Estimation of Fertility due to Contraception in Nepal

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ABSTRACT

Fertility has an important role for demographic transition and total fertility rate (TFR) which is one component measurements of fertility. Absences of complete and reliable data, a large number of indirect techniques have been developed to estimate demographic parameters. Some of these techniques are based on stable population theory and others are regression equations between the dependent variables, the TFR and the independent variables, the socio economic as well as demographic variables. The unwanted or unintended pregnancies can be avoided through the use of contraceptives; it becomes very important to estimate the births averted or pregnancies stopped by use of contraception. Though there is increase in the use of contraception, still many couples do not use contraception in spite of the fact that they require to use contraception. To satisfy this unmet need of contraception is one of the policy targets of national population policy for population stabilization. In this study, 12862 married females between 15-49 years of age, whose marital duration is more than 5 years, have been taken to study the distribution on different background characteristics and their behavior. Firstly, a regression study was done to know the impact on contraceptive use and further multivariate study has been carried out to know the effect of background characteristics and behavior on absence of birth five years jointly at different sub division. This method is based on the relationship between the Total fertility rate (TFR) and contraceptive prevalence rate (CPR).By using this modified estimate of TFR, birth averted for different area. The variables are CPR that about 71.4 percent variation in TFR can be explained by the first regression approach. The second is based on the relationship between total fertility rate (TFR) and Additive combination of CPR and proportion of currently married females having open birth interval (NPV) explained about 82percent of the variation in TFR. The findings revealed that the TFR calculated by the present method are quite close to the observed values of the TFR. Estimates of births averted and the percent change in births in the absence of contraception, based on the two methods are fairly consistent.

Keywords: births averted, total fertility rates, contraception, linear regression, contraceptive prevalence rate.

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1. Introduction

Fertility is one of the basic measures of population change which governed by a complex set of biological, socio-economic, political, legal and psychological factors which widely affected by different demographic and socioeconomic factors as well as reproductive attitude and behavior (Bongaart, 1978). Another indirect technique for estimation of TFR is proximate determinants model (Bongaart & Potter, 1983). Several studies have been made to obtain the indirect measurement of these fertility indicators, models based on polynomial models, Coale- Trussell function (Coale & Trussell, 1974). The other indirect measures of fertility are parity progression ratio (PPR), stable method, regression techniques that Brass's (1968) suggested a P/F ratio method for estimating fertility by Hobcraft et al. (1982). Ross (1991); Jain (1997) have used contraceptive prevalence rate (CPR) to predict TFR of any population. The methods of estimating births averted were described in the literature in the late 1960s and early 1970s (Kelly, 1971). The P/F ratio method for estimating fertility and stable population method (United Nation, 1983) has been used for estimating TFRs (Rele, 1987). Indirect method is very reliable for estimating TFR and overcome these difficulties (Devkota, 2014). The continuous rise of contraceptive use nationally and globally implies that pregnancies, related complicates, used contraceptive prevalence rate (CPR) to predict TFR of any population (Palmore &James, 1978).

With the steady increase in the use of contraception and implementing various family planning programmers especially in the high fertility countries, many attempts have been done in researches to estimate the births averted due to the use of contraception. For the evaluation of family planning programs, the estimation of births averted were mainly done by the researchers and program managers and it is also used for the cost effectiveness of family planning methods (Liu et al., 2008).Kelly (1971) modified this approach slightly and created what is called the "parity approach". Prada-Salas (1975) tried to estimate the births averted using the same parity approach from primary follow up survey of a family planning clinic was performed in Cambodia in 1969.A model has been derived for estimating the number of births to a female during a time interval since marriage assuming the conception rate, incidence of foetal losses and chance of on-set of sterility following a child birth. This model can be widely used to study the impact of increased contraception or induced abortion and of induced sterility on fertility (Bhattacharya et al., 1984).

Recently Liu and others (2008) have suggested three simple methods of estimating the number of births averted that is attributable to the use of contraceptive. The

first method is based on the observed relationship between TFR and CPR. The third method is based on the Bongaarts' proximate determinants model of fertility. They have estimated number of births that would have occurred in a recent year in the absence of contraception for 156 countries around the world. The purpose of using family planning method by women is to delay or avoid pregnancy. But sometimes though women want to use family planning method, they are not using any method. According to Ross and Winfrey (2002), more than 100 million women in less developed countries, or about 17 percent of all married women, would prefer to avoid a pregnancy but are not using any form of family planning. Demographers and health specialists refer to these women as having an "unmet need" for family planning. Over the past few decades, increasing level of contraceptive use has reduced unmet need for family planning in most of the countries. Unmet need for contraception can lead to unintended pregnancies, which pose risks for women, their families, and societies. In less developed countries, about one-fourth of pregnancies are unintended that is, either unwanted or mistimed (Herstad & Britt 2002). According to Basu (1996) "Governmental goals for family planning should be defined in terms of unmet needs for information and services".

A significant numbers of women say that they do not want another child but are not using any method of contraception. This gap between women's preferences and actions inspired many governments to initiate or expand family planning programs in order to reduce unintended pregnancies and lower their countries' fertility rates (Casterline & Sinding 2000). From a demographic standpoint, reducing unmet need can lower fertility in countries struggling to cope with rapid population growth. Reducing unmet need is also important for helping couples in achieving their reproductive goals. Reducing unmet need and serving current users of contraceptive scan help in reducing unintended pregnancies that lead to abortions and unwanted births both of which are unacceptably high in many countries (Becker, 1999). In general, the lower the unmet need for family planning services the higher is the effectiveness of the program. However, an effective program itself may further generate the demand for contraceptives.

Many policies and campaign have been conducted by government for publishing and to distribute several modern birth control devices. Other than several organizations, non-government organizations attached with this program to promote the birth control devices in the areas where the use of birth control devices are less and females are having larger number of children. Now, it is necessary to know that how much family planning methods are effective to restrain the

population pressure. Under this, the important question is the assessment of the potency of the birth control programs i.e. with the use of family planning and practices, what are the numbers of births that have been avoided?

In recent years, socialization vastly adopted by Nepali women and it has a huge impact on their reproductive preferences. The demand for small family became more pronounced nowadays compared to the past. Majority of the couples now desire to have fewer children and to fulfill their desire they have the means to control their family size in the form of various methods of contraception. Therefore, within last few years the proportion of couples using contraceptives has increased steadily and the mix of methods is now dominated by modern methods that have become easily available compared to the before. The major target of the population programmed and policies is to control the rapid growth of population in high fertility countries. Promoting family planning methods, specially the modern contraceptive methods has been the priority of the population programs or family planning programs of those countries to achieve that target in a direct way. Government aims to make policies and campaign for promoting and distributing various modern contraceptive methods. Apart from government, many organizations and NGOs are also working in this field for promoting the modern family planning methods especially in those areas where use of contraception is less and women are having a large family size. Now the question arises that how much effective this contraceptive use is to control the population pressure. In this linkage, the main question of the evaluation of the effectiveness of the family planning program is how many births have been averted by the use of family planning? This study is an attempt to estimate the TFR and births averted and due to use of family planning.

The next section deals with materials and methods followed by result and discussion, and finally the study presents the conclusion section.

2. Materials and Methods

Nepal Demographic Health Survey is monitor and evaluates the success of its family planning and reproductive and child health programs at national level which has taken data set. The current NDHS has been conducted in 2016 to know the current scenario of fertility pattern. Demographers always face problems due to non-availability of complete and reliable data. For the proposed analysis we have used available data on combination of contraceptive prevalence and proportion of females having no children during last 60 months prior to survey date and not using any contraceptive during last 5 years for the estimation of TFR. Total number of

births in last three years were also considered for estimation of births averted in last three years. Observed values of TFR have been taken from NDHS 2016 report. Also in the present study, data for CPR and open birth interval for women who are currently married has been taken form NDHS 2016(Ministry of Health (MOHP), 2016).

The proposed method is essentially based on the technique of regression analysis. This analysis is carried out by ordinary least square (OLS) assumptions. Here the basic assumption of OLS has been fulfilled since the data are taken from normal population and they are independent also. Using regression analysis concept, firstly the relationship between TFR and CPR has been established. Line of regression between TFR (Y) and CPR (X) is drawn taking NDHS data and its equation is as follows:

Estimated TFR, $TFR = \alpha + \beta * CPR$ …….(1)

Where,

TFR = Estimated TFR

β = Regression coefficient

CPR = Contraceptive prevalence rate

α = Intercept and can be treated as the extreme point of TFR which indicate the maximum TFR in the absence of CPR

Again a similar type of regression analysis has been done by taking dependent variable as TFR and independent variable NPV, which are combination of CPR and the proportion of women whose open birth interval. The line of regression is between TFR (Y) and NPV (X) for data of NDHS.

Estimated TFR, $TFR = \alpha^1 + \beta^1 * NPV$ …….(2)

Where,

Estimated TFR = Proposed estimated TFR using regression equation.

β^1= Coefficient of regression line for equation

NPV = New Predictor Variable (Additive combination of CPR and proportion of currently married females having open birth interval)

α^1= Intercept and this can be treated as the extreme point of TFR indicates the maximum TFR rate in the absence of NPV

The model after considering the NPV gives higher value of R^2 than the previous onewhere only CPR is taken as predictor variable and using the proposed NPV (Singh, Singh,& Gupta, 2012).

The NPV for obtaining more reliable and efficient estimates for TFR has been proposed. This predictor variable is the combination of proportion of females currently using contraceptives and proportion of females having open birth interval more than 5 years or more and not using any contraceptive during last 5 years.

3. Results and Discussion

The variables are CPR and TFR utilizing the NDHS data on sub regions of a country. Furthermore, it shows the regression line taking TFR as dependent variable and CPR as independent variable. The estimated value of coefficient of this regression line is -0.0504, which is negative. This means that the increment in CPR will decrease the TFR. Through the regression equation it is cleared that if we increase the CPR by one unit the TFR is lowered down by 0.42 units. If CPR is equal to zero then TFR will take the value a, i.e. it will go up to 2.36. A model 1 shows the province and development shows that, the coefficient of determination (R^2) of this regression line is 0.714. This indicates that about 71.4 percent variation in TFR can be explained by this regression line in province level and other way of classification. Caused by contraception was changed in TFR which is shown in Table 1.

Table 1: *Estimation of Total Fertility Rates using CPR Using Model-1*

Sub Regions	CPR	TFR (Obs)	Estimated TFR	Percentage Change
Ecological Zone				
Mountain	54.6	3	2.61	13.1564
Hill	53.9	2.1	2.54	21.1175
Terai	51.4	2.5	2.32	7.0958
Development Region				
Eastern	54.1	2.4	2.34	2.4225
Central	54.2	2.4	2.34	2.3945
Western	46.1	2.2	2.29	4.0004
Mid- western	52.7	2.5	2.33	6.7026
Far- Western	57.3	2.2	2.36	7.4273
Province				
Province 1	55.1	2.3	2.22	3.2728
Province 2	47.7	3	2.60	13.4200
Province 3	60.6	1.8	1.95	8.2077
Province 4	48.5	2	2.56	27.8555
Province 5	48	2.4	2.58	7.5955
Province 6	51.1	2.8	2.43	13.3510
Province 7	57.3	2.2	2.11	3.9122

Education				
No education	58.2	3.3	2.35	28.7688
Primary	50.4	2.7	2.22	17.9541
Some Secondary	45.2	2.1	2.00	4.7601
SLC and above	51.5	1.8	2.38	32.3678
Place of residence				
Urban	54.8	2.26	2.17	3.7006
Rural	49.2	2.9	2.85	1.8634
Nepal	52.6	2.3	2.44	5.9806

TFR (Obs): Observed Value of TFR

Table 1 shows the CPR, TFR (observed) and TFR (estimated) for different sub regions of Nepal. The predicted value of TFR is obtained with the help of linear regression using Model-1. Province 3 shows highest use of CPR which is 60.6 percent. Province 7 is at second highest in contraceptive use with CPR 57.3percent.Province 2 is the lowest contraception 47.7 percent. Different place and different socio economic status' use of contraception has different results which are mentioned in Table 1. Educated people use lowest contraception which is 45.2 percent and rural area use 49 percent. The highest changing TFR is non educated person and province 4 which are 28.7 and 27.85 percent. The lowest changing TFR are rural area and province 2 which are 1.83 and 2.39 percent. Overall, 5.98 percent change in fertility changed in TFR in Nepal where contraception rate was 52.6 percent.

The simple linear regression analysis has been carried out to find the relationship between TFR and NPV. With the help of different kinds sub regions data, the estimated value of regression coefficient of this model was obtained as -0.909. From the regression equation it is clear that one unit increases in NPV will give 0.033 units reduction in TFR. This Model-2 has coefficient of determination higher than Model-1. The value of coefficient of determination (R^2) was observed as 0.826. It implies that about 82.6 percent of the variation in TFR is explained by NPV as much in province.

Table 2: *Estimation of Total Fertility Rates Using NPV Using Model-2*

Sub Regions	CPR	NvrC	NPV	TFR(Obs)	Est. TFR	Percentage Changed
Ecological Zone						
Mountain	54.6	17.5	72.1	3	2.53	15.6190
Hill	53.9	27.1	81	2.1	2.17	3.4621
Terai	51.4	16.6	68	2.5	2.70	7.8674

Development Region						
Eastern	54.1	23.1	77.2	2.4	2.39	0.3539
Central	54.2	17.5	71.7	2.4	2.31	3.7722
Western	46.1	23.7	69.8	2.2	2.28	3.6876
Mid- western	52.7	20.8	73.5	2.5	2.34	6.5473
Far- Western	57.3	17.4	74.7	2.2	2.35	7.0098
Province						
Province 1	55.1	27.5	82.6	2.3	2.08	9.5234
Province 2	47.7	10.3	58	3	2.91	3.1440
Province 3	60.6	32	92.6	1.8	1.75	3.0161
Province 4	48.5	33.2	81.7	2	2.11	5.5567
Province 5	48	22.6	70.6	2.4	2.48	3.4693
Province 6	51.1	12.4	63.5	2.8	2.72	2.8111
Province 7	57.3	17.4	74.7	2.2	2.35	6.6277
Place of Residence						
Urban	54.8	24.6	79.4	2.26	2.17	4.0038
Rural	49.2	15.9	65.1	2.9	2.82	2.5965
Nepal	52.6	20.3	72.9	2.3	2.47	7.2024

NvrC : Proportion of females having no births in last 5 years

TFR (Obs): Observed Value of TFR

Table 2 gives the data for CPR, proportion of females whose open birth interval is more than 5 years, contraceptives prevalence rate, TFR (observed) and TFR (estimated) for sub regions using Model-2. The estimated TFR in this case is more closed than previous estimate of TFR which is given in Table-1. Province 3shows lowest estimated TFR 1.75 and Province 2 shows highest estimated TFR 2.91. Nepal has estimated value of TFR as 2.47.

The changes were occurred due to the use of an additive indicator in addition to CPR which has proportion of females whose open birth interval is more than 5 years. Overall, in Nepal, change was 7.2 percent caused in contraception and birth spacing in five years. Different sub region and different places change in TFR shows Table 2 using model 2 by NPV. The highest changes TFR are province1 and lowest in province 6 which are9.5 percent and 2.8 percent respectively. The different demographic and socio-economic Characteristics also affect of estimated TFR which is discussed in Table 3.

Table 3: *Estimation of TFR for Socio-Economic Characteristics Using Model-2*

Sub Regions	CPR	NvrC	NPV	TFR(Obs)	Est.TFR	Percentage Changed
			Education			
No education	58.2	17.4	75.6	3.3	2.40	27.3341
Primary	50.4	18.9	69.3	2.7	2.51	6.9227
Some Secondary	45.2	22.6	67.8	2.1	2.54	20.9759
SLC and above	51.5	29.4	80.9	1.8	2.30	27.8409
			Wealth quintile			
Lowest	49.1	14.8	63.9	2.53	2.56	1.0104
Second	53.4	19.5	72.9	2.19	2.31	5.0822
Middle	49.6	17.4	67	2.49	2.47	0.8977
Fourth	50.1	21.7	71.8	2.45	2.34	4.8227
Highest	60.4	36.1	96.5	1.64	1.64	0.0005

NvrC : Proportion of females having no births in last 5 years

TFR (Obs): Observed Value of TFR

Table 3 represents the CPR, proportion of females having no births in last 5 years, NPV, observed value of TFR and estimated value of TFR and percentage change in the observed and estimated values of TFR according to different socio-economic background characteristics of a country by the application of Model 2. TFR is estimated with the help of NPV for different groups for example wealth index, educational status for the country. In case of education differential, the highest, no education group have CPR 58.8 percent and another additive indicator in NPV have 17.4 percent proportion and 10+ education group have CPR 75.6 percent. The lowest, no education group has CPR 45.2percent and another additive indicator in NPV has 22.6 percent proportion and 10+ education groups have CPR 67.8 percent. The highest changed in second quintile is 5.0 percent. The difference between lowest and highest wealth index groups with respect to the estimated value of TFR is observed and estimated values of TFR in Table 3.

Table 4: *Estimation of Total Number of Births Averted due to Contraception*

Sub Regions	NPV	Est. TFR	NvrC	Pot. of TFR	PD	Birth	Female	Birth Averted
Ecological Zone								
Mountain	72.1	2.53	17.5	7.47	66.11	353	775	233
Hill	81	2.17	27.1	7.83	72.24	1859	5556	1343
Terai	68	2.70	16.6	7.30	63.08	2628	6531	1658
Development Region								
Eastern	77.2	2.39	23.1	7.61	68.57	1091	2900	748
Central	71.7	2.31	17.5	7.69	69.97	1768	4569	1237
Western	69.8	2.28	23.7	7.72	70.45	887	2597	625
Mid- western	73.5	2.34	20.8	7.66	69.51	666	1650	463
Far- Western	74.7	2.35	17.4	7.65	69.21	428	1145	296
Province								
Province 1	82.6	2.08	27.5	7.92	73.72	776	2173	572
Province 2	58	2.91	10.3	7.09	59.04	1286	2563	759
Province 3	92.6	1.75	32	8.25	78.85	798	2732	629
Province 4	81.7	2.11	33.2	7.89	73.24	385	1249	282
Province 5	70.6	2.48	22.6	7.52	66.96	840	2274	562
Province 6	63.5	2.72	12.4	7.28	62.61	328	724	205
Province 7	74.7	2.35	17.4	7.65	69.35	428	1145	297
Place of Residence								
Urban	79.4	2.17	24.6	7.83	72.34	1931	8072	1397
Rural	65.1	2.82	15.9	7.18	60.63	2909	4790	1764
Nepal	72.9	2.47	20.3	7.53	67.27	4840	12862	3256

Est. TFR: Estimated Value of TFR using Model-2
NvrC : Proportion of females having no births in last 5 years
Pot. TFR: Potential Total fertility in the absence of Contraceptives
PD: Percentage decrement in TFR due to contraceptive use

This indicates that Model-2 is quite helpful to get the estimates of TFR at different background characteristics at state level and it is very easy to obtain. Table 4 represents the NPV, estimated value of TFR, proportion of females having no births in last 5 years in their complete reproductive period prior to survey date, potential TFR in the absence of current contraceptives, percentage decrement (PD) in TFR due to use of contraceptives and number of births averted in last three year among the females who were exposed for 3 ecological zone, 5 development region and 7 states and rural–urban sub regions of Nepal by using current contraceptives. Estimated value of TFR is obtained with the help of NPV and potential value of TFR is obtained by taking additive indicator, which is the proportion of females who have not given births in last 5 years till reference date, using NPV in Model-2. The use of current contraception is a reduction of 3256 births in all over NEPAL

among the total 12862 females considered who are exposed to the risk of conception. Maximum 759 births have been reduced by Province 2 for sample size of 2563 currently married females and minimum 205 births with sample size of 724 currently married females have been averted in province 6. Ecological zone, development region and place of residence also averted birth estimated in Table 4. This analysis shows that large number of births has been averted in the presence of current contraceptives of the country.

It is very crucial, critical and important and noted that in this method the dependent and independent variable(s) should be highly correlated. There are so many predictor variable(s) for estimating the TFR. Mauldin and Ross have used CPR to predict TFR of any population (Jain, 1997). The use of contraception is more but it is not properly practiced then the effect of the method for birth aversion. In 156 countries and areas around the world, the estimated number of births that the estimates of the approximately 230 million, which is more than the estimated 129 million births that actually 81 percent variants(Liu, 2015).India taking as about 63.5 percent decrement in TFR due to the use of contraceptives and reduction of 14629 births in all over India among the total 87925 females considered who are exposed to the risk of conception and 85 percent variation (Singh, Singh & Gupta, 2012).Use of contraception also plays a significant role in births in last five years. The females using contraception shows about 20 percent less chance than the non-user females for higher number of births (Roy et al., 2015).This study shows that NPV, the improved model explained about 82.6percent of the variation in TFR. These various studies are close to estimation regression analysis.

4. Concluding Remarks

In this study, estimation of the total fertility rate is done using indirect method. Here, ridge regression estimator is applied for this purpose where exogenous variables are correlated to each other. Also, estimation of number of unintended births using various family planning methods and the percent of increment in births in the absence of birth control devices is studied. Empirical analysis is done for Nepal and data is taken from Nepal Demographic Health Survey (2016). Since total fertility rate depends on various factors i.e. human development index, literacy, maternal care, contraception use, birth interval so on. But, in this study, an improved model is also applied for estimation of TFR with correlate Contraception. Here, in the study contraceptive prevalence rate (CPR) is taken in the percentage for the women aged 15-49 years who are using contraceptive methods. The obtained results show that there are variation in the births avoided using family planning practices in Nepal.This result was described as gap between increasing

desire to control fertility and ability to do so and then eventual decrease as more women use contraception. The use of current contraception is a reduction of 3256 births in all over NEPAL among the total 12862 females considered who are exposed to the risk of conception. Nepal is taking about 67.27percent decrement in TFR due to the use of contraception. Highest decrement in TFR (78.85 percent) is shown by Province 3 and lowest decrement in TFR (59.04 percent) is Province 2. It also includes the recent study of number of births averted due to the contraceptive use at state level. In fact, it is provided reasonable estimates of births averted due to contraceptive use by national populations. The variables are CPR that about 52.6 percent variation in TFR can be explained by the first regression approach. Using NPV, the improved model explained about 82.6percent of the variation in TFR. Estimates of births averted and the percent change in births in the absence of contraception based on the two methods are fairly consistent. This model can be used to estimate TFRs up to the different demographic dividend of sub division of the country also. It also includes the recent study of number of births averted due to the contraceptive use at states level.

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