Natural Resource Responsibility and Seasonal Patterns in Contraceptive Behavior: Evidence from Nepal

Elizabeth G. Sutherland

Carolina Population Center, Department of Maternal and Child Health

University of North Carolina at Chapel Hill

Annual Meeting of the Population Association of America

March 29, 2006

Abstract

This paper uses of discrete-time multilevel hazard models to explore the effects of natural resource responsibility and season on contraceptive adoption and discontinuation between 1997 and 2003 in the Western Chitwan Valley of Nepal. Data from the Chitwan Valley Family Study, containing a sample of 1,761 women of reproductive age, were used for this analysis. Women in this study were found to be less likely to adopt any method and more likely to discontinue non-permanent methods in the monsoon months than in the winter. There is little evidence to suggest that this seasonal pattern in contraceptive behavior was significantly stronger among women with greater natural resource responsibilities, although more sensitive measures of seasonal responsibility would be desirable for better assessing this relationship. This study contributes to the literature by looking beyond seasonality in births to examine the effects of season and natural resource responsibility on contraceptive behavior.

Introduction

Seasonality of conceptions and births is a widely recognized phenomenon occurring across cultures. Explanations of the relationship between season and fertility are divided into two categories, biological and behavioral. The best studied of these suggested mechanisms are biological. Temperature, photoperiod, and seasonal fluctuations in food security and physical activity (at least among marginal subsistence groups), have all been hypothesized to have

an effect on fecundability (1). In fact, Panter-Brick has demonstrated that increased physical activity, associated with agricultural responsibilities, leads to suppressed ovulation in the monsoon season for non-contracepting Tamang women of central Nepal (2). The same relationship between agricultural season and fecundity has also been documented in Bangladesh (3).

Less research has been done regarding behavioral determinants of seasonal fertility patterns. Some research suggests that where there is significant seasonal migration, spousal separation is a small but significant predictor of seasonal fertility (4). One recent European study found that sociodemographic factors are a strong predictor of seasonal fertility in the Czech Republic (5). These authors suggest that the stronger seasonality in births among older and more educated mothers may reflect widespread and very effective use of family planning among these women, leading to fewer unplanned pregnancies and a greater tendency to plan conceptions for the culturally preferred summer holiday season. An earlier study in Egypt suggests that women may time marriage and periodic abstinence to avoid pregnancies and births during the busy agricultural season (6). Despite this suggestion of seasonality in fertility regulation behavior as well as births, no studies have directly examined disparities in seasonality of contraceptive use among women.

Worldwide, women carry the majority of household natural resource responsibilities (7), including the collection of water, fodder, and fuelwood, tending crops, managing livestock, and a host of other agricultural duties. These responsibilities are time consuming and tie women closely to home, especially

during the height of the agricultural season. This has been found to be the case in southern Nepal, where women spend approximately 9 hours of every day engaged in natural resource activities including water and forest product collection, livestock management, and crop production (8) in November's millet season. Resource collection activities are more time consuming in the dry season (9, 10). Women have to go farther to find water because ephemeral water sources are dry. Additionally, preferred fodder and fuelwood sources are unavailable during the dry season and many people are driven into protected park and forest land to collect illegally during this time of the year. The pressure is so great that Royal Chitwan National Park allows for some legal collection of fuelwood and fodder during the dry season (9, 10). As far as agriculture, there are three cropping seasons in a year: Monsoon (from June to September) winter (from October to February) and summer (from March to May). The important crops are paddy, maize and millet in monsoon, wheat lentil, potato and buckwheat in winter, and paddy and maize in summer (11). The cropping patterns are paddy-based in low lands and maize based in uplands.

Time demands associated with greater natural resource participation are often seasonal in nature, with the greatest time commitment to agricultural activities occurring during planting and harvesting times. A previous small (n=98) study from the Western Chitwan Valley in Nepal found that women were less likely to be sterilized and slightly less likely to adopt other methods in June-August when agricultural demands were the highest. This study did not examine the timing of discontinuation of temporary methods. In semi structured interviews

women cited a lack of time for seeking health services and for recuperation from the surgery, as well as a fear of infection following surgery during the monsoon, as reasons for preferring to be sterilized in the winter (12). A second study in the Terai (n=189) also found a midwinter peak in sterilization, suggesting the presence of mobile camps and the relative freedom from agricultural duties as possible hypotheses for this observed seasonality in sterilization (13). The Thapa study also noted that June- August is also a time when travel is slower due to monsoon rains, increasing the time needed to reach service delivery points and making contracepting easier in the winter. This study did not examine possible seasonality in other methods of birth control. Women in the Stash study and in other studies have expressed concern that side effects from any means of contraception would prevent them from being as productive in natural resource activities as they could be (12, 14). This concern may translate into less patience with seeking contraceptives and tolerating side effects during the summer months among women with greater natural resource responsibilities, and therefore, a greater rate of contraceptive discontinuation and a lower rate of contraceptive adoption during this time, or may influence the method chosen during these months.

The aim of this study was to quantitatively examine the relationship between season and both contraceptive adoption and discontinuation by utilizing a prospective contraceptive calendar from a large (n=1,761) sample of women from the Western Chitwan Valley. I also assessed various hypotheses explaining the role of season in the timing of contraceptive use, including the role of

seasonal natural resource responsibility. Because natural resource activities play such an important role in women's daily lives throughout the year, it is important to understand how these activities influence contraceptive use. Family planning programs that take these factors into account might better meet the needs of women in rural, agricultural areas.

Methodology

Data

Data were collected in the Western Chitwan Valley of south-central Nepal between 1996 and 2003. The Western Chitwan Valley covers an area of 100 square kilometers and is bordered to the south by Royal Chitwan National Park and to the east by Barandabar Forest. A random sample of all communities within the Western Chitwan Valley was taken, with oversampling to ensure representation by each of the five major ethnic groups inhabiting the area: high caste Hindus, hill Tibeto-Burmese (such as Gurung, Tamang, and Magar), indigenous Terai Tibeto-Burmese (such as Tharu, Darai, and Kumal), Newar, and other caste Hindus. A total of 171 communities were included in the sample. Within the 171 sample neighborhoods, every resident (regardless of sex) between the ages of 15 and 59 and their spouses were asked to participate in the research. The response rate was over 97% and the total sample was 5,271 individuals, of which 2,663 were women. For this study the sample will include all married women of reproductive age (between 15 and 49) in the overall sample (n=1,761).

The Chitwan Valley Family Study consists of many different data collection efforts, involving more than 10 different survey instruments and including thousands of variables. For the purposes of this analysis, data from four different instruments were used. The first of these is a household level survey called the 1996 Agriculture and Consumption Survey. This survey yielded information on different household natural resource activities such as the collection of fuelwood, water, and fodder, and different livestock and cultivation activities.

A second source of information comes from the 1996 Individual Baseline Survey, which was administered to every individual survey participant. The baseline survey includes information on family relationships, living arrangements, educational attainment, parity, and marriage. A third instrument, the personal Life History Calendar, collects retrospective information related to the timing of major life events, including education, marriage, childbirth, and use of family planning occurring prior to the 1996 baseline surveys. A fourth instrument, the monthly Family Planning Data Sheet and Household Registry, has been administered to each woman in the sample on a monthly basis since the 1996 baseline sample. This monthly update is the source of data on contraceptive behavior of individual women from 1996 up to 2003. .

Each respondent was interviewed in Nepali by a trained interviewer of the same sex. All interviews, except the monthly family planning updates, were conducted in 1996. Since 1996 each woman in the sample was subsequently followed monthly for updates in her contraceptive use and pregnancy status using the Family Planning Data Sheet. Even women who subsequently moved

out of the study area were kept in the study and were followed up monthly where possible. Interviewers recorded all responses to the baseline questionnaires and monthly contraceptive use updates on paper and pencil. The data from these paper and pencil surveys were then entered into a database separately by two different analysts. Discrepancies were reconciled before the data file was considered complete.

Measurement

For the purposes of this study, contraceptive adoption was defined as a transition from a state of nonuse to a state of use of a contraceptive method. The monthly risk of contraceptive adoption among nonusers was examined separately by method and for the adoption of any method, the adoption of non-permanent and permanent methods, and the adoption of supply and non-supply methods, as sample size allowed. When examining contraceptive adoption by method, all adoptions of other methods were treated as censored. Episodes of nonuse were constructed from 1996 onwards and left-censored episodes were excluded from the analysis. Episodes containing missing contraceptive information were also excluded from the analysis. Women who were sterilized exited the analysis and never reentered since they were no longer at risk for adoption. Women were also excluded from the analysis during pregnancy and reentered the analysis immediately upon the end of pregnancy.

Contraceptive discontinuation was defined as the transition from a state of use of any method to a state of nonuse of any method for any reason (including

pregnancy). Voluntary discontinuation refers to discontinuation for any reason other than method failure. A method failure was considered to occur when discontinuation resulted from pregnancy. The monthly risk of users of temporary methods discontinuing the use of contraception was examined in this study. Interruptions in use of 1 month or greater were considered to be a discontinuation. In addition to all method discontinuation rates, discontinuation was also disaggregated by most recent method used prior to the abandonment of contraceptive use. Episodes of use were constructed from 1996 onwards and missing and left-censored episodes were dropped.

I also constructed a measure of natural resource responsibility as a part of this research. Natural resource responsibility has two dimensions. The first of these is participation in agriculture, and the second is engagement in the collection of natural resources such as fuelwood, water, and fodder. A complete definition of natural resource responsibilities can be found in Table 1.

In the Western Chitwan Valley of Nepal, as in many other rural agrarian settings, one of the best indicators of socioeconomic status (SES) is land ownership. This is because, with almost 95% of Nepal's labor force engaged in agriculture, land is an important measure of production, and thus, wealth. Land ownership in the Western Chitwan Valley is measured as a series of three dichotomous variables representing the ownership of any of three types of land. The first is the ownership of any khet, or wet, land. This type of land is low-lying and the most valuable for production because it can support 2 rice crops per year without irrigation. The second type of land is bari, or dry uplands. This type of

land requires irrigation in order to support a rice crop and often supports other crops, such as millet and maize. The third type of land is house plots. These small land parcels cannot support a large crop but can be used for small kitchen and truck gardens or to support a small business. The ownership of these three types of land have been found to correlate well with more traditional consumption based indicators of SES (such as consumer durables, electricity and toilet facilities) in the Western Chitwan Valley. Land ownership has furthermore been found to provide a more direct wealth measurement than consumption measures such as asset indices, which in rural settings tend to be less reliable (15).

Statistical Approach

Data were analyzed using STATA 8.0 S.E. statistical computing software. All models are estimated using mulitilevel discrete time hazard models. Hazard models, also called survival or duration models, or event history analyses, are appropriate for use in this context because both contraceptive adoption and contraceptive discontinuation represent transitions in state (16-18). Because there were women who did not change state during the length of data collection, observations are censored, making traditional regression analyses biased and inefficient. Because information on contraceptive use is collected at discrete time intervals (monthly) rather than continuously, discrete time hazard models are appropriate. Multilevel models are estimated because the data structure is inherently multilevel, with the unit of analysis being an episode of use or nonuse of contraception, experienced by an individual woman living in a sample

neighborhood, making it necessary to account for random error at these multiple levels. In STATA, models were fitted using the SVYLOGIT command, modeling the hazard as a logit function and with neighborhoods as the primary sampling unit. Time is included in the model as both a period effect (month 1-72 of data collection) as well as representing the length of a single continuous episode of contraceptive use or nonuse in months. Adjusting for episode length is important since it allows us to account for changes in the hazard over the interval. For example, most studies find that the hazard of discontinuing contraception decreases the longer a woman uses family planning (18-21)

This study examined the effect of season and natural resource responsibility on contraceptive adoption and discontinuation. In order to assess this effect, all natural resource responsibility variables were examined independently and selected variables were examined as interaction terms with season. Interactions to be evaluated were selected on the basis of theory and to test specific hypotheses. For example, women who participate in agriculture may be particularly tied to home during the rice planting and harvesting times in the monsoon months. Therefore, these women may be particularly prone to prefer winter to monsoon for adopting a contraceptive method and may be more likely to discontinue using a temporary method during the busy monsoon months. Predicted probabilities were used to determine the degree to which interaction terms modify the main effect of season and natural resource responsibility on contraceptive adoption and discontinuation. Because true statistical significance of interaction terms is difficult to assess in a logistic model (used to fit the hazard

model), interaction terms in this study were evaluated through a Wald test for joint significance with the individual variables that make up the interaction. Other independent variables were included in the model as controls. Control variables included age, education, parity, SES/land ownership, and caste/ethnic group. For a complete description of model variables see Table 1.

Results

In the 72 months of the study period, there were 3,096 eligible episodes of nonuse contributed by 1,355 women, and 618 eligible episodes of temporary method use contributed by 427 individual women. In order to be at risk for adoption in this sample, one must have discontinued contraceptive use or been pregnant during the study period (first time adopters who have never been pregnant would have a left censored episode of nonuse and be dropped from the sample). In order to be at risk for discontinuation a woman must have adopted a method other than sterilization during the 72-month period. Women who continuously used contraception through the 72-month period would have had a single left-censored episode and would have been dropped. Women who never used contraception and those who were sterilized were also considered to be not at risk of discontinuing and were therefore excluded from the analysis. All told, in the study period there were 781 eligible adoptions and 422 eligible discontinuations. Adoptions during this period consisted predominantly of Depo Provera (41%) followed by oral contraceptive pills (22%), sterilization (18%), and

condoms (18%). Similarly, discontinuations were predominantly of Depo Provera (49%), followed by the pill (26%), and condoms (22%).

As has been documented in other study settings, both adoption and discontinuation were more likely early in an episode, with the percent adopting and discontinuing dropping off sharply and leveling off near zero. A look at discontinuation rates during the study shows a similar pattern for all method discontinuation. Table 2 outlines the 12-month life table rates of total discontinuation and of voluntary discontinuations (discontinuation for a reason other than method failure) and contraceptive failures (discontinuation due to pregnancy), by method. Similarly Table 3 presents the 3- 6- and 12-month life table total and all-method adoption rates. The 12-month voluntary discontinuation rate ranged from a low of 69.8% for the oral contraceptive pill to 78.6% for condoms, averaging at 73.66% for all modern methods. These rates are high when compared to similar rates calculated using demographic and health survey calendar methods, which range from 19 to 65% (21). The all-method failure rate in this study was 3.3%, which, while on the low end, is comparable to that found in other countries including, Bangladesh, Indonesia, and Zimbabwe (21). The all-method adoption rate ranged from 25% at 3 months to almost 33% at 12 months. The role of individual and household and service variables in predicting the likelihood of a particular episode ending in adoption or discontinuation of contraception is outlined more fully below.

Adoption

Model coefficients and standard errors from the multilevel discrete-time event history analysis of contraceptive adoption (excluding interaction terms) are presented in Table 4. As hypothesized, season played a role in the timing of contraceptive adoption in the Western Chitwan Valley of Nepal, where women were much less likely to adopt any method during the monsoon months. As expected, seasonality in adoption was particularly pronounced for sterilization, which was less likely to be adopted in the summer or monsoon than in the winter. However, season was not a strongly significant factor in the timing of temporary method adoption. Women were marginally less likely to adopt condoms during the monsoon months, but the timing of Depo Provera and pill adoption seemed unaffected by season, at least by itself.

Natural resource responsibilities by themselves did not seem to have a major role in predicting the probability that a woman will adopt any method of contraception, although women who spent moderate amounts of time collecting water (an average of 2-5 minutes/woman) were less likely to adopt a method. Natural resource responsibility seemed to have a greater effect on method choice, with women who spent greater amounts of time collecting fuelwood, fodder, and water being significantly less likely to adopt the pill.

As far as explaining the seasonal patterns observed for contraceptive adoption, there were no overwhelmingly significant interactions between natural resource responsibility and season to suggest that the seasonal pattern of adoption was much stronger or weaker among those with greater resource

responsibilities. Although there were no strong interaction effects, there were, however, a couple of very small, marginally significant interactions between season and natural resource responsibilities. An example of these interactions is shown graphically in figure 2. These interactions suggested that women who lived in farming households were slightly less likely than other women to adopt any method of contraception in the monsoon (see figure 2a), and that women who spent 5 minutes or more on average collecting water were marginally less likely than others to be sterilized in the monsoon months (not shown).

In addition to season and natural resource responsibility, travel time to clinic was examined as a factor that could influence the overall and seasonal likelihood of contraceptive adoption. Women who lived more than 30 minutes from a clinic were less likely to adopt any method of contraception, and in particular, less likely to adopt Depo Provera. There were, however, no significant interactions between season and physical accessibility of services to suggest that women who must travel longer to obtain family planning were significantly more affected by season.

As expected, demographic factors, namely age and parity had a significant, consistent effect, with older women and women with more living children being significantly more likely to adopt any and all methods. Education, surprisingly, showed little effect on the probability of adopting any method, although women in the highest education group, with a school leaving certificate or higher, are more likely than women with no formal education to adopt condoms. Education was not a significant factor even in bivariate analyses, as

the proportion of those in each education group among those who ever adopted contraception matching the proportions in each group in the overall sample. As was expected, however, ethnicity had a strong influence in this region on the overall probability of contraceptive adoption and the probability of adopting a specific method. For example, low caste Hindus were more likely than higher caste Hindus to adopt any method of contraception, but this result was driven by a greater likelihood among low caste Hindus to adopt oral contraceptive pills and Depo Provera. Both groups are equally likely to adopt condoms and sterilization.

Discontinuation

Model results for contraceptive discontinuation are summarized in table 5. Season was an important factor in predicting method discontinuation as well as method adoption. Women were much more likely to discontinue using contraception during the monsoon months. Natural resource responsibility was not an extremely strong predictor of method discontinuation, although there is some evidence that women who spent moderate to large amounts of time collecting fuelwood and water were actually less likely to discontinue using contraception. No strong evidence was found that season and natural resource responsibility interacts such that those with greater natural resource responsibility showed a greater or less seasonal relationship with the likelihood of method continuation. However, a marginally significant interaction was found between the monsoon season and farming households, such that women who lived in non-farming households showing a greater propensity than those in farming

households to discontinue during the non-monsoon than the monsoon (see figure 2b).

Finally, in addition to season and natural resource responsibility, travel time to the nearest family planning provider was examined as a factor influencing contraceptive discontinuation. Women with a greater than 30 minute travel time to the nearest family planning provider showed a significantly increased likelihood of discontinuation. However, there was no evidence of any interaction between season and travel time to services.

Demographic factors do not seem as important for predicting discontinuation as for predicting contraceptive adoption. Age was unimportant, and with increasing parity I find that, although women are more likely to adopt contraception, they are also more likely to discontinue using temporary methods. This effect does not seem to be explained by a switch to sterilization. While 73 discontinuations were followed by an adoption of sterilization, only 1 of these switches were among the highest parity group. Education is largely not significant, although women with a school leaving certificate or higher are much less likely than women with no formal education to discontinue using a temporary method. We find that women whose last method was the pill or condoms are much more likely to discontinue that a woman who last used Depo Provera.

Discussion

The aim of this research was to determine if and how season plays a role in the timing of contraceptive adoption and discontinuation. Previous studies had

found some evidence of a peak in sterilization (12, 13) and, to a lesser extent, other methods (12) during the winter in South Central Nepal. This study also finds evidence of this seasonal pattern in adoption of sterilization, and also finds that the adoption of condoms is marginally less likely in the monsoon months of June- September. However, after further investigation into the relationship between season and contraceptive behavior, I found the discontinuation of temporary methods also showed evidence of seasonality, with discontinuation significantly more likely to occur in the monsoon months.

Given the seasonal pattern that exists for the discontinuation of temporary methods and the slight seasonality shown in the adoption of condoms as well as for the adoption of sterilization, the hypothesis that seasonal patterns of contraceptive (sterilization) adoption is due to the presence during the winter months of mobile sterilization units(13) is insufficient to explain the full range of seasonal contraceptive behavior found in the Western Chitwan Valley. As suggested by the Stash and Thapa studies, the presence of mobile sterilization units together with the cultural preference expressed in semi structured interviews to avoid surgery during the monsoon as a preventative to infection may help to explain the especially strong seasonality in the adoption of sterilization, which is much less likely in both the summer and the monsoon than in the winter. However, these hypotheses do little to explain seasonality in the adoption of other methods, or the increased likelihood of method discontinuation during the monsoon months.

A second possible explanation for a decrease in adoption and an increase in discontinuation of contraception during the monsoon months is that the monsoon rains make travel to clinics more difficult, thus increasing the probability that women will delay adoption and lapse in current use of a temporary method (13). Travel time to the nearest family planning provider is significantly related to the overall likelihood of adoption of any method (and particularly of Depo Provera) and to the likelihood of discontinuing any non-permanent method. However, travel time to the nearest facility does not seem to act as a modifier of the season-adoption or season-discontinuation relationship.

A third possible explanation of the seasonal pattern in contraceptive adoption and discontinuation that has been suggested in the literature and emerged also from past qualitative work is that women are less likely to adopt or continue using contraception during times of increased household responsibility, such as during the planting and harvest of rice (12, 13). Women cited a fear of side effects (and recovery time in the case of female sterilization) that would compromise their ability to fulfill their household responsibilities as well as the lack of time to seek services (12, 13). While some weak evidence that resource collection time had some influence on the overall likelihood of adopting contraception and more particularly on method choice (those with greater responsibility are less likely to adopt the pill), overall these effects were small. Furthermore, a variety of marginally significant interactions were found which suggest that overall, women with greater responsibilities were marginally less likely than other women to adopt contraception in the monsoon and those in

farming households were a bit less likely to discontinue during non-monsoon rather than monsoon months than other women.

While the interactions between natural resource responsibility and seasonal patterns of contraceptive behavior were small and weak in this study, the hypothesis that seasonal workloads influence the probability of adopting or discontinuing contraception cannot be completely dismissed and is worthy of further investigation with more refined measures. The data used in this study had only a household level measure of the amount of time women spent collecting fuelwood, fodder, and water. This measure did not assess seasonal variation in these tasks, nor did it specify how individual women in the household delegated these tasks among themselves. I was therefore forced to assume an equal distribution of labor and create an average collection time for each woman in the household. Furthermore, the most seasonal of household responsibilities is likely to be participation in important agricultural events such as planting and harvesting rice. However, the only measure of women's participation in agriculture in the data set was a measure of whether her household engaged in any farming. There was not much variation in this measure as the vast majority of households engage in some type of farming. Also problematic, this measure did not capture individual women's participation in agriculture, seasonal variation in women's participation in agriculture, or what types of agriculture families engaged in. This last could have a substantial influence on seasonal workloads, as there are different crops requiring different labor intensities for different seasons. Once again, we were forced to assume that women whose households

were engaged in agriculture and who reported the greatest average collection times were also the women with the greatest seasonal variation in workload. Further research that captures women's individual workloads, by season, would be more useful for understanding the relationship between seasonal contraceptive behavior and natural resource responsibilities.

It is ultimately important to understand that there is a seasonal pattern in contraceptive behavior because a season of low adoption and high discontinuation represents a seasonal barrier to the successful, effective use of family planning by women in the Western Chitwan Valley and in other areas where seasonal contraceptive behavior may not have yet been recognized. This barrier could create a window of time when a woman risks an unintended pregnancy while waiting for a more convenient time to adopt or resume contraceptive use. Better understanding why this seasonality occurs may help family planning providers to better help couples in overcoming this barrier to effective contraceptive use in rural, agrarian settings.

References

1. Lam DA, Miron JA, Riley A. Modeling seasonality in fecundability, conceptions, and births. Demography 1994;31(2):321-346.
2. Panter-Brick C. Proximate determinants of birth seasonality and conception failure in Nepal. Population Studies 1996;50(2):203-220.
3. Becker S, Chowdhury A, Leridon H. Seasonal patterns of reproduction in Matlab, Bangladesh. Population Studies 1986;40(3):457-472.
4. Ferguson AG. Fertility and contraceptive adoption and discontinuation in Rural Kenya. Studies in Family Planning 1992;23(4):257-267.
5. Bobak M, Gjonca A. The seasonality of live birth is strongly influenced by socio-demographic factors. Human Reproduction 2001;16(7):1512-1517.
6. Levy V. Seasonal fertility cycles in rural Egypt: Behavioral and biological linkages. Demography 1986;23(1):13-30.
7. Obaid TA. Footprints and milestones:population and environmental change. New York; 2001.
8. Brown S. Spatial analysis of socioeconomic issues:Gender and gis in Nepal. Mountain Research and Development 2003;23(4):338-344.
9. Nagendra H. Tenure and forest conditions: community forestry in the Nepal Terai. Environmental Conservation 2002;29:530-539.
10. Neupane RP, Thapa GB. Impact of agroforestry intervention on farm income under the subsistence farming system of the middle hills, Nepal. Agroforestry Systems 2001;53:31-37.
11. Pariyar MP, Singh G. GIS Based Model for Agro-Ecological Zoning: A Case Study of Chitwan District, Nepal. In: Asian Conference on Remote Sensing; 1994 November 17-23; Bangalore, India; 1994.
12. Stash S. Explanations of unmet need for contraception in Chitwan, Nepal. Studies in Family Planning 1999;30:267-287.
13. Thapa S, Friedman M. Female sterilization in Nepal: A comparison of two types of service delivery. International Family Planning Perspectives 1998;24(2):78-83.
14. Casterline JB, Sinding SW. Unmet need for family planning in developing countries and implications for population policy. New York, NY; 2000.
15. Axinn WG, Barber JS, Biddlecom AE. Social Change, Family Size and Environmental Consumption. In: Annual Meeting of the Population Association of America; 2000 March 23-25; Los Angeles, CA; 2000.
16. Barber JS, Murphy SA, Axinn WG, Maples J. Discrete-time multilevel hazard analysis. Sociological Methodology 2000;30:201-235.
17. Zhang F, Tsui AO, Suchindran CM. The determinants of contraceptive discontinuation in Northern India: A multilevel analysis of calendar data. Chapel Hill, NC: MEASURE Evaluation; 1999.
18. Steele F, Curtis SL, Choe M. The impact of family planning service provision on contraceptive use dynamics in Morocco. Studies in Family Planning 1999;30:28-42.
19. Steele F, Geel F. The impact of family planning supply factors on unmet need in rural Egypt 1988-1989. Journal of Biosocial Science 1999;31(3):311-326.

20. Steele F, Diamond I, Duolao W. The determinants of the duration of contraceptive use in China: A multilevel multinomial discrete-hazards modeling approach. Demography 1996;33:12-23.
21. Curtis SL, Blanc AK. Determinants of contraceptive failure, switching, and discontinuation: An analysis of DHS contraceptive histories. Calverton, MD: ORC Macro International; 1997.

Figure 1. Map of Study Area

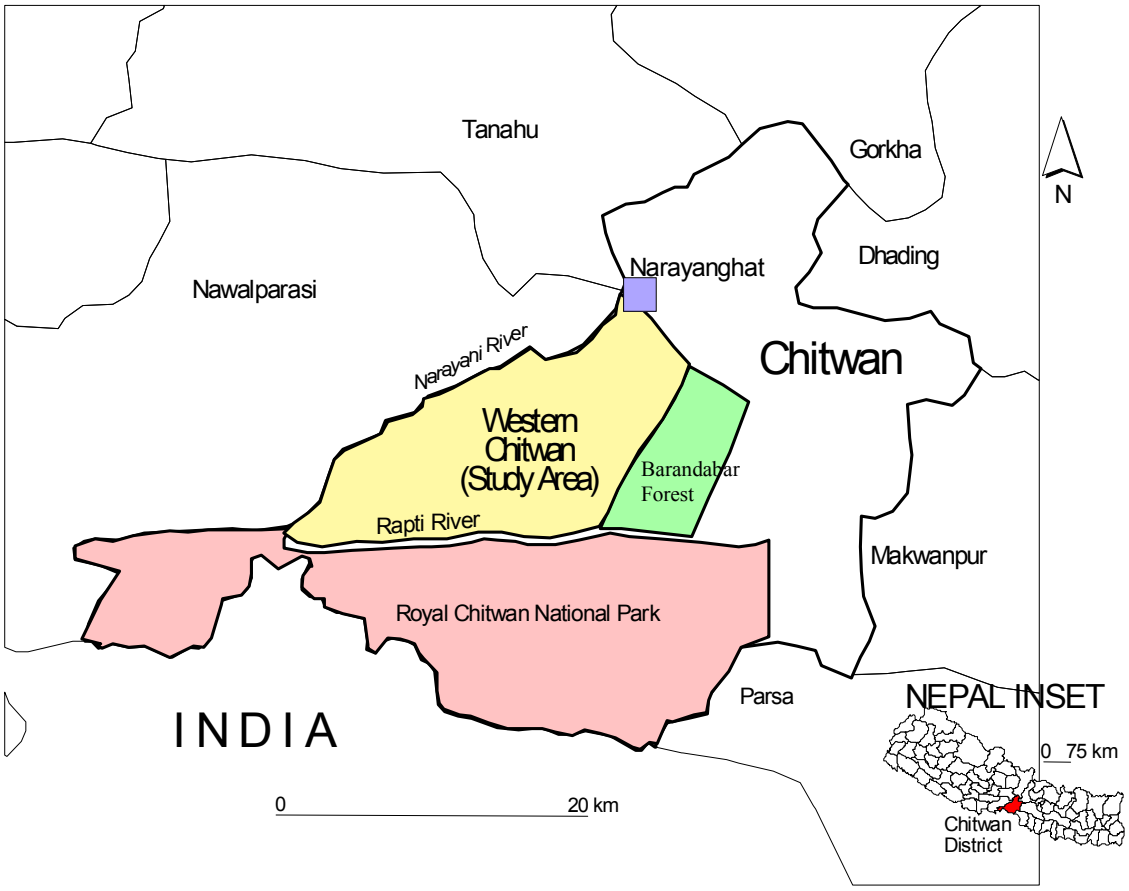


Table1. Model Variable Descriptions

Variable	Description
Physical Accessibility	
Travel time to nearest clinic	Travel time on foot to nearest clinic (classified as <15 min, 15-30 min, 30+ min)
Natural Resource Responsibility	
Farming	Household engages in agriculture
Fodder	Time spent by women in the household collecting fodder for livestock in hours (categorized as less than 1 hr, 1 to 2 hrs, 2+hrs)
Water	Time spent by women in the household collecting water in minutes (categorized as water onsite, or less than 1-5 min, 5+min)
Firewood	Time spent by women in the household collecting fuelwood in hours (categorized as less than 2 hrs, 2 to 4 hrs, 4+hrs)
Season	
monsoon	Months June-September
summer	Months March-May
winter	Months October-February
Other Explanatory Variables	
Demographic Characteristics	
age (time varying covariate)	Age of a woman (classified as under 20, 20-29, 30-39, or 40-49)
education	Highest educational level obtained by a woman (classified as none, some primary, some secondary,or S.L.C. or higher
number of living children (time varying covariate)	The number of living children to whom a woman has given birth
caste/ethnic group	Caste or ethnicity of a woman (classified as low class hindu, high class hindu, hill tibetan burmese, terai tibetan, and newars)
Land Ownership (SES)	
own khet land	A household owns khet (wet) farmland
own bari land	A household owns bari (dry) farmland
own houseplot	A household owns their own houseplot
Last Method Used (for Discontinuation only)	
Pills	Last method used before discontinuation was pill
Condoms	Last method used before discontinuation was condoms
Depo Provera	Last method used before discontinuation was Depo Provera

Table 2. 12-month life table method discontinuation, failure, and voluntary discontinuation rates by method

Rates	**%**
Total Discontinuation rate	76.92
Failure rates	
All methods	3.26
Condom	2.91
Depo Provera	5.13
Oral contraceptive pill	2.48
Voluntary Discontinuation rates	
All methods	73.66
Condom	78.64
Oral contraceptive pill	69.80
Depo Provera	72.65

Table 3. 3- 6- and 12-month life table modern method adoption rates by method

Rates	**3 months**	**6 months**	**12 months**
All methods	25.31	29.32	32.63
Pills	4.77	5.10	6.64
Depo Provera	8.51	11.94	13.13
Condoms	6.64	7.06	7.58
Sterilization	5.19	5.10	5.15

Table 4. Parameter estimates (with standard errors) from the discrete-time event history analysis of contraceptive adoption

	Nonpermanent Supply Methods				Nonpermanent Nonsupply Method		Permanent Methods		Any Method	
Variable	Pills		Condoms		Depo Provera		Sterilization			
Physical Accessibility										
Clinic 0-14 minutes by foot (ref)										
Clinic 15-29 minutes by foot	0.33	(0.26)	-0.24	(0.34)	-0.26	(0.20)	0.00	(0.22)	-0.09	(-0.12)
Clinic 30 or more minutes by foot	-0.40	(0.43)	-0.19	(0.37)	-0.43	(0.23)	-0.03	(0.33)	-0.29*	(-0.14)
Natural Resource Responsibility										
Farming	0.43	(0.35)	0.18	(0.52)	0.15	(0.26)	0.04	(0.42)	0.18	(-0.19)
Fodder <1hr (ref)										
Fodder 1-2hrs	-0.57*	(0.26)	0.19	(0.33)	0.28	(0.19)	0.20	(0.31)	0.14	(-0.19)
Fodder 2 plus hrs	-0.06	(0.49)	0.14	(0.56)	-0.03	(0.33)	0.42	(0.40)	0.08	(-0.14)
Fuelwood <1 hr (ref)										
Fuelwood 1-4 hrs	-0.43	(0.23)	-0.04	(0.31)	0.05	(0.18)	0.11	(0.28)	-0.07	(-0.11)
Fuelwood 4plus hrs	-0.67*	(0.31)	0.08	(0.36)	0.22	(0.22)	0.08	(0.31)	-0.00	(-0.13)
Water onsite (0 minutes) (ref)										
Water 1-4 minutes	-0.70**	(0.24)	-0.01	(0.29)	-0.26	(0.16)	-0.04	(0.20)	-0.25**	(-0.10)
Water 5 or more minutes	-0.63*	(0.30)	-0.60	(0.52)	0.12	(0.16)	-0.07	(0.24)	-0.17	(0.12)
Season										
Winter (ref)										
Summer	0.16	(0.18)	0.01	(0.22)	-0.20	(0.14)	-1.08	(0.23)	-0.16	(0.10)
Monsoon	-0.01	(0.17)	-0.22	(0.19)	-0.20	(0.13)	-1.50	(0.26)	-0.21**	(0.08)
Other Explanatory Variables										
Demographic Characteristics										
Under 20 years old (ref)										
20-29 years	0.13	(0.29)	0.75*	(0.33)	1.29**	(0.30)	2.89**	(1.02)	1.01**	(0.15)
30-39 years	0.24	(0.32)	0.79*	(0.41)	1.00**	(0.34)	2.48*	(1.06)	0.82**	(0.17)
40-49 years	-0.14	(0.46)	-0.97	(0.75)	-0.41	(0.52)	0.13	(1.28)	-0.31	(0.28)
No education (ref)										
Some or completed Primary	0.18	(0.30)	-0.39	(0.41)	-0.16	(0.18)	0.038	(0.28)	-0.11	(0.11)

Some or completed Secondary	0.37	(0.33)	-0.00	(0.35)	-0.18	(0.17)	-0.18	(0.27)	-0.04	(0.11)
S.L. C. or Higher	0.06	(0.39)	0.83**	(0.28)	0.10	(0.23)	-0.34	(0.32)	0.28	(0.17)
No living children (ref)										
1 child	0.34**	(0.32)	0.25	(0.30)	0.50**	(0.20)	1.33**	(0.45)	0.52**	(0.14)
2-5 children	1.48**	(0.26)	0.49	(0.27)	0.79**	(0.17)	2.20**	(0.42)	1.09**	(0.11)
5 or more children	1.65**	(0.54)	0.60	(0.68)	1.10**	(0.26)	2.18**	(0.54)	1.26**	(0.19)
High caste Hindu (ref)										
Low caste Hindu	1.23**	(0.32)	-0.86	(0.66)	0.47**	(0.19)	-0.20	(0.34)	0.34**	(0.12)
Hill Tibetan Burmese	1.04**	(0.25)	-1.09*	(0.48)	0.16	(0.16)	-0.60*	(0.28)	0.12	(0.12)
Terai Tibetan	-0.21	(0.39)	-0.62	(0.40)	-0.30	(0.21)	-0.34	(0.27)	-0.36**	(0.14)
Newar	0.28	(0.44)	-0.97*	(0.46)	0.01	(0.23)	0.22	(0.30)	-0.07	(0.16)
Land Ownership (SES)										
own khet land	0.09	(0.25)	-0.07	(0.32)	-0.46**	(0.16)	-0.05	(0.26)	-0.19	(0.12)
own bari land	-0.06	(0.28)	-0.01	(0.31)	-0.22	(0.16)	0.26	(0.23)	-0.06	(0.11)
own houseplot	-0.20	(0.26)	-0.64	(0.52)	-0.32**	(0.17)	-0.41	(0.27)	-0.39	(0.13)
Constant	-7.29**	(0.53)	-5.38**	(0.67)	-6.33**	(0.45)	-9.03**	(1.28)	-5.11**	(0.23)
Study Month (1-72)	0.06**	(0.02)	0.01	(0.02)	0.05**	(0.01)	-0.01	(0.02)	0.03**	(0.01)
Study Month squared (1-72)	-0.00**	(0.00)	-0.00	(0.00)	-0.00**	(0.00)	0.00	(0.00)	-0.00**	(0.00)
Duration	-0.01	(0.01)	-0.03**	(0.01)	-0.02**	(0.00)	0.01	(0.01)	-0.01**	(0.00)
Duration squared	-0.00**	(0.00)	-0.00*	(0.00)	-0.00**	(0.00)	-0.00**	(0.00)	-0.00**	(0.00)

(ref) reference category --not applicable
* Significant at p<0.05 ** Significant at p<0.01

Table 5. Parameter estimates (with standard errors) from the discrete-time event history analysis of contraceptive discontinuation

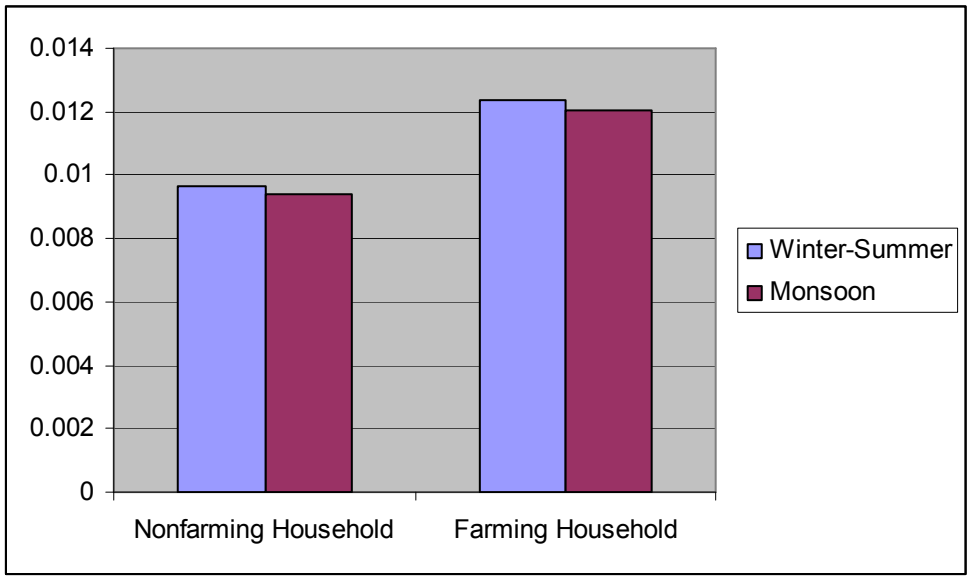
Variable		
Physical Accessibility		
Clinic 0-14 minutes by foot (ref)		
Clinic 15-29 minutes by foot	0.15	(0.14)
Clinic 30 or more minutes by foot	0.30*	(0.14)
Natural Resource Responsibility		
Farming	-0.20	(0.20)
Fodder <1hr (ref)		
Fodder 1-2hrs	-0.01	(0.21)
Fodder 2 plus hrs	0.08	(0.15)
Fuelwood <1 hr (ref)		
Fuelwood 1-4 hrs	-0.28	(0.16)
Fuelwood 4plus hrs	-0.24	(0.16)
Water onsite (0 minutes) (ref)		
Water 1-4 minutes	-0.30*	(0.13)
Water 5 or more minutes	-0.09	(0.13)
Season		
Winter (ref)		
Summer	0.03	(0.14)
Monsoon	0.27*	(0.11)
Other Explanatory Variables		
Demographic Characteristics		
Under 20 years old (ref)		
20-29 years	0.01	(0.30)
30-39 years	-0.31	(0.34)
40-49 years	-0.58	(0.41)
No education (ref)		
Some or completed Primary	0.22	(0.17)
Some or completed Secondary	0.31	(0.18)
S.L. C. or Higher	-0.57**	(0.17)
No living children (ref)		
1 child	0.12	(0.17)
2-5 children	0.29	(0.17)
5 or more children	0.67**	(0.27)
High caste Hindu (ref)		
Low caste Hindu	0.04	(0.16)
Hill Tibetan Burmese	-0.08	(0.15)
Terai Tibetan	0.10	(0.18)
Newar	0.12	(0.21)
Land Ownership (SES)		
own khet land	0.08	(0.12)
own bari land	0.01	(0.12)
own houseplot	0.10	(0.15)
Constant	-2.19	(0.37)
Study Month (1-72)	-0.00	(0.01)
Study Month squared (1-72)	0.00	(0.00)
Duration	0.00	(0.01)

Duration squared	-0.00**	(0.00)
Last Method Used		
Depo Provera (ref)		
Oral Contraceptive Pills	0.26*	(0.11)
Condoms	0.65**	(0.12)

(ref) reference category --not applicable
* Significant at p<0.05 ** Significant at p<0.01

Figure 2. The predicted probabilities of a) adopting any method of contraception and b)of discontinuing a temporary method as a function of both season and natural resource responsibility.

a)



b)