period 1976-2000, only in ages (15-29).
2. Contraception use shall increase by 3% for every five years during period 1976-2000, on all reproductive age groups (15-49). Assuming that the contraceptive effectiveness is .87 according to the results of National fertility Survey (1974/1975).
3. Lactation period shall decrease as modernization increases however, as shown by this analysis, lactation is common in rural areas and is still high in urban areas too. Yet we shall assume in future a low practice of lactation as a whole, because it related to a number of modernization factors as female's employment. The decrease is assumed by 5% for five years period.
4. Induced abortion index equals one as a result of its illegality, and any attempt to assess the number of abortions must be plausible estimates with no claim to accuracy.

b) The second group:

Concerning the basic assumptions:

1. Migration and mortality effect on fertility has been neglected. The projection is separate from the course of mortality and migration.
2. It is more convenient to use the TFR as the measure for change in fertility.

2. Considerations Affecting the Accuracy of the Results:

The accuracy of results obtained in the projection undertaken is affected by many factors. Among these factors are the following (Makhlouf, 1979):

1. The type and quality of data used in projection.
2. The assumptions underlying the projection technique adopted.

3. The duration of projection period.
4. The technique or the model used.

3. Projection of Intermediate Variables:

3-1 Proportion Married:

Under the assumptions used relating to proportion married, table (5) summarize the results and shows degree of change of TFR as a result of assumed changes in the various proportion married. The results of projection indicate a decrease in age specific fertility rates among age groups (19-29), and consequently TFR. The TFR of 1976 Census is 5.6 births per women and the reduction to achieve TFR 4.593 can be achieved by the decline in the proportion married index from .748 in 1976 to .593 by 2000. This exercise assumes that the other variables remain constant (See table 6 and Fig. 3).

TABLE (5)

Effect of Changes Proportion Married on
Fertility Assuming Other Variables Constant

PERIOD	C_m	C_c	C_i	TF	TFR
-1975	.748	.727	.788	13.07	5.600
1976 -1980	.700				5.239
1980 -1985	.669				5.006
1985 -1990	.640				4.791
1990 -1995	.616				4.609
1995-2000	.593				4.439

3-3 Contraception Use:

The influence of contraception use can be see from table (7). The results show that, the effect of increase in contrace-

TABLE (6)

Proportion Married Projection

AGE GROUP	1976			1976-1980			1981-1985			1986-1990			1991-1995			1996-2000		
	F(a)	m(a)	g(a)	m(a)	F(a)	m(a)	F(a)	m(a)	F(a)	m(a)	F(a)	m(a)	F(a)	m(a)	F(a)			
15-19	.0205	.2106	.097	.189	.0183	.170	.0164	.153	.0148	.137	.0132	.123	.0119					
20-24	.1859	.5899	.315	.531	.1672	.478	.1505	.430	.1350	.387	.1219	.348	.1098					
25-29	.3106	.8270	.375	.744	.2790	.669	.2508	.602	.2250	.542	.2032	.487	.1826					
30-34	.2471	.8773	.309		.2471		.2471		.2471		.2471		.2471					
35-39	.2062	.8755	.236		.2062		.2062		.2062		.2062		.2062					
40-44	.0856	.8096	.106		.0856		.0856		.0856		.0856		.0856					
45-49	.0444	.7680	.058		.0444		.0444		.0444		.0444		.0444					
TFR & TM	5.6		7.48		5.23		5.006		4.791		4.609		4.439					
Cm		.748			.700		.669		.640		.616				0.593			

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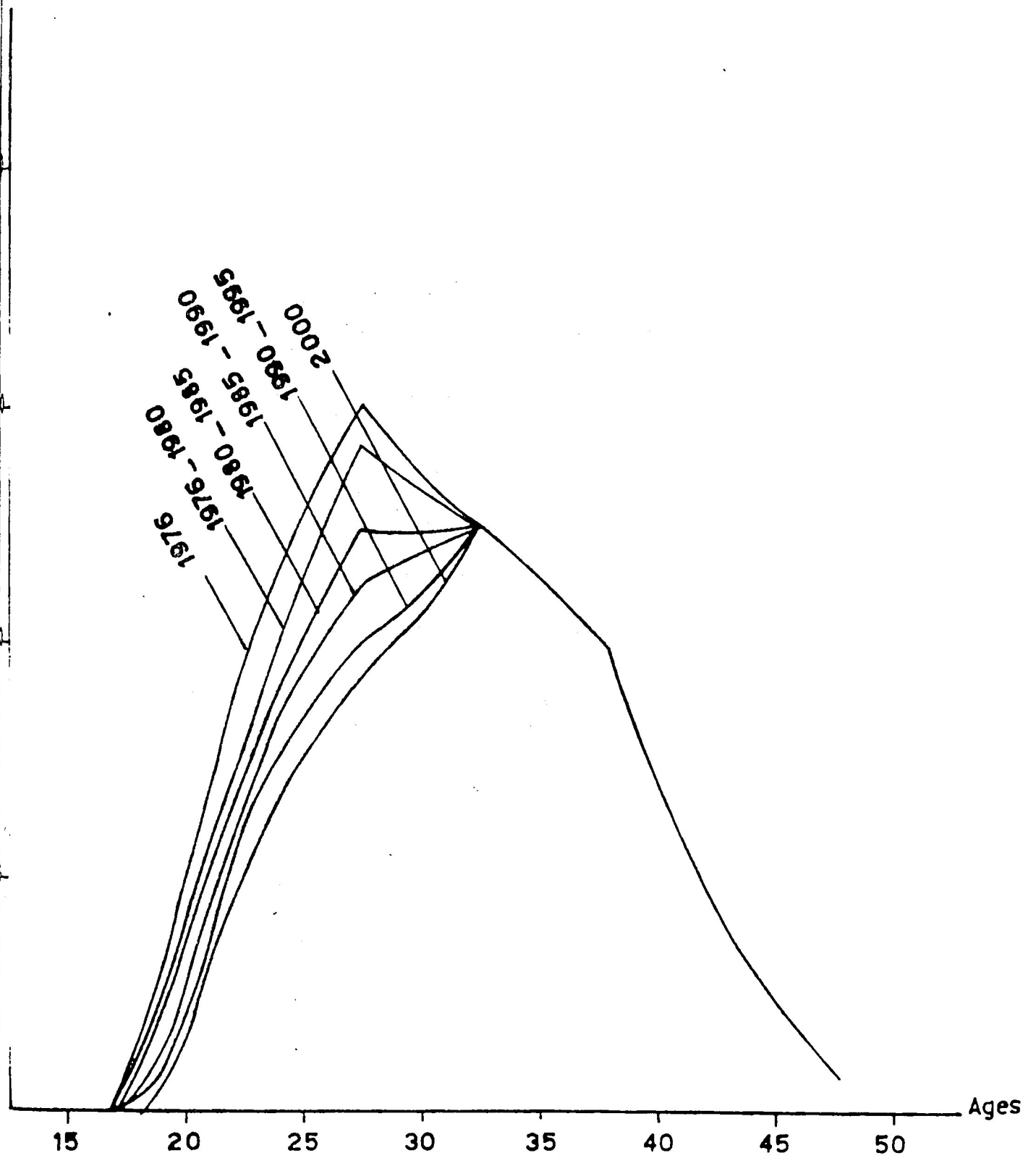


Fig (3) : Age Specific Fertility Rates During (1976_2000) .

ption use will have a decreasing effect on fertility under the condition that the contraceptive effectiveness is .87. Consequently, if we desire to achieve a a TFR cf 4.418, in year 2000, we can raise the contraceptive use from 26.5% to 41.5% by the year 2000, assuming other variables are constant (See tables 7 , 8 and 9).

TABLE (7)
Effect of Changes Contraception Use on
Fertility Assuming Other Variables Constant

PERIOD	C _m	C _c	C _a	TF	TFR
-1976	.748	.727	.788	13.07	5.600
1976-1980		.697			5.360
1980-1985		.666			5.127
1985-1990		.635			4.888
1990-1995		.604			4.649
1995-2000		.574			4.418

TABLE (8)
Contraceptive Use Projection

Proportion Use of Contracep- tion NFS (1974) /1975	1976-1980	1981-1985	1986-1990	1990-1995	1996-2000
	+3%	+6%	+9%	+12%	+15%
26.5	29.5	32.5	35.5	38.5	41.5
C _c	.697	.666	.635	.604	.574

3-3 Lactational Infecundability:

The decrease in lactation period shall increase the TFR (See table 9). This decrease in lactation shall increase TFR from 5.6 to 5.904 in year 2000. (See tables 10 & 11). (See tables 10 & 11).

TABLE (9)

Average Contraceptive Effectiveness

Method	Percent of Use [*] Contraception	% U	e_i	Ue_i
Pill's	19.880	.750	.98	.735
I.U.D.	2.544	.096	.96	.092
Condom	.106	.004	.91	.004
Other	31970	.150	.90	.135
TOTAL	26.500	1.000		.966

* Where, $e = \sum Ue_i \times .9 = .89$

TABLE (10)

Effect of Change Lactation Period on
Fertility Assuming Other variables Constant

PERIOD	C_m	C_c	C_i	TF	TFR
-1976	.748	.727	.788	13.07	5.600
1976-1980			.800		5.677
1980-1985			.805		5.713
1985-1990			.811		5.755
1990-1995			.822		5.833
1995-2000			.832		5.904

In the previous section we tried to demonstrate what the effect on overall fertility of Egypt would be up to year 2000, if one only of the three main intermediate variables changes according to our assumptions.

TABLE (11)

Lactational Infecundability Projection

(Initial) (NFS)	1976-1980 -5 %			1981-1985 -10 %			1986-1990 -15 %			1991-1995 -20 %			1996-2000 -25 %				
	L	I	C _I	L	I	C _I	L	I	C _I	L	I	C _I	L	I	C _I		
9.623	6.888	.788	9.143	6.619	.800	8.66	6.349	.805	8.18	6.135	.811	7.69	5.81	.822	7.217	5.541	.832

TABLE (12)

Summarized The Projection of Fertility
In Egypt (1976-2000)

PERIOD	Cm	Cc	C _I	Cm Cc C _I	TF	TFR
-1976	.748	.727	.788	.428	13.07	5.600
1976-1980	.700	.697	.800	.390	13.07	5.101
1980-1985	.669	.666	.805	.358	13.07	4.687
1985-1990	.640	.635	.811	.329	13.07	4.307
1990-1995	.616	.604	.822	.305	13.07	3.997
1995-2000	.593	.574	.832	.283	13.07	3.701

A decrease of 10% in proportion married of the ages 15-29 years every five years will reduce the TFR by the year 2000 by 1.161 births.

Similarly an increase of 3% of contraceptive users every five years will reduce TFR in the same period by 1.182 births.

Naturally to achieve these rates of both proportion married and contraceptive use, certain social and economic changes should occur which affect the degree of modernization and lower the average duration of lactation. This change will decrease the controlling impact of this intermediate variable on fertility as shown before.

Table (12) summarizes the projected fertility of Egypt from 1976-2000, when all the three projected changes assumed in the proportion married, contraception use and lactation take place. TFR will decline from 5.6 births per woman in 1976, to 3.7 births per woman by the year 2000, a decline of 1.9 births per female in the reproductive age. (See Fig. 4).

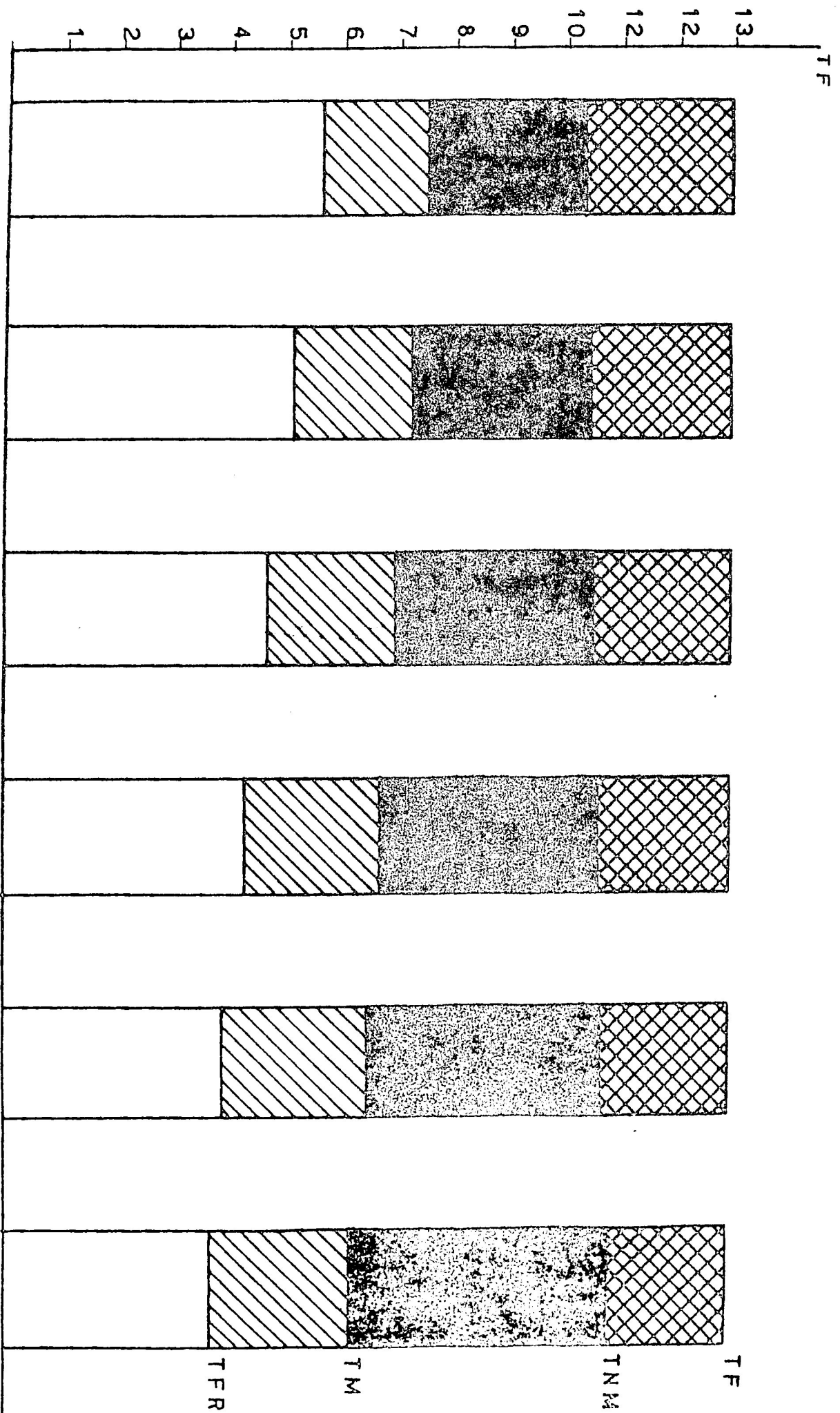


Fig (14) : The changes in TFR, TM, TNM & TF Through Period (1976 - 2000) .

Conclusion:

- Bongaart has suggested four intermediate variables as primary proximate causes of fertility differences among population. these variables are: marriage, contraception, induced abortion and lactation.
- The analysis suggests that the level of contraceptive use is the main intermediate variable responsible for the differences in the level of fertility among Urban and industrial residence areas.
- The study has also shown that differences in marriage patterns are almost as important as contraception in the differences observed between the levels of fertility in rural, urban and industrialized areas.
- It has been proved, however, that fertility is largely controlled by lactation. Thus, the duration of lactation plays the most dominant role in depressing the level of fertility in rural areas. With very low level of contraceptive use together with universal marriage, fertility in rural areas would have been still higher had the duration of lactation in rural areas been shorter. However it may be expected that socio-economic development in rural areas will tend to reduce the duration of lactation.
- Total fecundity, that is the natural reproduction capacity of a woman has been estimated at 11.861 for urban areas, 14.267 for rural areas and 16.576 for industrial residence areas.
- Using Bongaart's model and the estimates of intermediate variables derived from the survey data, a series of projection of the level of fertility has been produced. The most important finding of this projection indicates that a reduction in the total fertility rate from its 1979 level of 5.6 births per woman to 3.701 by the year 2000, will require an increase in the proportion of married women using contraception to about 41.5 percent. This should, be the minimum target for the family planning Programme in Egypt.

REFERENCE

- [1] Bongaart, (1978) Framework for Analyzing the proximate Determinants of Fertility. Population and Development Review. Vol. 4, No. 1, (march) pp 105-132.
- [2] Davis, K. and Blake, J. (1956) social structure and fertility: An Analytic Framwork. Economic Development and cultural change. Vol., 4, No., pp 24-235.
- [3] Makhoulf, H.H. (1979) projection of the population of Egypt. The Egyptian Population and Family Planning Review. Vol. 13, No. 122, (June, Dec). PP 95-167).
- [4] Naguib, M. (1982) Study of Some Intermediate Variables Affecting Fertility in Egypt, M.Sc.. Thesis Cairo University.