Contextual influences of modern contraceptive use among rural women in Rwanda and Nepal

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Introduction

This study takes a multilevel approach to identify determinants of women's use of modern contraceptives in two diverse settings: Nepal and Rwanda. While historically, the majority of research on determinants of women's contraceptive use has focused on characteristics of the woman herself, a growing body of research examines community-level determinants as well. Rwanda and Nepal offer two very different contexts of family planning: Nepal has a longer history of family planning policy and the rate of modern contraceptive use among married women has been relatively high – over 25 percent in 1996 – for over 15 years, but appears to have stalled between the 2006 and 2011 Nepal Demographic and Health Surveys (DHS). In Rwanda, on the other hand, the family planning policy was implemented more recently. Modern contraceptive use was quite low in 2000 (6 percent according to the 2000 Rwanda DHS), but between the 2000 and 2010 surveys the contraceptive prevalence rate increased rapidly to 45%, exceeding all expectations. While Nepal and Rwanda each face unique challenges, both governments have invested major resources into population and family planning policies.

While the proximal determinants of fertility and influence of individual characteristics on modern contraceptive use have been well examined in the literature, the study of contextual influences is limited in comparison. This study will build on previous work that has examined contextual determinants of contraceptive use, in an attempt to examine multiple spheres of influence. Specifically, we explore the extent to which four spheres of community-level influence – socio-economic development, women's empowerment, access to family planning information and services, and fertility norms – shape women's contraceptive use, after adjusting for her own socio-demographic characteristics and for other contextual factors. We hope these findings can be used to inform policy makers in a variety of settings.

Context of Family Planning in Nepal

Family planning initiatives were first introduced in Nepal in the late 1950s by the Family Planning Association of Nepal (FPAN), a non-governmental organization which disseminated

information about family planning and promoted a small family size norm. Government-supported family planning programs were initiated in 1968 with the implementation of Nepal's Third Development Plan (1965-1970), which first stated the need for a national population policy and identified family planning as a critical component of this policy (Ministry of Health and Population (MOHP) [Nepal], New ERA, & Macro International Inc., 2007). Since that time, family planning programs have expanded their goals and have increased the availability of family planning methods across Nepal. In addition to directing resources towards increasing the supply and availability of contraceptives and the reach of trained providers, family planning and population policies in Nepal have long focused on promoting a small family norm through education and media campaigns, and have recognized the interconnectedness of women's status and fertility, promoting women's employment and education (Ministry of Health and Population (MOHP) [Nepal] et al., 2007).

Most recently, the Three-Year Interim Plan (2006/07-2009-10) put forth the goal to remove all costs of family planning services in the public sector. Family planning supplies are now available free of charge at public facilities in Nepal (Shrestha, Shrestha, & Ghimire, 2012). Temporary family planning methods can be obtained from a wide range of health facilities including health posts and primary health care outreach clinics, and can also be obtained from periphery-level health workers and volunteers. More permanent methods such as the intrauterine contraceptive device (IUCD) and implants are available at certain hospitals, primary health care centers, and health posts with trained staff. Sterilization services are provided at some health facilities and through mobile outreach services (Shrestha et al., 2012).

Between 1996 and 2011 fertility has declined steadily in Nepal, from a total fertility rate (TFR) of 4.6 in 1996 to 4.1 in 2001, 3.1 in 2006, and 2.6 in 2011 (Ministry of Health and Population (MOHP) [Nepal], New Era, & ICF International Inc., 2012). This reduction in fertility was accompanied by an impressive rise in the use of modern contraceptives among currently married women, from 26 percent in 1996 to 35 percent in 2001 and 44 percent in 2006. However, between 2006 and 2011 the contraceptive prevalence rate (CPR) remained stagnant, estimated at 43 percent in 2011 (Ministry of Health and Population (MOHP) [Nepal] et al.,

2012). The stall in CPR has been attributed to several potential factors, including increased levels of spousal separation, failure to reach remote populations and special sub-groups, and an increased use of traditional methods, abortion (following the introduction of a safe abortion policy in 2003), and emergency contraception (Shrestha et al., 2012). According to the 2011 NDHS, female sterilization remains the most prevalent form of contraception currently used by married women: 15 percent of currently married women were sterilized at the time of interview, while 9 percent used injectables, 8 percent relied on their partner's being sterilized, and 7 percent used traditional methods (Ministry of Health and Population (MOHP) [Nepal] et al., 2012).

Due to Nepal's mountainous terrain at the foothills of the Himalayas, certain areas of the country – largely in the hill and mountain areas – are very remote. These remote and rural areas tend to have fewer or inadequate reproductive health care facilities, fewer supplies and method choices, insufficient health care professional staff, and the staff at health posts may not be trained to counsel women regarding family planning options. Spousal separation has also become a critical component of the family planning context in Nepal today; nearly one third of married women aged 15-49 had absent husbands at the time of the 2011 Nepal DHS, and 11 percent of husbands were away for at least one year (Khanal, Shrestha, Pant, & Mehata, 2013).

Context of Family Planning in Rwanda

Rwanda implemented its first family planning program, in the early 1980s (May, Mukamanzi, & Vekemans, 1990). Since this time, the government has invested ample resources in making contraceptive methods available, affordable, and acceptable across the country (Wang, Wang, Pullum, & Ametepi, 2012). While family planning activities were suspended in the 1990s due to the Rwandan genocide, reproductive health and family planning services have received renewed attention since the early 2000s. In 2007, the Government of Rwanda prioritized family planning as part of its effort to reduce the country's high population growth rate, address poverty, and achieve development goals (Muhoza, Rutayisire, & Umubyeyi, 2013). The government has taken a comprehensive approach to increasing family planning uptake, which has included an ambitious expansion of services, including the construction of new hospitals,

health centers, and health posts in previously under-served areas; an increase the range of methods available at existing facilities; expansion of trainings for medical staff in family planning service provision; and a decentralization of family planning service delivery to gain community support and participation (Muhoza et al., 2013). Between 2000 and 2013, Rwanda's family planning efforts have also emphasized transforming community norms around family planning in Rwanda. The Government of Rwanda led a widespread national public education campaign to promote a small family size norm and proper birth spacing, acceptance of family planning, and to frame population policy and family planning as an important means to achieving national development goals and reducing poverty (Muhoza et al., 2013). Finally, Rwanda's family planning efforts have long acknowledged the interconnectedness of family planning uptake, socioeconomic development, and women's empowerment. To create an environment favorable to behavioral change that would result in lower fertility rates, population and family planning policies have promoted education, school attendance, and the employment and advancement of women, and have addressed issues of land use (National Institute of Statistics of Rwanda (NISR) [Rwanda], Ministry of Health (MOH) [Rwanda], & ICF International Inc., 2012).

Rwanda's TFR remained stagnant at roughly 6 births per woman between 1992 and 2005, but then declined rapidly between 2005 and 2010, from 6.1 to 4.6 births per woman (National Institute of Statistics of Rwanda (NISR) [Rwanda] et al., 2012). During this same period, there has been a dramatic rise in modern contraceptive use, from 5.7 percent in 2000 to 10.3 percent in 2005, 27.4 percent in 2007/08, and 45.1 percent in 2010 among currently married women (MEASURE DHS STATcompiler). Injectables are the most prevalent method among currently married women (26 percent), followed by the pill (7 percent), and implants (6 percent) (National Institute of Statistics of Rwanda (NISR) [Rwanda] et al., 2012).

Overall, the governments of Rwanda and Nepal have incorporated numerous strategies into their population policies. Both have focused largely on increasing the supply of family planning methods, so that women can access family planning methods of their choice. Both policies have recognized the relation between socioeconomic development and contraceptive use and

have integrated these two goals. Both policies have also focused on altering norms – to promote small family policies and to enhance the acceptability of the use of family planning. Finally, both countries have understood the importance of women's empowerment to the success of family planning programs, and have included programs to promote women's education and participation in the work, along with efforts to address gender norms.

Research Question: Community-Level Influences on Modern Contraceptive Use

This study uses the most recent data from the DHS in Rwanda and Nepal to examine the role of four realms of community-level influence – socio-economic development, women's empowerment, access to family planning information and services, and fertility norms – on women's current use of modern contraception, after accounting for the influence of women's individual and household socio-economic characteristics. Each realm of community influence could affect individual women's decision to use modern contraception, either by impacting her access to contraceptives, or her decision to use contraceptives – via her desire for more children or her sense of the acceptability of family planning itself. These four realms are examined in more detail below.

Socio-economic Development

Household socioeconomic status and the community's overall level of economic development could impact women's contraceptive use through several pathways. Better roadways and higher population density relate closely to women's geographic access to family planning. At the same time, living in a community with higher levels of socioeconomic development, better access to education, expanded employment opportunity, and exposure to modern ideas could impact women's ideal family size and attitudes towards using family planning (Giusti & Vignoli, 2006).

Within the research that has used multilevel modeling to examine community-level determinants of women's contraceptive use, the majority of studies have included measures of

the community's socioeconomic development, with mixed findings (DeGraff, Bilsborrow, & Guilkey, 1997; Giusti & Vignoli, 2006; Stephenson, Baschieri, Clements, Hennink, & Madise, 2007). Giusti and Vignoli (2006) used the community's mean household wealth index score as a measure of the community's degree of modernization, and found this to be positively associated with women's contraceptive use in Ethiopia. However, using a similar measure of community wealth, Stephenson and colleagues (2007) found the community's mean score to be positively associated with women's modern contraceptive use in only two of six sub-Saharan African countries (Tanzania and Burkina Faso). Other community-level measures of socioeconomic development have been included in studies modeling women's contraceptive use, including the percentage of women with access to piped water (Kaggwa, Diop, & Storey, 2008), the presence of asphalt or concrete roads in a community, the distance to the nearest population center, and the presence of electricity, irrigation, and secondary schools (DeGraff et al., 1997), and habitat type (Stephenson et al., 2007); however, these indicators were not found to be determinants of contraceptive use.

Women's Empowerment

There is ample evidence to suggest that women's personal level of empowerment impacts their own contraceptive use (Barbieri & Hertrich, 2005; Kaye, Mirembe, Bantebya, Johansson, & Ekstrom, 2006). Barbieri and Hertrich (2005), for example, examined spousal age difference as a proxy for gender inequality within the couple, in a study using DHS data from eighteen sub-Saharan African countries, and found that being at least 15 years younger than one's husband was associated with lower contraceptive use. Women's educational attainment, employment status, and discussion of family planning with one's partner have also been correlated with women's use of contraceptives (Kimuna & Adamchak, 2001).

A smaller body of research has examined community-level measures of women's empowerment as determinants of contraceptive use (DeGraff et al., 1997; DeRose & Ezeh, 2010; Moursund & Kravdal, 2003; Speizer et al., 2009; Stephenson, Beke, & Tshibangu, 2008). Many of these studies have found positive relationship between community level measures of gender attitudes and women's empowerment on contraceptive use. The rationale behind this

research is that women's contraceptive behavior is likely to be influenced not only by her own level of autonomy, but also by the level of autonomy of other women in her community, and by prevailing gender norms. DeGraff and colleagues (1997) found that the community-level average wage for women – interpreted as a measure of women's status and independence – had a positive effect on women's contraceptive use. Building on this finding, Stephenson (2008) found that among sexually active women currently using a method of contraception in South Africa, the proportion of women in a community that controlled their own earnings was positively associated with women's use of the pill or another more permanent method of contraception, rather than the injection. They also found that the proportion of women with only a primary education – another measure of women's autonomy – was inversely associated with the use of a more permanent method of contraception, rather than an injection.

A recent study by DeRose and Ezeh (2010) using Ugandan data from the 1995-96 Negotiating Reproductive Outcomes Study, examined the influence of both individual and community-level measures of women's control over household decision-making on the adoption of modern contraceptive methods. They found that women in communities where women more commonly have control over household decisions were 29 percent more likely to use modern contraception as compared to women with little decision-making power, independent of individual and community educational attainment.

Finally, women's experience of domestic violence has been found to be a risk factor for unwanted pregnancy and for induced abortion (Kaye et al., 2006). Community-level measures of spousal violence have also been correlated with contraceptive use. In a sample of sexually-experienced, unmarried youth in South Africa, Speizer and colleagues (2009) found that youth from communities with higher levels of sexual violence were less likely to have used a condom at last sex, were more likely to have had an adolescent pregnancy, and also were more likely to be HIV-positive than youth from communities with lower levels of sexual violence.

There is evidence, then, to suggest that both individual levels of empowerment and community-level measures of gender attitudes impact women's use of contraceptives. In this

study, we examine the extent to which community-level gender norms and attitudes shape women's individual decision to use contraceptives in Rwanda and Nepal.

Fertility Norms

In general, individuals' decisions are shaped by the perceived attitudes and behaviors of others in the community (Rimal & Real, 2003). Community norms regarding family size and family planning, then, are likely to impact women's own attitudes, and ultimately influence their family planning behaviors. Family planning programs in Nepal and Rwanda have both sought to transform fertility norms and to encourage small family size – but little research has studied the extent to which community norms around family planning may explain geographic variation in contraceptive use in these two settings.

Prior studies in other settings have had mixed findings regarding the extent to which community-level norms around family planning and family size impact individual women's use of modern contraceptives (Kaggwa et al., 2008; Stephenson et al., 2007). Kaggwa and colleagues (2008) examined the impact of several community-level measures of family planning norms on women's contraceptive use in Mali. After controlling for individual-level factors, they found no evidence that women's use of modern contraceptives was impacted by community norms around desired family size (measured using the proportion of women desiring 4 or fewer children and the mean number of births per woman), or attitudes towards family planning (the proportion of women in the community who approved of family planning). However, in another study examining myriad contextual factors as determinants of women's contraceptive use in six sub-Saharan African countries, Stephenson and colleagues (2007) found that after adjusting for individual and other community-level factors, the percentage of women in the community that approved of family planning was positively associated with women's individual current use of modern contraceptives in four of the six countries (Kenya, Malawi, Tanzania, Ghana). In the same study, men's community-level approval of family planning was a significant positive predictor of women's contraceptive use in Kenya; this association held even after adjusting for the partner's approval of family planning at the individual level, indicating a community influence above and beyond that of the nuclear family.

The normative context in South Asia is likely to be a little different than the context in sub-Saharan Africa. Nepal is traditionally a patriarchal society; particularly in rural areas, there is a persistent culture of obedience to one's husband (Stash, 1999). In this context, husband's approval of family planning may be even more important, and in fact it has been shown to be a pivotal determinant of women's contraceptive use in Nepal (Kamal & Lim, 2010). In Rwanda as well, attitudes toward the use of contraceptives and the gender power balance in households are key determinants of family planning use (Ndaruhuye, Broekhuis, & Hooimeijer, 2009). However, son preference is closely tied to women's fertility aspirations in Nepal (Brunson, 2010). Brunson (2010) conducted ethnographic work with Hindu women in one semi-urban village and concluded that son preference remains strong in Nepali culture. According to Brunson and colleagues, women have internalized the expectations of their society, community, and family, and still feel a strong pressure to produce sons.

Family Planning Information and Services

There is general agreement that expanding family planning service provision leads to increased use of contraceptives. In addition to helping to meet a community's current demand for family planning, increasing the presence to family planning services in a community can enhance the desirability and acceptability of using family planning, through greater visibility.

The majority of the literature examining the effect of family planning service provision on contraceptive use has relied on data collected at the health-facility level to assess the availability and quality of family planning services, and has then linked these data with women's individual survey data to assess the relationship with women's contraceptive use. Such linked studies have been undertaken since the 1970s, when World Fertility Surveys often included a community-level module with information on service availability. Early phases of the Demographic and Health Surveys (DHS) also included a service availability module, enabling this type of analysis. Studies using these earlier survey data provided empirical evidence that women's contraceptive use is indeed shaped, at least to some extent, by the availability of services, and also by the perceived quality of those services (Magnani, Hotchkiss, Florence, & Shafer, 1999; Mensch, Arends-Kuenning, & Jain, 1996; T Pullum, 1991; Steele, Curtis, & Choe,

1999). For example, Steele et al (1999) linked data from the 1995 Morocco DHS with data from the 1992 Morocco DHS service-availability module in a study examining the impact of family planning service provision on aspects of women's contraceptive use. Using multilevel models that adjusted for individual women's characteristics, they found that the presence of a nearby public health center was associated with higher rates of adoption of a modern method after giving birth, and with lower method failure rates (Steele et al., 1999). Similarly, in a study linking DHS data from Peru with a situation analysis, Mensch et al (1996) found that the quality of family planning care had an effect on women's contraceptive use, independent of women's individual and household characteristics; according to this study, contraceptive prevalence would have been 16 to 23 percent greater if all women lived in a community with the highest quality of care.

While important, these early studies have several methodological issues. Some studies linked cluster-level health facility data to individual women's data without specifying, in their statistical models, that this was cluster-level data that could only explain between-cluster variation in contraceptive use. Additionally, these early service availability modules were based on interviews with key informants, rather than on information directly from health facilities, and were not necessarily representative of all health facilities. Finally, while many of these studies adjusted for women's characteristics and for characteristics of the household, few adjusted for other spheres of community influence, which would provide useful information on the relative importance of different aspects of women's physical and social environment.

Several studies have used GIS coordinates of health facilities and of DHS clusters to link SPA and DHS data

Since the late 1990s, MEASURE DHS has conducted the Service Provision Assessment (SPA) to collect information on health facilities. SPA data provide nationally-representative, detailed information about the health service environment. Several studies have used GIS coordinates of health facilities and of DHS clusters to link SPA and DHS data(Hong & Mishra, 2006). Using data from the 2002 Egypt Service Provision Assessment (ESPA) survey and the 2003 Egypt Interim Demographic and Health Survey (EIDHS), Hong and colleagues (2006) found that the quality of

available family planning services was positively associated with women's use of an IUD, independent of the distance to the facility, the facility type, and individual demographic characteristics. However, while the SPA is a nationally-representative, high quality data source, important methodological challenges remain, surrounding linking DHS and SPA data. Most often, SPA surveys use a sample – rather than a complete census – of all private and public facilities, and this sample is not typically designed to be representative beyond the regional level. Linking these data at lower levels of geographic disaggregation than the sample was designed to permit can produce important misclassification error (Skiles, Burgert, Curtis, & Spencer, 2013). Furthermore, there is often a gap in the time period at which the facility data and women's data were collected – so the study must make the assumption that the service environment had not changed. Finally, this type of linkage also makes the assumption that cluster-level summaries accurately describe women's individual service environment and access – however, some portion of women are likely to travel outside their cluster for family planning services.

A less common method of assessing the family planning service environment is to aggregate women's individual responses to the cluster level, in order to make inferences about the local service environment. This strategy has not to our knowledge been used in studies examining determinants of contraceptive use, but it has been used in other analyses of reproductive health service utilization. Pullum and colleagues (2006) used women's DHS data from Malawi and Kenya to empirically examine the potential acceptability of integrating reproductive and sexual health services (Thomas Pullum, Cleland, & Shah, 2006). They examined women's responses to DHS questions regarding respondents' source of supplies for family planning, place of childbirth, and place to obtain an AIDS test, in order to draw inferences about the acceptability of integrating those services. A critical component of the study was to control for the availability of services, so that limited availability would not be misinterpreted as preference. In order to assess the cluster-level availability of services, Pullum and colleagues counted the total number of different types of facilities that women reported using within a cluster, and used this count as a proxy for the total number of facilities available in that cluster.

Our study will use a similar strategy to assess health service availability at the cluster level. While imperfect, aggregate measures provide a useful proxy for the availability and reach of family planning services within a cluster, and this approach avoids the myriad methodological challenges associated with facility data.

Data and Methods

This analysis uses data from the most recent round of the Rwanda and Nepal DHS – 2010 in Rwanda and 2011 in Nepal. DHS surveys typically adopt a two-stage sample design in countries after ensuring representativeness at the level of the region, and in urban and rural areas. The first stage involves selecting clusters (usually neighborhoods in urban areas and villages in rural areas) with probability proportional to size from a national master sample frame. During this stage, 492 clusters were selected in the Rwanda survey and 289 clusters were selected in the Nepal survey.

At the second stage, a random systematic sample of households is drawn from a listing of households in each of the DHS clusters. All women age 15-49 in the selected households are eligible for the individual interview. For the purpose of this analysis, we focus on currently married women in rural areas in both countries. We further limit the analysis to women who did not want (or were not sure if they wanted) a birth in the next two years from the date of the survey as these women have a need for contraception to limit or space births. In the end, 5460 women in Rwanda and 7502 women in Nepal who meet the criteria (currently married, living in rural areas, and not wanting a child within two years) were included in the analysis. Data on background characteristics of these women and households, including their age, educational attainment, number of children, household wealth status, and urban-rural residence, as well as their current use of contraceptive methods are available.

Outcome variable

The outcome variable for this analysis is women's current use of any modern contraceptive methods including female sterilization, male sterilization, IUD, injectables, pill, implants, male condom, lactational amenorrhoea method, and standard days method. Women could give

multiple methods but the most effective method is considered as their current contraceptive method.

Contextual variables

The main focus of the analysis is on community level influences on modern contraceptive use which are measured at the cluster level. The analysis is based on measures of four types of influences:

1) Community's socioeconomic development
    a. Region/Province
    b. Distance to the main road
    c. Distance to a large city (km)
    d. Population density in the cluster as compared to the national average
2) Women's empowerment
    a. Female educational attainment
    b. Women to men ratio in educational attainment
    c. Women's experience of domestic violence
    d. Women's participation in household decision- making on health care
    e. Women's participation in decision-making on family planning
3) Community fertility norms
    a. Average age at marriage
    b. Fertility desire
4) Community access to family planning information and services
    a. Access to modern contraception
    b. Exposure to family planning message
    c. Access to family planning services

The operational definitions of the variables are presented in Table 1. Most of the variables are obtained by aggregating individual-level responses to the cluster level. The exceptions are the three socioeconomic development measurements - distance to the main road, distance to a

large city, and population density, which are based on geographical data and then merged with the DHS clusters in each country; these variables are described in the next section.

Measurements of socioeconomic development

Three geographic variables were merged with the DHs clusters to create the measures of socioeconomic development: distance to main road, distance to the nearest city of 50,000, and estimate the cluster's population density. The in meters distances to the nearest main road and nearest city of 50,000 were calculated using ArcGIS Desktop (ESRI, Redlands, CA) tools and extensions. Data were obtained from the CIESIN website including the Global Roads Open Access Data Set (gRoads) and for the cities the Global Rural Urban Mapping Project (GRUMP). A list of cities with populations than 50,000 (according to the 2002 census in Rwanda and 2011 census in Nepal) and was taken from the City Population website (http://www.citypopulation.de/). The final variable is categorized into groups as indicated in Table 1.

The calculation of the population density for each cluster used the AfriPop and AsiaPop data layers which are population density estimate for approximately 100m2 from 2010 adjusted to match UN population estimates. The mean population density for the buffers of 10km around the DHS rural cluster points was calculated. Finally, by comparing the cluster's population density with the national average -395 people per square kilometers in Rwanda and 181 in Nepal-, a variable is created with two categories: 0-lower than the national average, 1-equal or greater than the national average.

The maps below display the DHS clusters included in the Rwanda and Nepal surveys as well as the variable of population density estimated for some clusters.

[Insert figure 1 and 2 about here]

Measurements of women's empowerment

All of the women's empowerment variables are obtained by aggregating individual-level data at the cluster level. The responses from all interviewed women and men in the cluster are used to

calculate the average years of schooling among women and the women-to-men ratio in education. Women's experience of domestic violence is measured based on women's responses to a set of questions related to physical or sexual perpetrated by their husband/partner. In both countries, the domestic violence module was covered only in a subsample of households included in the survey , for example, the households selected for the men's survey, the cluster-level variable-percentage of women in the cluster who reported spousal physical or sexual violence is calculated based on the households selected for this module.

Two variables on women's participation in decision-making are analyzed. Women are considered to participate in decision-making if they make decisions alone or jointly with their husbands. While data on the percentage of women participation in decision-making for their own health care is based on all interviewed women in the cluster, decision-making on family planning use is limited to women who currently use a method (modern or traditional).

Measurements of access to family planning information and services

We measure the access to modern contraception by the total number of modern contraceptive methods reported by women in the cluster- the greater number of methods reported, the better the access. It is a proxy measurement and is based on an assumption that a specific contraceptive method is accessible to the cluster when at last one woman in this cluster reported this method. This assumption may not be true if some women obtained certain methods through special channels that are not available for the majority of women. It is also possible that some methods are available to the community, but are just not used by women for some reason. We also measure the cluster-level exposure to family planning messages based on the percentages of women in the cluster who heard about family planning messages through TV, radio or newspapers. Lastly, an aggregate of sampled women's contacts with family planning providers at the community level are used to measure community-level access to family planning services.

Measurements of fertility norms

Two variables are used to measure cluster-level fertility norms- women's average age at marriage and mean number of children desired by women in the cluster. Both variables are based on all women interviewed in the cluster.

Table 1 about here

Individual variables

In the multivariate analysis, we control for the individual variables that may influence women's contraceptive use. These include the woman's age, education level, occupation, household wealth status, number of living children, religion, and husband's education all of which have been shown in the literature to be associated with use of family planning. All of these variables are specified as categorical variables in the models.

While the variables and reference groups are typically the same in both countries, the definitions of region/province and religion vary for each country. The analysis for Nepal includes two additional variables – whether the husband lives at home or has been away for less than one year, or for more than one year; and whether the respondent has at least one son to account for the effect of son preference.

Analysis Method

We use random-effects logit regressions for the multivariate analysis presented in this research paper. DHS data follow a hierarchical structure, that is, individuals are nested within clusters, and clusters are nested within regions. Respondents who live in the same cluster or region may not be independent of one another. Compared with regular individual level regression analyses that assume that all individuals are independent, the multilevel modeling approach accounts for the fact that people who live in the same area may be similar in some characteristics.

While the outcome of this study, modern contraceptive use is measured at the individual level, the predictors of most interest (community level influences) are measured at the cluster level. Using the standard statistical approach, questions arise about the appropriate unit of analysis.

Individual level analysis ignores the nesting of people within clusters, which results in underestimating the standard errors and increasing the chance of incorrectly rejecting null hypotheses (Raudenbush and Bryk 2002). Alternatively, if the unit of analysis is the cluster, it becomes difficult to include individual-level variables in the analysis. These problems are addressed with multilevel modeling that allow for simultaneous investigation of the effects of the group-level and individual-level predictors on individual-level outcomes.

Another important feature of the random-effects model is to give information on the proportion of total variation that is explained by the cluster-level predictors. Random-effects models typically include a random intercept and/or random slopes. This analysis allows for random intercepts across clusters and assumes fixed effects of covariates across clusters.

The analysis is performed separately for Rwanda and Nepal. The model for each country can be expressed with two equations: one at the individual level and one at the cluster level.

At the individual level:

$$Log\left(\frac{p_{ij}}{1-p_{ij}}\right) = \beta_{oj} + \beta_1 X_{ij} + r_{ij}$$

At the cluster level:

$$\beta_{oj} = \gamma_{00} + \gamma_{01} R_j + \mu_{oj}$$

$$\mu_{0j} \sim (0, \tau_{00})$$

where p_{ij} is the fitted probability of using a modern contraceptive method for the ith individual in the jth cluster, Xij is a column vector of individual-level variables, and R_j represents contextual variables at the cluster level. β_{oj} is a random intercept, which varies across clusters,

and β_1 is a row vector of fixed coefficients for the predictors. μ0j is the random component of the intercept and is assumed to be normally distributed with mean zero and variance τ_{00}. Significance of the random effect for cluster will indicate that the cluster-level predictors play a role after adjusting for individual-level variables.

In order to examine the variation in outcomes explained by different sets of variables, particularly the contribution of the four types of community-level influences in explaining the variation in contraceptive use, for each country we examine six random-effects models sequentially, with different groups of variables included in each model. Model 1 includes only individual-level variables. Models 2-5 have the individual-level variables in all models with each of the four sets of community level influences in each model. Model 2 has predictors for community socioeconomic development, Model 3 has community-level variables for women's empowerment, Model 4 has variables for community fertility norms, and Model 5 includes variables for community access to family planning information and services. Model 6 is the complete model including all the individual- and cluster-level variables considered. Given the high levels of sterilization in Nepal, one additional model is fitted for Nepal-Model 7, which is the same as Model 6; except that it is restricted to women whose current method is not female sterilization or male sterilization. Table 2 gives a summary of the models for both countries.

Table 2: Random effects regression models included in the analysis

	Variables in regression model
Model 1	Individual level variables only
Model 2	Individual level variables + Community socio-economic development
Model 3	Individual level variables + Community variables for women's empowerment
Model 4	Individual level variables + Community fertility norms
Model 5	Individual level variables + Community access to family planning information and services
Model 6	Individual level variables + All individual and community level variables
Model 7	All individual and community level variables (restricted to women who did not use sterilization methods

Descriptive Results

Background characteristics of individuals and clusters

Table 3 shows selected background characteristics of women included in the sample in each country (currently married women in rural areas who did not want (or were not sure if they wanted) a birth in the next two years). Slightly more than 60 percent of women were below the age of 35 in both countries. However, Nepal has a younger population with one quarter of women under the age of 25 as compared to 15 percent in Rwanda. A majority of the women (72 percent) in Rwanda have primary education, and only 7 percent secondary education. In Nepal on the other hand, most women are either not educated (51 percent) or educated beyond the secondary level (30 percent). A little over 20 percent of women in Rwanda are not educated as compared to 50 percent in Nepal. In both countries, agriculture or manual labor are the common occupations among women although 20 percent of women in Nepal also reported that they were unemployed. Most women in Rwanda were either Catholic or other Christian while Hinduism is the predominant religion in Nepal. Women in Rwanda are almost equally divided between those who had 1-2, 3-4 or 5 or more living children and very few women reported no children. A smaller proportion of women in Nepal compared with Rwanda reported five or more children and more women instead reported having 1-2 children. Given that the analysis is restricted to women in rural areas, as expected fewer women live in households from the highest wealth quintile than from other quintiles in both countries.

Insert Table 3 about here

Background characteristics of the clusters included in the sample are described in Table 4. In total, 411 clusters in Rwanda and 194 clusters in Nepal are included in the analysis. About half the analysis sample in Rwanda is based in the Southern and Western regions of the country. In Nepal, they are in the Eastern and Central regions. Most clusters in both countries are not far from the main road. More than half the studied clusters in Rwanda are at a distance of less than 1 km from the main road, as opposed to 31 percent in Nepal. Another 33-39 percent in both countries are at a distance 1-2.9 km from the main road. In Nepal, overall access is more difficult, and at least 36 percent of sampled clusters are at a distance greater than 3 km from

the main road. Poor access in Nepal is also reflected in the distance from a large city. More than 40 percent of clusters in Nepal were located at a distance greater than 40 km from a city with 50,000 people or more as opposed to 11 percent in Rwanda. A majority of the sample in Rwanda is located 10-30 km from a large city. In both countries, more than 45 percent of clusters have a population density equal or greater than the national average (56 percent in Rwanda).

With regard to measures of women's empowerment, the gender ratio in education is practically equal in Rwanda. In Nepal, however, more men than women are educated. Overall, women's education level is about the same in both countries (3-4 years in average). Women's participation in decision making both on women's own health care and family planning are high in both countries. Decision making for family planning in particular is higher, at more than 85 percent in both countries. Spousal violence is more prevalent in Rwanda than in Nepal. On average, 46 percent in Rwanda but 15 percent in Nepal of women in the clusters examined reported some kind of violence, either physical or sexual.

Although on average, more than 60 percent of women in a cluster have access to family planning messages in both countries, fewer women have access to family planning services. Less than 40 percent of women in a cluster in Rwanda visited a health facility for family planning or were visited by a family planning provider. In Nepal, this percentage is lower at 19 percent, possibly because many women may already have been sterilized. In terms of number of methods reported by women within a cluster, overall in both countries women within any given cluster used 3-4 modern methods on average. Among 411 clusters in Rwanda, women in about 90 percent have access to 3 or 4 modern contraceptive methods, women in 20 percent of the clusters reported access to 5 or more methods but very few (4 percent) reported 6 or 7 methods. Women in a greater number of clusters in Nepal have access to a large number of methods. For example, 28 percent of the 194 clusters included in the analysis in Nepal reported 5 methods and 15 percent reported a total number of 6 or 7 modern methods.

Women in Nepal on average get married at a younger age (17 years) as opposed to 20 years in Rwanda. However, desired fertility is higher among Rwandan women (3.3) as compared to Nepal (2.2).

Insert Table 4 about here

Contraceptive prevalence and method mix

The contraceptive prevalence rate is about the same in Rwanda and Nepal. Among currently married women in rural areas who do not want a child within two years, 47 percent in Rwanda and 46 percent in Nepal are currently using modern contraception. The method mix however is quite different between the two countries. In Rwanda among modern method users, injectables are the most popular method of contraception (Figure 3). Close to 60 percent of women in Rwanda use injectables. Other methods in use are the pill and implant (about 15 percent), and male condom (6 percent). Use of permanent methods such as male and female sterilization is very low. In contrast, long acting and permanent methods are very popular in Nepal (Figure 4). Female and male sterilization account for 56 percent of modern method use. The other popular method is injectables (21 percent) followed by the pill (9 percent) and male condoms (8 percent).

Insert Figures 3 and 4 about here

Modern contraceptive use by women's background characteristics

A description of the prevalence of modern contraceptive use by women's characteristics is presented in Table 5. In Nepal, the groups with the highest use are women older than 35. Especially among the 35-44 age group, 63 percent of women used a modern method. Given the high levels of sterilization among women in Nepal, a significant percent likely includes women who are sterilized. Women's education is associated with contraceptive use in Rwanda with 59 percent of women with secondary or higher education using contraception in Rwanda. The reverse relationship is evident in Nepal. Contraceptive use is highest among women with no

education (53 percent) and lowest among women with secondary or higher education (37 percent). Again, the popularity of methods such as sterilization, among not educated or less educated women in Nepal may contribute to this pattern. Those not employed are the group with the lowest levels of contraceptive use in both countries. Women in professional occupations in Rwanda and those in sales and service related occupations in Nepal are the groups with the highest contraceptive use. Differences in contraceptive use by religion are not very big in both countries except in Nepal, those belonging to non Hindu/Buddhist religions use contraception the least (37 percent) compared to the other groups. Overall, a positive relationship between wealth status and contraceptive use is evident in both countries. In both countries, women with 3-4 living children are the group most using modern methods. In Nepal, where son preference is known to be the norm, more than half the married women in the analysis sample use a modern method as compared to only 20 percent among the subset of women without a son. Not surprisingly, husband's being away is also associated with lower modern contraceptive use.

Insert Table 5 about here

Multilevel Analysis Results

Results of the multilevel analyses for Rwanda and Nepal are presented in Tables 6 and 7 respectively. As described earlier, Models I-5 present results of the individual level variables and the different community level predictors. In both tables, the full model showing the effect of all variables included in the analysis is in Model 6. The analysis sample is currently married women in rural areas who did not want (or were not sure if they wanted) a birth in the two years after the survey. Given the high rates of sterilization in Nepal, an additional model (Model 7) in Table 6 for Nepal is based on a smaller analysis sample restricted to currently married rural women in Nepal who were not sterilized and her husband was not sterilized.

In both tables, as we examine results presented across models, we look at the variation explained by different sets of variables, especially the contribution of cluster-level variables in explaining variability in contraceptive use among sampled women. The intra-class correlation coefficient (rho), measures the proportion of variation in contraceptive use that is between

clusters. The total variance can be partitioned into within-cluster variance and between-cluster variance. While individual-level variables explain within-cluster and between-cluster variance, cluster-level variables can explain only variance at the cluster level. As more predictors are added to the model, rho is expected to move toward zero.

Rwanda

Insert Table 6 about here

Individual and Household Characteristics

Multilevel analysis results in Rwanda indicate that women's age is negatively associated with modern contraceptive use while their education and household socio-economic status has a positive association. These relationships remain consistent across all models even after taking into account the role of contextual effects. Women 45-49 are one-fifth as likely as women 15-24 to use modern contraceptive methods. At the same time, women with secondary or higher education are one and a half times as likely as uneducated women to use contraception. The role of wealth diminishes marginally as we take into account contextual effects (Model 6). Even so, women in the richest households are more than 1.5 times as likely as the poorest women to use modern methods. Employment of women in agriculture is also associated with contraceptive use. The odds of Catholics using modern contraception as compared to other Christians or Muslims are also higher. As compared to women with 5 or more children, women with no or 1-2 children are less likely to use contraception. However, there is little difference between women who have 3-4 or 5 or more children. A rho of 0.07 for Model 1 indicates that the between-cluster variation accounts for 7 percent of the total variation in contraceptive prevalence. After taking all contextual effects into account this rho drops to 1 percent in Model 6.

Contextual Effects

Among the contextual effects, the level of development of the community where women reside in Rwanda has no bearing on their use of contraception. Two key aspects defining women's empowerment that are significant are the level of women's education and women's ability to

make decisions regarding family planning in the cluster (Model 3). Both are positively associated with women's contraceptive use and contribute to the decline in the between cluster variation to 6 percent. After controlling for all other individual and community level characteristics, we find that residence in a community with a higher percentage of women making decisions on family planning is the only characteristic that remains statistically significant with a strong positive effect (Model 6).

With regard to the influence of fertility norms in the community, while the mean age of women in the community of residence does not influence contraceptive use in Rwanda, the mean number of children desired by women in the community does. Women in communities with a greater average number of children desired are less likely to use modern methods (Model 4). This relationship holds strong even after taking into account all other effects in Model 6. Between Models 1, 4 and 6, the rho drops considerably from 7 percent to 5.5 percent and further to 1 percent.

The relationship between the community's access to modern contraception, family planning messages, and family planning services and women's contraceptive use are also examined in Model 5. In Rwanda, contraceptive use is higher among women in communities where women report a greater method mix of contraceptives as compared to women in other communities. Adding these variables in the models further contribute to the decline in rho to 4 percent in Model 6. The role of the indicators of family planning information and contact with family planning providers is not statistically significant.

Overall, contextual effects influence women's use of contraception. As indicated above, specific characteristics of communities where women reside encourage their increased use of modern methods. The declining rho in successive models demonstrates the increase in between-cluster variation that is explained by the addition of these variables into the regression models. In the final model, after considering all contextual effects, the between-cluster variance is as low as 1 percent.

Nepal

Insert Table 7 about here

Individual and Household Characteristics

As in the case of Rwanda, multilevel analysis results for Nepal in Table 7 indicate that women's age bears a positive relationship to their contraceptive use (Model 1 in Table 6). A somewhat curvelinear relationship is observed with the odds of modern contraceptive use among women, 35-44 being particularly high. These are women who have possibly completed child birth and not sterilized, thus seeking the use of modern methods, while more women in the youngest age group seek to have children. The picture is different for the analysis restricted to women who had not been sterilized (Model 7). After taking into account the role of all individual and contextual variables, we find that women in the age group 25-34 are most likely to use modern methods. While the general curvilinear relationship remains, the odds of modern contraceptive use are considerably lower among all age groups of women. Furthermore, the uptake of contraceptive use among women 35-44 is not statistically different from women 15-24. Model 6 also indicates that the effect of women's education is negative while the role of household wealth is positive. With regard to the number of living children, a strong negative relationship is evident in Nepal. Women with 3-4 living children are almost twice as likely as a woman with 5 or more children to use contraception (Model 6). But, when the analysis is based on the sample of women without male or female sterilization (Model 7), there is no difference by education or household wealth. Also, the difference between women with 1-2, 3-4 and 5 or more children is eliminated. Only women with no children have any likelihood of modern contraceptive use. These findings are possibly because of the popularity of sterilization as a method of contraception among less educated and women in households of lower socio-economic status.

Occupation has some effect on contraceptive use; women who are not employed are least likely to use modern methods. The odds of modern method use are greatest among those in agricultural or manual occupations, and among women belonging to the dominant religion, Hinduism.

While husband's education has little effect on contraception, with Nepal's high levels of spousal separation, the fact that husbands live at home matter. The odds of contraceptive use among

women with husbands who have lived away from home for more than one year are only 17 percent that of women with husbands who live at home. Son preference is also reflected in the results. Having a son increases the likelihood of contraceptive use considerably (odds ratio is 2.6). Among women who have not been sterilized, the effect is weaker but the odds of using a modern method is still 1.7 times that of women without a son (Model 7).

Contextual Effects

Selected measures of all four key contextual factors are relevant in influencing rural women's choice of modern methods in Nepal are community level measures of women's empowerment, fertility norms, and their access to family planning information and services.

The level of development of the community where women reside in Nepal has some bearing on their use of contraception (Models 2 and 6). Controlling for all variables in Model 6, the odds of using contraception among women is higher among women in the Central as compared to the Eastern region, and in areas where the population density is higher than the national average. Taking out all women who use sterilization from the analysis sample, the main indicator that remains relevant is distance from the city (Model 7); the odds of contraceptive use steadily diminish with proximity to a large city. Adding these measures of community socio-economic development also result in a decline in the between-cluster variance from 6 percent in Model 2 to 3 percent between Models 2 and 6, and further to 1 percent in Model 7.

The two key aspects defining women's empowerment that influence contraceptive use in Rwanda are the level of women's education and women's ability to make decision regarding family planning in the cluster (Model 3). After controlling for all other individual and community level characteristics, results indicate that residence in a community with a higher percentage of women making decisions on family planning is a key characteristic that remains statistically significant with a strong positive effect (Model 3). After controlling for all other characteristics in Model 6, decision making on health care is also a predictor of contraceptive use. While residence in a community with a high level of women's decision making on health care has a negative effect on contraceptive use, the effect of residence in a cluster with higher percentage of women's decision making on family planning is positive. This relationship is consistent

whether the analysis is based on all women or women who had not used a permanent method (Models 6 and 7).

With regard to fertility norms, a strong negative relationship between the mean number of children desired by women in the community and contraceptive is evident in Nepal (Model 4). Women in communities where there is a greater desire to have more children is associated with lower use of modern contraceptive methods. A similar negative relationship with mean age at marriage of women is also observed. When women live in communities where the mean age at marriage is higher, the likelihood of their use of modern contraception tends to be lower. Both relationships remain consistent even we restrict the analysis to women not using a permanent method (Model 7).

The relationship between the community's access to modern contraception, family planning messages, and family planning services and women's contraceptive use are also examined. In Nepal, contraceptive use is higher among women in communities with a greater method mix of contraceptives as compared to women in other communities (Models 5-7). The role of the indicators of family planning information and contact with family planning providers is not statistically significant in Model 5, community access to family planning services also bears a positive relationship to use of modern methods in the complete model (Models 6 and 7). Among women who did not use a permanent method such as male or female sterilization, the role of community access to family planning services is significantly higher (7.66). Furthermore, residence in communities with greater exposure to family planning messages also has a positive effect (Model 7).

Overall, after taking into account all individual and household level characteristics, Model 1 shows that the between cluster variance is 10 percent. Controlling for all contextual effects brings the rho down to 0.03 (Model 6) and further to 0.01 in Model 7 when the analysis sample is more restricted to women who have greater exposure to modern methods.

Discussion

Interventions to improve levels of contraceptive use require a better understanding of influences of individual factors as well as contextual factors. Rwanda and Nepal represent two different contexts with regard to family planning programs, socioeconomic development, women's status, and social norms on marriage and fertility. Building on previous research and the unique context of each country, we analyzed contextual determinants of modern contraceptive use in these two settings with a primary interest in four spheres of contextual influences- socioeconomic development, women's empowerment, access to family planning information and services, and fertility norms.

Our analysis included four measures of the community's socioeconomic development – region, distance to the main road, distance to a large city, and the population density. In Nepal, we find evidence that the distance of the cluster from a large city, a measure of geographic remoteness, is inversely associated with women's contraceptive use; among rural women who are not sterilized and who do not want a child in the next 2 years, this pattern is particularly strong, even after adjusting for other individual and contextual factors (Model 7 in Table 7). By contrast, no measures of community-level socioeconomic development are found to be significant determinants of women's contraceptive use in Rwanda. This finding highlights the particular challenges of Nepal's mountainous topography, and points to the need for family planning programs to continue to seek new ways to make contraception available in the most remote settings.

Among the indicators of women's empowerment, community norms around women's involvement in family planning decisions shows to have an important positive effect on individual women's contraceptive use in both countries. With regard to its effect on contraceptive use, among all empowerment measures, the translation of women's decision-making power to make decisions on their family planning and contraceptive use is critical.

In both countries, community-level indicators of women's access to family planning information and services are associated with women's contraceptive use. Women living in communities that have better access to modern contraceptive methods in both countries (measured by the total number of methods reported by women in the cluster) are also more likely to use a modern

contraception. Indeed, the literature has shown that easy access to a wide range of methods results in a more balanced method mix and higher levels of contraceptive prevalence (Roser 2002). A study based on the linked DHS and Service Provision Assessment (SPA) data at the regional level in four African countries (Rwanda, Kenya, Uganda, and Tanzania) found that regional variation in contraceptive use is significantly associated with regional differences in family planning service availability and the service environment at health facilities (Wang et al, 2012).

Contact with family planning providers is important for women to receive family planning information and counseling about adopting a contraceptive method. The level of contact with family planning providers is low especially in Nepal, where in an average cluster less than 20 percent of the women in the cluster visited or were visited by a family planning provider in the last 12 months. This community level variable represents contact with family planning providers (measured as the percentage of women in the cluster who had contact with family planning providers in the last 12 months) is not significantly associated with modern contraceptive use in Rwanda, but the association is significant in Nepal after sterilization users are excluded. In Nepal, female community health workers and reproductive health volunteers are the two types of health providers visiting women in the field. The findings from the analysis in Nepal highlight the importance of contact with family planning providers for women in rural Nepal to adopt a reversible modern method.

We also found evidence that community-level norms are important determinants of women's decision to use contraception. Previous research has shown that the number of children desired by women is associated with their contraceptive use. This analysis highlights that women's use of contraception is also affected by fertility desire of others in the community. In both countries, women living in communities in which people desire more children have a lower likelihood of using modern contraception. The negative effect of fertility desire on contraceptive use is significant and strong in both countries. Indeed, family planning programs in Nepal and Rwanda have both sought to encourage small families and have shown impact

over the time. In Rwanda in particular women's desired number of children has decreased from 5.0 in 2000 to 3.6 children.

Given the aforementioned methodological challenges surrounding the analysis of community-level factors – such as the lack of data collected directly at the community level, and the fact that most population and socioeconomic indicators are only available for larger geographic areas, i.e. districts, provinces or regions – it is worth commenting on the methodology adopted in this study. The analysis is based on data from the most recent DHS survey of each country and linked spatial data from a variety of sources. Aggregating responses of individuals living in the same area is one way to obtain measurements for small geographic units such as communities. Since DHS surveys randomly select clusters and then households and women within the selected clusters, the aggregation of indicators for individuals in the cluster acts as a good proxy for the cluster's characteristics. For example, it is fairly safe to say that a community has a well educated population if the average years of schooling of the interviewed individuals in that community are high. In this analysis, aggregate, cluster-level indicators provided meaningful information regarding the context in which women live. We also took advantage of the availability of spatial variables from a variety of sources and linked them to the DHS cluster locations with GIS software. Three GIS variables - distance to the main road, distance to a city with 50,000 residents or more, and population density - are included in the analysis as they have been shown to be closely related to socioeconomic development of the communities.

Our results have built on the recent literature on the role of contextual factors on women's use of modern contraception. Using proxy measures at the community level, the findings reiterate that where women reside is important to consider with regard to the family planning choices they make.

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Figure 1 DHS clusters in the 2010 Rwanda DHS and populaiton density estimated for some clusters

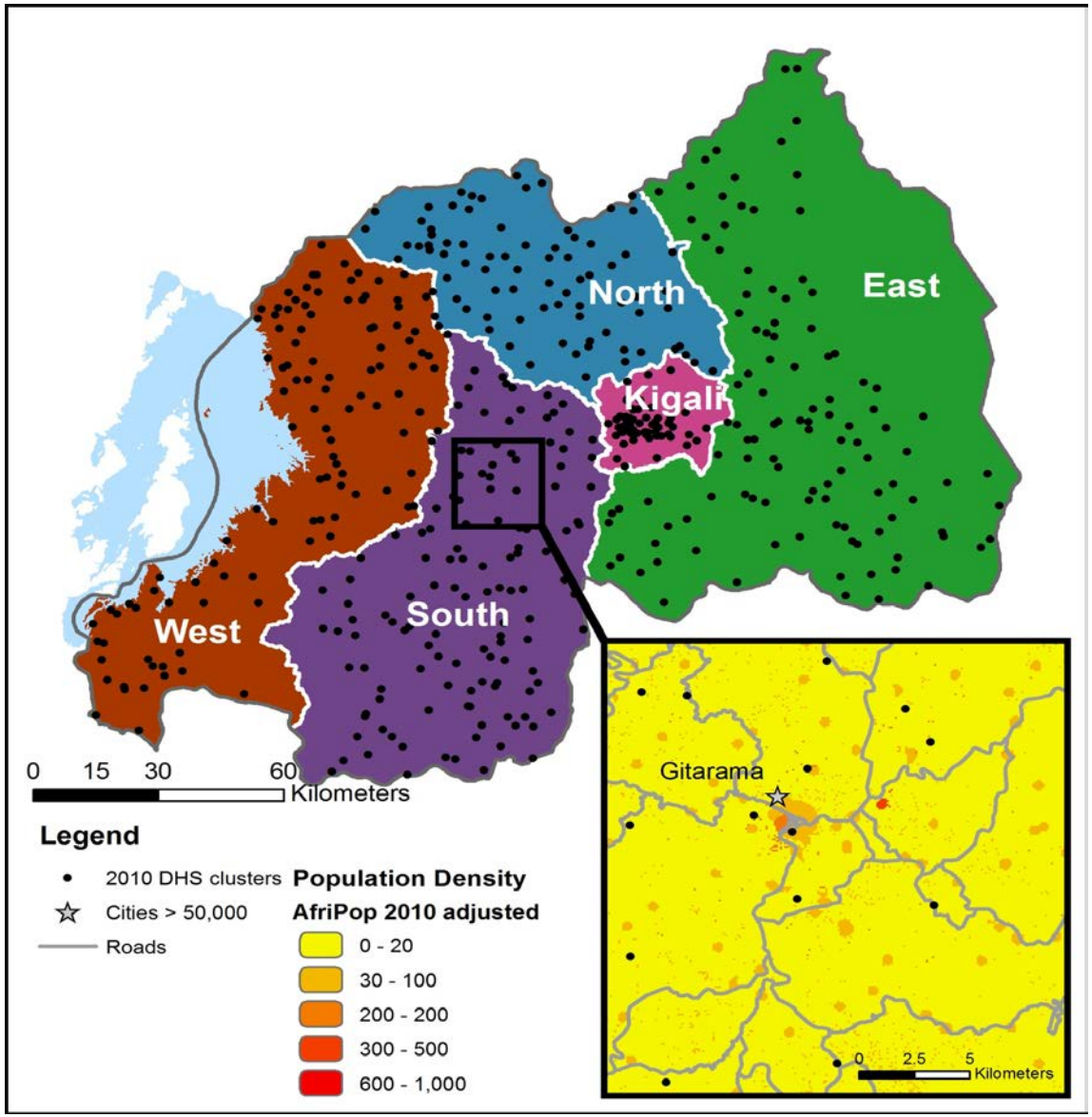

Figure 2 DHS clusters in the 2011 Nepal DHS and populaiton density estimated for some clusters

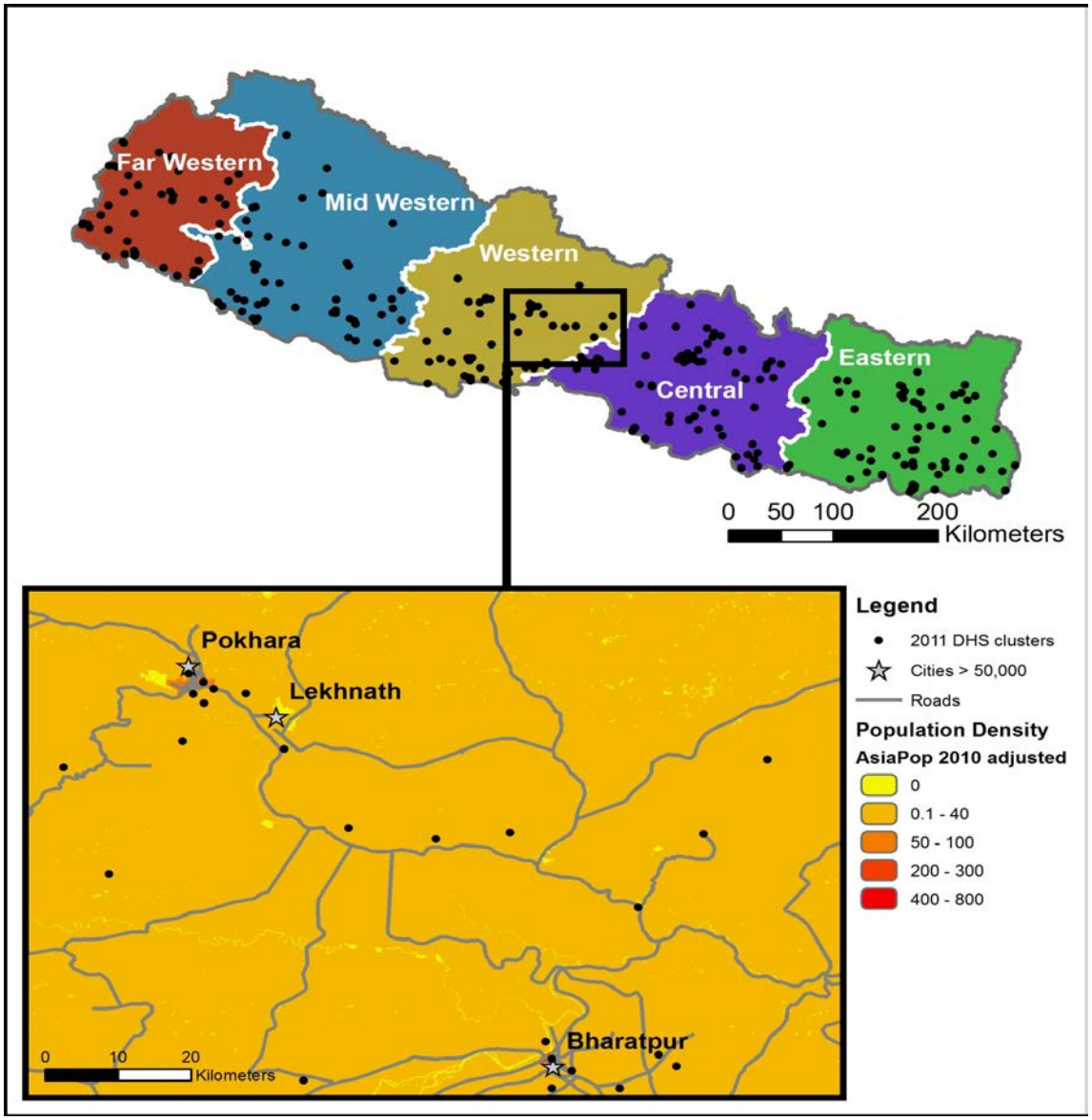

Table 1- Operational definitions of individual, household and community variables

Variables	Operational definition
Individual and household variables	
Age of woman	Self-reported age at time of survey: 15-24, 25-34, 35-44, 45-49 years
Woman's educational level	Highest level of education attained: none, primary, seconary or higher
Occupation	Current occupation: not-employed, agricultural or manual, professional/technical/managerial/clerical, services and other
Religion	Rwanda-Catholic, Protestant and Adventist, Muslim and other; Nepal - Hindu, Buddhist, and Muslim/Kirat/Christian/Other
Parity	Number of living children the woman had: 0, 1-2, 3-4, 5+
Having a son	Having at least one son
Husband's education	Reported by wife: none, primary, secondary or higher
Husband's residency status	Lives in house, lives elsewhere for less than 1 year, and lives elsewhere for a year or longer
Houshold wealth quintile	Lowest, second, middle, fourth, and fifth
Community variables	
Socioeconomic development	
development region/province	Rwanda- Provinces: Kigali, South, West, North and East Nepal- development regions: Eastern, Central, Western, Mid-Western, Far-Western
Distance to main road	Distrance of cluster site to the nearest main road: <1, 1-2.9, 3-4.9, 5+Km
Distance to large city	Distance of DHS cluster point from its nearest populated settlement of 50,000 people or more <10km, 10-19, 20-29, 30-39, 40-49km, 50+km
Population density	Population density(people per square kilometer) of the cluster compared with the national average: lower than the average, equal or greater than the average
Women's empowerment	
Female educational attainment	Average years of schooling among women in the cluster
women to men ratio in education	Ratio of women to men in completed years of schooling in the cluster
Women's experience of domestic violence	Percentage of women in the cluster who reported spousal physical or sexual violence
Women's participation in household decision-making	Percentage of women in the cluster who participated in household decision-making on woman's own health care
women's participation in decision-making on family planning	Percentage of women in the cluster who participated in decision-making on using contraception
Access to family planning information and services	
Access to modern contraception	Total number of modern contraceptive methods reported by women in the cluster
Exposure to family planning message	Percentage of women in the clustser who are exposed to family planning message through mass media
Access to family planning services	Percentage of women in the cluster who visited health facility for family planning or were visited by family planning providers in last 12 months
Fertility norms	
Average age at first marriage	Mean age at first marriage among women in the cluster
Fertility desire	Mean number of children desired by women in the cluster

Table 3 Background characteristic of currently married women in rural areas who did not want a birth within two years

	Rwanda		Nepal		
	%	Number of women	%	Number of women	
Age					
15-24	15.1	825	25.6	1,924	
25-34	46.8	2,557	36.8	2,762	
35-44	27.8	1,518	29.1	2,181	
45-49	10.3	560	8.5	635	
Education level					
No educatioin	21.4	1,168	50.7	3,801	
Primary	71.9	3,926	19.5	1,459	
Secondary or higher	6.7	366	29.9	2,241	
Occupation					
Unemployed	7.9	431	20.0	1,498	
agri/manual	87.1	4,755	69.3	5,202	
Professional	4.7	257	2.7	205	
other	0.3	17	8.0	597	
Religion					
Catholic	43.2	2,356	84.8	6,360	Hindu
Other Christian	53.8	2,939	8.4	631	Buddhist
Muslim/other	3.0	164	6.8	511	muslim/kirat/Chris/other
Wealth quintile					
Lowest	21.0	1,146	19.9	1,490	
Second	23.0	1,255	21.3	1,594	
Middle	22.5	1,231	22.9	1,720	
Fourth	22.0	1,200	21.0	1,578	
Highest	11.5	629	14.9	1,120	
Number of living children					
5+	30.4	1,660	12.0	904	
3-4	32.5	1,775	35.4	2,652	
1-2	33.8	1,844	45.0	3,374	
none	3.3	181	7.6	571	
Total	100.0	5,460	100.0	7,502	

The analysis sample includes married women in rural who did not want (or was not sure) a birth within 2 years.

Table 4 Description of community variables

Community variables		Rwanda (%)	Nepal (%)
Socioeconomic development			
Province/Development region			
Kigali city	(Eastsern)	2.4	24.7
South	(Central)	27.5	24.2
West	(Western)	25.6	17.0
North	(Mid-western)	18.5	19.6
East	(Far-western)	26.0	14.4
Distance to main road			
<1km		51.1	30.9
1-2.9km		38.7	33
3-4.9km		8.5	18
5+km		1.7	18
Distance to large city			
<10km		12.9	9.8
10-19km		32.9	20.1
20-29km		28.7	12.4
30-39km		14.1	17.0
40+ km		11.4	40.7
Population density			
Lower than the national average		44.3	54.6
Equal or greater than the average		55.7	45.4
Women's empowerment			
Female educational attainment (mean)		4.0	3.9
Women to men ratio in education (mean)		0.98	0.68
Women's experience of domestic violence		45.9	14.5
Women's participation in household decision-making		72.8	63.5
women's participation in decision-making on family planning		87.8	86.8
Access to family planning information and services			
Access to modern contraception (mean)		3.7	4.2
Exposure to family planning message		65.8	64.0
Access to family planning services		39.1	19.4
Fertility norms			
Average age at first marriage		20.5	17.3
Average number of children desired by women		3.3	2.2
Total number of clusters		411	194

Figure 3 Percent distribution of women who currently use modern contraceptions, by type of method, Rwanda

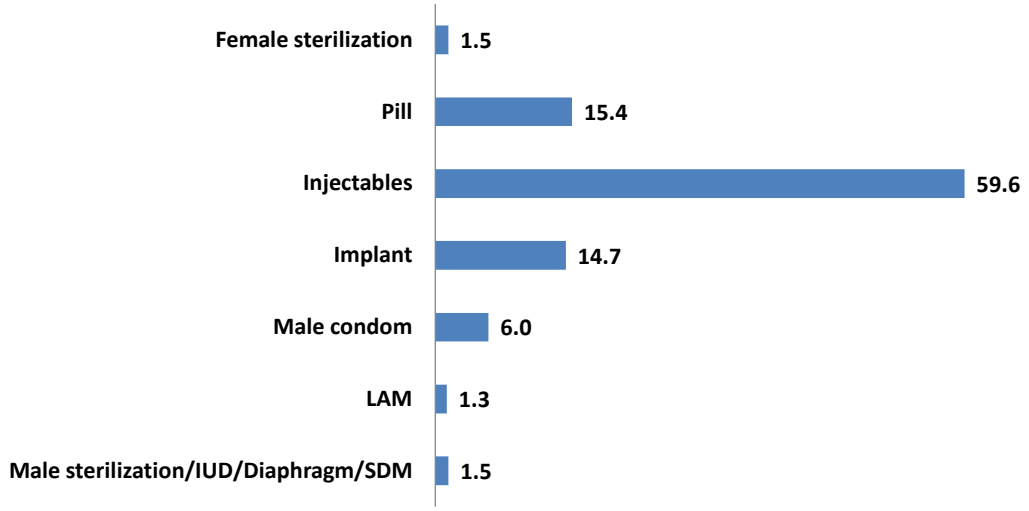

Figure 4 Percent distribution of women who currently use modern contraceptions, by type of method, Nepal

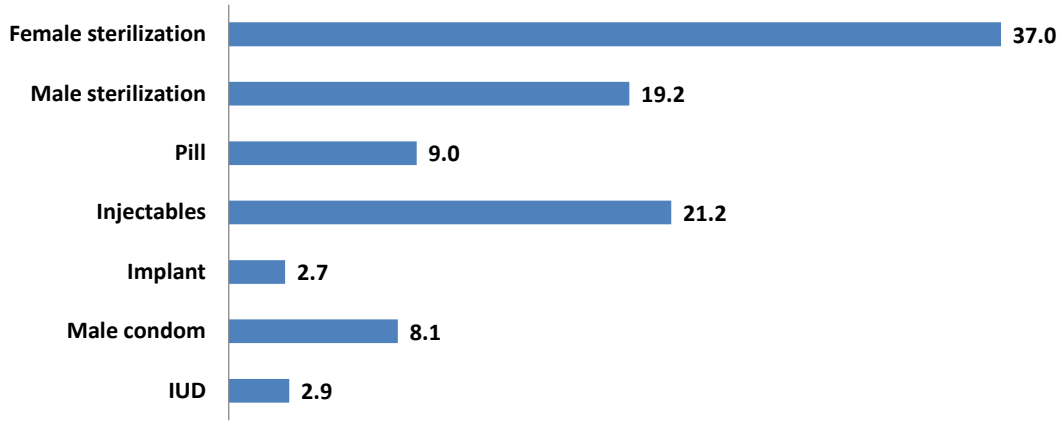

Table 5 Prevalence of modern contraceptive use among currently married women in rural area, according to background characteristics

	Rwanda		Nepal		
	%	Number of women	%	Number of women	
Age					
15-24	43.7	825	22.5	1,924	
25-34	52.5	2,557	48.7	2,762	
35-44	50.1	1,518	62.5	2,181	
45-49	22.5	560	53.3	635	
Education level					
No educatioin	39.2	1,168	53.2	3,801	
Primary	48.8	3,926	42.3	1,459	
Secondary or higher	58.8	366	37.4	2,241	
Occupation					
Unemployed	37.1	431	35.5	1,498	
agri/manual	48.1	4,755	48.7	5,202	
Professional	51.5	257	41.4	205	
other	47.4	17	55.5	597	
Religion					
Catholic	50.8	2,356	47.5	6,360	Hindu
Other Christian	44.5	2,939	42.7	631	Buddhist
Muslim/other	50.1	164	36.6	511	muslim/kirat/Chris/other
Wealth quintile					
Lowest	40.2	1,146	38.5	1,490	
Second	43.1	1,255	45.9	1,594	
Middle	50.3	1,231	47.5	1,720	
Fourth	52.1	1,200	49.2	1,578	
Highest	54.7	629	51.8	1,120	
Number of living children					
5+	43.0	1,660	49.3	904	
3-4	52.7	1,775	61.4	2,652	
1-2	50.8	1,844	39.7	3,374	
none	1.8	181	11.3	571	
Having a son					
No			20.3	1,584	
Yes			53.4	5,918	
Husband's residence status					
Lives in house			57.4	4,965	
lives elsewhere for less than one year			26.0	1,664	
lives elsewhere for one year or more			22.2	872	
Total	47.4	5,460	46.4	7,502	

Table 6 Results of multilevel modeling of modern contraceptive use in rural areas in Rwanda, 2010 DHS

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
VARIABLES	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI
Age (ref.=15-24)												
25-34	0.94	0.77 - 1.14	0.94	0.77 - 1.14	0.92	0.76 - 1.12	0.92	0.76 - 1.12	0.93	0.77 - 1.13	0.93	0.76 - 1.13
35-44	0.76*	0.60 - 0.98	0.75*	0.58 - 0.95	0.74*	0.58 - 0.95	0.73*	0.57 - 0.94	0.75*	0.59 - 0.95	0.72**	0.57 - 0.92
45-49	0.20***	0.15 - 0.28	0.20***	0.15 - 0.27	0.20***	0.15 - 0.27	0.19***	0.14 - 0.27	0.21***	0.15 - 0.28	0.20***	0.15 - 0.28
Education level(ref.=none)												
Primary	1.13	0.97 - 1.32	1.11	0.95 - 1.29	1.09	0.94 - 1.27	1.11	0.95 - 1.29	1.11	0.95 - 1.29	1.08	0.93 - 1.26
Secondary or higher	1.54**	1.14 - 2.07	1.50**	1.12 - 2.02	1.45*	1.08 - 1.96	1.49**	1.11 - 2.00	1.51**	1.13 - 2.03	1.48**	1.10 - 1.98
Occupation (ref.=not employed)												
agri/manual	1.44**	1.13 - 1.83	1.34*	1.05 - 1.70	1.43**	1.13 - 1.82	1.40**	1.10 - 1.77	1.36*	1.07 - 1.73	1.25	0.99 - 1.58
Professional	1.36	0.95 - 1.96	1.31	0.91 - 1.88	1.32	0.92 - 1.90	1.34	0.93 - 1.93	1.30	0.90 - 1.86	1.28	0.89 - 1.84
other	1.14	0.39 - 3.32	1.10	0.38 - 3.17	1.15	0.39 - 3.35	1.12	0.39 - 3.25	1.08	0.37 - 3.14	1.14	0.40 - 3.25
Wealth(ref.=Poorest)												
poorer	1.08	0.90 - 1.29	1.11	0.93 - 1.32	1.08	0.90 - 1.29	1.07	0.90 - 1.28	1.07	0.89 - 1.27	1.09	0.92 - 1.31
middle	1.52***	1.26 - 1.82	1.54***	1.28 - 1.85	1.49***	1.24 - 1.78	1.50***	1.25 - 1.80	1.48***	1.24 - 1.78	1.49***	1.25 - 1.79
richer	1.65***	1.37 - 2.00	1.68***	1.39 - 2.03	1.62***	1.34 - 1.96	1.64***	1.36 - 1.98	1.57***	1.30 - 1.89	1.60***	1.33 - 1.94
richest	1.72***	1.34 - 2.20	1.75***	1.36 - 2.24	1.61***	1.26 - 2.07	1.69***	1.32 - 2.16	1.55***	1.21 - 1.97	1.61***	1.26 - 2.07
Religion (ref.=Christian)												
Other Christian	0.78***	0.68 - 0.88	0.81***	0.71 - 0.91	0.78***	0.69 - 0.89	0.79***	0.70 - 0.89	0.78***	0.69 - 0.89	0.82**	0.72 - 0.92
Muslim/other	0.95	0.67 - 1.35	0.97	0.69 - 1.38	0.95	0.67 - 1.35	0.95	0.67 - 1.34	0.94	0.66 - 1.32	0.94	0.67 - 1.33
Number of living children (ref.=5+)												
3-4	1.06	0.89 - 1.25	1.04	0.88 - 1.23	1.05	0.89 - 1.24	1.03	0.87 - 1.22	1.05	0.89 - 1.24	1.03	0.87 - 1.21
1-2	0.86	0.71 - 1.05	0.84	0.69 - 1.03	0.85	0.70 - 1.04	0.81*	0.67 - 0.99	0.85	0.70 - 1.04	0.82*	0.67 - 1.00
none	0.01***	0.00 - 0.04	0.01***	0.00 - 0.04	0.01***	0.00 - 0.04	0.01***	0.00 - 0.04	0.01***	0.00 - 0.04	0.01***	0.00 - 0.04
Husband's education(ref.=None)												
Primary	1.16	1.00 - 1.35	1.16	1.00 - 1.35	1.15	0.99 - 1.34	1.15	0.99 - 1.34	1.16	1.00 - 1.35	1.14	0.98 - 1.33
Secondary or higher	1.06	0.82 - 1.37	1.06	0.82 - 1.38	1.03	0.79 - 1.33	1.03	0.80 - 1.34	1.07	0.83 - 1.39	1.04	0.81 - 1.35
Provinces (ref=Kigali City)												
South			1.16	0.72 - 1.86							1.38	0.90 - 2.12
West			0.64	0.40 - 1.04							0.90	0.58 - 1.39
North			1.20	0.74 - 1.94							1.47	0.96 - 2.26
East			1.00	0.61 - 1.64							1.23	0.80 - 1.91
Distance to main road												
1-3km			1.09	0.94 - 1.27							1.09	0.95 - 1.24
3-5km			0.96	0.73 - 1.25							0.83	0.65 - 1.05
5+ km			1.03	0.61 - 1.76							0.93	0.59 - 1.47
Distance to large city												
10-19km			0.98	0.76 - 1.26							1.04	0.84 - 1.30
20-29km			1.10	0.84 - 1.45							1.14	0.90 - 1.46
30-39km			1.06	0.76 - 1.47							1.12	0.83 - 1.50
40+km			0.75	0.51 - 1.08							0.98	0.69 - 1.38
Compared to National density												
Greater			1.07	0.90 - 1.28							1.05	0.90 - 1.23
Average years of education					1.14***	1.06 - 1.23					0.99	0.92 - 1.07
Women-to-men education years ra					0.95	0.73 - 1.23					0.89	0.71 - 1.13
Decision making on health care					0.74	0.49 - 1.10					0.79	0.55 - 1.14
Decision making on FP					2.24**	1.31 - 3.85					2.44***	1.51 - 3.94
Any Spousal violence					0.85	0.62 - 1.17					0.93	0.70 - 1.24
Average ideal number of kids							0.60***	0.52 - 0.70			0.72***	0.63 - 0.84
Average age at marriage							1.01	0.96 - 1.07			1.01	0.95 - 1.07
expose to FP message									1.40	0.89 - 2.21	1.09	0.68 - 1.74
contact with FP providers									1.69	0.95 - 2.99	1.57	0.92 - 2.68
Number of FP methods reported									1.35***	1.26 - 1.45	1.34***	1.25 - 1.43
Rho	0.070		0.051		0.061		0.055		0.042		0.014	
Number of v001	411		411		411		411		411		411	

*p<0.05 **p<0.01 *** p<0.001 (different from the old tables)
The analysis sample is currently married women in rural who did not want (or was not sure) a birth within 2 years.
Two-level random effects models:
Model 1=only indiviual vars
Model 2=Individual + geographic vars
Model 3=Individual + Empowerment vars
Model 4= Individual + fertility/fp norms
Model 5=individual + service availability
Model 6=All vars
By comparing rhos of the models, we can see the extent to which the additional variation is explained after adding each group of contextual variables

Table 7 Results of multilevel modeling of modern contraceptive use in rural areas in Nepal, 2011 DHS

VARIABLES	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 6X	
	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI
Age (ref.=15-24)														
25-34	1.92***	1.62 - 2.26	1.99***	1.68 - 2.34	1.93***	1.63 - 2.28	1.92***	1.63 - 2.27	1.92***	1.62 - 2.26	2.00***	1.69 - 2.36	1.26*	1.04 - 1.54
35-44	2.67***	2.19 - 3.25	2.85***	2.34 - 3.47	2.70***	2.22 - 3.30	2.65***	2.17 - 3.22	2.67***	2.19 - 3.25	2.81***	2.31 - 3.42	1.26	0.98 - 1.62
45-49	1.42**	1.09 - 1.83	1.55***	1.20 - 2.01	1.44**	1.11 - 1.86	1.40*	1.08 - 1.81	1.41**	1.09 - 1.83	1.52**	1.17 - 1.97	0.36***	0.24 - 0.52
Education level(ref.=none)														
Primary	0.81*	0.69 - 0.95	0.85*	0.72 - 1.00	0.82*	0.70 - 0.96	0.80**	0.68 - 0.94	0.81**	0.69 - 0.95	0.82*	0.69 - 0.96	0.84	0.68 - 1.04
Secondary or higher	0.75**	0.62 - 0.89	0.80*	0.67 - 0.95	0.75**	0.62 - 0.89	0.74***	0.62 - 0.88	0.74***	0.62 - 0.88	0.77**	0.64 - 0.92	1.12	0.90 - 1.40
Occupation (ref.=not employed)														
agri/manual	1.90***	1.61 - 2.24	1.95***	1.66 - 2.30	1.90***	1.61 - 2.25	1.84***	1.56 - 2.17	1.87***	1.58 - 2.20	1.83***	1.55 - 2.16	1.89***	1.53 - 2.34
Professional	1.31	0.90 - 1.89	1.33	0.92 - 1.93	1.32	0.91 - 1.90	1.29	0.89 - 1.86	1.30	0.90 - 1.89	1.36	0.94 - 1.96	1.57*	1.03 - 2.40
other	1.65***	1.30 - 2.09	1.73***	1.37 - 2.20	1.64***	1.30 - 2.08	1.65***	1.30 - 2.08	1.64***	1.29 - 2.07	1.71***	1.35 - 2.16	1.66***	1.24 - 2.21
Wealth(ref.=Poorest)														
poorer	1.43***	1.19 - 1.72	1.37***	1.14 - 1.66	1.46***	1.21 - 1.76	1.42***	1.18 - 1.71	1.43***	1.19 - 1.72	1.32**	1.10 - 1.59	1.07	0.85 - 1.34
middle	1.75***	1.43 - 2.15	1.62***	1.32 - 1.99	1.82***	1.48 - 2.23	1.76***	1.44 - 2.15	1.76***	1.44 - 2.16	1.61***	1.31 - 1.97	1.16	0.90 - 1.49
richer	2.08***	1.66 - 2.61	1.83***	1.45 - 2.32	2.16***	1.71 - 2.72	2.09***	1.67 - 2.62	2.08***	1.66 - 2.61	1.75***	1.39 - 2.22	1.17	0.87 - 1.58
richest	2.18***	1.66 - 2.88	1.83***	1.37 - 2.44	2.27***	1.70 - 3.03	2.25***	1.70 - 2.97	2.19***	1.65 - 2.89	1.80***	1.35 - 2.41	1.40	0.98 - 1.99
Religion (ref.=Christian)														
Other Christian	0.82	0.65 - 1.03	0.82	0.65 - 1.03	0.83	0.66 - 1.04	0.86	0.68 - 1.07	0.81	0.65 - 1.02	0.81	0.64 - 1.01	1.26	0.98 - 1.63
Muslim/other	0.68**	0.53 - 0.88	0.69**	0.54 - 0.89	0.68**	0.52 - 0.87	0.76*	0.59 - 0.97	0.69**	0.53 - 0.88	0.72**	0.56 - 0.92	1.52**	1.13 - 2.05
Number of living children (ref.=5+)														
3-4	1.90***	1.59 - 2.28	1.94***	1.62 - 2.32	1.92***	1.60 - 2.30	1.89***	1.58 - 2.27	1.90***	1.59 - 2.28	1.93***	1.61 - 2.32	1.01	0.79 - 1.28
1-2	1.26*	1.03 - 1.55	1.30*	1.06 - 1.60	1.27*	1.04 - 1.57	1.25*	1.01 - 1.54	1.26*	1.02 - 1.55	1.26*	1.02 - 1.55	0.93	0.71 - 1.22
none	0.58**	0.40 - 0.86	0.60*	0.41 - 0.89	0.59**	0.40 - 0.88	0.58**	0.40 - 0.86	0.58**	0.40 - 0.86	0.59**	0.40 - 0.87	0.28***	0.18 - 0.44
Husband's education(ref.=None)														
Primary	0.87	0.74 - 1.02	0.92	0.78 - 1.08	0.87	0.74 - 1.02	0.85	0.72 - 1.00	0.86	0.73 - 1.01	0.88	0.74 - 1.03	0.85	0.68 - 1.06
Secondary or higher	1.11	0.94 - 1.32	1.20*	1.01 - 1.42	1.11	0.94 - 1.31	1.08	0.91 - 1.28	1.09	0.92 - 1.30	1.15	0.97 - 1.37	1.14	0.91 - 1.43
Husband living in home														
Away for <1 yr	0.25***	0.22 - 0.29	0.25***	0.21 - 0.29	0.25***	0.22 - 0.29	0.25***	0.21 - 0.29	0.25***	0.22 - 0.29	0.26***	0.22 - 0.30	0.17***	0.14 - 0.20
Away for 1+ yr	0.16***	0.13 - 0.20	0.17***	0.14 - 0.20	0.16***	0.14 - 0.20	0.17***	0.14 - 0.20	0.17***	0.14 - 0.20	0.17***	0.14 - 0.21	0.03***	0.02 - 0.04
Number of sons														
At least one son	2.63***	2.20 - 3.14	2.61***	2.18 - 3.12	2.62***	2.19 - 3.14	2.62***	2.19 - 3.13	2.62***	2.19 - 3.14	2.59***	2.17 - 3.09	1.67***	1.36 - 2.03
Development region (ref. Eastern)														
Central			2.45***	1.92 - 3.11							1.83***	1.43 - 2.34	1.00	0.75 - 1.32
Western			1.23	0.95 - 1.59							0.81	0.63 - 1.05	0.60***	0.45 - 0.80
Mid-western			1.68***	1.24 - 2.26							0.97	0.72 - 1.31	0.72	0.52 - 1.00
Far-Western			1.92***	1.38 - 2.65							0.90	0.63 - 1.28	0.82	0.56 - 1.21
Distance to main road														
1-3km			0.96	0.78 - 1.18							0.94	0.78 - 1.14	1.01	0.82 - 1.24
3-5km			0.77*	0.60 - 0.99							0.82	0.66 - 1.03	0.86	0.67 - 1.11
5+ km			1.00	0.76 - 1.32							0.97	0.76 - 1.25	1.23	0.93 - 1.62
Distance to large city														
10-19km			1.00	0.75 - 1.34							0.93	0.73 - 1.20	0.65**	0.50 - 0.86
20-29km			1.17	0.84 - 1.65							1.19	0.89 - 1.60	0.58**	0.41 - 0.80
30-39km			0.76	0.54 - 1.07							0.68*	0.50 - 0.91	0.46***	0.33 - 0.64
40+km			0.77	0.56 - 1.07							0.78	0.59 - 1.04	0.41***	0.30 - 0.56
Compared to National														
Greater			1.28*	1.01 - 1.62							1.27*	1.02 - 1.58	0.93	0.73 - 1.18
Average years of education					1.01	0.92 - 1.11					1.04	0.95 - 1.14	1.02	0.92 - 1.14
Women-to-men educat					1.10	0.52 - 2.34					0.70	0.38 - 1.28	0.81	0.40 - 1.62
Decision making on he					0.67	0.31 - 1.47					0.31***	0.16 - 0.59	0.25***	0.13 - 0.51
Decision making on FF					2.47*	1.01 - 6.03					2.09*	1.05 - 4.14	3.35**	1.53 - 7.32
Any Spousal violence					2.22	0.97 - 5.08					1.35	0.68 - 2.65	1.03	0.49 - 2.14
Average ideal number of kids							0.43***	0.32 - 0.60			0.32***	0.22 - 0.48	0.46***	0.29 - 0.73
Average age at marriag							0.77***	0.71 - 0.85			0.79***	0.72 - 0.86	0.89*	0.80 - 0.99
expose to FP message									0.66	0.41 - 1.07	0.76	0.44 - 1.32	2.07*	1.12 - 3.81
contact with FP provid									1.19	0.46 - 3.10	2.69*	1.23 - 5.91	7.66***	3.24 - 18.09
Number of FP methods									1.17***	1.08 - 1.27	1.15***	1.07 - 1.23	1.27***	1.17 - 1.37

Rho	0.102	0.062	0.095	0.082	0.093	0.031	0.019
Number of v001	194	194	194	194	194	194	194

*p<0.05 **p<0.01 *** p<0.001 (different from the old tables)
The analysis sample for model 1-6 is currently married women in rural who did not want (or was not sure) children within 2 years
In model 6x, women who currently use male and female sterilization are excluded
Two-level random effects models:
Outcome: current use of modern contraception
Model 1=only indiviual vars
Model 2=Individual + geographic vars
Model 3=Individual + Empowerment vars
Model 4= Individual + fertility/fp norms
Model 5=individual + service availability
Model 6=All vars
By comparing rhos of the models, we can see the extent to which the between-cluster variation accounts for the total variation in contraceptive use after adding each group of contextual variables