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Reducing Fertility Through Family Planning in Nepal: A Cost-Benefit Evaluation

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PREFACE

Family planning has been a part of His Majesty's Government's programme for socio-economic development since the early 1960's. Some people may therefore find it curious why Integrated Development Systems should now undertake an analysis of the cost and benefit of public investment in family planning. The critical nature of the population problem in Nepal today has lent greater interest and urgency to fertility reduction programmes. It has even become fashionable to set fertility reduction targets for future years as in a planning exercise. So it is necessary to develop a comprehensive framework as well as specific methods for identifying and justifying the resource committments required to meet these targeted declines.

Of course, family planning alone will not suffice; and this conclusion is not altered by deriving a favourable rate of return to family planning investments. Our study is motivated more by the fact that the economic implications of investment in family planning programmes have not been fully explored. It is not enough to proceed on vague concepts about the usefulness or the benefits of family planning. Like any other public sector investment, a firm and rational basis for justifying resource allocation is required. More than the actual measure of the rates of return to family planning investments, our purpose is served if this study demonstrates the nature and dimensions of an economic evaluation of fertility reducing investments in Nepal.

The study also highlights the inter-dependence between population growth and public investment required for various social services. We hope that a wider discussion and awareness of the impact of population size on other sectoral resource requirements would help to evoke favourable and concrete responses from those concerned public sector agencies. Their co-operation and constructive intervention are of the utmost importance for the design and successful implementation of an integrated population policy. The efforts of the reconstituted National Commission on Population along these lines are commendable. It is our hope that the present study will contribute to a better understanding of the economic relationships involved, thereby facilitating the policy-making process of His Majesty's Government.

Lastly, when this report was at the final drafting stage, His Majesty's Government announced a target of reducing fertility to a total fertility rate of 2.5 births per women by 2000. This specific target could not be incorporated into our analysis. Nonetheless,

the implications in terms of the required family planning programme level can be judged by comparing this target with the less optimistic scenarios examined in this study.

The study has many limitations of which the major ones should be noted here. The sectoral implications of population growth have not been assessed through a macro-econometric model of the Nepalese economy. Nor has the relationship between fertility and family planning investment been estimated from past performance. These were not feasible due to the lack of data. In both instances, we have worked with assumed relationships, which for sure introduce a great deal of arbitrariness in the computations and the results. Similarly, a very crude joint-cost allocation method has been used to estimate the required family planning expenditures for each contraceptive method. Without meaning to mitigate the errors that occur, it should also be noted that our purpose is not to identify the "optimum" investments in family planning but merely to provide broad estimates of the associated cost and benefit in the Nepalese context.

This study is essentially the contribution of Prem Thapa and Ram Risal, both IDS economists. An early version of the study's findings was presented by Prem Thapa and Ram Risal in the National Conference on Population and the Sixth Plan organized by the National Commission on Population in April 1982. There have been significant changes in the methodology as well as orientation of the study since then.

During the early stages of the study IDS benefitted from the contribution of many other specialists. Mr. Suresh Prasad Sharma (Consultant Economist), and Dr. P. L. Joshi (Consultant Demographer) assisted with the development of the research design as well as the analysis in their respective areas. Dr. Joshi also is primarily responsible for the derivation of the unit cost estimates of family planning services which are projected in this report. Laurie Zivetz (Programme Director, IDS) contributed as Population Specialist. Mr. Rabindra Bhandary (IDS economist) helped with the literature review. Devendra Raj Panday (Executive Director, IDS) provided general coordination of the research activities.

IDS also wishes to place on record its grateful thanks to Dr. Bed Prakash Uprety, Dr. Raghab Pant and others in the National Commission on Population for the positive interest they have shown in this study. Dr. David Mutchler (USAID/Kathmandu) has also been a source of encouragement and guidance. Dr. Jim Knowles and Dr. Dennis Chao of Research Traingle Institute have contributed great-

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I. INTRODUCTION

The recently released preliminary figures for the 1981 Census of Nepal show a total population size of 15 million, growing at an annual rate of 2.6 percent. While these numbers are subject to revision, they nonetheless indicate the alarming dimensions of Nepal's population problem. The current size of our population of over 15 million already indicates severe over-population in the context of a predominantly rural, agriculture-based economy suffering from both backward technology and topographically dictated land scarcity.1/

But the more gloomy aspect of Nepal's population problem is the projected rate of growth. With a continued 2.6% annual growth rate, the population size will be over 25 million by the turn of the century, and will have doubled within the very brief span of 27 years (by 2008 A.D.). From a historical perspective, a population that increased only by a factor of 1.7 (i.e. less than double) in the fifty years between 1911 and 1961 will have increased four times - doubled twice - in the subsequent 54 years (by 2015 A.D.).

Our ability to cope with such an unprecedented scale of expansion will be determined to a large extent by the future growth rate of national output. On this account, the past performance of the Nepalese economy generates very little optimism. The last decade shows a modest per annum growth in real GDP of 2.4%. Even this limited achievement is marred by the fact that it represents mostly the effect of bringing new land under cultivation in the Terai at a rate which cannot be matched in the future.

On the basis of the newly released population figures, current per capita GDP remains more or less stagnant at the 1964/65 level in real terms. Aggregate growth of the Nepalese economy will continue to be influenced primarily by the trends in the small-scale subsistence farming sector. Population growth has already adversely affected this sector through the depletion of the natural resource base available to these small-scale farmers who cannot readily incorporate modern inputs and technology into their cultivation practices. The point of irrepairable ecological damage in the Hill area agro-system may have already been passed. The prospects are indeed very bleak: Nepal is the only Asian country for which FAO projection of the average yield of cereal crops in 2000 A. D. is lower than the 1973/77 levels.2/

Apart from directly productive investments in agriculture and in other sectors, substantial and immediate reductions in the rate of

population growth are necessary for any realistic hope of achieving a sustained increase in per capita income. More than anything else it is this haunting spectre - that as we go into the 21st century and beyond, Nepal's per capita GDP in real terms may not be any higher than the first recorded level of 1964/65 - which demands that population control objectives be viewed from a national development perspective.

The factors that lead to Nepal's high and accelerating rate of population growth follow a pattern similar to that of many developing countries, whereby mortality rates are falling but fertility remains high and relatively stable. Apart from mortality and fertility levels, the size of a population is also affected by international migration. For Nepal, there unfortunately is no systematic information about the levels of in and out migration. It is quite reasonable to assume that historically the scale of out-migration from the Hill regions and in-migration from India into the Nepal Terai were both substantial. But even within recent decades, there is no conclusive evidence about the magnitude of both of these migratory movements, and much less so about the net effect.

The available evidence about the recent trend in fertility and mortality levels in Nepal is very rudimentary. Large fluctuations occur in specific estimates for a given year or within a span of only a few years. Table 1.1 gives some of the available estimates of the crude birth and death rates, and the implied crude rate of growth. It clearly shows that the combination of a steadily declining crude death rate and a birth rate that remains in the upper range of what is observed in the developing countries has led to an accelerating rate of growth.

As for the more refined measures of fertility which are independent of the age distribution of the population, reliable estimates of the age-specific fertility rates exist only for recent years. Several surveys designed specifically to estimate these age-specific rates (ASFR) were conducted between 1974 and 1978. The computed Total Fertility Rates (TFR) - vary from 6.8 to 6.2 births in these surveys, as indicated in Table 1.2. These variations in the TFR are more properly attributed to sampling error than to any real fluctuations between survey periods; hence the average of these estimates, which is 6.3, is customarily taken as the current level of TFR in Nepal.

A total fertility rate of 6.3 births per women is in the upper range of values observed for developing countries. It exceeds the rates for India (4.8) and Bangladesh (5.7) and is well above the average TFR of 4.5 for a diverse group of thirty-six countries that

Table 1.1

Crude Birth and Death Rates and Crude Rate of Growth

	CBR (per thousand)	CDR (per thousand)	Crude Growth Rate (percent)
1952/54	45-50	30-37	1.4 a/
1961	47	33	1.15
1971	42	22	2.0
1974/75	44.7	19.5	2.52
1976	46.8	22.2	2.46
1977/78	42.6	17.1	2.55

a/ This crude growth rate is based on the average CBR and CDR of the indicated range.

The sources for the estimates are as follows: 1952/54 - the indicated range reflects the estimates of several authors, Thakur, Krotki and Thakur, Vaidyanathan and Gaige, and the UN (for whose reference see Nepal Fertility Survey, First Report (1976) pg. 5-9; 1961: Krotki and Thakur, op. cit.; 1971-CBS, Population Projection For Nepal 1971/86. The remaining years are from the respective Demographic Sample Surveys conducted by the Central Bureau of Statistics.

Table 1.2

Age-Specific Fertility Rate by Years and Sources of Estimation

Age Group	1971 Census a/	DSS 1974/75 b/	DSS 1976 b/	DSS 1977/78 b/	NFS 1976 c/
10 - 14	-	2.45	2.34	2.82	-
15 - 19	74.33	111.64	118.21	127.14	138
20 - 24	267.14	269.89	304.52	294.07	306
25 - 29	310.37	297.25	283.89	293.76	314
30 - 34	161.34	259.84	252.11	251.92	261
35 - 39	196.23	169.31	170.48	179.87	226
40 - 44	168.73	89.46	95.49	71.77	93
45 - 49	48.43	49.55	34.45	24.08	33
TFR per 1000 Women	6,308.40	6,156.95	6,407.7	6,242.15	6,855

Source: a/ CBS, The Analysis of Population Statistics of Nepal, pp. 117-118.

b/ The Demographic Sample Survey of Nepal, 1977/78, p.2.

c/ Nepal Fertility Survey, 1976, p. 2.

the World Bank classifies as low-income.3/ High age specific fertility rate in combination with:

(i) an early age at marriage (mean age for women in the 1976 Fertility Survey is 15).

(ii) a near universal nuptiality rate (over 99% of Nepalese women are eventually married).

(iii) declining mortality, as indicated in Table 1.1.

(iv) a relatively youthful age distribution (about 54% of Nepal's population is below age 19).

— this is a basic recipe for a population explosion.

Since only very slow changes can be expected in the age and proportion of women getting married, and since very little can be done (technically and ethically) about the age distribution and declining mortality levels, any noticeable reduction in Nepal's population growth rate must come through reduced age-specific fertility rates. It is in this sense that an increasing emphasis on a family planning programme - which can reduce fertility by reducing the number of unwanted births as well as, in the long run, by changing peoples' attitudes about desired family size - is the most promising approach for tackling Nepal's population problem.

While there may be general agreement on such an assessment of the role of a family planning programme in Nepal, one still has to evaluate, as the next step, what type and size of a family planning programme would be most effective. This requires, first of all, estimates of the expected reduction in fertility from any given level of programme effort; secondly an assessment of the programme costs; and measurement of the beneficial effects of reduced fertility. As in most other developing countries, Nepal's family planning programme is a public sector operation which uses up resources that could be utilized for other purposes. So a cost benefit framework is used for evaluating the social profitability of resources devoted to a family planning programme.

In many circles such a cost-benefit analysis of fertilicy control programme is often dismissed as much a do about nothing. But this is a misguided view. Evaluation is an important and essential part of any programme and a cost-benefit analysis is one such evaluation procedure by which competing programmes and projects can be ranked in terms of their desirability on economic grounds.A family planning programme conducted as an official government activity is

fundamentally like any other public sector investment. It incurs certain costs (uses scarce resources) and produces a certain output (birth avertions). One then assess how much more or less efficiently resources are utilized in a particular type and scale of family planning program as opposed to alternative programme designs, and ultimately in comparison to other public sector investment that are foregone. It is necessary to go through such a quantitative exercise to give more depth and meaning to what is apparently a widely held conviction that the potential benefits of an expanded family planning programme in Nepal are very large.

II. THE COST-BENEFIT FRAMEWORK

2.1 Overview

It is customary to distinguish two procedures for the economic evaluation of population-related investment projects. Robinson and Horlacher (1968) have called these the "growth model" and the "investment model" approach. The former focuses on tracing the effects of varying population size on future income, consumption and other relevant variables through a macro-economic model. The basic format consists of a functional relationship between population growth, aggregate savings and capital formation. In this approach the economic justification for projects that reduce the population growth rate comes not only from a higher current per capita income, but also because a lower population growth rate leads to higher aggregate savings, and consequently higher per capita income in future periods.

The second approach rationalizes population growth reducing projects by directly comparing the future stream of social benefits generated by such an investment with the costs incurred. The "output" of such projects is usually taken as an unit birth avertion; and the cost and benefits of one birth avertion are discounted to yield a net present value or an internal rate of return.

While the contrast between the two approaches, both in purpose and method, are quite evident in the original formulations made by Coole and Hoover (1958) and S. Enke (1960), the analytical differences between them are not as sharp as they were once taken to be. Zaidan (1971) notes that if the net benefits per birth averted, measured by the cost-benefit technique, is multiplied by the number of prevented births that occur in each future period (as a result of the fertility reduction programme), and if this total net benefit is divided by the existing population in each period, then the results are equivalent to the time-stream of per capita income that would be obtained from the Coole-Hoover approach.4/

Comparing the relative limitations of each of these two approaches also does not make the choice between them any easier. The computational techniques are different; so, naturally, some specific problems occur in one context and not in the other. But the major problematic issues - e.g. choosing an appropriate social welfare function and relative weights for public and private benefits; evaluation of multiple objectives of a family planning programme; the exclusion of any "social utility" of children factors; as well as more routine matters such as relating a given family planning

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programme scale to a future stream of birth avertions - all these are common to both approaches.

Nonetheless, for this case study of Nepal, we have opted to work within an investment model approach. This choice is dictated primarily by the numerous uncertainties inherent in specifying and estimating a meaningful macro-economic model for Nepal that relates population size to future national income and other various economic variables of interest. The National Accounting data base for Nepal is not adequate to estimate a neo-classical type of production function either at a sectoral or an aggregate level. Even within the limited scope of a Harrod-Domar model, the simple functional relationships between income, savings, capital formation and growth cannot be assessed. Nor would it be appropriate to assume or borrow the estimates of various parameters from other countries. There is little merit in merely repeating an often-used methodology (and one that has been often criticized as well for being inadequate) without the precision of information to bring out the special characteristics of the Nepalese case.5/ Consequently, the cost-benefit approach is adopted because it operates independently of future levels of national income and other macro-aggregates; and so it is more manageable from a computational point of view.

The basic structure of a cost-benefit approach to project analysis as well as the special dimensions and limitations this approach takes on when used to evaluate family planning (hereafter, only FP) programmes are too well documented to bear repeating here.6/ But the methodology used in this study for the cost-benefit evaluation of Nepal's FP programme differs in a major way from the one developed by Enke and Zaidan, which now has gained general acceptance. In the conventional methodology the "output" of the FP programme investments is expressed as an unit birth avertion; and costs and benefits are identified accordingly for one birth avertion. In our study, cost and benefits are computed for the total birth avertions which will be required as the output of a FP programme to achieve a targeted reduction in fertility rates. Evaluating FP programme efforts at such an aggregate level has several advantages.

Firstly, it becomes an useful programming tool for population-policy makers and planners who can assess the resource as well as cost-benefit implications of different FP and fertility scenarios. Setting fertility targets has become part of the overall economic planning framework in Nepal. The Sixth Five Year Plan was prepared with a targeted reduction in the total fertility rate from 6.3 to 5.8 births by 1985. Converting such fertility reduction rates to a birth avertions stream for which costs and benefits are computed conveys a lot more useful information to planners about programme

scale, total required resources, the time distribution of net benefits, etc. than merely knowing by how much the benefits of one birth avertion exceed unit costs. Accordingly, the cost benefit calculus can be used to rank different type of FP programmes that lead to the same reduction in fertility; or to judge the relative economic merits of FP programmes required to achieve different fertility targets.7/

Another advantage of the aggregate cost-benefit analysis is the possibility of computing marginal as well as average cost and benefit for birth avertion. In the conventional method of working with an unit birth avertion, the distinction between the average and the marginal cannot be made. This has been one of the main criticism of the cost-benefit analysis of fertility reduction programmes. Whatever the computed net benefit per birth avertion is, this is assumed to hold true for the nth birth avertion as well as for the n thousandth one. Consequently, if one birth avertion is socially beneficial, then by inference the optimum is reached when the birth rate is zero. The aggregate analysis does not necessarily preclude such an implausible conclusion; but at least non-linear relationships can be used in the estimation of cost and benefit such that the net present value per birth avertion will vary with programme scale.

2.2 Methodology and Assumptions of the Study

The basic elements of an aggregative cost-benefit analysis of reducing fertility through FP investments consist of:

(a) A population projection reflecting the fertility baseline* which is projected under the maintained hypothesis that no further FP programme investments are made in the future.

(b) Alternate population projections based on specific targeted rates of fertility decline* which are to be achieved through a FP programme.

(c) The design of an annual programme of FP contraceptive use which is consistent with the number of birth avertions needed to achieve the fertility targets set in (b). (The required birth avertions are allocated to different contraceptive methods; and several different scenarios can be compared.)

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* Both of these fertility projections are made on the basis of the total fertility rate (TFR).

(d) Estimates of the costs of providing the annual programme of FP contraceptive services.

(e) Identifying and estimating the economic benefits realized by the society from the reduced number of births.

The conceptual framework of the analysis, as outlined above, is relatively straight forward, but making the necessary estimates is an altogether different matter. Numerous data as well as methodological problems arise for each of the five items. Estimating the economic benefits of reduced fertility is relatively the least difficult. The methods outlined by Enke and Zaidan have gained some general acceptance. Similarly for costs, data from the existing FP programmes in Nepal provide some basis for projecting future costs per unit of contraceptive protection, by each method. But the remaining three items (a, b and c) are really open-ended issues.

Even for countries that have a reasonably long and well documented record of fertility levels, projecting the future trend with and without a FP programme involves making a whole range of heroic assumptions. Such assumptions can be made less arbitrary for countries where there is a past trend of fertility decline in conjunction with an active family planning programme. But for Nepal such conditions do not occur. In the absence of any accurate documentation of past trends to project future fertility levels, our cost-benefit analysis is based on assumed rates of decline in either case - i.e. with a FP programme and without.

One small way to reduce the effects of these uncertain future levels of fertility on the cost-benefit calculations is to take a relatively short time horizon for the analysis. The choice of a 20 year projection period is based primarily on this consideration. Not only are the errors in the assumed rates of fertility likely to be smaller, but a 20 year projection period also avoids compounding these errors from second-generation effects. (The births averted today will lead to future birth avertions as these people enter their reproductive periods.)

Regarding items a and b, the base level total fertility rate (for 1980) is taken as 6.3 births per woman. This is the average estimate from the three Demographic Sample Surveys referred to in Section I. Now even if the FP programme were discontinued (i.e.no more public sector provision of contraceptive services) there will be some reduction in the TFR in future years, partly because of past programme efforts and partly because of the modest improvements in socio-economic conditions that may be achieved. The projected TFR

in 2000 A.D. under this assumption is 5.9 births per woman. This is, of course, a marginal decrease over a twenty year period. But it should be emphasized that the 5.9 births represents the case where there is not any public sector organization involved in delivering FP contraceptive services. Even if better socio-economic conditions were to reduce the demand for children and thus increase the demand for contraceptive protection, this demand could be satisfied only by traditional contraceptive practices or through the private sector sales of modern FP methods. Under such a scenario, a TFR of 5.9 births by 2000 is not unrealistic.

For comparison with this baseline fertility projection, two other fertility reduction scenarios are constructed. One is an interpolation of the Sixth Plan's targeted TFR of 5.8 births by 1985, which by 2000 A.D. would give a terminal period TFR of 4.3 births per woman. The alternative projection is an even faster decline in the TFR to 3.0 births by 2000 A.D. In all cases, a linear trend is assumed.

Information about item c - the relationship between FP contraceptive use and birth avertion - is also very rudimentary in Nepal. Three separate organizations provide FP services in Nepal. Two of them are centrally administered public sector undertakings - the Family Planning and Maternal Child Health Project and the Integrated Community Health Services Project. The third unit, the Family Planning Association of Nepal, is a voluntary, non-profit organization. Though each of these organizations maintains a service record of contraceptive acceptors and distribution additional information about the characteristics of the acceptors and of the continuation rate and effectiveness of contraceptive use is very limited. Consequently, the birth avertion estimates are based on the couple year of protection method of measuring the total impact of each type of contraceptive method.8/

FP programme costs (item d) are estimated on the basis of the service record and budgetary expenditures of the Family Planning and Maternal Child Health project (FP/MCH). The FP/MCH project is the main source of FP services in Nepal.9/ Instead of estimating an average unit cost per birth avertion, separate cost estimates are made for each of the contraceptive methods used in Nepal - sterilizations, IUDs, pills, condoms, and depo-provera injections. The total cost of providing one couple year of protection by each method is estimated on the basis of a cost allocation exercise of the FP/MCH project expenditures.

The cost of providing contraceptive protection through the FP programme will vary for each method - particularly between temporary

and permanent methods. One should not gross over these differences by working with an average unit cost because the actual combination of methods employed in any FP programme can be varied considerably. The mix of methods is partly determined by the resource constraint and policy choices of the FP programme administrators, as well as by the preferences of the acceptors. The total costs of two programme designs can be quite different even though the total birth avertions impact is the same. On the other hand, because of certain resource constraints, it may not be feasible to achieve two different fertility rate reduction targets with the same proportional-mix of contraceptive methods. To account for such cost differences in the FP programme design, and also to see how costs per method vary, a method specific approach to estimating FP programme costs is used.

Regarding the benefits, one can conceptually distinguish two types of beneficial effects due to a specified number of birth avertions: (1) benefits derived from the redistribution of a given level of national aggregate output to a smaller population; and (2) benefits derived from those effects that lead to additions in national income over and above what it would have been in the absence of the fertility decline. Benefits of the first type consist of the future consumption of the unborn child throughout his/her life; and the expenditures on social services that the government would have to make on behalf of the child. Both of these reflect resources released from current consumption (in the private and public sector) which become available to the rest of the population as higher per capita output.

The national income-increasing effects of reduced fertility represent second round (or indirect) effects of the first type of benefits. The increased levels of per capita consumption of the smaller population may affect health and nutrition levels of the working population so that labour productivity increases. Along with increased per capita consumption, the level of savings may increase, making more resources available for investment and thus increase future income.

While both types of effects are important consequences of reduced fertility, in this cost-benefit analysis we shall directly measure only the first type - the resources released from private consumption and government expenditures on social services. Of the expenditures on social services, we shall focus only on the health and education sector. Of the numerous types of social welfare services that are provided through the public sector, the health and education expenditures are more directly a function of the population size and/or its age distribution. And in terms of magnitude, these

two sectors account for 78 percent of the total social services budget for 1980/81.10/

Ignoring the second round effects does not mean that their magnitudes are negligible. But in comparison to the direct benefits from private and public consumption savings, they will be small. Because of Nepal's current low level of per capita income, the resources released from private consumption when fewer births occur will almost completely be devoted to additional consumption. Available estimates of the marginal propensity of of consumption of Nepalese households derived from the Household Budget Survey conducted by the Rastra Bank are around 0.9 to 0.95.11/ Since these estimates are from urban samples, the national marginal propensity of consumption is expected to be even higher. Hence the extra output available as savings which will increase the level of capital formation is relatively small.

It should also be noted that not all the effects of reduced fertility are socially beneficial. Reduced fertility will eventually lead to a smaller labour force and some potential output is lost in the future. But for Nepal, it is doubtful whether such a loss in output will occur. For this reason (and because of the methodological problems of estimating the relationship between future output and labor supply) the foregone output cost of a FP programme is ignored in our analysis. In spite of reduced fertility, the labour force will be growing in the future. Given the conditions of surplus labour that already occurs today, reductions in the number of people in the working-age group may not necessarily affect the volume of employment (in labor - days).

Finally, the time period over which benefits are measured is 1980 to 2020 A.D. As noted above, a 20 year period (1980/2000) is taken for projecting fertility with and without a FP programme. In the former case, the fertility projections are made in conjunction with a 20 year period of FP programme investments. So the FP programme costs are measured for the twenty year period between 1980 to 2000. But the calculation of benefits should be extended beyond 2000 for two reasons: (i) the FP investments incurred upto 2000 will produce birth avertions in the subsequent years, since many acceptors will have adopted permanent contraceptive methods; and (ii) even for the births prevented before 2000, benefits accrue over the expected life time of the child.

In the calculation of economic benefits made in this study, (i) is ignored completely; and for (ii), an arbitrary cut-off point of 2020 A.D. is adopted, giving a minimum of twenty years over which the benefits of any one birth avertion is measured. The purpose of both of these simplifications is to keep the computations within

manageable limits. The effect in both cases is to under-estimate the benefits. But in a framework where future costs and benefits have to be discounted, ignoring or reducing these very long-run effects should not alter the results substantially.

By way of a summary, the following is the set of working assumptions and simplifications adopted in this application of a cost-benefit analysis to a publicly funded FP programme in Nepal:

(1) Fertility projections are made over a 20 year period (1980/2000) to assess the effects of a FP programme conducted concurrently over this 20 year period.

(2) The projected baseline fertility (in the absence of any future FP investments) is a linear decline in the total fertility rate to 5.9 births per woman by 2000. (The population projection based on this fertility scenario is Projection A.)

(3) FP programme investments are reflected in two alternative TFR targets of 4.3 and 3.0 births by 2000. (The population projections reflecting these fertility scenarios are Projections B and C respectively.)

(4) The effect of contraceptive use is measured through the couple year of protection method.

(5) The estimates of the cost of the FP programme are based on the current costs incurred by the FP/MCH project. Estimates are made for the cost of providing one couple-year-of-protection for each contraceptive method from 1980 to 2000.

(6) The estimated benefits of the FP programme are limited to two sources: (a) private consumption savings and (b) public budgetary saving in the health and primary education sectors only.

(7) The following are ignored:
(a) the effect on future output from a smaller labour force which eventually results from reduced fertility.
(b) the birth avertions that occur beyond the year 2000 from the FP programme acceptance within the 1980/2000 period.

(8) For the stream of birth avertions created by the FP programme between 1980 and 2000, the economic benefits are measured upto the year 2020.

III. POPULATION PROJECTIONS

Table 3.1 below gives the estimated population of Nepal upto 2000 A.D. under the three different fertility scenarios referred to in Section II. Details of the methodology and the assumptions used to make these projections are given in Appendix A. Very briefly, the procedure used was to first adjust the 1971 census figures, and estimate the population in 1980. Then with the 1980 base population and assumptions, projections upto 2000 are made at five year intervals. Fertility varies with each scenario, but all other demographic assumptions are the same for each projection.12/

Table 3.1

Population Projections Under Different Fertility Assumptions

(In thousands)

Year	Projection A	Projection B	Projection C
1980	14,281	14,281	14,281
1981	14,621	14,590	14,564
1985	16,062	15,890	15,751
1990	18,244	17,679	17,220
1995	20,918	19,658	18,635
2000	24,145	21,780	19,866

Using a 1980 base year population estimate of 14.28 million,13/ Nepal's population is projected to reach 24.14 million in 2000 under scenario A. But if the targeted rates of decline in fertility assumed in scenario B and C can be achieved, then in 2000 there will be 2.36 million and 4.28 million less people. Though Nepal will experience a substantial growth in population even under Projection C - the total size reaching more than 19.8 million in 2000 - the relative differences in population size between these three projections are very substantial. The population in 2000 under Projection A is 11% higher than the corresponding population under Projection B, and more than 21% of the population under Projection C.

Since economic benefits are to be measured upto the year 2020, one has also to project the difference in population size beyond 2000

which is due to the FP programme investments made between 1980 and 2000. Since birth avertions that occur after 2000 are ignored in this study, the fertility rates and the number of births after 2000 do not have to be accounted for in any of the three projections. For our purpose, the relevant population in each case is the number of people living in 2000 who are still surviving in each year upto 2020. Estimates of this relevant population between 2000 and 2020 are given in Table 3.2 (in five year intervals).14/ Under Projection A, about 84% of the 2000 population survive to 2020. One would expect this survival ratio to be about the same under Projections B and C also because the same mortality conditions are assumed in all three projections. But a very small difference does occur - the corresponding percentage is 82.9 under Projection B and 81.8 under C - because of differences in the age-distribution. The projected population in 2000 is relatively younger in Scenario A because of the higher fertility between 1980 and 2000.

Table 3.2

Estimated Relevant Population After 2000

(In thousands)

Year	Projection A	Projection B	Projection C
2005	23,155	20,848	18,983
2010	22,228	19,957	18,107
2015	21,271	19,029	17,200
2020	20,278	18,068	16,269

The difference in population size caused by the assumed fertility scenarios for 1980/2000 is still very significant twenty years later. In 2000 there were 2.36 million more people under Projection A than in B; and by 2020, 2.21 million of them are still alive. Similarly, between Projections A and C, the difference of 4.28 million in 2000 is reduced only slightly to 4.01 million.

IV. MEASURING BENEFITS OF REDUCED FERTILITY

Within the limited framework of this study, the benefits that result from a FP programme are the annual stream of resources released from private consumption and public expenditure in health and primary education when there are fewer births. In any given year, the difference in the total population size between Projection A and Projection B, for instance, reflects the cumulative birth avertions caused by the FP programme required under the fertility targets of Projection B. So the difference in the total consumption expenditures of the population under Projection A and Projection B measures the consumption benefit of that year. It is the difference caused by the stream of birth avertions that have occurred upto that year.

A similar inference can be made about the annual health and education sector benefits. It is enough to project annual total expenditures on these categories for each population projection. The difference in any given year is the relevant annual benefit.

For each of the three categories of benefits, future expenditures are projected on the assumption that the 1980 base lavel of per capita expenditures are maintained constant throughout the projection period. This base level expenditure reflects the real resource cost of each of the expenditure categories which will be maintained in future years, irrespective of the changes in nominal prices (i.e. the rate of inflation).

4.1 Consumption Benefits

Since fertility changes affect the age-distribution of the population, and consumption expenditures are particularly sensitive to age, the consumption benefits are calculated on the basis of age-group specific expenditures. Five separate basic age-groups have been identified and the current estimated per capita expenditures are as follows:15/

Table 4.1

Base Level Age-Specific Consumption Expenditures

Age	Per Capita Consumption (Rs.)
0 - 4	312.0
5 - 9	624.0
10 - 14	968.0
15 - 49	1749.1
50 +	1062.0

Table 4.2

Annual Total Consumption Expenditures

(In Million Rs.)

Year	PROJECTION A	B	C
1981	17,244	17,236	17,226
1985	18,968	18,916	18,872
1990	21,556	21,327	21,142
1995	24,594	23,978	23,484
2000	28,296	26,882	25,718
2005	31,289	29,027	27,176
2010	33,463	30,338	27,792
2015	34,494	30,572	27,374
2020	32,287	28,419	25,273

Table 4.3

Annual and Cumulative Consumption Benefits

(In Million Rs.)

Year	Under Projection B		Under Projection C	
	Annual	Cumulative	Annual	Cumulative
1981	9	9	19	19
1985	53	160	97	289
1990	229	938	414	1,680
1995	616	3,214	1,109	5,779
2000	1,415	8,684	2,578	15,615
2005	2,262	18,226	4,093	32,982
2010	3,125	32,142	5,671	58,191
2015	3,921	50,234	7,120	90,951
2020	3,867	69,875	7,013	1,26,514

With these age-specific consumption levels, the total consumption expenditures in any given year can be readily computed for any population, assuming that the levels specified above are maintained.

The total annual consumption expenditures in year t under population projection A ($TC_{t.A}$) is given by:

$$TC_{t.A} = \sum_{i=1}^{5} (Q_{t.A})_i \cdot \overline{PC}_i$$

where $(Q_{t.A})_i$ = Population in age-group category i in year t under fertility assumption A.

$\overline{PC}_i$ = Per capita consumption in each age category (i=1 to 5).

Hence, the annual consumption benefit in year t (CB_t) for the reduced fertility scenario of projection B is

$$CB_t = TC_{t.A} - TC_{t.B}$$

$$\text{and } NCB = \sum_{t=1}^{T} CB_t$$

gives the cumulative consumption benefit over the total period upto 2020 A.D.

The total consumption expenditures incurred under each of the three projections is reported in Table 4.2 (at five year intervals). The corresponding annual as well as cumulative benefits derived under Projection B and C are given in Table 4.3.

Total consumption expenditures for the year 2020 is less than for 2015 under Projection A because the relevant population is smaller in 2020.16/ Under Projection C, this decline is already evident by 2015. It is because of such a decline that the annual benefits derived under projection B and C for the year 2020 are less than for 2015.

4.2 Health Sector Benefits

Budgetary expenditures of His Majesty's Government of Nepal (hereafter, HMG) in the health sector go for many purposes. They

support large urban hospitals, rural health posts, training costs of doctors and other medical staff, and many special programmes. The beneficiaries of these various expenditures will not only vary by type of service provided, but in a country like Nepal, large variations are to be expected across regions, between rural and urban areas as well income classes. Some of the health expenditures are also directly related to child birth and the care of the nursing mother. So these total expenditures will be very sensitive to the fertility rates assumed in the population projections.

Setting these issues aside, a very simple procedure for estimating the health sector benefits of reduced fertility is used. Benefits are computed with the assumption that the current (1980) level of per capita health services would have to be maintained for future populations. The 1980 level of per capita health services is, in turn, measured by the 1980 level of per capita current health expenditures of HMG.17/

Now to maintain this 1980 level of per capita health services in future years with a growing population, certain capital cost have to be incurred so that these services can be made available to the additional population. Two kinds of capital costs are identified - infrastructural and doctor-training costs.

Hence, given the total population in any year (P_t), the required health expenditures can be computed as follows:

$$THE_t = P_t \cdot HCC_o + DP_t \cdot IKC_t + \frac{DP_t}{R} \cdot TKC_t$$

where

THE_t = Required total HMG health expenditures in year t

P_t = Population size in year t

HCC_o = 1980 level of per capita current health expenditures

DP_t = Additional population in year t (i.e. $P_t - P_{t-1}$)

IKC_t = Infrastructural capital costs required per additional person in year t to maintain HCC_o

Table 4.4

Annual Current, Capital and Total Public Expenditures on Health Sector

(in million Rs.)

Year	Projection A			Projection B			Projection C		
	Current	Capital	Total	Current	Capital	Total	Current	Capital	Total
1981	77	16	93	77	15	92	77	13	90
1985	85	18	103	84	16	100	83	15	98
1990	96	22	118	93	18	111	91	15	105
1995	110	27	137	104	20	124	98	14	112
2000	127	33	160	115	21	136	105	12	117
2005	122	-	122	110	-	110	100	-	100
2010	117	-	117	105	-	105	96	-	96
2015	112	-	112	100	-	100	91	-	91
2020	107	-	107	95	-	95	86	-	86

Table 4.5

Annual and Cumulative Benefits From Health Sector

(In Million Rs.)

Year	Projection B		Projection C	
	Annual	Cumulative	Annual	Cumulative
1981	1.7	1.7	3.0	3.0
1985	2.7	10.8	4.9	19.6
1990	7.1	40.2	12.8	72.9
1995	13.9	99.0	25.0	179.5
2000	24.0	202.0	43.2	366.0
2005	12.2	264.0	22.0	478.0
2010	12.0	325.0	21.8	588.3
2015	11.8	385.2	21.5	697.2
2020	11.7	444.5	21.2	804.6

R = 1980 level of population per doctor (- this is 126,138).

TKC_t = Per unit doctor training cost in year t.

The computation of total health expenditures from the above equation are made with the following estimates for the unknown parameters.18/

HCC_o = (1980 level of per capita health services) = Rs.5.25

IKC_t = $\overline{IKC}$ (infrastructural capital costs per additional population, assumed constant in each year). = Rs.43

TKC_t = $\overline{TKC}$ (per unit doctor training cost, constant for each year). = Rs.125,000

As in the case of consumption benefits, the annual health sector benefit that occurs under the reduced fertility Scenario B (HB_t) is

$$HB_t = THE_{t.A} - THE_{t.B}$$

and similarly for fertility Scenario C.

Table 4.4 gives the estimated current and capital health expenditures for each of the three population projections. Since new births after 2000 are not reported in the analysis, capital expenditures are not relevant beyond 2000.

The health sector benefits that occur under population Projections B and C are given in Table 4.5. The pattern of benefits is similar to that for private consumption. The annual benefit for both projections increases rapidly upto 2000, reaching a peak in 2015, after which it declines slightly because of the smaller population base.

4.3 Education Sector Benefits

Savings in public expenditure on education because of a smaller school going age population due to fertility reduction is the monetary measure of the benefits of fertility decline accruable from the education sector. Since HMG has a declared objective of

attaining universal primary education, and making it free of cost to the student, the bulk of the education sector expenditures will have to be devoted to this objective. Secondly, it is rather difficult to forecast the demand for secondary and higher education in the future, and predict what proportion will be met by privately operated schools. For these reasons, only the benefits that occur in the primary education sector (Grades I to V) are estimated.

The procedure used for estimating the education sector benefits is similar to that used for the health sector. First, the current cost per student that has to be borne by HMG is estimated. HMG also bears certain capital costs for providing primary education. Since details on infrastructural cost (e.g. construction of school buildings) are not available, capital costs are limited to the costs incurred in training additional primary school teachers. The current cost per student is estimated to be Rs. 111 for grade I, Rs. 113 for Grade II and III; and Rs. 137 for grade IV and V; and the capital cost per additional student (irrespective of grade) is Rs. 114.19/

Secondly, the enrollment in each primary grade is forecast for the three different population projections using a grade transition model.20/ These individual grade enrollments are forecast for two different scenarios. Scenario 1 assumes that the new entrants in grade I in each future year is determined by the base year intake rate of 1980. Given the 1980 intake rate for grade I, and the assumed promotion and repetition rate for each grade, the gross enrollment in primary school in 2000 is only about 74% of the total primary school age population (age 6 to 10). Consequently scenario 2 is defined to represent a case where the intake rate in grade I increases steadily so that universal primary education is achieved by 2000 - i.e. total school enrollment in grade I to V by 2000 will be equal to the total population between the age of 6 and 10.21/

The total projected enrollment under both scenarios is presented in Table 4.6 for each population projection. The effect of fertility decline on primary school enrollment occurs from 1986 onwards because the assumed age of entry is six years. Subsquently, children born in 2000 will enter primary schools in 2006 and normally complete their primary education by 2010. Since our study ignores the birth avertions effect beyond 2000, the relevant differences in primary school enrollment occur only upto 2010, with the maximum difference being in 2006.

For Scenario 1, the total enrollment is expected to be 2.87 million in 2006, i.e. about 106 percent more than the base year under

Table 4.6

Projected Primary School Enrollment

(In thousands)

Year	Projection A		Projection B		Projection C	
	Sc-1	Sc-2	Sc-1	Sc-2	Sc-1	Sc-2
1986	1667	1759	1657	1749	1649	1740
1990	1811	2039	1725	1941	1655	1861
1995	2027	2591	1854	2289	1656	2042
2000	2457	3382	2006	2757	1638	2247
2005	2792	4024	2110	3041	1557	2244
2006	2874	4147	2141	3089	1548	2234
2010	433	627	306	448	216	315

Note: Sc-1 : Scenario One
Sc-2 : Scenario Two

fertility assumption A. Under Projection B, the school system will have to cope with 733 thousand less students in 2006. With the even more rapid fertility decline assumed under Projection C, the total students in school in 2006 will be 1.55 million, i.e. 1.33 million students less than under Projection A. Total primary school enrollment as projected under Scenario 1 will be increasing every year; but still by 2000 more than a quarter of the school going population of age 6-10 will not be enrolled in any grade. This out of school population will consist predominantly of girls. (The gross enrollment ratio of girls in 2000 will be only .434 if the current intake rate is maintained.)

In order to reach universal primary education by 2000 (Scenario 2), the enrollment under Projection A will be 3.38 million in 2000. This is almost 143% more than the base year student population of 1.39 million. Clearly the pressure on the school system would be very acute. In this scenario, the number of students enrolled in 2000 A.D. even under Projection C will be 2.25 million. This means 850 thousand more students than the base level. Primary school enrollment increases upto 2006 under Projection A and B, while a decline is evidenced after 2000 under Projection C. Whatever the fertility assumption, the schooling system needs to cope with a

much higher annual number of students than it is doing currently. In the absence of a significant decline in fertility the magnitude of the problem becomes so large that the target of attaining universal primary education by 2000 A.D. may not be attainable at all.

Given the grade-wise enrollment in each future year that lie behind the total enrollment figures reported above, the total HMG expenditures on primary education (TEE_t) can be calculated as follows:

$$TEE_t = \sum_{i=1}^{5} E_i^t \cdot PSC_i + DE_t \cdot KC$$

where: E_i^t = enrollment in grade i in year t (i = I to V)

PSC_i = per student current cost in grade i

DE_t = additional total enrollment in year t

KC = capital cost per additional student

Again, the annual benefits under Projection B and C are derived as the difference in total expenditure (- i.e. $TEE_{t.A} - TEE_{t.B}$).

The total primary education expenditures calculated in this manner is reported in Table 4.7 for each projection and scenario. And the respective differences between Projection A and B and between A and C - the education sector benefits - are given in Table 4.8.

Table 4.7

The Annual Total Resource Requirement for Primary Education

(In Million Rs.)

Year	Projection A		Projection B		Projection C	
	Sc-1	Sc-2	Sc-1	Sc-2	Sc-1	Sc-2
1986	199.4	212.9	197.5	210.9	196.0	209.2
1990	218.7	249.6	206.1	235.1	196.1	223.1
1995	254.7	319.7	222.5	279.1	196.3	246.1
2000	298.7	418.4	240.6	336.8	194.0	270.3
2005	338.0	488.5	251.9	364.1	184.8	266.2
2006	348.4	503.5	256.6	370.9	183.6	269.4
2010	59.3	85.8	41.9	61.3	29.5	43.1

While the 1979/80 public expenditure on primary education was Rs. 98.6 million (current expenditure only), the estimated requirement for 1986 ranges from Rs. 196.0 million to Rs. 212.9 million, depending on the rate of fertility decline and scenario visualized. For subsequent years, the requirement keeps on increasing upto year 2006 (except for Scenario 1 under Projection C). Attainment of universal primary education by 2000 requires a more than four-fold increase in HMG budgetary expenditures under Projection A. Even under the lowest fertility scenario (Projection C) there will have to be a 300% increase. The maximum resource requirements occur in the year 2006 when the enrollment figures will be the highest.

The education sector benefit is the difference between these required expenditures projected under fertility Scenarios B and C. As indicated in Table 4.8, the largest annual benefit occur in 2006 in each case, reaching a maximum of Rs. 234 million in the universal primary education scenario under Projection C. This saving is almost 50% of the required expenditure under Projection A for the corresponding scenario. By 2010, the cumulative benefits under Projection B is between Rs. 1.1 and 1.4 billion, and between Rs. 1.8 and Rs. 2.5 billion under Projection C.

Table 4.8

Annual and Cumulative Benefits from Education Sector

(In Million Rs.)

Year		Under Projection B		Under Projection C	
		Annual	Cumulative	Annual	Cumulative
1986	Scenario - 1	1.9	1.9	3.4	3.4
	Scenario - 2	2.0	2.0	3.7	3.7
1990	Scenario - 1	12.6	33.6	22.6	61.1
	Scenario - 2	14.6	38.1	26.5	69.7
1995	Scenario - 1	32.2	153.9	58.4	279.3
	Scenario - 2	40.5	185.2	73.6	336.8
2000	Scenario - 1	58.1	389.5	104.6	705.0
	Scenario - 2	81.7	503.7	148.2	915.2
2005	Scenario - 1	86.1	756.8	153.3	1361.6
	Scenario - 2	124.4	1031.6	222.3	1867.3
2006	Scenario - 1	91.9	848.7	164.9	1526.5
	Scenario - 2	132.7	1164.2	234.2	2101.5
2010	Scenario - 1	17.4	1019.6	29.8	1845.4
	Scenario - 2	24.5	1405.6	42.7	2548.0

V. ESTIMATES OF THE COSTS OF FERTILITY REDUCTION

Since Projection A reflects the case of no FP programme in the 1980/2000 period, the economic costs associated with population Projections B and C are the FP programme costs of producing the fewer births that occur in these latter projections. Hence these costs can be measured as the FP programme costs of an annual stream of birth avertions between 1980/2000.

5.1 Estimating Required Birth Avertions

The relevant number of birth avertions in each year is the difference in the population aged 0 between Projections A and B and between A and C. To reduce the computations, the FP programme design is identified in five year intervals. The corresponding number of birth avertions required in these five year intervals upto 2000 are given in Table 5.1.22/ Population Projection B implies a total of 171,526 birth avertions during the 1981/85 period, increasing upto 1.14 million between 1996 and 2000. For Projection C the corresponding number of birth avertions is slightly less than double.

Table 5.1

Births to be Averted for Projection B and C

Period	Projection B	Projection C
1981/1985	171,526	310,891
1986/1990	403,665	781,642
1991/1995	717,776	1,300,968
1996/2000	1,142,704	2,063,667
Total	2,435,671	4,407,178

Given the targets of birth avertions to be achieved through the FP programme for these five-year-intervals, the next step is to allocate them in a consistent manner to the different contraceptive methods made available through FP programme activities. As noted before, a twenty year schedule of birth avertions can be achieved through a variety of FP programme designs. The total birth avertions effect will depend on the relative emphasis and distribution of acceptors among the various methods. For each method, the

effect will also depend on the age distribution and the age-specific-marital-fertility of the target group of acceptors. With more detailed information about the background characteristics of FP acceptors in Nepal and about the length of effective usage of contraceptive methods, a regular simulation analysis of FP programme designs could be done to identify the least-cost combination of methods that would yield the birth avertions targeted in Table 4.3. But with the information that is available, many critical variables have to be assumed and projected over the 1980/2000 period. So a more limited exercise is done whereby several FP programme scenarios are compared under both Projections B and C.

5.2 Estimating Birth Avertions by Method

Establishing the link between some measurable index of contraceptive services provided by a FP programme and the final output - averted births - is the most critical part of any evaluation analysis of a FP programme. Fairly complex statistical procedures have been developed, most of which require a wealth of country-specific data on acceptor characteristics and use-effectiveness of each method (see UN, 1979). For most project purposes, it is not clear that the gain in precision from these detailed procedures are worth the extra computation. So a more approximate method, as outlined in Robinson and Schutzer (1980) is adopted here.23/

The reduced fertility scenarios assumed in Projections B and C are already based on projected levels of the TFR between 1980 and 2000. Ignoring illegitimate births, the marital age specific fertility rates which are consistent with these targeted TFR's (and the expected increase in the age at marriage) can be computed for each future period. Given the MASFR and certain minor penalty adjustments, the birth avertion effect of any contraceptive method that provides one full year of protection can also be easily calculated. So then, the other additional information required are:

(a) What level of contraceptive use constitutes a full year of protection for each method.

(b) What is the average length of effective usage of method.

Item (a) presents little problem in the case of sterilizations; and for the other temporary methods, reasonable estimates can also be made of what constitutes one couple year of protection in terms of units distributed and used. For instance, we have taken 14.4 cycles of pills distributed to equal one CYP (13 cycles of actual use plus a 10% wastage adjustment). Similarly 107 condoms used is

one CYP, which requires 137 units distributed if 20% of total distribution is wasted.24/

Defining FP programme activities in terms of units distributed rather than as the number of acceptors of pills and condoms reduces the uncertainties associated with item (b). The birth avertions effect of any annual programme of pill and condom distribution will be limited to that year and the following nine months only. No estimates of life-time continuation rates and effective use have to be made.

For the non-temporary methods, some adjustment have to be made for continued effective usage. For sterilization, we assume that the birth avertions effect will last upto the end of the wife's reproductive period (age 49), and that it will continue to be 100% effective. Estimating effective usage of IUD's in future periods is a particularly tricky problem. But since very low rates of IUD acceptance are projected, a crude method of estimating birth avertions is applied to IUD (as well as to depo-provera) acceptors.25/ The assumptions and methodology for estimating birth avertions from each method are given in Appendix C.

5.3 Forecasting FP Programme Levels: Projection B

Two alternate annual programme of FP services are presented below, both of which satisfy the schedule of birth avertions that are implied in Projection B. The first programme (Mix B.1) is an extension of the current pattern of contraceptive use in Nepal. Current acceptance of IUD's and depo-provera injections is very low; and it is not reasonable to expect any substantial increase in the use of these two methods. Very modest levels of acceptance of IUD's and depo-provera injections are projected - an average of 2500 IUD's per year, increasing to 4000 after 1990; and 2000 depo-provera acceptors per year, increasing to 3000 after 1990. Consequently the brunt of any FP effort in Nepal through the 1981/2000 period must be borne by the pill, condom and sterilization programme.

In 1980/81, a total of 22,842 sterilization were performed in Nepal.26/ So in Mix B.1 sterilizations have been projected at the average rate of 30,000 per year in the first ten years, increasing to 40,000 per year between 1990 and 2000. The pill and condom distribution programme are set so that the remaining birth avertions (once the sterilization, IUD and depo-provera programs are fixed) are allocated on a 55:45 basis between pills and condoms. The projected distribution between 1981/85 is 800 thousand pill cycles and 6.6 million condoms per year, increasing to 7.8 million pill cycles and 61.4 million condom pieces annually between 1991 and 2000.

Table 5.2

Methodwise Annual FP Program for Projection B: Mix B.1

(in '000 units)

Time Period:	1981/85	1986/90	1991/95	1996/2000
Sterilization a/	30	30	40	40
IUD a/	2.5	2.5	4	4
Depo-Provera a/	2	2	3	3
Pill (cycles) b/	800	1600	3800	7800
Condom (pieces) b/	6644	12372	29620	61405

a/ annual new acceptors.
b/ total units distributed annually.

The second programme (Mix B.2) indicated in Table 5.3 reflects a programme design in which more emphasis is placed on sterilization: 40 thousand per year in 1981/1990 and 50 thousand per year in the last ten years. The programme for IUD and depo-provera acceptors is kept the same as in Mix B.1. The residual birth avertions is allocated on an approximately 60:40 basis between pills and condoms. This allocation gives relatively more emphasis to the pill programme than in Mix B.1. The net effect of the greater emphasis on sterilizations and pills is that the required units of condom distribution is reduced substantially in Mix B.2.

Table 5.3

Methodwise Annual FP Program for Projection B: Mix B.2

(in '000 units)

Time Period:	1981/85	1986/90	1991/95	1996/2000
Sterilization a/	40	40	50	50
IUD a/	2.5	2.5	4	4
Depo-Provera a/	2	2	3	3
Pill (cycles) b/	800	1200	3600	8000
Condom (pieces) b/	3034	7020	18635	44256

a/, b/: as in Table 5.2.

The difference in the programme impact of Mix B.1 and B.2 in terms of the share of each method in the total birth avertions required under Projection B is given in Table 5.4. The relative contribution of the IUD and depo-provera programmes - with a maximum combined share of 5% - is very small. The highest periodwise share (62.7%) is that of sterilization under Mix B.2 in 1986/90; and in Mix B.2 the share of sterilization is always higher than that of any other method. The same is not true for Mix B.1 where the birth avertion share of both the pill and condom programme exceed that of sterilization in the last period (1996/2000). In terms of the average twenty year impact, the shares of sterilizations, pills and condoms are respectively 35.7%, 33.1% and 28.1% of the total births averted between 1981 and 2000 in Mix B.1. In Mix B.2 the corresponding shares are 46.6%, 31.8% and 18.6%.

Table 5.4

Distribution of Births Averted by Method for Mix B.1 and B.2

(in percent)

Time Period	1981/85	1986/90	1991/95	1996/2000	Total 1981/2000
Sterilization					
(i) Mix - B.1	35.5	47.1	38.9	29.8	35.7
(ii) Mix - B.2	47.4	62.7	51.0	38.0	46.6
IUD					
(i) Mix - B.1	2.9	3.1	2.2	1.8	2.2
(ii) Mix - B.2	2.9	3.1	2.2	1.8	2.2
Depo-Provera					
(i) Mix - B.1	2.3	1.0	0.8	0.5	0.8
(ii) Mix - B.2	2.3	1.0	0.8	0.5	0.8
Pill					
(i) Mix - B.1	31.2	26.6	31.6	36.8	33.1
(ii) Mix - B.2	31.2	20.5	29.4	37.4	31.8
Condom					
(i) Mix - B.1	28.1	22.2	26.5	31.1	28.1
(ii) Mix - B.2	16.2	12.7	16.6	22.3	18.6
Total Birth Avertions	171,526	403,665	717,776	1,142,704	2,435,671

5.4 FP Programme for Projection C

Three different FP programme scenarios have been constructed which produce the birth avertions required under Projection C - Mix C.1*, C.2* and C.3. In the first two mixes the percentage share of births averted from each method in the designated five year intervals is the same as in Mix B.1 and B.2 respectively.27/ This ensures that the higher scale of the FP programme methods required for Projection C occurs solely from the lower fertility targets and not from changing the emphasis given to any particular method. Table 5.5 and 5.6 below give the period-wise annual FP programme for each method under Mix C.1* and C.2* respectively.

Table 5.5

Methodwise Annual FP Programme for Projection C: Mix C.1*

(in '000 units)

Time Period	1981/85	1986/90	1991/95	1996/2000
Sterilization a/	55.8	64.5	91.1	113.8
IUD a/	4.5	4.5	7.4	7.4
Depo-Provera a/	3.6	3.6	5.2	5.2
Pill (cycles) b/	1,493	3,220	7,554	15,882
Condom (pieces) b/	12,451	24,695	58,711	124,356

a/ annual new acceptors.
b/ total units distributed annually.

The difference in programme design between Mix C.1* and C.2* follows the pattern of the difference between Mix B.1 and B.2 since the same relative shares of births averted are imposed. In comparison to Mix C.1*, C.2* has a stronger emphasis on sterilization (relative to all the methods) as well as a stronger emphasis on pill distribution (relative to condoms).

By imposing a uniform methodwise share of birth avertions between the FP programmes designed for Projection B and C, the number of sterilizations required annually in Mix C.1* and C.2* become much higher than the actual numbers performed currently in Nepal. Mix C.1* requires about 55 thousand sterilizations annually in the

Table 5.6

Methodwise Annual FP Programme for Projection C: Mix C.2*

(in '000 units)

Time Period:	1981/85	1986/90	1991/95	1996/2000
Sterilization a/	74.5	85.4	115.5	139.2
IUD a/	4.5	4.5	7.4	7.4
Depo-Provera a/	3.6	3.6	5.2	5.2
Pill b/	1,493	2,411	7,141	16,256
Condom b/	7,198	14,116	37,040	90,202

a/, b/: as in Table 5.5.

1981/85 period, while the total number of sterilizations performed in 1980 was only about 23 thousand.28/ Furthermore, a very rapid increase is required in the subsequent five year intervals: the annual rate is 113 thousand in 1996/2000. Similarly, Mix C.2* requires about 74 thousand sterilizations annually in 1981/85, increasing to 139 thousand in the 1996/2000 period.

Consequently a third programme design (Mix C.3) has been projected with a reduced and more feasible target of sterilizations: 40 thousand and 50 thousand annually in the first two five year intervals, and 80 thousand in the 1991/2000 period. IUD and depo-provera acceptors are set at the same limited level of Mixes B.1 and B.2. Consequently, the brunt of the programme effort falls on pill and condom distribution. The average share of birth avertions from sterilization in Mix C.3 is about 28% in contrast to 35.7% and 46.6% under Mix C.1* and C.2*. The combined pill and condom share is over 70% in C.3.29/

5.5. Estimation of FP Programme Costs

The FP programme of contraceptive services identified for the various mixes noted above is based on two different indices of programme scale. The programme for sterilization, IUD, and depo-provera is defined in terms of new acceptors each year; while the pill and condom programme is stated in terms of total units distributed annually. Accordingly, to estimate the total resource cost

Table 5.7

Methodwise Annual FP Programme for Projection C: Mix C.3

(in '000 units)

Time Period:	1981/85	1986/90	1991/95	1996/2000
Sterilization[a/]	40	50	80	80
IUD[a/]	2.5	2.5	4	4
Depo-Provera[a/]	2	2	3	3
Pill[b/]	1,8000	4,100	8,600	17,400
Condom[b/]	15,093	32,975	68,809	136,893

a/, b/: as in Table 5.5.

Table 5.8

Methodwise Distribution of Birth Avertions : Mix C.3

(in percent)

	1981/85	1986/90	1991/1995	1996/2000	Total (1981/2000)
Sterilization	25.4	34.7	30.7	23.9	27.8
IUD	1.6	1.7	1.2	1.0	1.2
Depo-Provera	1.3	0.5	0.5	0.3	0.5
Pill	37.6	33.7	36.3	40.5	37.9
Condom	34.1	29.4	31.4	34.4	32.7
Total Birth Avertions	310,891	731,642	1,300,968	2,068,677	4,407,178

of these FP programmes one requires estimates of the unit cost of distribution per condom piece and pill cycle; and the unit cost for each vasectomy, laparoscopy, IUD and depo-provera acceptors. These unit costs are reported in Table 5.9. They are based on the expenditure and service records of the FP/MCH project only. Each of the relevant per unit cost is first derived for the 1979/1980 fiscal year, and on the assumption that some component of these unit costs will increase over time, the costs for the subsequent five year intervals have been projected.30/ (See Appendix D for the details of the cost estimation procedure.)

Table 5.9

Unit Annual Costs of Contraceptive Service

(in Rupees)

Time Period:	1981/85	1986/90	1991/95	1996/2000
Vasectomy	574.05	591.95	611.67	633.36
Laparoscopy	694.37	700.33	733.08	766.91
IUD	223.92	233.17	243.34	254.53
Depo-Provera	221.80	230.82	240.74	251.65
Pill (per cycle)	13.63	14.66	15.08	17.05
Condom (per piece)	1.67	1.80	1.95	2.11

The annual total FP programme costs that are based on these unit cost estimates is given below in Table 5.10 for each of the five mixes identified above.31/ The lowest FP budget in the initial 1981/85 period occurs under Mix B.1 (Rs. 41.7 million annually). The required FP expenditures even in this lowest cost scenario is about Rs. 10 million more than the actual FP expenditures made during the 1980/81 fiscal year.32/ For Mix C.3, the annual expenditures during this initial period is as high as Rs. 75 million.

The annual FP cost in the subsequent intervals increase rapidly for all the mixes. This occurs for two reasons. The real unit costs for each contraceptive method is projected to increase. Secondly, the scale of contraceptive services projected for the latter periods is also greater for each method because of the higher number of required birth avertions. The greatest increase

Table 5.10

Projected FP Program Costs

(in Rs. Million)

Program	1981/85	1986/90	1991/95	1996/2000	Grand Total (1981/2000)
Mix B.1	41.7	66.2	146.4	292.3	2733
Mix B.2	43.2	57.2	128.5	266.6	2477
Mix C.1*	77.8	135.3	298.1	616.1	5636
Mix C.2*	80.7	117.9	265.7	567.9	5161
Mix C.3	75.7	152.9	325.5	643.3	5987

in cost occurs again for Mix C.3. The annual expenditure in 1996/2000 is more than eight times the initial period expenditure. But even for the other mixes, the increase is at least six fold. The grand total FP expenditures during the entire 1981/2000 period varies between Rs. 2477 million and Rs. 2733 for Projection B; and between Rs. 5161 million and Rs. 5987 million for Projection C.33/

The effect on total programme costs of a stronger emphasis on sterilizations is quite evident from comparing the cost for Mix B.1 and B.2 and for C.1* and C.2* respectively. In spite of a higher initial annual cost, the total twenty year cost is lower in the programme mixes that have a stronger emphasis on sterilization. The continuing birth avertion effect of sterilizations is so dominant that the future cost reduction arising from a lower scale of other FP services more than compensates for the higher unit cost of sterilization. There is a Rs. 255 million difference between Mix B.1 and B.2 which is about a 10% saving in total cost for Mix B.1. The cumulative difference in cost between Mix C.1* and C.2* is Rs. 475 million, and the corresponding cost savings is also about 10%.

VI. COST-BENEFIT MEASURES OF THE RETURN TO FP PROGRAMME INVESTMENTS

In Section IV the social benefits that occur when the Nepalese population size follows Projection B or C instead of Projection A were identified and measured. The corresponding economic costs associated with Projections B and C were estimated in Section V. These two results are brought together in this section to assess what the social returns of FP programme investments are under the various scenarios and programme mixes that have been identified. Alternative methods of ranking these different "investment programmes" are also presented.

The annual FP programme expenditures and benefits of fertility reduction under Projection B are compared in Figure 1. Benefits are presented only for the universal primary education scenario (scenario 2) in which the total benefits are higher. FP programme costs are presented for both Mix B.1 and B.2. In both cases FP programme costs exceed annual benefits for the first three years only - i.e. from 1981 to 1983. Total benefits show an increasing trend upto 2000 and beyond. The peak occurs in 2017 after which there is a slight decline because the relevant population difference for which benefits are computed is declining.

The distribution of the annual benefit between private consumption and public expenditure savings is also indicated in Figure 1. This gives a surprising result that the annual savings in government expenditure on health and primary education alone are always less than the annual FP programme costs. Even in terms of the cumulative benefit and cost, the total public savings benefit between 1981 and 2020 is less than the total FP programme cost incurred between 1981 and 2000. The shortfall is quite large: total public savings benefit is only between 21% and 28% of total cost, depending on the scenario and FP programme mix. (See Table 6.1.)

Such a result contrasts sharply with the ones obtained by Zaidan (1971) for the U.A.R. and by Abel et al. (1981) for Thailand.34/ The main reason why the opposite result occurs for Nepal is that the current level of HMG expenditures on health and primary education are very limited on a per capita basis. Our study is based on the hypothesis that HMG will have to maintain this same (low) level of per capita expenditures for the future population also. The public savings benefit would be larger if future expenditures are projected to increase. Another reason for the low public savings benefit is that the birth avertions which occur after 2000 are not accounted for in the study even though they are directly

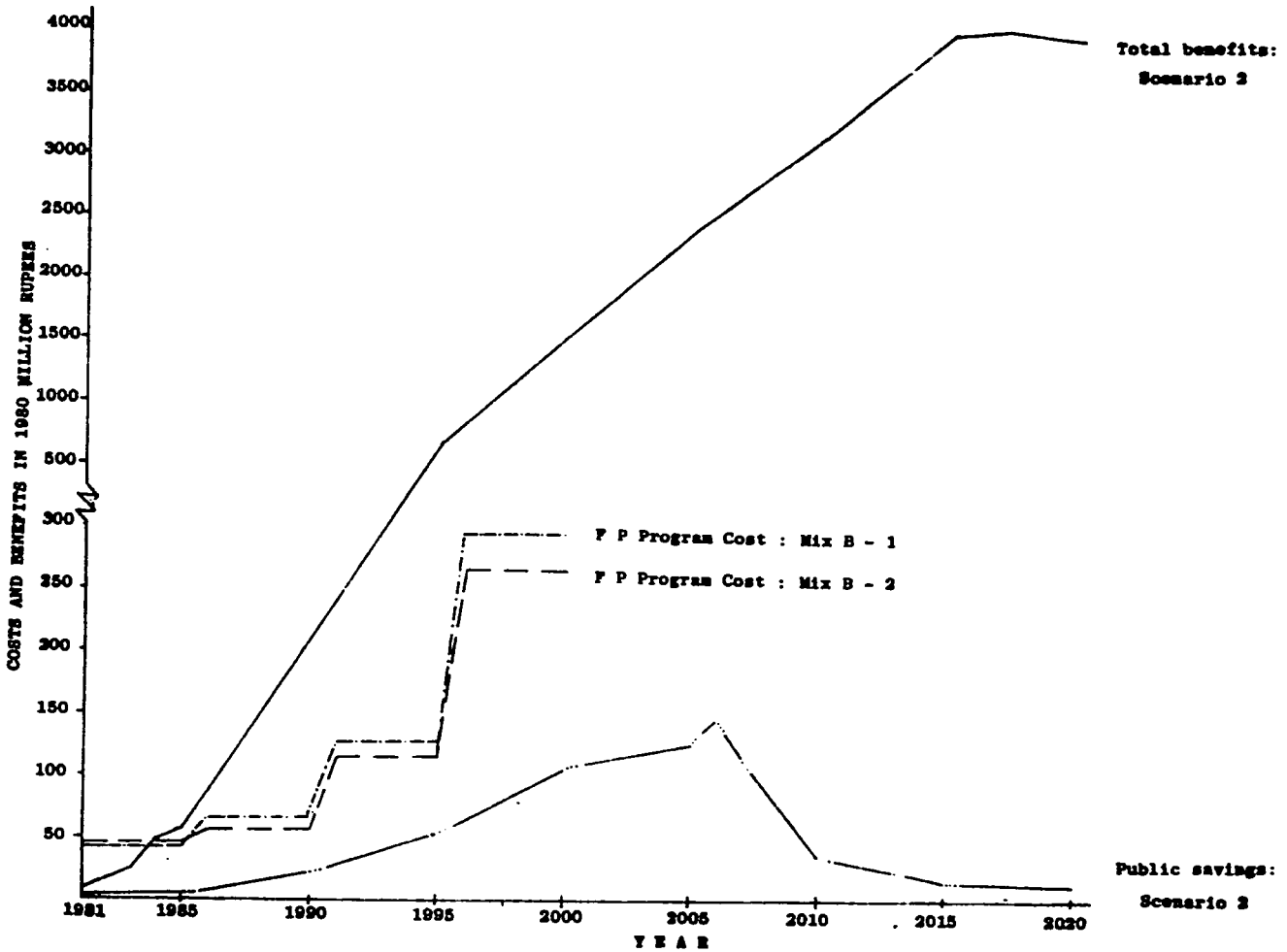

Figure 1. Annual Costs and Benefits Under Projection B.

caused by the FP programme expenditures incurred between 1981 and 2000. However, even if this under-estimation of the public sector benefits were to be corrected, it is unlikely that the benefits would increase sufficiently to exceed FP programme costs, unless higher per capita expenditure levels are projected in the future.

The corresponding comparison of annual costs and benefits for the fertility reduction scenario under Projection C is given in Figure 2. Here also the same two general results hold: (i) total annual benefits exceed FP cost after 1984; and (ii) benefits from public savings in health and primary education expenditures alone do not cover FP programme costs in any period.

The cumulative cost and benefit totals for both fertility projections are given in Table 6.1. Benefits are cumulated over two different periods: 1981 to 2000 only; and 1981 to 2020. Cumulative benefits exceed costs for each and every FP programme mix and time period. Table 6.1 also shows that the saving in private consumption always accounts for an overwhelming share of the total benefits. Even under the higher public savings assumption (scenario 2 with universal primary education by 2000), the share of private consumption in total benefits is never less than 90%. Secondly, the distribution of the total benefits between the two time periods is also very disproportionate. Only about 12 to 13% of the total cumulative benefits occur within the twenty year period (1981/2000) concurrent with the FP programme. Even though these benefits cover FP programme cost, the bulk of the benefits are generated in the subsequent twenty years.

The rates of return to the FP programme investments should be properly assessed with discounted future costs and benefits. A discounting framework is necessary for making the two different annual stream of costs and benefits comparable. There is, of course, a lot of controversy over what the appropriate social discount rate should be in evaluating public sector projects under the conditions of domestic capital market imperfections. Consequently, the present value of costs and benefits are computed for three different discount rates (3%, 5% and 10%) along with the undiscounted case (implying a 0% discount rate).

The rates of return for the various FP programme mixes designed for Projection B and C are reported in Table 6.2 in terms of the cost-benefit ratio and the internal rate of return. These results are based on the benefits computed under the non-universal primary education assumption (scenario 1) only. In this scenario the public saving benefits are smaller than when the target of achieving universal primary education is imposed. Thus, within our

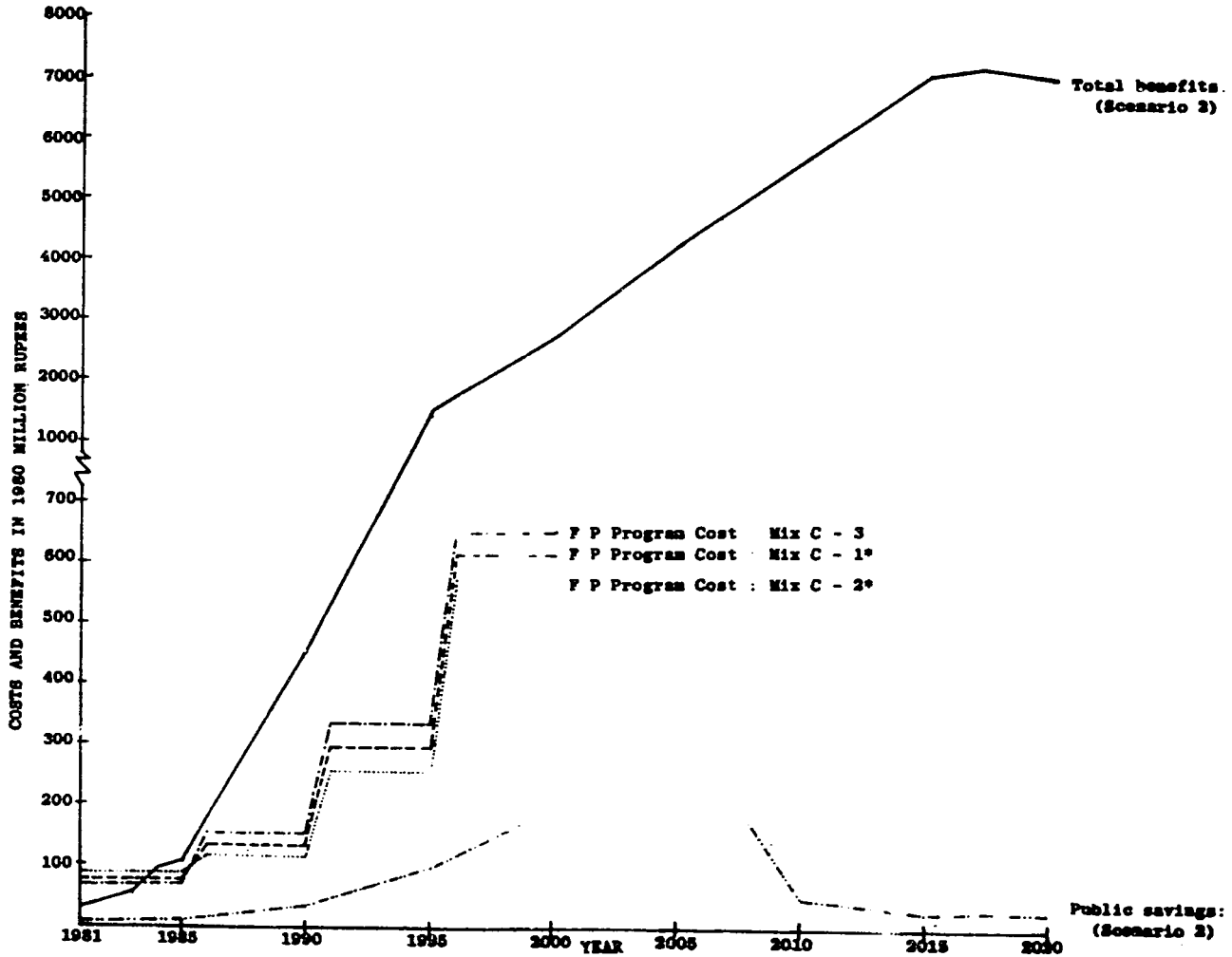

Figure 2. Annual Costs and Benefits Under Projection C

Table 6.1

Cumulative Benefits and Cost of Fertility Reduction

(in Rs. Million)

	PROJECTION B		PROJECTION C	
	Period I (1981/2000)	Period II (1981/2020)	Period I (1981/2000)	Period II (1981/2020)
Benefits				
1. Consumption	8634	69875	15615	126514
2. Public Savings				
(a) Scenario 1	592	1464	1071	2650
(b) Scenario 2	706	1850	1281	3352
3. Total				
(a) Scenario 1	9226	71339	16686	129164
(b) Scenario 2	9340	71725	16896	129866
FP Programme Cost (between 1981/2000)				
Mix B.1	2733		Mix C.1*	5636
Mix B.2	2477		Mix C.2*	5161
			Mix C.3	5987

measurement framework, Table 6.2 gives the minimal estimate of the economic returns to family planning programme in Nepal.35/ In order

to judge how sensitive the calculated returns are to the population projection interval, the rates of return are computed with the benefits measured over two time intervals as in Table 6.1. (Period I is the twenty-years concurrent with the projected FP programme; while in period II benefits are extended upto 2020.)

As expected, the cost-benefit ratio is very sensitive to the discount rate as well as the time period chosen. There is a large difference in the cost-benefit ratios between the two time period. When benefits are measured only upto 2000 A.D., the cost-benefit ratio ranges from 2.3 to 3.7. In the extended period, the

Table 6.2

Rates of Return to FP Programme Investments[a/]

r=	Cost-Benefit Ratios 0	3	5	10	Internal Rate of Return
PERIOD I*					
Projection B					
Mix B.1	3.4	3.2	3.1	2.8	49.5
Mix B.2	3.7	3.5	3.4	3.0	49.6
Projection C					
Mix C.1*	3.0	2.8	2.7	2.5	47.0
Mix C.2*	3.2	3.1	3.0	2.7	47.2
Mix C.3	2.8	2.7	2.6	2.3	46.4
PERIOD II**					
Projection B					
Mix B.1	26.1	16.7	12.8	7.1	50.1
Mix B.2	28.8	18.4	14.0	7.7	50.2
Projection C					
Mix C.1*	29.9	14.8	11.3	6.3	47.8
Mix C.2*	25.0	16.1	12.3	6.8	48.0
Mix C.3	21.6	13.9	10.6	6.0	47.3

a/ These rates of return are for the FP programme benefits under the education sector scenario 1.

* Period I: Costs and benefits over 1981/2000.

** Period II: Costs over 1981/2000; benefits over 1981/2020.

undiscounted cost benefit ratio is as high as 28.8 for Mix B.2. Over the 40 year period, however, these ratios are very sensitive to the discount rate. With a 10% discount factor, the benefits under Projection B are only around seven times the cost, and the corresponding factor for Projection C is around 6.

In spite of the large fluctuations in the cost-benefit ratios for the different programme mixes and time periods, two patterns are clearly established in Table 6.2. Firstly, in each projection the return on FP investments is the highest for the mix that has the greatest emphasis on the sterilization programme. With the fertility scenario of Projection B, the cost-benefit ratio for Mix B.2 is always greater than that for Mix B.1. Under Projection C's fertility scenario, the highest return is also for Mix C.2* (with the same distribution of births averted by method as in Mix B.2). The ranking does not change with the discount rate or the time period in both instances. Thus the initial high cost of a sterilization programme is always more than compensated for by the FP programme cost reductions in subsequent years.

The second consistent pattern is that the return to the FP programme required for Projection B is always higher than the corresponding return under Projection C. The limited target of reducing the total fertility rate to 4.3 births by 2000 has a higher economic pay-off than the investment required to reduce the TFR to 3.0 births. Irrespective of the discount rate, the time period for measuring benefits, and the FP programme mix adopted, the cost-benefit ratio for Projection B is higher than the corresponding one for Projection C. Finally, the higher pay-off to the slower rate of fertility decline assumed for Projection B is also confirmed by the internal rate of return criteria. The actual difference in the internal rates of return is very small - about 2% only - but, nonetheless, it gives the same ranking. Considering the five FP programme mixes identified as alternative investment projects, one would choose Mix B.2 first since it has the highest internal rate of return, whether benefits are measured upto 2000 only or upto 2020.

The reason why the FP programme investment needed for Projection C has a relatively lower economic return than for Projection B is that the extra cost is not matched by the extra benefit. In comparing Mix B.1 and C.1*, for instance, the (undiscounted) cost of the latter is more than two times higher. But benefits are higher only by a factor of 1.8. Hence the "marginal returns" to the extra birth avertions of Projection C are less than the average returns of the births averted under Projection B.

It is unusual that the FP programme with the larger number of birth avertions should have a smaller cost-benefit ratio or a lower internal rate of return. In some ways, this result is artificial because our analysis has excluded the benefits of the birth avertions occurring after 2000, but caused by the FP programme investment made during 1981/2000.36/ Another reason for this result is that the implied average unit cost of birth avertion under Projection C is higher. We have assumed an increasing real cost of contraceptive provision over time. (See Table 5.9.) The average cost per birth avertion is higher under Projection C because it requires relatively more birth avertions during the latter period of the programme (between 1991/2000) when unit costs are higher.

It should be clearly stated that our results do not mean that Nepal's population policy and FP programme scale should be set with a TFR target of 4.3 instead of 3.0 births for 2000. Our results only indicate the greater relative social profitability of the 4.3 target; and not that the 4.3 target is preferable to the 3.0 target. This is an important distinction which requires a bit of clarification.

The procedure for ranking competing projects on the basis of the discounted cost-benefit ratio or the internal rate of return is generally valid only when no two projects are inter-dependent or mutually exclusive.37/ But in this study, choosing the FP programme for Projection B precludes choosing the one for Projection C. Furthermore, the different programme mixes designed for each projection are mutually exclusive projects (which give the same targeted number of averted births). When two or more projects are mutually exclusive, the cost-benefit ratio or the internal rate of return can give an erroneous ranking. For instance, in comparing two similar projects that differ only in scale (e.g. building a 60 MW hydro-electric plant or a 100 MW one on the same site) the larger investment may have a smaller cost-benefit ratio, but is still preferable if the extra benefits exceed the extra costs. This will make the net present value of the larger project higher than the present value of the smaller one.

Such marginal cost-benefit consideration for the FP programme of Projection C is illustrated in Table 6.3. One can think of the FP investment required for Projection C as the sum of two components: (a) the investments required to reach the TFR target of 4.3 births set for Projection B; and (b) the additional investment needed to further reduce the TFR from 4.3 to 3.0 births. Rates of return can be computed for both components. (The cost and benefit associated with component (b) is the difference in the total cost and benefit of Projection C and Projection B.) These rates of return are compared in Table 6.3.

Table 6.3

Returns to the Extra Investment of Projection C [a/]

r =	3%	5%	10%	Internal Rate of Return (%)
Cost-benefit ratio				
Investment B*	16.7	12.8	7.1	50.1
Investment C-B**	12.9	9.9	5.6	44.5
Net Present Value (in Rs. Million)				
Investment B*	28,522	16,116	3,810	
Investment C-B**	22,669	12,613	2,638	
Total (for Investment C)	51,191	28,729	6,448	

a/ Returns computed with the benefit scenario 1 and time period upto 2020 for FP Mix B.1 and C.1*.

* FP programme investment to reduce TFR to 4.3 by 2000.

** The extra FP investment required to reduce the TFR from 4.3 to 3.0 by 2000.

The above table shows that the extra FP programme investments required under Projection C is clearly worth doing. This component (Investment C-B) has an internal rate of return of 44.5% and the cost-benefit ratio is about 5 even with a 10% discount rate. These rates of return are not as high as for the smaller investments for Projection B, which has a higher cost-benefit ratio and internal rate of return as well as a larger net present value.Nevertheless, the second stage of the FP programme (which leads to Projection C) is clearly remunerative on its own account. If this additional investment is not undertaken, society would forgo the Rs. 22,669 million present value of net benefits (with a 3% discount).

The net present value of benefits under Projection C is always

higher than that under Projection B. If the required investment funds are available, or can be borrowed, there is no reason to forgo these extra benefits. Only when funds are limited, the choice of the smaller FP programme of Projection B may become forced by a budgetary constraint. Other non-FP programme investments may have a higher rate of return than any of the FP programme mixes, so that the remaining funds are sufficient only for the FP programme scale of Projection B. Alternatively, other public investment projects have a rate of return in between that for Projection B and Projection C. If the investment funds are not sufficient to cover these other projects and the FP programme of Projection C, then only the limited FP investment of Projection B should be undertaken. But otherwise, the generally valid investment criteria for two mutually exclusive (or redundant) projects is to choose the one that maximizes net present value. Hence the FP programme for the lower fertility target of a TFR of births is preferable to that of the 4.3 births target by 2000 A.D.

VII. SUMMARY AND CONCLUSIONS

In this study we have analyzed the cost and benefit of public investment in family planning in Nepal. Currently family planning services are provided under two public sector programmes: The Family Planning and Maternal Child Health Project and the Integrated Community Health Services Project. Our study has not focused on evaluating the return to the public investment already made in these two programmes. Substantial difficulties arise in estimating the births averted through the family planning investment already made. There is insufficient documentation of the recent trend in Nepalese fertility levels; and very limited information on the characteristics of family planning acceptors is available. Instead, our analysis is formulated more as a planning exercise. The expected cost and benefit of fertility reduction in future years are assessed under certain assumed relationships between FP contraceptive distribution/use and births averted.

A cost-benefit analysis of fertility reducing investments is usually done in terms of a unit birth avertion. But in this study costs and benefits were computed for a twenty-year stream of birth avertions which is required as the output of a family planning programme to achieve a targeted reduction in fertility. Two such fertility reduction targets were assessed: a linear decline in the total fertility rate to 4.3 births by 2000 (Projection B); and a second, faster, rate of decline, leading to a target of 3.0 births (Projection C).

The measurement of the economic benefits of reduced fertility was limited to the savings in private consumption and the savings in public expenditures required for health and primary education services only. For each fertility projection, the family planning programme costs were computed for two or three programme mixes with varying emphasis on individual contraceptive methods. The births averted effect of each contraceptive method was estimated through a modified couple-year-of-protection technique. A cost - benefit evaluation is made for a family planning programme conducted over the twenty year period of 1981 to 2000, with benefits measured upto 2020, but ignoring the births averted after 2000.

The results presented in Table 6.1 showed that the returns to investment in family planning are very favourable in Nepal. The annual benefits exceed family planning expenditures after only 3 years, under any of the five programme mixes identified. Even with a high discount rate of 10%, benefits are at least six times as large. An internal rate of return of around 50% compares very

favourably with other public sector investment opportunities. But there is one discouraging result. The savings in public budgetary expenditures in health and primary education alone do not cover family planning cost, if the current low levels of per capita expenditure in these sectors are projected for the future.

Several results relevant from a planning and policy point of view were also reported. Family planning expenditures required for any reduced fertility target are very sensitive to the relative emphasis given to individual contraceptive methods. As expected, the most cost-effective contraceptive method is sterilization. But even among the temporary methods, the unit cost per birth averted is lower considerably for pills.38/

The relative share of individual contraceptive methods within an annual family planning programme will depend ultimately on the preferences of the acceptors. But such choices are also conditioned by the preferences and resource constraints faced by the programme administrators. Over a twenty-year period there is considerable leeway to vary unit costs per averted birth. Rather than take such cost as given data, it would be fruitful to undertake budgetary programming exercises that identify variations in cost related to the design and scale of family planning programmes.

Another aspect of the study that is very relevant from a policy perspective is the initial framework that has been developed to quantify, however tenuously, the link between targeted fertility rates and an annual programme of contraceptive use in Nepal. The net benefit of achieving a TFR of 4.3 births by 2000 is very large; but so is the scale of the required programme of family planning contraceptive use. Even if an average of 45 thousand sterilizations are performed annually between 1981 and 200, more than 12 million condoms and 1.6 million pill cycles must be distributed every year in the 1986/90 period. These unit distribution figures increase to 61 million condoms and 7.8 million pill cycles annually in the 1996/2000 period. In contrast, a total of about only 2.8 million condoms and 340 thousand pill cycles were distributed, and only about 23 thousand sterilizations were done in Nepal in the 1980/81 fiscal year.

Thus, even for the modest fertility target of 4.3 births per woman by 2000, a massive increase in family planning contraceptive use is required. Will these acceptors materialize? This becomes the more critical issue than measuring the economic pay-off to fertility reduction. There is some firm basis to believe that a significant portion of the demand for modern contraceptive methods goes unmet in Nepal.39/ Fulfilling this potential demand, however, will

be only the easy, initial phase of an expanded family planning programme in Nepal. This effort will also be greatly facilitated if the pace of socio-economic development picks up more than what can be presently anticipated. But it is equally apparent that a much more concerted effort will be required to achieve any meaningful reduction in Nepalese fertility by the end of this century.

After a certain point, the mere setting of targets for increasing contraceptive use and expanding the distribution network for contraceptives will not be sufficient. Population planners as well as the family planning programme administrators should seek out ways to improve operational efficiency and develop means to motivate and attract new acceptors, including the unexplored question of designing an incentive package through which individual households with lower fertility are rewarded. But it will also be necessary to expand research activities to get a better understanding of the basic forces behind Nepal's high fertility. As yet, we know very little about what economic and social factors will lower the demand for children in the predominantly rural, agrarian setting of Nepal. A cost-benefit analysis of projected reductions in fertility through family planning contraceptive use, as we have done, quickly loses its relevance without a firmer understanding of what is and what will be feasible fertility reductions in the Nepalese setting.

NOTES

1/ *Over-population is, of course, a relative concept which is quite intractable as far as measurement is concerned. By way of regional comparison, Nepal's per capita cultivated land area is about 35% higher than that of Bangladesh. Yet the supportive base of the land - if defined as the gross harvested area per agricultural worker - is 15% lower in Nepal, even though Bangladesh's population is more than six times larger. Secondly, the output from this smaller resource base, which is the yield per harvested area, is also lower in Nepal. cf. ARTEP (1981) pg. 26 and 79.*

2/ *Yield levels and projections as cited in David and Zivetz (1982), pg. 71.*

3/ *IBRD, World Development Report, 1981, pg. 168.*

4/ *Zaidan (1971), pg. 22.*

5/ *In the case of Nepal, most observers would question the validity, even for illustrative purposes, of a model where growth depends solely on domestic savings. Foreign capital inflow, ecological factors and the subsistence orientation of agricultural production are some of the critical elements which affect future growth. Most of these factors need not be responsive to changes in population size; or even if they are, as in the case of ecological factors, the relationship is not easily captured.*

6/ *cf. Zaidan (1971); and for a more recent evaluation, Robinson and Schutjer (1980).*

7/ *Recently, the National Population Commission has set a target of reducing Nepal's total fertility rate to 2.0 births by 2000 A.D. This is, of course, a very ambitious target, given the current rate of 6.3 births. But one way to judge how realistic this (or any other) target is would be to identify the required scale and cost of the FP programme that would support such a rapid decline in the TFR; and to evaluate whether such a programme will be feasible in Nepal. Issues about programme scale and the total resources required have important planning and policy implications which are valuable independently of the net benefit calculations.*

8/ *There are several variations of the couple-year of protection*

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method. Our approach is based on the original calculation proposed by Wishik (1973) which takes the physical supplies of contraceptive units distributed during a given year and converts them into CYP's. cf. Robinson and Schutjer (1980) for an evaluation of these various CYP techniques.

9/ *In the 1980/81 fiscal year, the FP/MCH project accounted for over 90% of the new acceptors of FP services (194,787 out of 216,010). The Integrated Community Health Services Project and the Family Planning Association had 11,672 and 9,551 acceptors each respectively. cf. FP/MCH Project, Annual Report, 1980/81.*

10/ *HMG, Ministry of Finance, Budget Speech, 1980/81.*

11/ *This is the range of estimates of the marginal propensity to consume in the 18 samples of the Household Budget Survey conducted in 1973/74 cf. Rastra Bank (1976).*

12/ *From the 1980 base level of 6.3 birth, the TFR is assumed to decline linearly to 5.9, 4.3, and 3 births by the year 2000 under Projection A, B, and C respectively. (International migration is ignored; and life-expectancy at birth increase uniformly from 47 in 1980 to 56 by 2000 for all three fertility scenarios.)*

13/ *Now that the preliminary census estimate for 1981 is available, the projected 1980 population of 14.28 million is an apparent underestimation. But since the same base year figure is applied to all three projections, and the analysis is ultimately based on the difference in population size between Projections A and B and A and C, such an under-estimation will not affect our cost-benefit calculations in a major way.*

14/ *Details of the estimation procedure are given in Appendix A.*

15/ *For the detail derivation see Appendix B.1.*

16/ *The relevant population actually declines after 2000 since no new births are accounted for while some proportion of the existing population is dying each year. But total consumption expenditures do not decline immediately because as the population ages, more people are pushed up into the higher per capita expenditure age groups.*

17/ *The health budgetary expenditures for 1979/80 contain items that are purely capital expenditures and are not related to*

the level of health services provided during that year. The current expenditures relate to the recurrent operating costs of providing this base level of health care; and so the capital items have been deducted from the total budget to obtain the current cost estimates. For details see Appendix B.2.

18/ *The basis on which these estimates are made is given in Appendix B.2.*

19/ *For details see Appendix B.3.*

20/ *UNESCO (1979).*

21/ *Actually, the primary school enrollment in 2000 in Scenario 2 is slightly larger than the population aged 6-10 because we have made some adjustments for over-age enrollment in grade I. When these student move through the primary grades, they will be older than 10 years in grade V. By 2000, this ratio of gross enrollment to the population aged 6-10 is approximately 1.02 in each projection.*

22/ *This is computed as the difference in the size of the 0-4 age-group population at five year intervals. Such a procedure gives an under-estimate of the number of birth avertions that occurred in the reduced fertility scenario because it ignores the deaths in the 0-4 age-group over the relevant five year period. Even with the same mortality rates, the difference in the number of people actually born in that five year interval will be greater than those who survive to the end of the five year period. But because mortality rates are changing every year, the required adjustments involve fairly lengthy computations. Since so many other procedures involved in estimating FP program costs are simple approximations, the extra precision on this account only is forsaken to reduce the already lengthy computations involved.*

23/ *The procedure involves three basic steps: (1) estimating average length of effective usage by method for each age class; (2) estimating average interval per potential birth, which is the reciprocal of the martial-age-specific fertility rates (MASFR) when illegitimate births are ignored; (3) dividing 1 by 2 yields estimated births averted by method. We have made some minor adjustments because our computations are not based on the number of FP acceptors each year but on the CYP equivalent of any annual programme of contraceptive distribution. See Appendix C for details.*

24/ *cf. Appendix C for the derivation of these estimates.*

25/ *Unlike the pill, condom and sterilization programmes, the age distribution of the IUD and depo-provera acceptors is not specified. It is simply assumed that, on the average, 1 IUD insertion will avert 0.2 births each year for the next five years; and that 0.4 births are averted from one depo-provera acceptor.*

26/ *Computed from the annual performance data of the FP/MCH Project, Integrated Community Health Project, and the Family Planning Association of Nepal. cf. Table C.10 in Appendix C.*

27/ *Mix C.1* is a linear expansion of Mix B.1 not in terms of the FP services performed or distributed but in terms of the birth avertion impact in the five year intervals. The percentage share of each method in the total required birth avertions is kept the same. Mix C.2* is a similar blow-up of Mix B.2.*

28/ *cf. FP/MCH, Annual Report, 1980/81, pg. 6.*

29/ *These respective shares are the percentage of the total 20 year stream of birth avertions required under Projection C. The share of each method under Mix C.1* and C.2* will be exactly equal to the corresponding share under Mix B.1 and B.2 respectively because C.1* and C.2* were designed under this condition. So no separate table for the relative distribution of birth avertions under C.1* and C.2* is given above.*

30/ *The trend of increasing unit cost reflects projected increases in the real resources required for providing the contraceptive services, and not nominal increases arising from inflation. There is no need to control for future inflation because all costs and benefits are measured in real terms in 1980 prices. But even with constant prices, unit contraceptive costs increase if more real resources are required. These unit requirements are projected to increase because in the early phase of a FP programme acceptors will be relatively more easy to recruit. But with a progressively expanding programme scale, future acceptors must come increasingly from groups that are not favourably inclined to FP services, and from groups which, in any case, will be difficult to reach given the scattered rural base of the Nepalese population.*

31/ *The programme mixes in Section 5.2 identified only the total number of sterilizations to be performed annually. But unit cost varies considerably between a vasectomy and laparoscopy acceptor. The annual FP programme expenditures of Table 5.10 are based on an equal distribution of the required sterilizations between these two method, even though current acceptors data show a considerably higher rate of laparoscopies. For the other contraceptive methods, the relevant unit costs are already given in Table 5.9.*

32/ *The recorded expenditures of the three organizations which provide FP services in Nepal amount to Rs. 31.9 million in 1980/81. Of this, the FP project accounts for Rs. 26.1 million, but this sum includes expenditures for the maternal child health component of the project. Thus the Rs. 31.9 million figure is an overestimation of current FP expenditures.*

33/ *At the current exchange rate of Rs. 14.20 = US $ 1 these indicated range of total FP programme cost convert to $ 174-192 million and $ 363-421 million, respectively, over twenty years.*

34/ *In Zaidan's computations the public savings benefit from an averted birth is limited to savings in primary education only. Yet it exceeds FP service cost per birth avertion (E£ 24-20 vs. E£ 4-20 respectively). In the Thai study, public expenditures include numerous other categories besides education and health expenditures, and consequently, the public sector savings alone exceed FP program costs after three years of the program.*

35/ *Actually, the difference in the rates of return to FP programme with benefits measured for scenario 1 and scenario 2 is negligible. As indicated in Table 6.1, the difference in the public savings derived from the education sector with and without the universal primary education assumption is very small relative to the private consumption benefits and the total FP programme costs. These two latter items dominate in the computation of the economic rates of return. In comparison to the results presented in Table 6.2 for scenario 1, there is at most an absolute difference of 0.1 in the cost-benefit ratios for the universal primary education scenario. Similarly, the internal rate of return is higher by less than 1 percent.*

36/ *The scale of sterilizations performed under any of the*

programme mixes for Projection C is larger than for Projection B. In actuality this would produce relatively more birth avertions after 2000. The costs of these birth avertions are already accounted for in the 1981/2000 program; but their benefirs are not included.

37/ *cf. Reading 1 (Prest and Survey, "The Main Questions") and the Introduction of Richard Layard ed. Cost-Benefit Analysis (1971) for an evaluation of the different investment criteria.*

38/ *The total expenditure required for one couple-year-of-protection through pills (13.4 cycles) is Rs. 197 in the 1981/85 period; while the corresponding cost for condoms (137 pieces) is Rs. 277. The unit cost per vasectomy (Rs. 574) and laparoscopy (Rs. 694) are much higher. But taking the mean age of these acceptors to be 32, each sterilization yields 17 CYP's on the average. Thus the corresponding cost per CYP is only Rs. 34 and Rs. 40 respectively.*

39/ *A recently completed contraceptive prevalence survey reports that only 7% of the married women in the 15-49 age category use any modern family planning contraceptives. This low level of current acceptance is due in large part to contraceptive supply and distribution problems. The same survey reports that only about 52% of these women are aware of any modern family planning practices; and that a full 34% of the non-current users would adopt family planning. cf. HMG, FP/MCH Project (1981).*

APPENDIX A

DEMOGRAPHIC PROJECTIONS

Three different projections of population size between 1980 and 2000 are required to correspond with the three different assumptions of fertility decline in this period. Since benefits are measured upto 2020 (but ignoring births averted after 2000) it is also necessary to project the number of people from the 2000 population who survive in each subsequent year upto 2020. For ease of reference, we call this the "relevant population" in the 2000/2020 period. Finally, since consumption benefits are measured with age-specific per capita expenditure figures and since primary school enrollment figures are different for boys and girls, the age and sex distribution of the population also has to be projected.

The complete results of the 1981 population census of Nepal are not available yet. Hence the following three steps were required for our demographic projections:

a. estimate the base level (1980) population size from the 1971 census base.

b. using the 1980 population base, project annual population size by age and sex upto 2000 A.D.

c. estimate the "relevant" population size each year by age and sex during 2000/2020.

a. Estimating the 1980 Population from the 1971 Census Base

(i) The age group 0-4 in the 1971 census is under-enumerated. So the adjusted figure for this age-group is obtained by first determining the number of births in the years 1966/71. This is done by using the estimated CBR (44.2 births per thousand population) and the expectation of life at birth for that period (41.75 years for males and 38.75 years for females), and then by using life table survival ratios.

(ii) The other age groups are smoothed by using the three point moving formula,

$$S = \tfrac{1}{4} (R_{-1} + 2R + R_{+1})$$

where, S = the smoothed number in one age group

R = the reported number in the same age group

R_{-1} = the reported number in the preceding age-group

R_{+1} = the reported number in the following age-group

(iii) The age-specific-fertility rates (ASFR) are assumed to be constant from 1971 to 1980 and are estimated from the average of three Demographic Sample Surveys (1974/75, 1976, 1977/78). The estimated ASFR gives a total-fertility-rate of 6.3 births per woman.

(iv) The expectancy of life at birth upto 1974 is assumed constant at the 1971 level. For 1975 it is obtained from the average of 1974/75 and 1976 D.S. Surveys, which is 44 years; and this is assumed to increase by 0.5 year per year upto 1980.

(v) The sex ratio at birth is assumed to be 105 males for 100 female births.

(vi) International migration factor is not taken into consideration.

b. Projecting the Population by Age and Sex Upto 2000 A.D.

(i) From the 1980 population base, three sets of population projections are made with the following assumotions. International migration is not taken into consideration; and the sex ratio at birth is assumed to be 105 males for 100 female births.

	Year	Projection A	Projection B	Projection C
Total Fertility Rate	1980	6.3	6.3	6.3
	2000	5.9	4.3	3.0
Life Expectancy at Birth	1980	47	47	47
	2000	56	56	56

With these assumptions, and the age structure of the estimated 1980 population, the Futures Group's computer programme for making demographic projections for Nepal was used to obtain population size and age distribution for every fifth year between 1980 and 2000.1/ The

1/ This is a program called Futures Nepal, adapted by Royce Jones from the Futures Group's demographic program for Nepal.

population size in between the five year intervals is estimated by using the average annual rate of growth in that five year period. The age distribution for each year is obtained by interpolating the age distribution between the successive five year intervals.

(ii) The next step is to project the population by sex. Since the Futures Group's demographic projection program for Nepal is not designed to give the sex distribution of the population, we have borrowed the estimates of sex distribution from two different sources. They are: (a) the population projection made for the Sixth Five Year Plan (1980/85) and (b) the CEDA population projection based on the 1971 census.2/ The former gives the sex distribution of population by age-group for each year of the 1980/85 period; while the latter reports the projected population figures by age and sex upto 2001 at five year intervals.

For our population projection, the male-female distribution for each age-group upto the year 1986 is obtained from (a). For the 1987/2000 period, the sex-distribution is obtained by interpolating the male-female ratios that are reported in (b) for every fifth year.

The projected population for each year between 1980/2000 under the three different fertility reduction scenarios is given in Table A.1.

c. Estimating the Relevant Population beyond 2000

Since birth avertions that occur beyond 2000 due to FP programme investments made between 1981/2000 are ignored in our study, the fertility rates and the number of births after 2000 do not have to be accounted in any of three population projections.So the relevant population for each year between the period 2000/2020 is estimated as follows:

(i) For each of the three projections, estimates of total population size and its age distribution at five year intervals is projected upto 2025 with the Futures Nepal programme. An arbitrary value of the TFR is assumed for the 2000 to 2025 period since this does not affect our "relevant population". But life expectancy is assumed to increase at the rate of 0.4 years annually.

(ii) As noted before, the population size for each year of the five year interval is estimated by using the annual average rate of growth; and the age distribution is obtained by interpolating the age distribution between each five year interval.

2/ cf. V.B.S. Kansakar, Population Projection for Nepal 1970/2000; Centre for Economic Development and Administration, Kathmandu.

Table A.1

Projected Population Size Under Different Fertility Assumptions*

(In Thousands)

Year	Projection A	Projection B	Projection C
1980	14,281	14,281	14,281
1981	14,621	14,590	14,564
1982	14,968	14,904	14,852
1983	15,324	15,226	15,146
1984	15,689	15,555	15,445
1985	16,062	15,890	15,751
1986	16,476	16,233	16,034
1987	16,901	16,583	16,323
1988	17,338	16,940	16,617
1989	17,785	17,306	16,916
1990	18,244	17,679	17,220
1991	18,750	18,058	17,494
1992	19,270	18,446	17,773
1993	19,804	18,841	18,056
1994	20,354	19,245	18,343
1995	20,918	19,658	18,635
1996	21,527	20,066	18,875
1997	22,154	20,481	19,118
1998	22,798	20,905	19,364
1999	23,462	21,334	19,613
2000	24,145	21,780	19,866

* Projection A, B and C assume a linear decline in the TFR from 6.3 in 1980 to 5.9, 4.3 and 3.0 births, respectively, by 2000. Mortality assumptions are the same in all three projections - life expectancy increases from 47 to 56 years.

(iii) Within each age-group population computed above, certain proportions will be irrelevant for our purposes - e.g. in the 0-4 age-group population of 2002, we are concerned only with those aged 2, 3 or 4 (born before 2000). Estimates of these relevant proportion of the given age-groups are made through life table survival ratios.

(iv) The sexwise allocation of the age-group population is required only for ages 6 to 10 because in our study the sexwise differences are relevant only for primary school enrollment. After 2000, our "relevant population" is out of school by 2010; so the sexwise allocation is required only upto 2010. Here, the same male-female distribution of 2000 is assumed constant upto 2010.

The total relevant population estimated in the above manner is reported in Table A.2.

Table A.2

Estimated Relevant Population After 2000 *

(In Thousands)

Year	Projection A	Projection B	Projection C
2001	23,992	21,625	19,709
2002	23,829	21,466	19,554
2003	23,645	21,286	19,386
2004	23,421	21,084	19,190
2005	23,155	20,085	18,983
2006	23,038	20,718	18,841
2007	22,895	20,567	18,690
2008	22,710	20,389	18,511
2009	22,493	20,183	18,320
2010	22,228	19,957	18,107
2011	22,111	19,819	17,966
2012	21,951	19,655	17,798
2013	21,768	19,472	17,625
2014	21,542	19,263	17,425
2015	21,271	19,029	17,200
2016	21,131	18,880	17,056
2017	20,098	18,712	16,885
2018	20,783	18,526	16,694
2019	20,551	18,307	16,490
2020	20,278	18,068	16,269

* The "relevant population" is the number of people born before or in 2000 A.D. who are still surviving in each of the years indicated in the table.

APPENDIX B.1

DERIVATION OF AGE SPECIFIC CONSUMPTION EXPENDITURES

In order to derive the age specific consumption expenditure, we have chosen the 1976 level of average annual per capita consumption expenditure of Rs. 932 as reported in the NPC Survey on Employment Income Distribution and Consumption Patterns in Nepal - the first (and only) large scale survey with consumption pattern information. Even so, the survey does not give age specific consumption expenditure. The only published information on age specific consumption pattern is from a small scale survey of a Tharu village in Far Western Nepal.1/ It is naturally not feasible to use the consumption expenditures estimated in this survey of a rather unrepresentative small sample as a national average. But what we have derived from the Tharu village sample are:

(i) the modification of the conventional five year age intervals into five separate but relevant age-group categories (based on large inter-group differences in per capita consumption). These age-categories are (a) 0-4; (b) 5-9; (c) 10-14; (d) 15-49 and (e) 50 +.

(ii) the proportional factor by which per capita expenditure in the last four age categories exceed that in the 0-4 age-group. Here we assume that, though the consumption level of Tharu village may not be representative, the ratio by which group levels vary are representative of the national level.

The proportional factor borrowed from the Tharu village sample for the five age categories are 1: 2: 3.1: 5.6: 3.4 respectively. Using these proportional factors, and assuming that the age distribution of the NPC sample was the same as of the 1976 population (for which the proportion of the total population on each of above 5 age-group categories are 17.3, 13.8, 11.9, 45.0 and 10.9 percents respectively) the age specific consumption level is given by the following equation:

$$0.173\ (x) + 0.136\ (2x) + 0.119\ (3.1x) + .46\ (5.6x) + .109\ (3.4x) = \text{Rs. } 932$$

where x is the per capita consumption expenditure in the 0-4 age-group.

1/ Bajracharya (1979).

This equation yields a value for x of Rs. 247.50. When this as well as the other proportional age-group consumption expenditures are converted to current prices, the estimated age-specific consumption levels are as follows:

Per Capita Annual Consumption Expenditures

(in Rs.)

Age-Group	At 1976/77 Prices	At 1979/80 Prices
0 - 4	247.5	312.0
5 - 9	495.0	624.0
10 - 14	767.3	968.0
15 - 49	1386.0	1749.1
50 +	841.5	1062.0

APPENDIX B.2

DERIVATION OF THE PUBLIC EXPENDITURES IN THE HEALTH SECTOR

I. Derivation of Current Expenditure

The annual budgets of HMG for the health (as well as in other) sectors report expenditures under two categories - regular and development. In theory this distinction is supposed to reflect the annual operating costs of existing health facilities (Regular budget) and expenditures incurred in new investments in the health sector (Development budget). But in practice, the Development budget contains many items that are not properly new capital investments, but are really operating costs that should have been reported under the Regular budget. For this adjustment, we have used the National Planning Commission's own estimate that only 76% of Development Budget represents actual capital formation at the national level.1/ We assume this same percentage holds in the health sector too (in the absence of any other method of adjusting the health sector-specific Regular and Development budget). With the adjustments of adding 24% of the Health Development budget to the Regular, the 1979/80 operating expenditures for the current level of health services is Rs. 57.7 million which converts to a per capita level (HCC_o) of Rs. 5.28.

II. Derivation of Capital Expenditure

(1) The derivation of IKC_t - the health infrastructural capital costs per additional person - is done in a more roundabout way. If we take the adjusted Development budget (76% of the reported figure) for any given year (or cumulated over several) and divide by the increment in population in that period, the resulting figure is bound to be a gross over - estimate of infrastructural capital costs per additional person. These capital investments in infrastructure development have not been made for these additional persons only. They have been incurred for the purpose of accommodating future increments in population and to increase the general level of health services for the whole population. Consequently we have derived IKC_t through the following procedure:

(a) Added up the total adjusted Development budget for the period 1970/71 - 1979/80. This is the cumulative health sector capital costs in infrastructure development in the ten year

1/ NPC, The Sixth Plan, p. 9.

period, and it amounts to Rs. 476.1 million in 1979/80 prices.

(b) Compute 1970/71 and 1979/80 levels of per capita health expenditures from the regular budget. These levels are Rs. 1.53 and Rs. 5.25 respectively.

(c) Breakdown the "output" created by the cumulative investment of Rs. 476.1 million into its two components.

(i) provide the Rs. 5.25 level of health services to the incremental population between 1970/71 and 1979/80. (This is 3.0 million.)

(ii) increase the level of health services per capita for the 1970/71 population (11.28 million) by Rs. 3.72 (Rs. 5.25 - Rs. 1.53).

(d) If the "efficiency" of capital investment for (i) is assumed equivalent to that of (ii), then we can compute what proportion of the cumulative investment was taken up by (i) simply through the ratio of the nominal costs of (i) over the total cost of (i + ii) i.e.,

$$\frac{(5.25) \times 3}{(5.25 \times 3) + (3.72 \times 11.28)} = .27$$

(e) If 27% of Rs. 476.1 million was the capital costs incurred to provide a Rs. 5.25 level of health services to the incremental population of 3 million, then, again assuming simple linear proportions, the capital cost in infrastructure development per additional person (IKC_t) is $\frac{(.27) \times 476.1}{3}$ = Rs. 43.

(2) The per unit doctor training cost (TDC) is estimated to be Rs. 125,000. This figures is the estimate made by the Planning Cell of the Department of Health for training doctors in India under the Colombo Plan Scholarship programme.

APPENDIX B.3

DERIVATION OF THE PUBLIC EXPENDITURES IN THE EDUCATION SECTOR

I. Estimation of Current Cost Per Student

The current cost per student is derived by dividing the annual public expenditure on primary education (both regular and development) by the estimated student population for that year. In 1978/79 public expenditure on primary education was Rs. 88,400,000 and the total enrollment of students was 875,494, and this gives the current cost per student of Rs. 101.

One more component - cost of textbooks for primary education - is added to the above figure to arrive at total current cost per student. The rationale in including textbook costs is HMG's declared policy of making primary education free of cost to the student. Provisions for free text-book distribution have been made, though it occurs more as an exception than a rule. The textbook cost for primary education at market prices are: Rs. 10 for grade I, Rs. 12 for grade II and III and; Rs. 36 for grade IV and V.

The total current cost per student therefore comes to Rs. 111 for grade I, Rs. 113 for grade II and III, and Rs. 137 for grade IV and V.

II. Estimation of Capital Cost

The capital cost is taken as the direct cost of producing a trained teacher. Cost for the development of physical facilities in the establishment of primary schools are also an important component of capital cost. But since public expenditure in the construction of school buildings are not reported separately, this is ignored.

Teachers' training is done by the Institute of Education of Tribhuvan University. The Institute conducts numerous training programmes for primary as well as secondary and high school teachers. These training programmes vary in purpose as well as cost. But since separate budgetary breakdowns are not available, the unit cost for training a primary school teacher is taken as the per student expenditure of the Institute of Education. In 1979/80 this comes to Rs. 3520.1/

1/ Tribhuvan University, 18th Annual Report, Kathmandu, 1980.

Not all of the teachers certified by the Institute of Education to be primary school teachers actually take up teaching. Some will "drop-out" from teaching and take up other professions while some will acquire further training and teach at the upper levels of secondary education. No information about such a wastage factor for trained primary teachers is available. Accordingly we have just assumed that to place one additional teacher in a primary school it is necessary to train 1.3 teachers. Finally, the current (1980) teacher to student ratio in primary schools is estimated to be 1:40;2/ and we have assumed this same ratio will have to be maintained in future years under the three population Projections (A, B, and C).

The education sector capital cost per student is then computed as follows:

40 additional primary school students require one extra teacher for which 1.3 teachers have to be trained. The cost per training one primary school teacher is Rs. 3520. Hence the capital cost per additional student, $\overline{KC} = \frac{3520 \times 1.3}{40} = \text{Rs. } 114.4.$

III. Base Level Data Used in Projection Primary School Enrollment

Primary school enrollment in each grade (between I and V) is made through the grade transition model for any year under each of the 3 population projections. The grade-transition model requires the following data:3/

(a) gradewise enrollment in the base year (1980)
(b) promotion rates for each grade in year t
(c) repeaters rate for each grade in year t
(d) apparent intake rate for grade I in year t
(This is the ratio of total enrollment in grade I to the total population aged 6, the age at which students begin primary school.)

These were derived or estimated in the following manner:

2/ The latest available data on total primary school teachers and student enrollment is for 1978/79. In that year the teacher student ratio is 1:38 (cf. Ministry of Education, 1979). Because primary school enrollment is likely to have grown faster than the number of primary school teachers, the estimated teacher student ratio for 1980 is taken as 1:40.

3/ cf. UNESCO, (1979)

(a) 1980 gradewise enrollment is derived by using the grade-transition model on the 1979 gradewise enrollment base. The projected enrollment for 1980 is as follows:

	Grade I	Grade II	Grade III	Grade IV	Grade V
Male	437,192	202,788	163,787	119,207	92,580
Female	186,754	75,301	56,613	35,343	24,916

(b) gradewise promotion rates: computed as the average of the annual rates available or derived for 1976 to 1979.These are:

Male	.4439	.8146	.7316	.8137	.8083
Female	.4023	.8643	.7543	.8563	.8655

(c) gradewise repeater rate: No estimates were available of the average repeaters rate in Nepalese primary schools. One small scale survey has reported that as much as 40% of the grade I students are repeaters.4/ We have used this estimate for grade I, and have assumed arbitrarily a 10% repeater rate for grade II to V. Again, these rates are assumed constant over the projection period.

(d) apparent intake rate: the average intake rate of the 1976/79 period is 1.1775 for boys and 0.5049 for girls.5/ We assume these same intake rates hold for 1980.

With the above data set, gradewise enrollment is projected for two different scenarios:

Scenario 1 assumes the same apparent intake rates reported above for boys and girls are maintained upto 2006.

4/ New ERA, (1979).

5/ The apparent intake rate can exceed 1 (as it does in the case of boys) because of over-age enrollment in grade I - i. e. enrollment of children older than age 6.

Scenario 2 (universal primary education by 2000) assumes that the apparent intake rate for boys is the same as in Scenario 1. But the intake rate for girls increase by 4.8% every year between 1981 and 2000 such that the gross enrollment ratio (the total primary school enrollment ÷ the number of children age 6 to 10) reaches 1 by 2000. And the apparent intake rate for girls is held constant upto 2006 at the 2000 level.

APPENDIX C

ESTIMATING BIRTHS AVERTED THROUGH SPECIFIC CONTRACEPTIVE METHODS

Family planning services currently prevalent in Nepal consist of the following: male and female sterilizations, pills and condoms, IUD, and depo-provera injections. We have projected future family planning programmes with only these same methods. In the case of IUD and depo-provera acceptors, a very crude method of deriving births averted is used. Current acceptance of these two methods is very low: in 1980/81, these acceptors (IUD and depo-provera combined) account for less than 2% of the total new acceptors (cf. Table C.10). A similarly small role is given to IUD's and depo-provera injections in all of the five FP programme mixes identified in Section V of this report.

Since both these methods play a small role, arbitrary assumptions have been made to compute births averted. Without paying attention to the age distribution of IUD acceptors or the average period of retention (such information is not available for Nepal, in any case), we have simply assumed one IUD insertion will avert 0.2 births each year for the next five years. Similarly we assume that each depo-provera acceptor will receive on an average six injections to provide protection over an 18 month period, during which 0.4 births are averted.

As for the remaining methods - male and female sterilization, pills and condoms - a more detailed procedure for computing births averted is used. The procedure is a modified version of the couple-year-of-protection method described in Robinson and Schutzer (1980) in which births averted are computed separately for each age-class. Basically, three sets of information are required:

(i) the average interval per potential birth for each age-class in each future period.

(ii) the CYP equivalence and average length of effective usage of each method.

(iii) the age-distribution of contraceptive acceptors for each method and future period.

Ignoring illegitimate births, item (i) is merely the reciprocal of the age-specific marital fertility rates (MASFR). As for item

(ii), the required information is different for the temporary and the permanent methods. For pills and condoms, effective usage is determined in terms of units distributed (not average continuation rate per acceptor). It is sufficient then to estimate the number of pill cycles and condom pieces required for one CYP. Births averted from one CYP can be readily computed from the MASFR, given certain penalty adjustments to be made for pill and condom contraceptive protection. As for sterilizations, it is necessary to estimate the births averted in future periods from sterilizations done in any one year. Hence the effective usage of sterilizations depend on the age distribution of the acceptors. The assumptions and estimating procedures used for each of these three components are detailed below.

C.1 Derivation of Marital Age-Specific Fertility Rates (MASFR)

This itself has two parts: (a) derivation of the age-specific fertility rates (ASFR) in each future period under both population projections; and (b) derivation of the proportion of women married in each age-group. Part (a) follows directly from the assumptions already made about the rate of decline in the total fertility rate; while for part (b) a gradual increase in the age at marriage is assumed.

Table C.1 gives the ASFR that is consistent with the declining trend in the TFR assumed under Projection B. The change from 6.3 births in 1980 to 4.3 by 2000 represents a 31% decline; and this same linear trend is assumed for each ASFR. The corresponding twenty year decline in the TFR under Projection C is 52%; and the ASFR constructed on this basis is given in Table C.2.

Table C.1

Estimated ASFR Under Projection B

Year / Age-Group	1980	1985	1995	1995	2000
15 - 19	126.33	116.59	106.54	96.49	86.44
20 - 24	289.51	267.18	244.15	221.12	198.08
25 - 29	291.63	269.14	245.95	222.73	199.53
30 - 34	254.62	234.99	214.73	194.48	174.22
35 - 39	173.22	159.86	146.08	132.30	118.52
40 - 44	85.57	78.97	72.16	65.36	58.55
45 - 49	36.03	33.27	30.39	27.52	24.66
T.F.R.	6.3	5.8	5.3	4.8	4.3

Table C.2

Estimated ASFR Under Projection C

Year / Age-Group	1980	1985	1990	1995	2000
15 - 19	126.33	110.06	93.47	76.89	60.31
20 - 24	289.51	252.21	214.21	176.20	138.20
25 - 29	291.63	254.06	215.78	177.50	139.21
30 - 34	254.62	221.83	188.40	154.97	121.55
35 - 39	173.22	150.90	128.16	105.42	82.69
40 - 44	85.57	74.55	63.31	52.08	40.85
45 - 49	36.03	31.39	26.66	21.93	17.20
T.F.R.	6.3	5.5	4.7	3.8	3.0

The proportion of women currently married in each age-group as reported in the 1976 Fertility Survey is indicated in Table C.3 below. It is expected that the mean age at marriage will slowly increase over time. This can be expressed as a reduction in the percentage of females currently married in the 15-19 age-group. We have assumed that this proportion, which is 61.5% in 1976, is only 60% in 1980; and that it will fall progressively to 57% in 1985, 54% in 1990 and 51% in 2000. For the other age-groups, the proportion of currently married females as reported in Table C.3 is assumed constant upto 2000.1/ This set of assumptions about the currently married rates is taken to be the same for both population Projections B and C.

Given the assumptions about the rate of decline in the ASFR and the changes in the marriage rates, the MASFR that will prevail in each future period under Projection B and C follows readily. These are reported in Table C.4 and C.5 in terms of the mid-point estimates for each five year interval, which represents the average MASFR for that period.

1/ With increasing life expectancy, these proportions should increase because of fewer separations from death of spouse. But this adjustment has not been made.

Table C.3

The Percent Distribution of Currently Married Females by Current Age as of 1976

Year Age-Group	Percent Currently Married
15 - 19	61.5
20 - 24	92.6
25 - 29	95.7
30 - 34	93.4
35 - 39	90.0
40 - 44	83.9
45 - 49	76.4

Source: Nepal Fertility Survey 1976, Table II, 4 (c), p. 241.

Table C.4

Estimated ASMFR[a/] for Projection B

Year Age-Group	1981/85	1986/90	1991/95	1996/2000
15 - 19	202.43	195.74	188.00	179.35
20 - 24	300.59	276.10	251.23	226.35
25 - 29	292.99	269.12	244.87	220.62
30 - 34	262.11	240.75	219.07	197.38
35 - 39	185.04	169.97	154.66	139.34
40 - 44	98.06	90.07	81.95	73.85
45 - 49	45.35	41.66	37.91	34.15

a/ Midpoint estimates for the indicated five year interval.

Table C.5

Estimated ASMFR[a/] for Projection C

Year / Age-Group	1981/85	1986/90	1991/95	1996/2000
15 - 19	197.00	178.54	157.74	134.51
20 - 24	292.51	251.85	210.81	196.76
25 - 29	285.11	245.48	205.48	165.48
30 - 34	255.06	219.61	183.82	148.03
35 - 39	186.07	155.03	129.77	104.51
40 - 44	95.42	82.16	68.77	55.39
45 - 49	44.12	38.00	31.81	25.62

a/ Midpoint estimates for the indicated five year periods.

C.2 Effective Usage and Births Averted

2.a Pills and Condoms

The marital fertility rates are known for each age-group. The births averted from the distribution of a specified number of condoms and pill cycles can be computed if the one-CYP equivalence of units distributed and the penalty rates for pill and condom protection are known.

The following assumptions are made:

(i) 1 CYP = 13 pill cycles used = 107 condoms used.

(ii) there is a 10% wastage in pill distribution and 20% wastage in condom distribution.

(iii) overlap between contraceptive use and post-partum amenorrhea is zero (FP/MCH data show that the open interval is about one year).

(iv) the penalty rates for contraceptive protection through both condoms and pills is as follows:

For the fertility scenario of Projection B, the following age-specific penalty rates hold throughout the 1981/2000 period.

Age-Group	Live Births Per 1000 CYP
< 25	40
25 - 29	30
30 - 34	20
35 +	0

Since the MASFR under Projection C are lower than for Projection B, the age-specific penalty rates will also be lower. The following declining trend is assumed:

Table C.6

Penalty for Pill and Condom Acceptors Under Projection C

Period / Age-Group	Live Births Per 1000 CYP			
	1980/85	1985/90	1990/95	1995/2000
< 25	40	40	20	0
25 - 29	30	30	10	0
30 - 34	20	20	0	0
35 +	0	0	0	0

Consequently, the births averted (BA) by a given distribution of pills cycles or condom pieces to acceptors in a certain age group i can be calculated with the following equation:

$$BA = (1-w)\, n_i^t \frac{1}{R} (ASMFR_i^t - P_i^t) \quad \ldots\ldots\ldots\ldots \quad \text{Eq.1}$$

where n_i^t = number of pill cycles/condom pieces distributed to acceptors in age-group i in year t.

w = wastage factor in contraceptive distribution (equals 0.1 for pills and 0.2 for condoms).

R = 1 CYP equivalence of units used (equals 13 cycle of pills or 107 condoms).

$ASMFR_i^t$ = marital fertility of age group i in year t (under Projection B or Projection C, as relevant).

P_i^t = penalty rate for age group i in year t (again under Projection B or C, as relevant).

t = from 1981 to 2000.

Finally, to account for the time interval between contraceptive use and the averted delivery, it is assumed that 25% of the births averted calculated from Eq. (1) occur in year t (the year of distribution) and 75% in year t+1.

Now the total births averted (TBA) from an annual program of N pill cycles or condoms distributed can be calculated by summing Eq. 1 for each age-group as long as the age-specific distribution of the N units is known. (These are derived in Section 3 below of this Appendix.)

Hence,

$$TBA = \frac{1-w}{R} \sum_{i=1}^{7} q_i^t \cdot N^t (ASMFR_i^t - P_i^t) \quad \ldots\ldots\ldots \quad Eq.2$$

where q_i^t = proportion of total acceptors who are in age-group i in year t

N^t = total pill cycles or condom pieces distributed annually.

i = represents the seven 5 year age interval between 15-19 and 45-49.

and the other variables as in Eq. 1.

2.b Sterilizations

The births averted from a given number of sterilizations performed in any year will depend on (i) the current age-group and fertility of the acceptors; (ii) the fertility of this cohort of acceptors in subsequent years upto a certain time period; and (iii) the assumed effectiveness of the sterilizations in future periods.

To simplify the computations, we assume that the birth averted effect of all sterilizations will occur until the end of the women's reproductive period (age 49); and that it will be 100% effective throughout this period. So for each sterilization performed in year t, it is necessary to keep track of the births averted in each t+i period until the women reaches age 49 (or alternatively till the births averted cut-off point of the year 2000 is reached). During this period of effective usage of a sterilization, the number of births averted in a particular year will keep changing. This occurs for two reasons: (i) the sterilized acceptor (or spouse, in case of vasectomy acceptors) will move into subsequent age-groups and thus experience different MASFR's; and (ii) even for the same age-group, the MASFR are changing over the

1980/2000 period (as indicated in Table C.4 and C.5 in Section 1 above).

Suppose n women in the age-group (a-b) are sterilized in any year t (where t ranges from 1981 to 2000). The stream of births averted caused by these n sterilizations is computed with the following assumptions:

(i) the age of all n acceptors is the mid-point of the (a-b) age interval. Let this be m $(= \frac{a+b}{2})$.

(ii) all vasectomies are done at the mid-point of the year t. So taking a 9 month conception period, these sterilization do not produce any births averted in year t. In year t+1, the births averted that occur are due to contraceptive protection for 9 months of that year only. Only in year t+2 and beyond, full year protection is achieved.

Hence, the stream of births averted (BA) can be written down as:

$$BA_t = 0$$

$$BA_{t+1} = \frac{3}{4} .n\ ASMFR^{t+1}_{m+1}$$

where $ASMFR^{t+1}_{m+1}$ is the marital fertility rate of women aged (m+1) in (t+1) year

Similarly,

$$BA_{t+2} = n.\ ASMFR^{t+2}_{m+2}$$

$$\vdots$$

$$BA_{t+1} = n.\ ASMFR^{t+i}_{m+i}$$

The births averted are relevant upto the period t+i such that either (t+i) is 2000 A.D., or (m+i) exceeds age 49. Hence, the total stream of births averted from n sterilizations in year t of women in age-group (a-b) can be written as:

$$TBA = n\ \frac{3}{4} .ASMFR^{t+1}_{m+1} + ASMFR^{t+2}_{m+2} + ..+ ASMFR^{t+i}_{m+i} \quad \ldots\ldots \quad Eq.3$$

where i is such that t+i = 2000 or m+i > 49.

Finally, as in the case of pills and condoms, the effect of N total sterilizations performed is a given year can be computed from the above equations, once the distribution of the N acceptors among the different age intervals are known.

C.3 Age Distribution of FP Acceptors

3.a Sterilization Acceptors

FP/MCH project data estimate the mean age of a vasectomy acceptor's spouse to be 32 years in 1979/80. For our purpose, this same mean age is assumed constant throughout the 1981/85 period. After that, it is assumed to decrease by about 0.1 year annually. We have then "fitted" an age distribution around the projected mean age estimates, as indicated in Table C.7. The age distribution given in Table C.7 is assumed to hold under both Projections B and C. The estimated mean age and age distribution for laparoscopy acceptors is also taken to be the same as for vasectomy acceptors' spouses.

Table C.7

Age Distribution of Sterilization Acceptors 1/

Time Period / Age-Group	1980/85	1985/90	1990/95	1995/2000
15 - 19	-	-	-	-
20 - 24	121	122	123	125
25 - 29	253	277	301	325
30 - 34	343	362	381	400
35 - 39	202	200	195	150
40 - 44	61	39	-	-
45 - 49	20	-	-	-
Total	1000	1000	1000	1000
Mean age (years)	31.95	31.1	30.75	30.37

1/ These are midpoint estimates for the indicated five year intervals.

3.b Condoms and Pills

The age distribution of pill and condom acceptors under the fertility scenario of Projection B is taken to be constant throughout 1981/2000. The assumed distribution is as follows:

Table C.8

Age Distribution of Pill and Condom Acceptors Under Fertility Assumption of Projection B

Age-Group	Number
15 - 19	42
20 - 24	206
25 - 29	236
30 - 34	277
35 - 39	166
40 - 44	73
Total	1000
Mean Age	30.19

Under the fertility scenario of Projection C, a larger number of pill and condom acceptors will be required to achieve the faster rate of decline in the TFR. So a slightly decreasing mean age of pill and condom acceptors is assumed in the 1991 to 2000 period for this projection, in comparison to Projection B. The fitted distribution is given in Table C.9.

Table C.9

Age Distribution of Pill and Condom Acceptors Under Fertility Assumption of Projection C

Period / Age-Group	1981/85	1986/90	1991/95	1996/2000
15 - 19	42	42	71	100
20 - 24	206	206	240	275
25 - 29	236	236	243	250
30 - 34	277	277	239	200
35 - 39	166	166	158	150
40 - 44	73	73	49	25
Total	1000	1000	1000	1000
Mean Age	30.19	30.19	29.1	28.00

Table C.10

New Acceptors and Annual Distribution of Contraceptive Methods

Year	NEW ACCEPTORS							Total Units Distributed	
	Vasectomy	Laparoscopy	IUD	Depo-Provera	Pills	Condoms	Total	Pill Cycles	Condom Pieces
1969/70	3888	-	1109	-	10263	14480	29740	36329	227636
70/71	4441	-	711	-	10496	18785	34433	62865	327098
71/72	3900	-	1162	-	15868	22908	43838	86831	470326
72/73	4161	558	607	-	24056	35713	65095	125176	725016
73/74	5166	810	862	25	27141	52075	86079	202590	1233624
74/75	3702	662	1110	81	26943	65814	98312	197061	1207731
75/76	9169	2162	1635	152	37640	87876	138634	254311	1383425
76/77	10953	5422	1149	976	33250	74782	126532	266549	1929975
77/78	12172	7923	863	1690	44346	107112	174106	315200	2363588
78/79	7009	11208	1231	1549	37896	106881	165774	274544	2238955
79/80	4277	11130	1036	1722	44270	134099	196534	313074	2509944
80/81	4802	18040	1304	2119	49079	140666	216010	343071	2856822
Total	73640	57915	12679	8314	361248	861191	13883577	2477648	17474140

Source: FP/MCH Project, Annual Report, 1980/81, pg. 43.

APPENDIX D

ESTIMATION OF UNIT COST PER CONTRACEPTIVE METHOD

To estimate the per unit costs of providing contraception by various methods in the future, we first estimate current unit costs. The following table shows the expenditure record of the FP/MCH project for fiscal year 1979/80.

Table D.1

Expenditure Record of the FP/MCH Project in 1979/80

Item No.	Description		Amount (Rs)
1.	Salary		9,648,290
2.	Allowance		2,178,844
3.	Travel and daily allowances		1,589,224
4.	Services		697,160
5.	Rent		539,561
6.	Repair and maintenance		180,265
7.1	Office equipment		309,331
7.2	Books etc.		14,613
7.3	Fuel		485,694
7.4	Clothes and food grains		86,462
8.	Other miscelleneous purchases		1,236,219
9.	Unforeseen expenditures		135,787
	Subtotal (items 1 through 9)		17,101,450
10.	Durable goods		158,846
10.1	(Furniture	106,896)	
10.2	(Transport	51,950)	
10.3	(Tools and machinery	-)	
11.	Land Purchase		-
12.	Construction/Rennovation		1,399
	TOTAL		17,261,695

1. Current Operating Costs

Budget items 1 to 9 reflect current operating cost, while the remaining categories are expenditures on durable goods and construction. The total of budget items 1 to 9 is Rs. 17,101,450. This represents costs for the family planning as well as the maternal child health component of the programme. But out of this total, it is possible to earmark certain amounts as going only to the family planning services. Certain incentives payments are made to doctors and other individuals who motivate FP acceptors for sterilizations and IUD's. These unit payments are known and can be allocated directly as method-specific cost. Similarly, the salaries of the panchayat based workers can be allocated completely to the FP component because they are mainly engaged in pill and condom distribution programmes.

So two types of current operating costs can be obtained from the expenditures recorded in Table D.1: (i) some directly method-specific unit costs which mainly represent field costs, and (ii) the share of family planning in the remaining total current expenditures which has to be allocated between family planning and maternal child health.

(i) Some Method Specific Costs (Field Costs)

With the available separate breakdowns on the budget items 1 to 9; we found that Rs. 5,970,988 (of the total Rs. 17 million) could be allocated solely to FP program expenditures, as estimated in Table D.2.

The expenditures reported in the first three columns of Table D.2 are already method specific Costs. An average per unit cost is obtained by merely dividing by the relevant number of method specific services performed. Two other items can be added as part of the method specific unit costs. The panchayat based workers salary is broken down on the assumption that 45% of their time is spent on pill distribution and another 45% on condom distribution and only 5% on the sterilization programme. Again average per unit costs can be computed by dividing by the total number of services/units performed or distributed. Finally, though doctors receive incentive payments for sterilizations and IUD injections, we feel this does not adequately reflect the real resource cost of the doctor's time involved in these services. An additional Rs. 5 per unit acceptor is added as an adjustment for the doctors time cost. The initial method specific unit costs obtained in this manner are given below in table D.3.

Table D.2

Expenditures Solely for FP Programme

Item No.	Description	Expenditure on Laparoscopy (Rs)	Expenditure on Vasectomy (Rs)	Expenditure on IUD (Rs)	Panchayat Workers Salary (Rs)	Total (Rs)
1.1	Salary	1,58,029	-	-	44,64,000	46,22,029
1.2	Incentives*	1,93,900	78,180	4,940	-	2,77,020
3.	Travel and Daily Allowance	2,34,619	1,10,000	-	-	3,44,619
4.	Service	1,40,771	-	-	-	1,40,771
7.3.1	Fuel for Transport	1,05,579	-	-	-	1,05,579
7.3.2	For other purposes	1,17,310	-	-	-	1,17,310
7.4	Clothes & Foodgrains	82,117	-	-	-	82,117
7.5	Other goods	2,81,543	-	-	-	2,81,543
Total		13,13,863	1,88,180	4,940	44,64,000	59,70,988

* Incentives given at the rate of Rs. 20 per sterilization and Rs. 5 per IUD insertion.

Table D.3

Some Method Specific Unit Costs (Rs)

	Vasectomy	Laparoscopy	IUD	Pill	Condom
1. Specific field costs*	48.14	135.52	5.0	-	-
2. Panchayat based workers salary	16.41	16.41	-	6.81	0.78
3. Doctors Time	5.0	5.0	5.0	-	-
Total (Cost A)	69.55	156.93	10.0	6.81	0.78

* Obtained by dividing the total expenditures for vasectomy and laparoscopy and IUD reported in Table D.2 by the relevant number of acceptors.

(ii) Other Current Operating Costs

Out of the total current cost of Rs. 17.1 million reported in Table D.1, Rs. 5.97 million has already been accounted for in the contraceptive method specific expenditures reported in Table D.2. The remaining Rs. 11,130,462 represents the joint-cost element of family planning and maternal child health activities of the FP/MCH project. This amount is allocated arbitrarily on a 2:1 basis between FP and MCH. The two thirds share of FP then comes out to be Rs. 7,420,308. Call this Cost B.

Two categories of the current operating costs for FP services have been derived: Cost A (Rs. 5,970,988) which is pure FP expenditures only; and Cost B (Rs. 7,422,308) which is the FP share of the joint cost items of the FP/MCH project. Cost A has already been allocated to individual contraceptive methods to derive unit costs. But this remains to be done for Cost B.

2. Expenditures on Durable Goods and Construction

We have assumed a simple linear depreciation process, taking 10 years as the useful life of all durable goods and 50 years for building and other costs involved in construction. So out of the aggregate durable goods expenditures for each year from 1969/70 to 1979/80, the service received in 1979/80 is one-tenth of the total expenditures. This amounts to Rs. 317,123. Similarly for building expenditures, the services received in 1979/80 are one-fiftieth of all project expenditures on this item. This comes to Rs. 216,900. Adding these two components, and allocating two-thirds to the FP component, the total value of durable goods and building services rendered in 1979/80 is Rs. 356,015 (Call this Cost C).

3. Other Capital Expenditures (Berkeley and Michigan Projects)

In addition to the budgetary expenditures of Table D.1, the FP/MCH project has incurred certain other costs since its inception. These will include expenditures made by foreign donors for various materials and training programmes, research expenses and other donations. A complete accounting of these extra-budgetary expenditures is hardly possible. Here we take into account only the two large scale USAID services - contract grants made with the University of Michigan and the University of California at Berkeley.

The UC Berkeley service expenditures can be broadly classified into two categories:

a. equipment, material, supplies, and transportation cost (US $ 30,125).

b. other infrastructural cost (US $ 2,242,299).

Component (a) is allocated to a 10 year useful period, and (b) to a 20 year period. So the 1979/80 services of the Berkeley project is Rs. 1,393,042 (using a Rs. 12.10 exchange rate for one US $).

As for the Michigan contract expenditures, the total amount is US $ 12,390, which converted into rupees and evaluated for a 20 year useful period comes to Rs. 370,495. The total of the Berkeley and Michigan contract service received in 1979/80 is Rs. 1,763 (Call this Cost D).

4. Direct Contraceptive Costs

The final category of FP costs are the direct costs of the contraceptive units - e.g. pills cycles, condoms, IUD units etc. In the case of IUD and sterilization services, the useful service time of the medical equipment required also has to be accounted for. The contraceptives and the medical sets are usually received as direct commodity grants and their costs are not reflected in the annual budgets of the FP/MCH project. The cost of these contraceptive units and medical sets are taken as the US $ cost that aid-donors incur in purchasing these items, and giving them to the FP/MCH project. The estimated unit costs (converted to Nepalese rupees at the 1980 exchange rate of US $ 1 - Rs. 12.10 is given in Table D.4 below. (Call these Cost E.)

5. Derivation of Total Cost Per Unit of Contraceptive Service

In the previous sections, five different category of costs have been reported. The field current operating cost (Cost A) and the direct cost of the contraception units (Cost E) have already been broken down into unit cost for each method. Such an inter-method allocation must also be done for the other three categories: other current costs (Cost B); capital and durable goods service (Cost C); and the services of the UC Berkeley and Michigan contract expenditures (Cost D).

In the absence of any detailed basis for allocating such joint costs, we have arbitrarily assumed the following equivalent cost proportions.

1 sterilization = 3 IUD = 3 depo-provera = 120 pill cycles = 1200 condoms

In 1979/80, FP/MCH project provided the following FP services: 3909 vasectomies, 9695 laparoscopies, 988 IUD and 1722 depo-provera

Table D.4

Costs of Contraceptive Units and Associated Medical Equipment

(in Rs.)

	Cost Per Contra-ceptive Unit	Unit Value of Medical Equipment Service	Total
Vasectomy	-	1.14 b/	1.14
Laparoscopy	-	4.96 b/	4.96
Pill Cycle	1.82	-	1.82
Condom	0.36	-	0.36
IUD's	42.35	1.0 b/	43.35
Depo-provera	51.24 a/	-	51.24

a/ Assuming one depo-provera acceptor will take on the average six injection each, for which a total dosage of 20 cc (costing US $ 4.20) is assumed.

b/ The unit cost for a vasectomy set, laparoscopy set and IUD set are US $ 95, $ 1496 and $ 82 respectively. To obtain service value per unit, we assume these sets are good for 1000 vasectomies, 1000 IUD insertions, and 365 thousand laparoscopies.

acceptors, 294,963 pill cycles and 2,581,849 condoms distributed. Using the sterilization-equivalent-cost factors reported above, this service record can be converted into a total of 19,116 units of sterilization-equivalent-cost. In this total, the share of each method is as follows: 3909 units for vasectomies, 9695 units for laparoscopies, 329 units for IUD, 527 units for depo-provera, 2458 for pills and 2151 for condoms. These equivalent units give the share of each method in the total costs under category B, C and D.

Finally dividing these method-specific costs by the units distributed or by the number of acceptors recorded in 1979/80 for the FP/MCH project, the unit cost per contraceptive service is obtained for each method. The same equivalent cost factor is assumed for all three cost categories (B, C and D).

The unit cost derived for each of the different cost categories and the total as well are reported in Table D.5.

Table D.5

Methodwise Per Unit Contraceptive Service Cost in 1979/80

(in Rs.)

	Vasec-tomy	Lapa-roscopy	Pill Cycles	Condom pieces	IUD's	Depo-provera-
Current Operating Cost						
Field Costs (Cost A)	69.55	156.93	6.81	0.78	10.0	-
Others (Cost B)	388.18	388.18	3.23	0.32	129.25	129.40
Capital Cost						
Durable Goods and Construction (Cost C)	18.62	18.62	0.16	0.02	6.20	6.21
Other Capital Expenditures (Cost D)	92.26	92.26	0.77	0.08	30.72	30.75
Direct Contraception Cost (Cost E)	1.14	4.96	1.82	0.36	43.35	51.24
Total Current Costs a/	457.73	545.11	11.86	1.46	181.60	180.64
Total Capital Costs b/	112.02	115.84	0.93	0.10	37.92	36.96
Total Costs c/	569.75	660.95	12.79	1.56	219.52	217.60

a/ Total current cost refers to the current operating costs and cost per contraceptive unit reported in Table D.4.

b/ Total capital cost is the sum of capital costs and unit value of medical equipment service given in Table D.4.

c/ The sum of total current and total capital costs.

Finally, what can be assumed about changes in these unit costs overtime. We performed a similar cost allocation exercise for the 1974/75 expenditures of the FP/MCH project. This revealed that for most methods, the capital costs decreased between 1974/75 and 1979/80 while there was a more than compensating increase in the different items of current operating costs. The decrease in the per unit capital costs can be attributed to the effect of an increasing scale of the programme, once the basic infrastructural expenditures have been made. Though this effect will also occur in the future, there will be a countervailing effect of increasing real resource costs with a greatly expanded programme. New acceptors will have to be found among people who are not already favourably disposed to modern contraception and who will be harder to reach in the rural communities.

As a consequence, we have projected the unit costs derived in Table D.5 to increase slightly over time. The increasing cost reflects greater real resource utilization and not inflationary trends. The categories for which real expenditures are expected to increase are the field operating cost (captured by Cost A), research and project cost elements under capital costs (Cost D). On this basis, the following set of unit costs per contraceptive service is projected over the 1981/2000 period.

Table D.6

Projected Average Unit Cost Per Contraceptive Service* (1981-2000)

(in Rs.)

Time Period:	1981/85	1986/90	1991/95	1996/2000
Vasectomy	574.05	591.95	611.67	633.36
Laparoscopy	694.37	700.33	733.08	766.91
IUD	223.92	233.17	243.34	254.53
Depo-Provera	221.80	230.82	240.74	251.65
Pill (per cycle)	13.63	14.66	15.08	17.05
Condom (per piece)	1.67	1.80	1.95	2.11

* Midpoint estimate for the indicated five year interval.

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