C. Chandrasekaran and **J.** S. Parsons

On the RFPI Model for Estimating Family Planning Targets

SEVERAL methods have been used to estimate the extent of contraceptive practice and, in turn, the number of acceptors required annually to attain prescribed reductions in levels of fertility and/or the crude birth rate in national family planning programs. These have varied from relatively simple ones that can be handled with a desk calculator to more complex procedures requiring the use of an electronic computer[1].

The complex ones allow for more detailed inputs such as age specific continuation rates of contraception. They also make it possible to prescribe future goals in terms of declines in age-specific birth rates. Factors such as age-specific sterility, age-specific non-exposure to reproduction associated with delayed marriage, widowhood and divorce or separation, or delayed effectiveness because of acceptance during post-partum amenorrhea can be more readily taken into account in the complex computer models.

I.[1] Several of the simple procedures used in different country programs have been reviewed in John A. Ross "Acceptor Targets" in *Measuring the Effect of Family Planning Programs on Fertility* ed. by C. Chandrasekaran and Albert I. Hernialin, Ordina Editions Belgium, 1975. For some of the complex ones see Dorothy Nortman and John Bongaarts, "Contraceptive Practice [required to meet a prescribed crude birth rate target : a proposed macro-model (TABRAP) and hypothetical illustrations", *Demography* Vol. VI No. 2 pp. 471-489 (1975) and *Some Techniques for Measuring the Impact of Contraception, United Nations Economic and* Social Commission for Asia and the Pacific, Asian Population Studies No. 18 Bangkok, 1974.

Application of advanced methods of model-building for target-setting provides policy makers with useful insights in program planning; however, the optimum effort required to balance theoretical findings with what is practicable has yet to be fully explored. It is also necessary to recognize that even the utility of the advances made in the field of target-setting depends on the validity of the parameters used in the models and thus cannot claim to take full account of patterns of acceptor behaviour, especially after discontinuance of the method.

This note examines the features of the RFPI (Rapid Feedback for Family Planning Improvement) model which is one of the earlier complex computer-based models developed in the field of target-setting[3]. It points to some fundamental errors in the recommended procedures which might not attract the attention of the unwary and which result in greatly over-estimating the family planning targets.

The RFPI Model

The basic aim of the RFPI model is to estimate the *fecund* woman-years of protection required if a particular target in terms of a fertility index such as crude birth rate or total fertility rate is to be achieved. This protection is to be provided through use of contraception, and its magnitude is to be estimated by taking into account lack of exposure to sex by fecund women (by remaining single, widowed, divorced or separated, or to some extent by what has been described as "structural protection"). The manual stresses that the state of pregnancy also offers protection and should be taken into consideration in working out the family planning target.

The fecund woman-years of fertility control required is termed the Total Family Planning Target. The model provides procedures for converting this target into a measure of acceptors required and provides methods for estimating the number of births averted if the target is reached.

Age specific natural sterility is estimated on the basis of observations recorded by Louis Henry and is assumed to be prevalent equally among women who

2, Donald J. Bogue, Scott Edmonds and Elizabeth J. Bogue *An Empirical Model for Demographic Evaluation of the Impact of Contraception and Marital Status on Birth Rates.* RFPI Family Planning Research and Evaluation Manual No. 6, Community and Family Study Centre, University of Chicago, 1973.

are and who are not currently-married. The number of currently-married women by age-group is obtained through use of any recognized method for making population projections beginning with a base-year, usually the census year. Sterility rates when combined with currently-married women by age-group provide estimates of fecund currently-married women. An estimate is then made of the number of women in this group who should be left "unprotected" by contraception if the desired birth rate is to be achieved, thus making it possible to estimate fecund currently-married women who should be protected by contraception.

The magnitude of the women falling into different categories can be seen from the following figures for women aged 15-49 used for illustrating the various steps in the RFPI manual.

Projected female population	7494000	l(a)
Number of fecund women	6010203	1(5)
Number of married women	4575920	l(c)
Number of fecund married women	3431409	*l(d)*
Number of fecund women who need not be protected	1900077	*l(e)*
Number of fecund women who must be protected	4110126	!(/)
Total family planning target	1531332	l(g)

(SOURCE : RFPI Manual tables 2, *4, 6,* 7, 13, 14, 15)

As stated in the manual, the figures are an unofficial illustration based on unpublished data from South Korea. The illustration given is in terms of five year age groups 15-19, 20-24, ... , 45-49, as well as of total women in the age-range 15-49. The demographic goal for the total fertility rate (TFR) to which the family planning target given below applies was 4015.

From the numbers given above (lo-lg), it will be seen that the number of fecund women who need not be protected (1900077) when added to the number of fecund women who must be protected (4110126) gives the number of fecund women (6010203) as it should. It will also be seen that the number of fecund women who need not be protected (1900077) when added to the total family

planning target (1531332) gives the number of fecund married women (3431409)[3]. It is therefore implicit that both the number of fecund women who need not be protected and the family planning target refer to fecund married women.

The RFPI manual assumes implicitly that sterile women do not accept family planning methods. In the context of developing countries, such an assumption is likely to be valid, and thus it helps to lower the family planning target. It is in the calculation of the "number of fecund women who need not be protected" that the manual has attempted to develop new methodology. Before turning to a discussion of this aspect, it is useful to have the following breakdown of the 4110126 fecund women who were marked as needing protection in item 1(*f*).

Fecund women not in married state (from equations 1 *(b)* and 1 *(d))*	= 2578794	*2(a)*
Family Planning Target	-1531332	2(6)
Fecund women who must be protected	4110126	2(c)

(SOURCE : RFPI Manual tables 9 and 15).

It will also be noted that 4110126 forms 68.39 per cent of the number of fecund women.

Number of Fecund Women who Need not be Protected: Preliminary Considerations

The RFPI manual sets out a series of linear equations which establishes a relationship between pairs of the three fertility rates : General Fertility Rate (GFR), Total Fertility Rate (TFR), and Crude Birth Rate (CBR). Given these relationships it is possible to convert the demographic goal in terms of one of these rates into each of the other two, and especially the goal in terms of CBR

3. It will be noticed in passing that the ratio of number of fecund women to projected female population given by the above figures does not tally with the ratio of number of fecund married women to number of married women; (his is because of the difference in the age distributions of the female population and of married women. The comparative ratios for each five-year age group as obtained from the figures given in the manual are in close agreement, as they should be, since it has been assumed that the sterility rate at each age is the same for married as well as all women.

into a measure of TFR. On the assumption that age-specific birth rates change in proportion to TFR, the goal in terms of age-specific birth rates also becomes defined, if the relative contributions of age-specific birth rates to TFR are known at the start of the national family planning program and are assumed to remain unchanged. The number of births which should occur to women in any specified 5 year age-group can be estimated from the desired level of age-specific birth rates, and therefore, the number of births to all women in the reproductive age group. Alternatively if a demographic goal set in terms of TFR is converted to one in terms of GFR, the number of births that should occur to all women in the reproductive age-groups can also be determined.

Given the number of births desired, the women-years to be spent in pregnancy is estimated in the RFPI manual by the formula that each live birth involves 0.926 women-years of pregnancy. This assumes that 86 per cent of pregnancies end as live births and 14 per cent end as pregnancy loss (abortion, miscarriage or still birth) and that each live birth and pregnancy loss gives respectively 10.5 and 3.75 months of pregnancy protection including the gestation period and the novulatory period that follows termination.

The next step followed by the RFPI manual is to establish a fertility-contraception function which will assist in working out the proportion of fecund women who can be left unprotected to the risk of pregnancy in order to attain a demographic goal specified in terms of CBR, GFR or TFR. For this purpose it is assumed that a CBR of 60, equivalent to a GFR of 280 for women 15-44 years of age or to a GFR of 267 for women 15-49 years of age or to a TFR of 8384, will be the maximum limit of human fertility and will be reached if all fecund women are exposed to the risk of pregnancy throughout their reproductive lives. At the other extreme, it is assumed that if 100 per cent of fecund women are protected from pregnancy, CBR, GFR and TFR will be zero.

Relationship between Proportion of Fecund Women Protected and Fertility Level

The RFPI manual calculates this relationship in the following manner. Under conditions of maximum fertility, GFR equals 280 for women in the age-group 15-44 years. This is equivalent to pregnancy-years of (.926) (.280) = .259; in other words, 259 out of 1000 women aged 15-44 years are in a state of protection from pregnancy because they are already pregnant when maximum fertility is attained. Since 11 per cent of women in the reproductive span is estimated

to be sterile, the pregnancy-years per 1000 *fecund* women is reckoned at .259 divided by 0.89, or .291. This means that 29 per cent of fecund women aged 15-44 years will be protected by pregnancy when fertility is at its maximum. The manual increases the 29 per cent protection by another 5 per cent which is provided by "structural protection" for such reasons as "some women will not marry as soon as they first become fecund, fecund widows will mourn the death of their husbands for a few months before remarrying; a few fecund women will never marry and some marriages will be incompatible and characterized by episodes of voluntary abstinence". Thus, it is assumed that 34 per cent of fecund women are protected from pregnancy under conditions of maximum fertility.

Using the two sets of values that 34.0 per cent of fecund women are protected when TFR equals 8384, and 100 per cent are protected when TFR equals 0, the following linear equation is established.

$$\text{TFR} = 8384 - (p - 34)\left(\frac{8384}{66}\right) = 12700 - 127p, \qquad (3)$$

where p is the percentage of fecund women who are protected from pregnancy. Similar equations are also obtainable in terms of CBR, GFR for women 15-44 years of age and GFR for women aged 15-49 years. The graphic representation which enables the calculation of these equations is given in Figure 1 adopted from the RFPI manual in terms of TFR[1]. It is interesting to note that equations (3) can be obtained from Figure 1 using the formula

$$\frac{\text{TFR}}{100 - p} = \frac{8384}{66}. \qquad (4)$$

The following equations as given in the RFPI manual express p in terms of the fertility indices.

$$p\ (\text{CBR}) = 100.0 - 1.10\ \text{CBR}, \qquad 5(a)$$
$$p\ (\text{GFR 15-44}) = 100.0 - .2358\ \text{GFR (15-44)}, \qquad 5(b)$$
$$p\ (\text{GFR 15-49}) = 100.0 - .2481\ \text{GFR (15-49)}, \qquad 5(c)$$
$$p\ (\text{TFR}) = 100.0 - .007874\ \text{TFR}. \qquad 5(d)$$

4. In the corresponding Figure 1-2 of the manual, the graph is erronoeously drawn at $p = 25$ per cent for TFR equal to 8384.

Substituting in equation 5*(d)* the value of 4015 for TFR, the same as that used in the Korean example, the value of *p* is found to be 68.39 per cent. Applying this figure to 6010203, the number of fecund women given in item 1(6), the number of fecund women to be protected works out to 4110126 which is in agreement with that given in equation *L(f)*. The number of fecund women who need not be protected works out to 1900077, as given in 1(e).

It should be recalled that in deriving equations 5(a) to *5(d)* it was assumed that 34 per cent of fecund women will be protected under conditions of maximum fertility, 5 per cent because of "structural protection" and 29 per cent because of pregnancy. The latter figure was found appropriate for fecund women 15-44 years of age but is also applied in the RFPI manual to women 15-49 years age. The extent of "structural protection" is also assumed to be the same for fecund women aged 15-44 and those aged 15-49 years. Further, it is implicit in equations *5(a)* to *5(d)* that CBR, (GFR, 15-44), (GFR, 15-49), and TFR are essentially proportional. These assumptions are at variance with linear equations between any two of the characteristics with which, the RFPI manual began the discussion[5].

Discussion on the Value of p as given in the RFPI Manual

The regression equation (3) above and similar equations used in the RFPI manual attempt to estimate the per cent of fecund women-years which should' be protected from pregnancy if the desired demographic goal is to be reached. Such protection, the manual indicates, can be obtained in a number of ways including "structural protection", "non-exposure", i.e., not being currently married, and me of contraception. In addition, the manual stresses that pregnancy itself is a condition which provides a woman protection from a subsequent pregnancy. The manual uses this fact in estimating the per cent of fecund women who require protection through contraception to attain the desired demographic goal. It is in making this estimation that a fundamental error has been made as pointed out below.

The manual assumes that 29 per cent of women-years will be spent in a pregnant state if 100% of fecund women are exposed to the risk of pregnancy. Some of these pregnancies need to be allowed since a certain number of births is required to reach a given demographic target. It is seen from equation (3)

5. See equations 3(a) to *3(f)* of the RFPI manual.

and Figure 1 that the estimated value of p, the percentage of all fecund women to be protected, is inclusive of the pregnancies which are necessary to reach the demographic goal. To this extent, the value of p exaggerates the per cent of

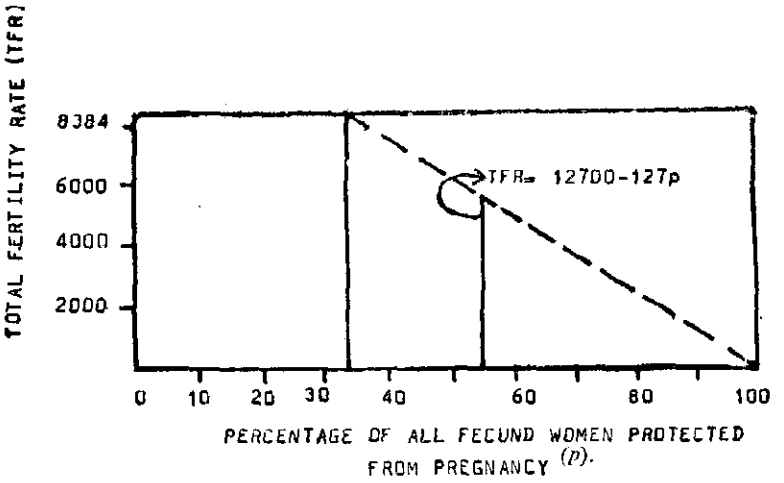

Fig. 1

women to be "protected" and under-estimates the per cent of women to be left "unprotected".

The above arguments can also be appreciated from the exposition in Figure 2

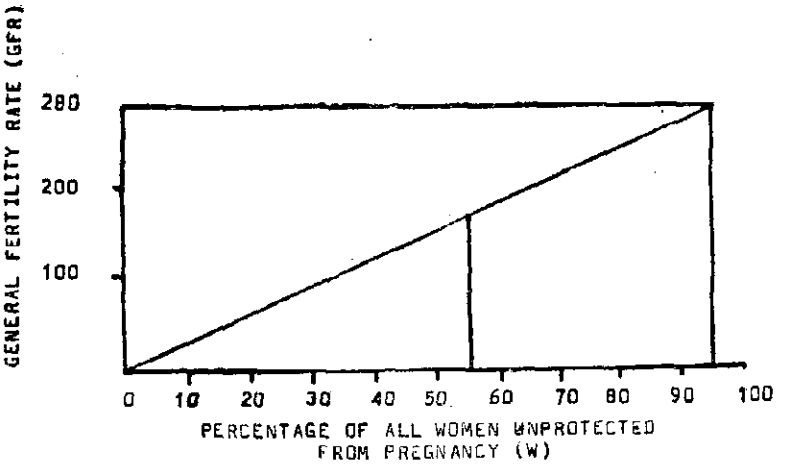

Fig. 2

which uses the basic assumptions of the RFPI manual but derives the fertility-

contraception function in a manner somewhat different from that used in the manual. The manual assumes that of the fecund women aged 15-44 years, 5 per cent will have "structural protection", and that if the remaining 95 per cent are exposed to the risk of pregnancy, a GFR of 280 will result. Using a simple law of proportionality, the percentage of fecund women who need not be protected, u to get a value of GFR, is given by the formula

$$\frac{u}{\text{GFR}} = \frac{95}{280}, \tag{6}$$

or

$$u = .3393 \text{ GFR}.$$

The percentage of fecund women p to be protected is given by

$$p = 5 + 95 - .3393 \text{ GFR}, \tag{7}$$

or

$$p = 100 - .3393 \text{ GFR} \tag{8}$$

assuming that the 5 per cent of women with "structural protection" have also to be protected. Comparing equation (8) with equation 5(*b*), the former gives a lower value for the percentage of women to be protected or what is equivalent to it, a higher value for women who need not be protected. The difference between the value of p in the two equations is equivalent to 0.1035 GFR which is the pregnancy-years corresponding to the GFR expressed as a percentage of fecund women years. The latter is equivalent to

$$\frac{.926}{.89} \frac{\text{GFR}}{10} = .1040 \text{ GFR},$$

where .926 is the factor used for converting births to pregnancies and .89 gives the proportion of fecund among women aged 15-44 years. The factor 10 allows for the fact that GFR is expressed in terms of 1000 women.

The value of p as given by the procedures described in the RFPI manual provides the basis for estimating the family planning target. In addition to its being over-estimated by the factor 0.1035 GFR it also includes the 5 per cent fecund women with "structural protection". Women with "structural protec-

tion" should not, for obvious theoretical reasons, be included in the family planning target. However, from a programmatic point of view, women with such protection may be difficult to identify, and thus for practical considerations the target should probably err on the conservative side.[6]

It is interesting to see the contribution which .1035 GFR makes in increasing the family planning target. In the example discussed above where TFR equals 4015, the family planning target was given in the manual as 1531332. With the value of .1035 GFR the pregnancy years required to achieve the demographic goal is given in the manual as 807610.[7] Inclusion of these pregnancy years in the family planning target tends, in this instance, to roughly double it.

Obtaining other Targets Using Family Planning Targets as the Base

The family planning target, as defined by the RFPI manual, is the women-years of contraceptive protection necessary to reach a specified demographic goal.[8] The manual deals with a sub-set of targets, the extent of protection that is obtained outside the program and the extent of protection that will be required from within the program. The latter is converted into the number of acceptors to be recruited, taking into account the quota for different planning methods and contraceptive use-effectiveness. The manual also provides methods for assessing the number of births averted.

An approximate method of estimating the number of acceptors to be recruited each year is given by the formula

$$\text{Acceptors} = \frac{\text{women years of protection}}{\text{average duration of use}}, \qquad (9)$$

where the average duration of use is weighted according to the mix of different

6. If women with "structural protection" are not to be treated separately, formulae such as equation (8) will have to be modified.

7. The number of births expected to occur for TFR = 4015 is 862832 as seen from Table 3 of the manual. The pregnancy years corresponding to these births are $862832 \times .926 = 798982$ according to the assumptions in the manual, although using .936 instead of .926 as the multiplying factor the pregnancy years have been shown in Table 10 of the manual as 807610.

8. The lag between pregnancy and a subsequent birth is not taken into any significant account in the manual.

family planning methods accepted. This procedure is justified by the statement, "**Each** year the family planning program must recruit the equivalent of all of the **women** years of protection required by the target, that in the long-run there is no hold-over from previous years nor any "carry-forward" to subsequent years". The statement raises a question of fundamental principle. Does a target-setting exercise aim to establish a prescribed course of fertility decline on a temporal basis, **such** as annually? If the answer is in the affirmative, the rough rule indicated in equation (9) has to be supplanted by other procedures which will **take** into account explicitly the "hold-over" from previous time periods and the "carry-forward'* to subsequent time periods.

In short, the application of equation (9) is contrary to the spirit of the development of procedures in the manual which focused attention on yearly achievements.

Concluding Remarks

The RFPI manual appears at first glance as an innovative document both in its conceptualization of the target-setting problem and in the logical development of the steps to be adopted in estimating the acceptors to be recruited to reach specified demographic goals. The manual lists five states in which a woman obtains protection against pregnancy : natural sterility; not currently-married; currently-pregnant; using contraception (both outside and inside the program); and "structural protection", and it discusses procedures for estimating the numbers found in each of these states. The concept of "structural protection" remains rather obscure. In focusing attention on these various states, the administrator is assisted in appreciating the three categories in which women in the reproductive age-group can be divided : (1) those who are not exposed, (2) those who should be left "unprotected" in order to reach the demographic goal and (3) those who should be "protected". The ratio between the latter two categories gives the administrator an idea of the relative ease or difficulty with which the target of acceptors can be recruited.

For much of the analysis, the manual utilizes the concept of "fecund women" which might have its advantages, but the general discussion gives the impression that the approach used is novel. A closer examination reveals that this approach is not fundamentally different from the relatively simple concept generally used for making rather quick estimates, viz., that the percentage reduction in fertility

is reflected by the percentage of currently-married women who are protected from becoming pregnant through use of contraception. In fact, the latter approach, by making use of the rate of reproduction of currently-married women gives proper attention to the cultural setting within which targets are set, **while** the manual which utilizes extraneous data in setting a maximum limit to fertility of fecund women has to assume that such data are applicable to women in all cultural settings.