



AN APPROXIMATION OF THE PROPORTION OF WOMEN WHO KNOW ABOUT LEGAL CONDITION OF ABORTION IN NEPAL THROUGH SMALL AREA ESTIMATION (SAE) TECHNIQUE

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ABSTRACT In Nepal, abortion has been conditionally legalized in 2002 but data on the level of public awareness about legal condition of abortion exist only for national and regional level. In this context, the main objective of this study is to estimate proportion of women of reproductive ages who are aware of legal condition of abortion in Nepal through small area estimation (SAE) technique. The study reveals that Siraha district with 15% and Kanchanpur district with 60% of the women having knowledge about legal condition of abortion in Nepal stands the lowest and the highest rank respectively. There are nine other districts, mostly from province # 2, in which only one-fourth or less of the women are aware of legal condition of abortion. Most of the top ten districts belong to province # 3 and 7 in which the corresponding proportion ranges between 49-60%.

KEYWORDS : small area estimation, awareness about legal abortion, district level data on legal abortion

INTRODUCTION

In Nepal, abortion has been conditionally legalized (liberalized) through the amendment of Muluki Ain (Civil Code) in September 2002. According to the new abortion law, any pregnant women can end pregnancy with her decision if fetus is up to 12 weeks, or 18 weeks fetus is caused by rape or incest (NLC, 2015). The new law also made mandatory provision of carrying out abortion with the help of qualified and registered health workers. Since then, Nepal government is implementing new abortion law through various policy instruments and institutional arrangements.

In order to ensure safety of mothers, and accessibility and affordability of safe abortion services in the country, Nepal government brought out National Safe Abortion Policy (NSAP) in 2003 which established national protocol for the implementation of abortion law in the country (MoH, 2003). As provisioned in the NASP, Comprehensive Abortion Care (CAC) service was initiated from 2004. The delivery of CAC services in Nepal is guided by CAC Reference Manual 2015 and CAC guidelines 2016. Ministry of Health has been made responsible for overall planning, monitoring, supervising, and follow up of CAC services in public and private sectors.

It may be argued that women in need of safe abortion services can utilize CAC services more comfortably and confidently, and, in a safe environment, if they are aware of legal conditions of ending pregnancy. Considering this, Nepal government, as provisioned in NASP, is also working for creating public awareness about safe abortion through advocacy, information, education and communication (IEC), and social mobilization.

Nepal Demographic and Health Survey (NDHS) 2011, conducted 9 years after legalization of abortion in Nepal indicates that only two-fifth of the women of reproductive ages (38%) are aware of the fact that abortion has been legalized in Nepal (MoH, New ERA & ICF., 2012). Proportion of such women increased only marginally during 2011-2016 (41%) with much lower proportion of such women in some sections particularly with no education (28%), who belong to the poorest economic group (30%), and the women in province # 6 (33%) (MoH, New ERA & ICF., 2016). As the same time, it is indicated that practice of unsafe abortion in Nepal is very common as nearly 60% of the abortions in Nepal is carried out in an illegal manner (Puri, M. Singh, S., Sundaram, S., Hussain, R., Tamang, A. and Crowell, M. (2016). *International Perspectives on Sexual and Reproductive Health*, 42(4), pp. 197-209.

The available data indicate that awareness of women about legal condition of abortion can be a prerequisite for awareness about other abortion-related issues and practices of safe abortion. For example, compared to those who are not aware of legalization of abortion (48%), much higher proportions of the women who are aware tend to have knowledge about places for safe abortion (82%) (MoH, New ERA & ICF., 2012). Likewise, there is strong indication that comparatively higher proportion of the women who are aware of legal condition of abortion carry out abortion in a safe environment than those who are not.

Although NDHS 2011 and 2016 provide estimates of the proportion of

women having knowledge about legal conditions of abortion for rural-urban residence, ecological belts, and development regions, and province (NDHS 2016 only), district level such estimates are still lacking in Nepal. In this context, the main objective of this paper is to provide district level estimates on the proportion of women of reproductive ages who know about legal condition of abortion in Nepal through small area estimation (SAE) technique, and examine their relative position in terms of the estimates.

DATA AND METHODS

- Small area estimation (SAE) technique

Sample surveys are generally used to provide estimates of variables for larger geographic areas such as regions or sub-regions. SAE technique is one of the widely used statistical techniques to estimate variables for the small areas for which survey estimates are not reliable due to small sample size. According to Tzavidis (2013),

SAE is concerned with the development of statistical procedures for producing efficient (precise) estimates for domains (planned or unplanned) with small or zero sample sizes. Domains are defined by the cross-classification of geographical districts by social/economic/demographic characteristics. The target is the estimation of a parameter (average/percentile/ proportion/rate) and the estimation of the corresponding prediction error.

ABS (2006) classifies small area estimation methods into two broad categories: i) methods without explicit application of statistical model (direct estimator, broad area ratio estimator, and calibration estimator), and ii) model-based method requiring regression modeling (synthetic and random effect regression model). ABS has also asserted that model-based SAE technique is used when a higher level of accuracy is required. Another advantage of the model-based SAE is that the model based approach is implemented by borrowing strength from related areas to find more accurate estimates for a given area (Ghosh & Rao, 1994). Strength is borrowed from larger datasets such as census or administrative records which is often called auxiliary information. The auxiliary information (dataset) contains explanatory variables, 'x' but not outcome variable, 'y'. The survey data however must contain both 'x' as well as 'y' variables. It is generally asserted that survey and auxiliary data collected in the same period of time can ensure best result.

- Sources of data

The present study utilizes information about women of reproductive ages (15-49 years) generated by two nationally representative surveys - NDHS and sample census both conducted in 2011 as part of official statistics.

Conducted by MoHP, New ERA & ICF. (2011), NDHS 2011 contains wide range of background and individual information including abortion-related information for 12,674 women of reproductive ages (15-49 years). District level sample size in this survey is highly variable. For example, no sample comes from three districts

(Nuwakot, Manang and Mustang) with largest sample size of 717 for Kathmandu district. In this study, relevant background and individual information provided in NDHS 2011 women data file have been utilized to model multivariate relationship between explanatory and outcome variables and estimate model coefficients (see next section).

Conducted by CBS in 2011, the sample census dataset contains background and individual information for 1,091,339 women of the reproductive ages which constituted 15.3% of the total women of reproductive ages in the country. Relevant information for the women of reproductive ages obtained from sample census have been extracted and used as auxiliary information for the present study. Like in NDHS 2011, district level sample size in sample census is highly variable – 254 (for Manang district) to 82,575 (for Kathmandu). It is to note here that the sample census 2011 did not apply self-weighted sample design (Suwal, 2015). Therefore, some civil and spatial units are over-represented in the sample others being under-represented. In order to minimize the effect of under and over representation of the civil and spatial units on the estimates, post-stratification weight has been calculated and used as suggested by Johnson (2008).

- Explanatory model, estimation of model coefficients, and model validation

In this paper, model-based approach to SAE particularly multivariate binary logistic regression model (nested) has been used. As described by Snow (n.d.), the general procedure of binary logistic regression model for SAE involves develop explanatory model and estimate model coefficients using survey data, apply the model coefficients to auxiliary data to predict individual probabilities, and aggregate the estimated probabilities to the small areas. Utilizing NDHS and sample census datasets (describe above), the SAE technique suggested by Snow (n.d.) has been used by Zhang (2016) to estimate district level contraceptive use in Nepal.

The outcome variable used in the binary logistic regression model is related to the women's awareness status about legal conditions of abortion in Nepal. Such information was collected by NDHS 2011 with a question "Is abortion legal in Nepal?". This question was asked to all the women of reproductive ages interviewed by the survey. Although response of this question is expected to be in binary form (yes/no), some respondents who were not sure about legal condition of

abortion have been classified in "Don't know" category. Following the method adopted by NDHS, the present analysis combines respondents in "Don't know" category with the respondents who negatively responded to the question about legal condition of abortion (i.e. "no" response).

The explanatory variables used in the model are related to the household and personal characteristics of women such as type of residence, ecological belt, provinces, eco-development regions, household amenities, types of house, language, caste/ethnicity, religion, age and education of household head and women, and ownership of women on land (Table 1). It is to note here that only the survey variables having similar categories to the auxiliary database, or having different categories but was possible to collapse into similar categories were included in the model. Then, frequency distribution of all the survey variables planned to include in the model was scrutinized and only those variables having relative distribution close to the auxiliary database have been included in the model. Finally, binary logistic regression model was run in SPSS (Version 20) to estimate model coefficients and test their significance. Only the main effects of the variables have been considered in this analysis.

An assessment of the model indicates that, compared to the intercept-only model, the model with variables tends to significantly improve explanatory power of the model ($\chi^2=2549$; Sig=0.000) (Table 1). Overall, the model, in terms of the Nagelkerke R², although this is not considered to be equivalent to the R² in linear regression model, explains 26% of the variation in the women's knowledge about legalization of abortion in Nepal. In total, 71% of the total cases have been correctly predicted by the model, 53.9% women having knowledge and 81.4% not having knowledge.

In addition, assessing the model fit with a more stringent criteria in terms of McFadden's rho (ρ), defined as one minus the ratio of log likelihood of intercept and variable model to the log likelihood with intercept-only model shows that the explanatory model used to predict the outcome variable in this analysis may be taken only a good fit with $\rho=0.160$ but not a very good fit of the model (a model with $0.20 \leq \rho \leq 0.4$ represents very good fit as cited in Lee, 2013). Based on the Wald Statistics, it is found that 4 variables related to women's level of education have the highest explanatory power (16% out of 26%) in the model.

TABLE 1 MODEL SUMMARY AND ESTIMATED REGRESSION COEFFICIENTS

N=12067		Chi-square: 2549 (Sig=0.000)					-2log likelihood: 13390		
Cox and Snell R square: 0.191		Nagelkerke R Square: 0.260					% correctly predicted cases: 71.0		
SN	Explanatory variables	B	S.E.	Wald	df	Sig.	Exp(B)	Name of variables	
1	V1	0.247	0.066	13.798	1.000	0.000	1.280	Types of residence: rural	
2	V2	0.229	0.080	8.264	1.000	0.004	1.258	Ecological belt: Tarai	
3	V3	-0.926	0.110	71.157	1.000	0.000	0.396	Province 1	
4	V4	-1.581	0.097	267.973	1.000	0.000	0.206	Province 2	
5	V5	-0.934	0.098	90.891	1.000	0.000	0.393	Province 3	
6	V6	-0.608	0.151	16.288	1.000	0.000	0.545	Province 4	
7	V7	-1.040	0.105	98.855	1.000	0.000	0.354	Province 5	
8	V8	-0.565	0.132	18.398	1.000	0.000	0.568	Province 6	
9	V9	-0.803	0.143	31.564	1.000	0.000	0.448	Western hill	
10	V10	-0.526	0.105	24.896	1.000	0.000	0.591	Eastern tarai	
11	V11	-0.545	0.119	20.810	1.000	0.000	0.580	Western tarai	
12	V12	0.127	0.064	3.935	1.000	0.047	1.136	Women's age: 30-34 years	
13	V13	0.140	0.068	4.251	1.000	0.039	1.150	Women's age: 35-39 years	
14	V14	0.245	0.069	12.692	1.000	0.000	1.278	Has electricity	
15	V15	0.122	0.044	7.578	1.000	0.006	1.130	Has radio	
16	V16	0.188	0.055	11.648	1.000	0.001	1.207	Has television	
17	V17	0.156	0.078	3.957	1.000	0.047	1.168	Has telephone	
18	V18	-0.261	0.077	11.388	1.000	0.001	0.770	Has refrigerator	
19	V19	-0.193	0.067	8.285	1.000	0.004	0.825	House wall: mud	
20	V20	0.205	0.055	13.809	1.000	0.000	1.227	Roofing materials: galvanized	
21	V21	0.189	0.062	9.394	1.000	0.002	1.208	Roofing materials: tiles	
22	V22	0.532	0.198	7.246	1.000	0.007	1.703	Source of drinking water: sprout	
23	V23	-0.327	0.115	8.085	1.000	0.004	0.721	Source of drinking water: river/stream	
24	V24	-0.341	0.065	27.516	1.000	0.000	0.711	Has household toilet	
25	V25	-0.205	0.067	9.414	1.000	0.002	0.815	Types of toilet: ordinary	
26	V26	-0.136	0.058	5.553	1.000	0.018	0.872	Cooking fuel: wood	
27	V27	-0.163	0.058	7.973	1.000	0.005	0.850	Never married	
28	V28	0.175	0.054	10.426	1.000	0.001	1.191	Mother tongue:Nepali	
29	V29	0.612	0.168	13.318	1.000	0.000	1.845	Caste/ethnicity: Caste group	

30	V30	0.538	0.165	10.598	1.000	0.001	1.712	Caste/ethnicity: Janajati
31	V31	0.490	0.175	7.817	1.000	0.005	1.632	Caste/ethnicity: Dalit
32	V32	-0.134	0.083	2.615	1.000	0.106	0.874	Religion: Buddhism
33	V33	-1.441	0.678	4.523	1.000	0.033	0.237	Household head: no education
34	V34	-1.302	0.678	3.683	1.000	0.055	0.272	Household head: primary education
35	V35	-1.288	0.679	3.600	1.000	0.058	0.276	Household head: secondary education
36	V36	-1.073	0.683	2.471	1.000	0.116	0.342	Household head: higher education
37	V37	0.339	0.065	27.416	1.000	0.000	1.403	Received non-formal education
38	V38	0.455	0.079	33.444	1.000	0.000	1.576	Literate
39	V39	-1.463	0.127	133.752	1.000	0.000	0.231	Women: no education
40	V40	-1.158	0.107	117.683	1.000	0.000	0.314	Women: Primary education
41	V41	-0.355	0.089	15.950	1.000	0.000	0.701	Women: Secondary education
42	V42	0.196	0.065	9.011	1.000	0.003	1.217	Occupation: Professional, clerical, sales, service
43	V43	-0.036	0.009	15.674	1.000	0.000	0.965	Number of household member
44	V44	0.004	0.002	3.633	1.000	0.057	1.004	Age of household head
45	V45	0.211	0.071	8.909	1.000	0.003	1.235	Women has ownership on land
	Constant	1.297	0.724	3.211	1.000	0.073	3.658	

- Prediction of individual probabilities and estimation of proportion

Individual probabilities of having knowledge about legalization of abortion have been predicted applying estimated logistic regression “B” coefficients to the auxiliary data. The predictive logistic regression function used to estimate individual probabilities (p) is given by

$$\hat{P}_i = \frac{e^{\hat{\alpha} + \hat{\beta}X_i}}{1 + e^{\hat{\alpha} + \hat{\beta}X_i}}$$

where, e = exponential (=2.718281828)

$\hat{\alpha}$ = constant

$\hat{\beta}$ = estimated B coefficients for explanatory variables, X_i

$\hat{\alpha} + \hat{\beta}X_i$ = predicted logits

After prediction of individual probabilities, proportion of women having knowledge about legal condition of abortion for different districts is estimated as a mean of the individual probabilities. Mean probability for any hth district (\bar{p}_h) having k number of women is estimated as

$$\bar{p}_h = \frac{\sum_{i=1}^k p_{hi}}{n_h}$$

where,

p_{hi} = probabilities of having knowledge for ith women of hth district

n_h = number of cases in the hth district

- Limitations

This study has the following two limitations

- Related to auxiliary data

The auxiliary data used for the present study is obtained from sample census dataset. Although few other scholars have also used this database for similar purpose, being sample survey, sample census data contains certain level of sampling errors. Due to this, prediction error might be higher than that with the use of census database. Despite this, it is to note here that district level sample size of sample census, except for Manang (254) and Mustang (559) districts, is large enough (minimum of 1,300 for Dolpa and maximum of 82,575 for Kathmandu) to yield the estimates close to the population estimate.

- Related to the use of NDHS 2011 data

The present study utilizes NDHS 2011 database for estimation of model coefficients despite the fact that NDHS 2016 has been already disseminated for public use. Here, use of NDHS 2016 database for modeling purpose is highly desirable in order to represent the estimates for the most recent time. However, it is to note here that use of NDHS 2016 data was constrained by the fact that auxiliary data are available only for the year 2011. Considering small change in the national level observed proportion of women for the period 2011-2016, it may be assumed that districts also follow similar changes. In this condition, estimated proportion for the districts based on the 2011 data also can provide close approximation for the year 2016.

RESULTS AND DISCUSSION

- Assessment of the results

The model predicted that 38.1% of the women in Nepal have knowledge about legalization of abortion in the country which is very close to the observed proportion, i. e. 37.8% (Table 2). Likewise, such a resemblance between predicted and observed proportion can also be observed by development regions with minor difference in eastern and central regions.

Table 2 further shows that predicted proportions, except for far western region, are lower or slightly higher than the observed proportion in 2016. Such a difference between estimated and observed proportion for 2011 and 2016 is generally expected because there has been some increased in the observed proportion during 2011 and 2016 period. All these indicate that the model has predicted the proportion of women having knowledge about legal condition of abortion fairly accurately and consistently for the year 2011.

Development region	NDHS 2011	Predicted 2011	NDHS 2016
Eastern	37.9	35.1	43.3
Central	35.1	38.5	41.8
Western	35.5	35.1	36.9
Mid-Western	36.9	37.3	36.3
Far-Western	52.6	52.1	43.7
Total	37.8	38.2	40.6

- District level estimates

Table 3 presents number of districts by predicted proportion of women having knowledge about legal condition of abortion in Nepal. The Table shows that Siraha district has the lowest proportion of such women (15%). It is the highest in Kanchanpur (60%).

Table 3 further shows that Siraha, Saptari, Rautahat, Parsa, Kapilbastu, Mahottari, Bara, Sarlahi, Dhanusa, and Mugu constitute bottom 10 districts in terms of the women's level of awareness about legalization of abortion in the country. All these districts, except Kapilbastu and Mugu, are from Tarai belt which belong to Province # 2. In these districts, only up to 25% of the women are estimated to have been aware of the fact that abortion is legalized in Nepal. There are another 10 districts in which only 25- 30% of the women are aware of legalization of abortion in Nepal. These districts are Rolpa, Humla, Dolpa, Rukum, Arghakanchi, Gulmi, Rupendehi, Jumla, Rasuwa and Sindhuli, of them, the former eight belong to province # 5 and 6.

Compared to the above districts, other 10 districts - Bajura, Doti, Terhathum, Achham, Kaski, Jhapa, Kavrepalanchok, Baitadi, Surkhet, and Dhankuta – lie at slightly higher side with 42 to 48% of the women aware of legalization of abortion. Half of the districts in this category belong to province # 6 and 7.

Considering the highest end, Kathmandu, Bhaktapur, Lalitpur, Chitwan, Kanchanpur, Kailali, Darchula, Dadeldhura, Ilam, and Manang constitute top 10 districts in terms of awareness of women about legalization of abortion in the country. Of the 10 districts, the former 4 districts belong to province # 3 and the later 4 to province # 7.

The corresponding estimates in these districts range between 49% (Darchula) to 60% (Kanchanpur).

Besides top 20 and bottom 20 districts described above, there are 30 other districts in which 31-42% of the women are having knowledge about legalization of abortion. Large majority of the districts in this category are from province # 1 (11 out of 14) and 4 (9 out of 11). Nearly half of the districts from province # 3 (6 out of 13), 5 (5 out of 11), and 6 (4 out of 9) also fall in this category. None of the districts from province # 2 and only one from province # 7 are in this category. This is because almost all districts of province # 2 are in bottom 10 positions, and 8 out of 9 districts of province # 7 are in top 20 positions.

TABLE 3 ESTIMATED PROPORTION OF WOMEN HAVING KNOWLEDGE ABOUT LEGALIZATION OF ABORTION IN NEPAL

SN	District	Belt	Province	Predicted proportion (%)	Rank	Rank
1	Siraha	Terai	2	15.4	Bottom 10 districts	Bottom 20 districts
2	Saptari	Terai	2	16.6		
3	Rautahat	Terai	2	18.4		
4	Parsa	Terai	2	19.3		
5	Kapilbastu	Terai	5	20.6		
6	Mahottari	Terai	2	21.0		
7	Bara	Terai	2	21.1		
8	Sarlahi	Terai	2	21.6		
9	Dhanusa	Terai	2	22.0		
10	Mugu	Mountain	6	25.0		
11	Rolpa	Hills	5	26.2		
12	Humla	Mountain	6	27.0		
13	Dolpa	Mountain	6	28.6		
14	Rukum	Hills	5	28.7		
15	Arghakhanchi	Hills	5	28.7		
16	Gulmi	Hills	5	29.7		
17	Rasuwa	Mountain	3	30.1		
18	Rupandehi	Terai	5	30.2		
19	Sindhuli	Hills	3	30.4		
20	Jumla	Mountain	6	30.6		
21	Palpa	Hills	5	31.1		
22	Solukhumbu	Mountain	1	32.9		
23	Taplejung	Mountain	1	34.3		
24	Kalikot	Mountain	6	34.3		
25	Jajarkot	Hills	6	35.1		
26	Okhaldhunga	Hills	1	35.5		
27	Bhojpur	Hills	1	35.7		
28	Khotang	Hills	1	35.8		
29	Sunsari	Terai	1	35.9		
30	Ramechhap	Hills	3	36.2		
31	Banke	Terai	5	36.4		
32	Pyuthan	Hills	5	36.6		
33	Lamjung	Hills	4	36.8		
34	Udayapur	Hills	1	37.2		
35	Myagdi	Hills	4	37.3		
36	Tanahu	Hills	4	37.9		
37	Salyan	Hills	6	37.9		
38	Bardiya	Terai	5	38.2		
39	Makwanpur	Hills	3	38.2		
40	Dhading	Hills	3	38.4		
41	Morang	Terai	1	39.0		
42	Panchthar	Hills	1	39.0		
43	Baglung	Hills	4	39.3		
44	Gorkha	Hills	4	39.7		
45	Mustang	Mountain	4	39.7		
46	Sindhupalchok	Mountain	3	39.8		
47	Sankhuwa-sabha	Mountain	1	39.9		
48	Dailekh	Hills	6	40.2		
49	Parbat	Hills	4	40.4		
50	Syangja	Hills	4	40.4		
51	Nuwakot	Hills	3	41.3		
52	Dang	Terai	5	41.4		
53	Dolakha	Mountain	3	41.5		
54	Nawalparasi	Terai	4	41.6		
55	Bajhang	Mountain	7	41.6		

56	Bajura	Mountain	7	42.3
57	Doti	Hills	7	43.4
58	Terhathum	Hills	1	44.1
59	Achham	Hills	7	44.3
60	Kaski	Hills	4	44.5
61	Jhapa	Terai	1	44.7
62	Kavrepalanchok	Hills	3	46.9
63	Baitadi	Hills	7	47.1
64	Surkhet	Hills	6	47.4
65	Dhankuta	Hills	1	48.1
66	Darchula	Mountain	7	48.9
67	Ilam	Hills	1	49.4
68	Dadeldhura	Hills	7	50.0
69	Manang	Mountain	4	52.3
70	Lalitpur	Hills	3	54.0
71	Bhaktapur	Hills	3	54.2
72	Chitawan	Terai	3	55.9
73	Kathmandu	Hills	3	57.5
74	Kailali	Terai	7	58.0
75	Kanchanpur	Terai	7	59.8
	Total			38.2

Top 20 districts

CONCLUSIONS

Considering district level estimates, all or most of the districts of four provinces, i. e. province # 1, 2, 4, and 7 fall in a particular rank in terms of reach of the information about legalization of abortion. Most of the districts of province # 1 and 4 are in medium rank while all the districts from province # 2 are in bottom 10 positions. Likewise, large majority of the districts from province # 7 are in top 10 positions. This is an indicative of the fact that reach of the information across the districts of these four provinces is more homogeneous.

The district level estimates further indicate that women in Siraha district have the lowest reach of the information about legalization of abortion while women from Kanchanpur have the highest reach. Considering very low estimate of the proportion of women having knowledge about abortion for Siraha and other 9 districts falling in the bottom 10 positions (<=25%), it may be said that these district are at early stage of diffusing information about legalization of abortion in Nepal.

Considering the highest end, it is found that the highest value of estimated proportion for Kanchanpur and some other districts falling in top 10 positions does not exceed 60%. This implies that districts falling in top 10 positions also have to make a concerted effort towards universal access to the information and education about legalization of abortion in Nepal.

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