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The Impact of Development Programmes on Fertility in Bangladesh

1. Introduction

THE goal of all development assistance whether agricultural projects, construction, educational assistance, rural electrification, or family planning assistance, is to improve the quality of life of people in the developing world. In Bangladesh, the government has recognized that rapid population growth is a major obstacle to the achievement of that goal and expansion and improvement of family planning services have been a major focus of the government's last two Five Year PI .ns.

The success of the family planning effort is indicated by the preliminary results of the most recent contraceptive prevalence survey (CPS), which indicate that as of December 1985, approximately 25 per cent of all eligible women were using contraception of some form. It is clear from data from many developing countries, nevertheless, that family planning efforts and other development projects are intricately linked. A decline in the rate of population growth, for example, may generate savings that could be used for development purposes. Development projects are, at the same time, likely to affect the socio-economic structure, which eventually affects fertility. Thus development assistance to non-family-planning projects not only improves the sector in which it is invested (whether it be agricultural, industrial, educational, or so on), but it may also indirectly reduce fertility, which in turn contributes to the process of development. To evaluate fully the contribution of development projects to the economy and select projects judiciously one needs to assess the demographic impact of the projects. Such an assessment is also useful for formulating specific family planning projects and determining the resources required for family planning services in the future.[1]

This paper attempts a quantification or the impact of several major development inputs on contraceptive prevalence and fertility in Bangladesh making use of Bongaarts model of the determinants of fertility to do so. These "proximate determinants" in turn rest on structural and socio-economic factors. Figure 1 is a simple schematic representation of the relationships our approach assumes.

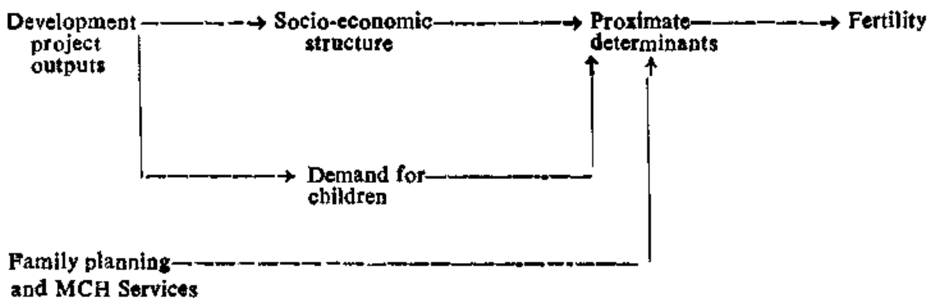

Fig. 1. A General Model of the Interrelationships between Development and Fertility

This simple model shows that development programme outputs affect the socio-economic status of households, which affects the demand for children, which in turn is translated into actual fertility behaviour through changes in the proximate determinants. The model also shows that changes in the socio-economic status of household members (males and females) may directly affect the proximate determinants, which finally affect fertility. The proximate determinants of the Bongaarts model include age at first marriage, proportion of currently married women, postpartum amenorrhoea, breastfeeding, induced abortion, and contraceptive usage.

This paper also presents a cost-effectiveness analysis of the relative efficiency of increasing contraceptive prevalence and/or decreasing fertility using increased family planning programme effort.

1. A considerable literature has grown up *on* this topic. See for example : John Stoeckel and Anrudh K. Jain (editors), *Fertility in Asia : assessing the impact of Development Projects* (London : Francis Pmter, 1986) : Richard E. Billsbarrow and Pamela F. Delargy (editors), *Impact of Rural Development Projects on Demographic behaviour* (New York; United Nations Fund for Population Activities, 1985); Robin Barlow (ed.), *Case Studies in the Demographic Impact of Asian Development Projects* (Ann Arbor, Center for Ressarch on Economic Development, University of Michigan, 1982); Wayne Schutjer and Shannon Stokes (eds.), *Rural Development and Human Fertility* (New York; MacMillan, 1984).

2. Estimation of the Bongaarts Model for Bangladesh

Bongaarts* developed a multiplicative model to quantify the relationship between fertility and its proximate determinants. In this model, the fertility-inhibiting effect of each of the proximate determinants is measured by an "index." The central equation of the model is :

$$TFR = C_c \times C_m \times C_a \times C_i \times TF, \qquad (1)$$

where,

TFR= total fertility rate,

C_c = index of contraception,

C_m = index of marriage,

C_a = index of induced abortion,

C_i = index of postpartum infecundability, and

TF = total fecundity rate

The value of each index will be between zero and one. Hence, C equals one in the absence of contraception and zero if all fecund women in marital unions use 100 percent effective contraception; *C* equals one if all women of reproductive age are in marriage and zero in the absence of marital union; C equals one in the absence of induced abortion and zero if all pregnancies are aborted; and *C* equals one in the absence of postpartum abstinence and zero if the duration of postpartum infecundability is infinite. Equation (1) states that the TFR of a population is reduced from its maximum TF by the multiplicative reductions of the four indexes.

Equation (1) can be applied for target setting, since the ratio of target fertility, TFR (0, to present fertility, TFR *(O),* can be estimated by the following equation :

$$\frac{TFR\ (r) = Ce\ (t) \times Cm\ (t) \times Ca\ (t) \times Ci\ (t) \times TF\ (t)}{TFR\ (O) = C_c\ (O) \times C_m\ (O) \times C_a\ (O) \times C_i\ (O) \times TF\ (O)'} \qquad (2)$$

2. J. Bongaarts, "The proximate determinants of Fertiliiy", *Population and Development Review* 1978. Bongaarts has revised and refined this approach several times since his original formulation of the model. Most recently, see: "A Simple Method for Estimating the Contraceptive Prevalence Required to Reach a Fertility Target", *Studies in Family Planning,* **15** (4), pp. 184-190. Our usage is based on this 1984 version.

where t refers to the target year and O to the base year. This equation shows that reduction in fertility from TFR *(O)* to TFR *(t)* depends on all of the indexes. The target fertility can be reached in a variety of ways : either by declines in one of the indexes or by combinations of changes in different indexes.

Equation (2) can be simplified if the following assumptions are made: TF (/) = TF *(O); Ca (t) = Ca (O);* and trends in the indexes *Cm* and *Ci* compensate one another. Bongaarts and Kirmeyei[3] have shown that the assumptions are realistic. With these three assumptions, Equation (2) simplifies to

$$\frac{\text{TFR}(t) = C_c(t)}{\text{TFR}(O) = C_c(O)}$$

The proportional reduction in fertility (PRF) is equal to 1 — TFR (t)/ TFR *(O).* Bongaarts 'and Potter have estimated* *Cc* with the equation *Cc* = 1 — 1.08 X u X *e,* where *u* = contraceptive prevalence among married women of reproductive age and *e* = contraceptive use effectiveness. Substituting these equations in Equation (2), we obtain :

$$\text{PRF} = 1 - \frac{1 - 1.08 \times u(t) \times e(t)}{1 - 1.08 \times u(O) \times e(O)} \qquad (3)$$

After rearranging, the basic equation for estimating the prevalence level requir-ed to achieve a desired reduction in fertility becomes :

$$u(t) = 1 - \frac{(1 - \text{PRF}) \times (1 - 1.08 \times u(0) \times e(0))}{1.08 \times e(t)} \qquad (4)$$

This equation is based on the above assumptions. Even if the above assump-tions are relaxed and the exact trends in other proximate determinants are specified, *u (t)* can still be estimated if we substitute C == 1 — 1.08 X *u* X *e* in Equation (2) and rearrange to obtain the following, more general equation :

$$u(t) = \frac{1 - K \times (1 - \text{PRF}) \times (1 - 1.08 \times u(O) \times e(O))}{1.08 \times e(t)} \qquad (5)$$

where,

$$K = \frac{C_m(O) \times C_a(O) \times C_i(O) \times \text{TF}(O)}{C_m(t) \times C_a(t) \times C_i(t) \times \text{TF}(t)},$$

3. J. Bongaarts and S. Kirmeyer; "Estimating the Impact of Contraceptive Prevalence on Fertility: Aggregate and Age Specific Versions of a Model." *In:* A. Hermalin and B. Entwisle, (eds), *The Rule of Surveys in the Analysis of Family Planning Programmes* (Liege : Editions ordina 1982).

4. J. Bongaarts and R. G Potter, *Fertility, Biology and Behaviour* (New York : Academic Press, 1983).

Using this model, we estimated the contraceptive prevalence levels required to achieve specified reductions in fertility in Bangladesh. The target year *(t)* is 1990 : 1983 was selected as the base year *(O)* so that data from the 1983 Bangladesh Contraceptive Prevalence Survey could be used[5] .

A set of eight population projections for Bangladesh prepared by Kantner[6] yield average annual rates of population growth ranging from 1.8 per cent to 2.9 per cent during 1985-1990, depending on the specific assumptions made. The Bangladesh government has decided to use the projection that results in a rate of growth of 1.8 percent per annum in its Third Five Year Plan (referred to as Model VIII). This seems highly ambitious, perhaps even unrealistic. In our analysis we also consider a projection with a 2.4 average annual population growth rate (referred to as Model IV). We have estimated the values of PRFs in Model IV (.16) and Model VIII (.38). The 1983 CPS data on the current use-rate of modem methods (.138) and that of all methods (.191) give the value of *u (O).*

Corresponding to the values of PRFs and w(1983), the values of w(1990) were calculated in five steps, each of which is denoted by different assumptions. ln step I, we used the relatively simple formula, as given by Equation (4), and assumed that *e* (0) = *e (t)*. The value of *e (O)* was calculated in the following manner. First, we used the standard values of method-specific levels of use-effectiveness of contraceptives, as assumed by Bongaarts (sterilization — 1.00, IUD—0.95, pill —0.90, and other methods *-0.70).* It is possible that these values may be somewhat too high for Bangladesh and yield an overestimate of the proportionate reduction in fertility. However, this will not affect analysis of the *relative* impact of various development projects. A weighted average of the method-specific levels was calculated taking the proportions of users as the weights. The value of e (1983) is estimated to be 0.86.

In step II, we no longer assume *e (O)* = *e (t)*. Instead, we assume that use-effectiveness will increase over time at the rate at which it was increasing annually during 1975-1983. The extrapolated value of *e(* 1990) is calculated to be 0 91.

In step III through step V, we used Equation (5) and assumed *K* = 1. However, in view of the paucity of data on *C,* we included only *Cm* and *Ca* in *K,* and defined

$$K_1 = \frac{C_a\,(1983)}{C_a\,(1990)},$$

$$K_2 = \frac{C_m\,(1983)}{C_m\,(1990)},$$

5. S. N. Mitra and G. M. Kamal, *Bangladesh Contraceptive Prevalance Survey,* 1983, (Dhaka : Mitra and associates, 1984).

6. Andrew F. Kantner, *Population Projections for Bangladesh* mimeo. (Dhaka : 1984).

and $K = K_1 \bullet K_2$,

so that $C_1(O) = C_1(t)$ and TF (0) = TF (t).

In step III, we considered only *K1,* in step IV we considered only *K2,* and in step V we considered both *K1.* and *K2.* In each of the last three steps the assumption made earlier in II, that use-effectiveness gradually increases, is maintained. In calculating *K1* and *K2,* we extrapolated *Ca* (1990) and *Cm* (1990) based on the trend of their values during 1975-1983.

The results of our calculations are presented in Table I. The required contraceptive prevalence varies greatly between the columns. The table clearly indicates that in all steps PRF in Model VIII requires a much higher value of *u* (1990) than does PRF in Model IV. One important point emerging from the data is that the current rates of increase in use-effectiveness of contraceptives (e) and induced abortion (C) do not bring about any significant decline in «. This becomes apparent when we compare the differential values of *u* (1990) in step II and step III. However, the differential is slightly greater in step IV. This implies that if *C* falls due to an increase in the female age at marriage or due to a reduction in the proportion of currently married women, the contraceptive prevalence required to achieve the targeted PRF will be somewhat lower. As seen by comparing step V with step I, the combined effect on *u* of an increase in *e, K* and *K2* is relatively large.

TABLE 1—ESTIMATED USE RATES REQUIRED TO ACHIEVE THE TARGETED PROPORTIONAL REDUCTION IN FERTILITY (PRF)

		Model IV (PRF = .16)		Model VIII (PRF = .38)	
Step	Assumptions	Modern methods	All methods	Modern methods	All methods
I	$e(t) = e(0)$	.29	.33	.49	.53
II	$e(t) \neq e(O)$	.28	.32	.47	.50
III	$e(t) \neq e(O)$ and $K_2 \neq 1$	.26	.31	.46	.49
IV	$e(t) \neq e(O)$ and $K_1 \neq 1$	.23	.28	.44	.47
V	$e(t) \neq e(O)$ $K_1 \neq 1$ and $K_2 \neq 1$	.21	.27	.43	.46

Assuming that the trend in the use rates of modern methods and all methods

Continues, and that the levels of use-effectiveness, proportion currently married, and induced abortion remain at the 1983 level, we projected the use rates of modern methods and all methods to 1990, 1995, and 2000 and estimated the PRFs implied by these levels of usage (Table 2). It is clear that if use increases at the current rate, reductions in fertility will be smaller and will come later than those required by even the most conservative projection.

TABLE 2—ESTIMATES OF CONTRACEPTIVE USE RATES AND THE CORRESPONDING PROPORTIONAL REDUCTION IN FERTILITY (PRF) IN 1990, 1995, AND 2030

Period	*Use Rate*		PRF	
	Modern methods	*All methods*	*Modern methods*	*All methods*
1990	.22	.30	.09	.12
1995	.28	.37	.15	.20
2000	.34	.44	.22	.28

Note : The method of calculation is as follows. First, we calculated the average rates of annual increase in the use rate during 1975-1979, 1979-1981, and 1981-1983. Then, we calculated the average of the moving averages for the above periods. The average annual rate of increase thus obtained was then used to extrapolate the use rates in 1990, 1995, and 2000. Finally, we calculated the corresponding PRF applying the Bongaarts model.

3. Impact of Development Projects on the Proximate Determinants

Now let us examine the impact on fertility of several development inputs (female education, rural electrification, agricultural modernization, and improvement of family planning service delivery) using the approach laid out above. For the purpose of this analysis, the model described in Section I can be simplified as shown in Figure 2.

Development projects		*Proximate determinants*		
1. Female education	}	1. Contraceptive usage	}	Fertility
2. Rural electrification		2. Age at marriage (AGEM)		
3. Agricultural modernization				
4. Family planning and MCH Services				

Fig. *2*

These specific development inputs were selected for several reasons. First, they are projects for which data, however limited, exist in Bangladesh and in

Other developing countries. Second, they are projects that are theoretically linked to the demand for children, the value of the wife's time, and other similar factors. Finally, they are all areas in which there is great potential for large-scale development inputs. We will examine the potential impact of each of the development interventions on the proximate determinants (specifically, age at marriage and proportion using contraceptives), and the proportional reduction in fertility of those changes.

(a) *Female Education*

According to Bangladesh Fertility Survey (BFS) data for 1975, female age at marriage is positively related to education. The mean AGEMs were 12.8 years, 13.6 years and 14.7 years, respectively, among women with no education, primary education, and education beyond primary level.' A more recent village study carried out in Bangladesh[8] shows a similar relationship between AGEM and education. The mean AGEM was 14.6 years, 16.8 years, and 18.2 years, respectively, for women with no schooling, primary schooling, and education beyond the primary level.

In order to quantify the relationship between changes in education and changes in the proximate determinants, certain assumptions are necessary. First, a girl normally completes her primary level of education when she reaches here llth birthday; by the time she is 14 years old, she has completed class VII; by 17 years of age she has completed class IX: and by about 18 years of age, she has completed her secondary school (SSC) education. We assume that she will be married by the age at which she completes her education or soon thereafter (this is shown in column 2 of Table 3). Data on the mean number of children boi n to ever-married women (obtained from the 1975 BFS data), shown in column 3 of Table 3, have been used as proxies for TFR in the absence of data on current fertility by different categories of age at marriage.

Any increase in AGEM leads to a decline in the proportion of women currently married in a population. As a result of this decline, fertility will fall. As seen in Table 3, the higher the AGEM, the lower the fertility and, consequently, the higher the PRF. If AGEM is raised by increases in education, fertility will decline.

Education is also related to the use of contraception. Various national and village-level studies carried out in Bangladesh lend empirical support to this relationship. According to the 1983 CPS data the current use rates were 16.00 percent, 20.96 percent, and 42.07 percent, respectively, among women with no

7. Government of Bangladesh, *The Bangladesh Fertility Survey 1975,* Ministry of Health and Population Control (Dhaka : 1978).

8. Barkat-e-K.huda, "Age of Marriage and Fertility in a Rural Area of Bangladesh," *Asian Profile* (Hong Kong), 1985.

schooling, primary schooling, and education beyond the primary level. The overall use rate for the country as a whole was 19.1 percent, which is exactly the same rate pervailing among women who did not complete their primary-level education. Thus it is evident that unless education is raised beyond the primary level, the impact of education on contraceptive use will not be pronounced.[9]

TABLE 3—PROPORTIONAL REDUCTION IN FERTILITY (PRF) CORRESPONDING TO DIFFERENT AGE AT MARRIAGE CATEGORIES

Education	*AGEM* (in years)	*Mean number of children*	*PRF*
No schooling	—	4.7	—
Completed primary	10-11	4.5	.02
Class VI-VII	12-14	3.9	.08
Class VIII-IX	15-17	3.1	.16
SSC and above	18+	2.6	.21

Using the Bongaarts model we can calculate PRF for the target year 1990 if women are provided with primary or higher levels of education. From Equation (4) in Section II we drived the following equation to calculate projected PRF using the 1983 CPS data on the current use rate of all methods by level of education.

$$\text{PRF} = 1 - \frac{1 - 1.08 \times u(t) \times e(t)}{1 - 1.08 \times u(O) \times e(O)}$$

Assuming e(t) = *e(O)* = .86 and u(1983) —.191, we obtain the values of PRF corresponding to different levels of education. An important finding is that while PRF increases by only 7 percent if all female children are allowed to complete primary schooling, it increases by 13 percent (almost double) if they

9. Government of Bangladesh, Planning Commission, *The Second Five Year Plan of Bangladesh, 1980-85,* (Dhaka : Govt. of Bangladesh, 1980); *Bangladesh Contraceptive Prevalence Survey,* 1979, (Dhaka; Govt. of Bangladesh 1981); NIPORT. 1981B *Bangladesh Contraceptive Prevalence Survey,* (Dhaka, PCFP Division, Govt. Bangladesh, 1982). Also : M. M. Khan, *Some Population Characteristics and Fertility Differentials in Four Micro Regions of Bangladesh; Some Results of the Study of Reproductive Behaviour and Poverty in Bangladesh* (Dhaka, Bangladesh Initiute of Development Studies, 1?81); and B. Khuda, *Family Planning in Rural Bangladesh,* DERAP Working Paper No. A229 (Bergen : Chr. Michelsen Institute, 1981).

complete class VI-VII (Table 4). If females complete class VIIMX, PRF increases by 27 percent, or about four times the PRF corresponding to primary education. Hence, if we consider the effect of education on contraceptive usage, we find that the targeted PRF in Model IV can be achieved only if education is raised beyond class VII. However, the targeted PRF in Model VIII is still unachievable. If education is raised further, to the SSC level and above, PRF will increase dramatically and fertility will decline substantially, allowing achievement of the PRF targeted in Model VIII.

TABLE 4—PROJECTED PROPORTIONAL REDUCTION IN FERTILITY (PRF) RESULTING FROM EDUCATION AT PRIMARY LEVEL AND ABOVE

Educational level	*Current use rate*	*Projected PRF*
Completed primary level	25.80	.07
Class VI-VII	31.40	.13
Class VII-IX	43.40	.27
SSC and above	56.84	.43

Huq and Rokeya[10] estimated the impact on fertility of increasing female education to the SSC level by projecting the fertility-education interrelation in the 25-29 age group to subsequent age cohorts as the women grow older. They estimate the likely rate of decline in fertility, as measured by the mean number of children born to women as they move from one educational level to the next higher educational level. Based on the data contained in their study, we have calculated the PRF corresponding to different educational levels (Table 5).

TABLE 5—PROPORTIONAL REDUCTION IN FERTILITY (PRF) CORRESPONDING TO DIFFERENT EDUCATION LEVELS

Educational Level	*PRF*
Primary schooling	0.13
Secondary schooling	0.16
SSC and above	0.41

10. M. M Huq and Rokeya Katun, "Fertility Impact of Female Education in Bangladesh." *In : The Fertility Impact of Development Inputs,* Population and Development Planning Unit, Planning Commission, (Dhaka : Govt. of Bangladesh, 1985).

In computing the PRFs shown in Table 6 no allowance was made for the fact that some women are already enrolled at different educational levels. This suggests that the amount of input required to achieve the targeted PRFs will be slightly less than indicated in Table 6.

TABLE 6—TARGETED PROPORTIONAL REDUCTION IN FERTILITY (PRF) AND THAT ACHIEVABLE BY RAISING EDUCATION TO DIFFERENT LEVELS

Education	Model IV			Model VIII		
	PRF target	Achiev-able	Difference	PRF target	Achiev-able	Difference
Primary schooling	.16	.13	+ .03	.38	.13	+ .25
Secondary schooling	.16	.16	0	.38	.16	+ .22
SSC and above	.16	.41	- .25	.38	.41	-.03

The question that arises is how much of the PRFs of Model IV and Model VIII can be achieved by raising female education to different levels As seen in Table 5 providing primary schooling to all female children would not be sufficient to achieve the PRF targeted in Model IV. By raising the educational level to secondary schooling the gap narrows, and in fact, the targets of Model IV become attainable. If education is raised beyond secondary schooling, a much greater PRF will be achieved than that targeted in Model IV.

It is evident that to achieve the officially targeted PRF (Model VIII) almost all female children would have to be provided education beyond the secondry level. This is clearly an impossibility in the foreseeable future, given the enormous financial involvement required on the part of the government. Huq and Rokeya, for example, estimated the cost of educating all girls aged 0-4 years in 1980 to the SSC level by 1997 to be Tk, 15935.4 million. (The method of estimating costs of schooling at various levels are discussed in Huq and Rokeya, *he. cit.)* The allocation for the entire education sector in the Second Plan was only Tk. 7070 million.

Ather[11] evaluated the demographic impact of the TAF/USAID/BACE School Scholarship Programme in Shahrasti Upazilla of Chandpur District. The study shows that the proportion of young girls remaining single was higher among the scholarship recipients who remained in school than among those who were not in school. The young girls who remained in school also married later. The majority of unmarried schelarship recipients were in favour of

11. S. A. Ather, *Evaluation Survey on "Young Women's Fertility" TAF/USAlD /BACE School Scholarship Programme, Shahrasti Upazilla, Chandpur District, Final Report* (Dhaka : USAID, 1985).

delayed marriage (age 20-22), while the majority of girls not in school were in favour of earlier marriages (age 16-18). Ninety-three percent of the scholarship recipients, both married and unmarried, believed in family planning. The comparable figure was only 55 percent for married respondents who were not scholarship recipients. Girls who had stayed in school longer were also more likely to be contraceptive users and to prefer smaller family sizes. Thus it appears from the Shahrasti study that provision of scholarship money to female students increases their enrollment in secondary schools, raises female age at marriage, increases contraceptive usage, and thereby helps to depress fertility.

(b) *Rural Electrification*

Rural electrification in Bangladesh is a recent phenomenon and data relating to electrification and demographic factors are limited. Nevertheless, Robinson[1]* has attempted to assess the impact of rural electrification on population-related factors.

Robinson found that over 95 percent of the respondents felt that electricity had made a difference in their lives : over 90 percent said their time available for household work had increased; 31 percent felt that they now had more time available for work outside the house; 82 percent said time available for children and parents to devote to the children's education had increased; and about 80 percent said they spent more time in family discussion. Women belonging to electrified households indicated a lower desired family size (2.9 children) than women belonging to nonelectrified households (3.3 children). There was almost no difference, however, in the use of contraception among women belonging to electrified households (18.5 percent) and nonelectrified households (18.4 precent). The results, thus, show that there exists a lag between attitudinal change and behavioural change.

Electrification exerts the greatest effect on wives' ability to earn money in their own right, on knowledge of family planning, and on desire for daughters' education. For Example, a 1 percent increase in electrificaton led to a 33 percent increase in the desired level of daughters' education, a 10 percent increase in knowledge of family planning (Robinson, 1985). However, none of these three variables is significantly related to the acceptability of family planning or use of family planning. Thus the impact of electrification on family planning use and, thereby, on fertility appears to be largely negligible

12. Warren C. Robinson, -'Rural Electrification and Demographic Change in Bangladesh", *The Fertility Impact of Development Inputs,* Population and Development Planning Unit, Planning Commission. (Dhaka : Government of Bangladesh, 1985). On the same topic more broadly considered, see : Warren C. Robinson and Sarah F. Harbison, "Rural Electrification and Fertility Decline," *Population Research and Policy Review,* 1985.

in the short run. Electrification does however seem to lead to attitudinal changes and changes in the behaviour pattern of women, which may affect fertility in the long run.

(c) *Agricultural Modernization*

Agricultural modernization through the adoption of HYV (high-yielding variety) crops leads to increased cropping intensity and higher productivity. As a result, employment opportunities and income increase. These economic effects of agricultural modernization are believed to bring about desired social changes, such as an increased level of education, greater exposure to media, and favourable attitudes toward small family size. These social changes, in turn, are believed to affect the proximate determinants of fertility, particularly age at marriage and contraceptive usage.

A village-level study was undertaken during 1979-1981 to examine these issues in a Bangladesh village that had been exposed to agricultural modernization and other rural development programmes for about two decades[18]. (A detailed description of the nature and level of agricultural modernization in in the study village is contained in Khuda, *loc. cit,,* 1985.) The study shows that female age at marriage (15.4 years) and contraceptive use (ever-use, 41 percent; current use, 25 percent) were higher in the study village than nationally during 1979-1981. Fertility, especially current fertility, was lower (TFR was 4 53) in the study village than nationally[11].

We considered the 1983 data on fertility, which in fact, yield a lower national level of fertility than prevailed in previous years. The 1983 CPS data give a TFR of 5.6.[15] Since the TFR was 4.5 in the study village, the PRF resulting from agricultural modernization was .20. We also calculated the contraceptive effect of agricultural modernization on fertility using the Bongaarts model. In the study village for use rate, we took the simple average of use rates prevailing in 1979 and 1981, on the basis of the 1979 and 1981 CPS data. That took the value of. 16. Given these values for the use rates, we obtained a PRF value of about .10. This is one-half of what we obtained as the overall effect of agricultural modernization on fertility.

(d) *Family Planning and Maternal and Child Health (MCH) Services*

Despite various efforts of the Government, contraceptive use remains relatively

13. See : Barkat-e-Khuda, 1981 and 1985 cited in note (8).
14. Barkat-e-Khuda, "Agricultural Development and Fertility Transition in Rural Bangladesh", *Asian Profile* (Hong Kong), 1985.
15. Barkat-e-Khuda and S. R. Howlader, *Fertility in Bangladesh : An Analysis Bated on the 1983 CPS Data,* a report prepared for the United States Agency for International Development, Dhaka, 1985.

low, although use has certainly increased during the past decade. According to the 1983 CPS data, the current use rate of all methods was 19.1.[la] In some areas of the country, however, considerably higher use rates have been reported. For example, m the Matlab area of Commilla District, use is reported to be about 50 percent.

The much higher use rate in Matlab relative to the national level is believed to have resulted from, among other things, the high MCH field worker density—1 : 800 couples in Matlab compared with 1 : 3000 at the national level. Based on the Matlab ratio, it would require about four times the number of MCH field workers at the national level to reach the Matlab use rate nationally. This would clearly involve a much higher level (about four times) of expenditure on the part of the government.

The 1983 CPS data enable us to examine the relationship between current fertility and current use status. Khuda and Howlader (1985a) found that fertility was lowest among women practicing modern methods (TFR = 2.6), followed by these practicing traditional methods (TFR = 4.7), and it was highest among those not using contraceptives (TFR == 6,2).

The Bongaarts model can be used to estimate the proportional reduction fertility that would result from increasing the density of MCH field workers nationally to the Matlab density. Using the same notation as in previous sections :

$$\text{PRF} = 1 - \frac{1 - 1.08 \times u(t) \times e(t)}{1 - 1.08 \times (u) \times e(u)}$$

in which $u(t) = \text{CPR Matlab of } .50,$

$(Q) = \text{CPR national of } .25, \text{ and}$

$e(t) = e(O) = .86;$

than $$1.0 - \frac{1 - 1.08 \times .50 \times .86}{1 - 1.08 \times .25 \times .86}$$

$$= 1.0 - \frac{1 - .46}{1 - .24}$$

$$= 1.0 - .71$$

$$\text{PRF} = 29.$$

Thus, if field worker density could be increased by fourfold nationally we could expect a 29 percent reduction in fertility. It should be noted that this is probably a maximum estimate of the impact of such an intervention since in addition to relatively high field worker density in Matlab, supervision and

16. S. N. Mltra and G. M. Kamal cited in note (4).

support services increase the effectiveness of the MCH workers.

4. Comparative Cost Analysis of the Various Programmes

Let us now compare the relative impact of the four alternative development input programmes on contraceptives and fertility, looking also at the cost of these programmes. That is, let us look at the relative cost-effectiveness of achieving a given increase in contraceptive prevalence and/or decrease in fertility. These results are shown in Table 7.

TABLE 7—DEMOGRAPHIC IMPACT OF AND COST INVOLVED IN DIFFERENT DEVELOPMENT PROJECTS

Development Programmes	Increase in the use rate (percent)	PRF	Cost (Taka)	Minimum time lag (in years)
Providing SSC-level education to 100 girls currently aged 0-4 year:	40.7	.45	234,000	15
Providing electricity to 100 females (assuming that, on average, each household has one female of reproductive age)	9.0	.10	484,800	10
Bringing 100 females (assuming that, on average, each household has one female of reproductive age) under agricultural modernization programme	90	.10	769,500[a] 387,400[b] 226,300[c]	10
Bringing 100 females from a ratio of 3000 : 1 family planning worker to 800 : 1	100.0	.29	3,700	3-5

[a]Deep tubewell (see text).

[b]Shallow tubewell (see text).

[c]Low-lift pump (see text).

In order to assess the relative magnitudes, a uniform unit of comparison is essential We have taken 100 females as a uniform unit of analysis. (The unit of comparison can be inflated simply by moving the decimal place.) In addition, we consider only the contraceptive-usage effect of development programmes on fertility, although the total effect of the projects will be greater in the long run As seen in Table 7, if 100 girls currently aged 0-4 years are provided with education up to the SSC level, the net increase in their contraceptive use rate will be 40 7 percent and the corresponding PRF will be .45. PFR has been calculated using Bongaarts approach as explained above. This will involve a lag of a minimum of 15 years, the time required for a girl currently aged 0-4 years to complete her education up to the SSC level, and we assume that she will get married after having completed her education. It must be conceded, however, that not all of the 100 girls will reach the SSC level because some will drop out at various grades. For the sake of simplicity, we have assumed that all 100 girls will reach the SSC level.

On the basis of Huq and Rokeya's estimate (1985) of the cost of schooling, we calculated that Tk. 234,000 will be required to educate 100 girls to the SSC level. In addition, capital costs will be incurred to provide class room space and facilities for the purpose. Even a conservative estimate shows that if a two-room, tin shed class room is to be raised at a new site (i.e. if new land is to be purchased for this purpose) and necessary furniture bought, it will involve an expenditure of a minimum of Tk. 40,000. The required amount will be less if a two-room, tin-shed class room space is raised at an existing site (i e., if no new land is to be purchased)—around Tk. 30,000.

The capital and recurring costs involved in providing SSC-level education to 100 girls currently aged 0-4 years may not appear to be high. When this figure is inflated to include all girls currently aged 0-4 years, however, the costs involved in providing SSC-level education to all of them will be considerably high and do not appear to be within the reach of the government in the foreseeable future.

The fertility impact of providing electricity to households of 100 females (assuming that, on the average, each household has one female of reproductive age) can also be estimated. If 100 females are so covered under the electrification programme, there will be a net increase of 9 percent in their contraceptive use rate, and the PRF will be .10. The time lag involved in the process will depend on whether electrification is purely for household lighting or largely to help the production process. It might be assumed that if electrification serves the former purpose, the time lag involved will be longer than if electrification serves the latter. Assuming that electrification is initially intended primarily to serve the latter purpose, fertility may in fact rise, because of the income effect of electrification in the short run. As a result of increased income, nutritional level is likely to improve and, consequently, subfecundity will fall. In the long run, however, the increased income will result in higher education of household members, higher aspirations for modern consumer durables, and so on, all of which are competitive with the desire to have a large number of children. This stage is likely to be reached in about 10 years' time.

We have tried to estimate the cost of installing a meter for domestic electri-

*That is, the difference between the use rate prevailing among women who have completed their education up to the SSC level and the use rate prevailing among those with no schooling. The assumption implicit here is that the difference between the two rates will remain constant during the next 15 years or so.

city consumption, using information on the number of meters installed by energized Pally Bidyut Sam-ties as of 30 June, 1985 (USAID-funded projects). Each domestic connection serves 2.5 households, and there were 10.635 domestic connections. In addition, there were 5,570, 2,690, 2i,364, and 1,394 connections, respectively, for irrigation, industrial production, commercial concerns, and street lights, A total of US? 120 million was spent for installing the above connections. The per-meter connection cost was approximately US$404, i.e., about Tk. 12,000 Since a domestic connection serves 2,5 households, meter connection cost per household amounts to about Tk. 4,800.

The most important component of agricultural modernization is irrigation. We attempted to calculate the cost of irrigating an acre of land under different irrigation methods. The per-acre costs, both capital and operational, of irrigation, are Tk. 7,695, Tk. 3,874, and Tk, 2,263 by means of deep tube well, shallow tube well, and low-lift pump, respectively. Data obtained through personal communication with personnel of the Water Development Board indicate that, on the average, the available cultivable landholding per household is about one acre. We have assumed that there is, on the average, one married couple of reproductive age in each household, and we obtained the cost of irrigating the cultivable land area belonging to 100 households by multiplying the per acre cost of irrigation under the different methods by 100 (Table 7). Roughly about 20 percent of the cultivable land area in Bangladesh is irrigated. Obviously, it will require a bugs expenditure on the part of the government to irrigate the remaining 80 percent of the cultivable land area, which the government will find almost impossible to arrange for.

The effects of increasing the density of field workers is also shown in Table 7. We assume that one family welfare worker (FWW) and her supplies and overhead cost Tk. 40,000 per year. At a density of one FWW per 3,000 couples, each couple costs about Tk. 13. At a density of one FWW to 800 couples, each couple costs about Tk. 50. Each 100 couples would thus cost Tk. 1,300 and 5,000 under the two worker regimes. Thus the net cost for the change would be Tk 3,700. Based on the Matlab experience, the increased prevalence would occur in 3 to 5 years.

It appears from the above analysis that the contraceptive use effect of female education is about four times greater than that of agricultural modernization or electrification In addition, the other beneficial effects of education, such as increased age at marriage, greater exposure to media, favourable changes m attitudes toward small families, are expected to reduce fertility further. It seems that the per unit cost involved in female education will not be higher than that for other development programmes. The minimum time lag involved is, however, longer with respect to female education than for other programmes. The short-run effect of electrification on fertility appears to be less pronounced. The future prospects for electrification will largely hinge on : (a) the actual demand for rural electrification with respect to both household consumption and production needs and (b) the financial and physical capacity of the government to undertake large-scale rural electrification in the country. Similarly, the short-run effects of agricultural modernization appear to be quite modest, but the long-run impact is likely to be more pronounced. The costs involved in undertaking a massive agricultural modernization programme are enormous, however, and may not be within the reach of the government in the foreseeable future.

5. Summary

In summary, this illustrative calculation strongly suggests that the quickest and most cost-efficient way to increase contraceptive prevalence is to increase the density of field workers. Table 7 suggests that even if our estimate per 100 women of the cost of increasing field worker density is off by a factor of 100 per cent and should be doubled to Tk. 7,400 per 100 females, it still is many times cheaper than the other interventions, assuming that the fertility impact is the major consideration.[17]

Female education, agricultural modernization, and rural electrification have many benefits other than their fertility impact. These interventions make valuable contributions to development in their own right. However, it does seem fair to conclude that, costly as it may initially seem, the most direct and efficient way to increase contraceptive prevalence and reduce fertility is to spend more on hiring additional family planning workers.

17. These conclusions are consistent with the findings of earlier investigations of the same question. See: George Simmons, "Family Planning Programmes on Development: Hew Persuasive is the new Conventional Wisdom", *International Family Planning Perspectives, 5* (1979); W. P. McGreevy *et al., The Policy Relevance ofRecent Social Reseaich on Fertility* (Washington, D.C. The Smithsonian Institution, 1974).