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## Household Environment and Maternal Health Among Rural Women of Northern Cross River State, Nigeria

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### **Abstract:**

*Background:* Despite policies and programmes designed to ensure safe motherhood, maternal morbidity and mortality rates have remained high in Nigeria. Household environment has been identified as crucial in maternal health; yet, little has been done to identify the environmental conditions that predispose women to morbidity and mortality in predominantly rural Northern Cross River State. This study investigated the role of household decision-making, domestic violence, access to and utilisation of maternal health facilities and socio-cultural practices that influence maternal health status.

*Methods:* A sample of 823 respondents was drawn and used for the study. The study involved both qualitative and quantitative approaches. Twenty each of Focus Group Discussions (FGDs) and In-depth Interviews (IDIs) were conducted among women of different ages, traditional birth attendants and elders were key informants.

*Results:* Household environment is significantly related to maternal health ( $\chi^2=15.8$ ;  $P<0.05$ ). The likelihood of better maternal health was significantly higher among households that used flush toilet than pit/latrine (OR=3.2;  $P<0.05$ ), pipe-borne water than stream water (OR=5.0  $P<0.05$ ),

electricity/gas for cooking than firewood (OR=8.9,  $P<0.05$ ). Toilet facilities, water sources and cooking environment were poor among many women thereby exposing them to various infections. Socio-economic status of women played a significant role in maternal health ( $\chi^2=13.8$ ;  $P<0.05$ ). Ever married women had better health status than those that were single ( $\chi^2=10.0$ ;  $P<0.05$ ); women who had their first babies earlier than 20 years of age had poorer health status compared to those who had them later ( $\chi^2=14.9$ ;  $P<0.05$ ). However, maternal educational qualification showed no significant relationship with maternal health. Household sanitation and hygiene behaviour were significantly related to maternal health status ( $\chi^2=10.5$ ;  $P<0.05$ ;  $\chi^2=16.5$ ;  $P<0.05$ ).

*Conclusion:* Maternal health is the result of cumulative effects of household environment, cultural practices, attitudes and behaviours. Improving the household environment and behaviour could improve maternal health. This could be achieved through improvement of health services and information in the rural communities.

**Key words:** Household environmental hygiene, Maternal health status

### **Resumen:**

#### **Ambiente doméstico y salud materna en mujeres del área rural de Northern Cross River State, Nigeria**

*Contexto:* A pesar de las políticas y programas diseñados para asegurar una maternidad segura, las tasas de morbilidad y mortalidad maternas en Nigeria se han mantenido altas. Si bien el ambiente doméstico ha sido identificado como un factor crucial en la salud materna, poco se ha hecho en pos de identificar las condiciones ambientales que predisponen a las mujeres a la morbilidad y mortalidad en la predominantemente rural Northern Cross River State. Este estudio investigó el rol de la toma de decisiones en el hogar, la violencia doméstica, el acceso y la utilización de instalaciones de salud y las prácticas socioculturales que influyen el estatus de la salud materna.

*Métodos:* Se ha diseñado y utilizado una muestra de 823 personas. El estudio involucró enfoques cualitativos y cuantitativos. Se han llevado a cabo veinte



*focus groups* y veinte entrevistas en profundidad entre mujeres de diversas edades, fueron informantes clave asistentes de parto tradicional y ancianos.

*Resultados:* El ambiente doméstico se encuentra significativamente vinculado a la salud materna ( $\chi^2=15.8$ ;  $P<0.05$ ). La probabilidad de una mejor salud se muestra significativamente superior en casas que cuentan con inodoros por sobre las que cuentan con pozos/letrinas ( $OR=3.2$ ;  $P<0.05$ ), en las que cuentan con agua de cañerías por sobre las que tienen corrientes de agua ( $OR=5.0$   $P<0.05$ ), las que tienen cocinas a gas/electricidad por sobre las que cuentan con cocina a leña ( $OR=8.9$ ,  $P<0.05$ ). Se ha observado que las instalaciones sanitarias, fuentes de agua y el ambiente de la cocina son pobres entre muchas de las entrevistadas, exponiéndolas a diversas infecciones. El estatus socioeconómico juega un rol significativo en la salud materna ( $\chi^2=13.8$ ;  $P<0.05$ ). Las mujeres casadas han revelado tener un estado de salud mejor que las solteras ( $\chi^2=10.0$ ;  $P<0.05$ ); las mujeres que han tenido su primer hijo antes de los 20 años de edad han revelado un estado de salud más pobre que aquellas que los tuvieron después ( $\chi^2=14.9$ ;  $P<0.05$ ). Sin embargo, el nivel educativo no ha mostrado una relación significativa con la salud materna. La sanidad doméstica y el comportamiento de higiene sí han revelado una relación significativa con la salud materna ( $\chi^2=10.5$ ;  $P<0.05$ ;  $\chi^2=16.5$ ;  $P<0.05$ ).

*Conclusión:* La salud materna es el resultado de efectos acumulativos del ambiente doméstico, las prácticas culturales, las actitudes y comportamientos. Su incremento puede ser promovido a partir de una mejora del ambiente doméstico y de la conducta sanitaria, a través del progreso en los servicios de salud y una mejor información en las comunidades rurales.

**Palabras claves:** Ambiente doméstico, higiene, salud materna.

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## Background of the study

Pregnancy is a life threatening condition in a majority of developing countries, and its outcome reduces the life expectancy of childbearing women. UNICEF, UNPFA and WHO (2000) indicated that 37,000 maternal deaths occurred in Nigeria in 1999 only. It has also been indicated that maternal mortality ratio varied from 700 to 1,500 per 100,000 live births in 2005 (State of Nigeria Health, 2006). A most recent estimate showed that over 52,000 women died of pregnancy complications in 2007 in Nigeria (Dada, 2008). According to the Demographic Health Survey NDHS (2008) maternal mortality, in the seven years preceding the survey was 545 per 100,000 live births. For every woman that dies of pregnancy related complication, over 20 others suffer life long disabilities. This situation is still prevalent despite several programmes introduced as interventions to check this trend and improve maternal health. Some of such programmes are the "safe motherhood initiative", which was introduced to suggest strategic interventions to reduce maternal mortality and morbidity in Nigeria and the Integrated Maternal, Newborn and Child Health (IMNCH) Strategy introduced in 2007 to fast-track high-impact intervention packages that include nutritional supplements, immunization, insecticide-treated mosquito nets and prevention of mother-to-child transmission of HIV.

It is therefore indicative that these interventionist programmes have either not been effective or are misdirected in addressing the issue of maternal morbidity and mortality in Nigeria. The preponderance of these deaths, as well as disabilities therefore, suggests that maternal health is not a simple consequence of reproductive risks alone, but an outcome of a host of maternal health conditions.

Despite pledges by successive governments, little progress has been made in saving women's lives. The United Nations (2008) maintained that its Millennium Development Goal 5—to reduce maternal mortality by 75 percent and to achieve universal access to reproductive health services by 2015 has made the least progress of all MDGs. At the global level, maternal mortality decreased by less than 1 percent per year between 1990 and 2005—far below the 5.5 percent annual improvement needed to reach the target. At this rate, MDG 5 will not be met in Asia until 2076 and many years later in Africa.

Following from above, the household environments where women of reproductive age live have conditions that affect their health (World Bank 2000; UNICEF, 2000). Racioppi (2002) observed that a variety of health conditions such as air quality, building standards, noise, contaminated water, food and toilet facilities are evident in some household environments. These undermine and determine the health status of childbearing women.

Besides, there has been poor understanding and appreciation of the health of women from the good, moderate and poor health status. The lack of interest by researchers on the

holistic approach to maternal health has led to the paucity of knowledge in this area. As a result, though these observations have been recognized as underlying factors in maternal health in the literature (Maine 1992), there has been very limited analytical work in this area (UN 1995). In addition, the publications that have appeared on maternal health in Nigeria have addressed the issue in other areas to the almost exclusion of the present study area. It is against this background that this study examined the effect of the household environmental condition on maternal health in Northern Cross River state of Nigeria.

### **Research questions**

The main question is: what are the effects of household environmental conditions on maternal health among rural women in Northern Cross River State of Nigeria? This main question can be delineated into the following:

- How does the household structure/status affect maternal health?
- How does sanitation facilities and hygiene behaviour affect maternal health?
- What role does the socio-economic status of women play in maternal health?
- How does access to and utilization of maternal health care facilities affect maternal health?

### **Objectives of the study**

The main objective of the study is to examine the household environmental conditions affecting maternal health among rural women of Northern Cross River State. The specific objectives include:

1. An examination of the household structures and condition that affect maternal health.
2. An assessment of the relationship between sanitation facilities and hygiene behaviour on maternal health.
3. An investigation on the effect of the socio-economic status of women on maternal health
4. An assessment of the relationship between access and utilization of maternal health care facilities and maternal health

## Significance of the study

The relevance of this study derived from the fact that demographic studies on the effect of household environmental conditions on maternal health have been very limited in the study area. The present study filled this intellectual gap by providing empirical explanation for the rate of maternal morbidity and mortality in the area.

There has been a lack of consensus concerning what maternal health is; as a result, maternal health status has been lumped into two categories of favourable and unfavourable. This trend is overcome by the present study which adopts a framework that divides maternal health outcome or status into three. It provides an epistemological explanation for the loss of useful data in previous demographic studies that lump data into two categories of good and bad or favourable and unfavourable (Stover, et al., 2002; Diallo, 2005; Ross et al., 2005).

## Methodology

### *Research design*

The study adopted the descriptive and exploratory designs that allowed the collection of data from a part or sub-set of a population whose analyses can be generalised on the entire population. The study employed the quantitative and qualitative instruments to explore the role of the physical and cultural environment of the household on maternal health. These methods were adopted in line with triangulation. This is a research methodology that allows the utilization of different research designs that draw on the strength of each while reducing the weaknesses of each. It gives a comprehensive understanding of a complex phenomenon. The adoption of these methods also gave a multi faceted articulation on the different aspects of the study. The Local Government Areas making up Northern Cross River State are located in the Northern part of the state. They are bounded in the north by Benue state; in the south by the Boki Local Government Area. In the east, it is bounded by the Camerouns and in the West by Ebonyi State. The area covers a large area of over 1000 square miles with a total population of over 2 million (NPC 1991).

The Area is divided into two main geographical zones. To the south is the thick rain forest belt which surges northwards to the foot of the hills that dominate the eastern and north-eastern part of the area. To the north is the savannah belt into which the southern forest zone gently merges.



### *Sample design*

Sampling is the process of selecting a sub-set of a population to represent the entire population. The subset is used for the study with the findings being generalised on the entire population. For this study, a multistage sampling procedure was adopted. It began with the purposive selection of the Northern part of Cross River State.

This part of the state has five local governments, and was clustered into political wards. These Local Governments were delineated into council headquarters, generally seen as urban and other areas, with absence of electricity, pipe borne water, etc, defined as rural.

The statistical approach in the selection of households was used. The sample was selected using Cochran's sample size formula. This method uses the "risk the researcher is willing to study"; commonly called the "Margin of error the researcher is willing to accept at a particular alpha level (i.e. 0.05 or 0.01)". The formula is

$$n_0 = \frac{(t)^2 * (S)^2}{(d)^2}$$

Where  $n_0$  = required sample size,  $t$  = value for selected alpha level of .05 in each tail. (The alpha level of 0.05 indicates the level of risk the researcher is willing to take that true Margin of error may exceed the acceptable margin of error).

$S$  = estimate of standard deviation in population

$d$  = estimate of variance deviation for 5 point scale or acceptable margin of error for mean being estimated (number of points on primary scale, acceptable margin of error).

$$= \frac{(2.97)^2 (12.20)^2}{(1.671)^2}$$

$$= \frac{8.76 \times 148.84}{1.36}$$

$$= 954.5$$

$$= 955$$

After deriving the sample size of 955, it was distributed among the households (Cochran 1977). However, where a household had more than one ever-pregnant woman, a simple random sampling method of lucky deep procedure was adopted to select the one that was finally interviewed or administered with a questionnaire.

The study population included a cross-section of women of reproductive age 15-49 and men who have ever fathered a child in the rural communities selected for the study. These were women from the rural communities of the Northern Cross River state.

The Cochran statistics generated 955 respondents with 86.18 percent return rate, which is considered adequate for the analysis.

## **Research instruments**

### *Focus Group Discussion*

This is a semi-structured in-depth discussion on a given topic by participants perceived as predominantly homogenous. The size is usually between 6-10 participants depending on the issues and the ability of the researcher to convene them. Members in this group were men and women who have ever had a child. There were 20 FGDs, 10 each for men and women. Each community had 2 FGDs, one for men and another for women. The characterisation of the groupings took into consideration the age and educational level of participants. Those with relatively higher level of education formed the same group while the less educated formed another. The older members of the communities were grouped together and the younger ones were grouped differently.

### *Questionnaire*

The major survey instrument was the structured questionnaire. The designing of the questionnaire was based on the pilot study that revealed the salient variables that influence maternal health. The survey instrument was cross-sectional and it adopted Self-reported Morbidity Prevalence Questionnaire (SRMPQ).

This questionnaire was drawn by the researcher and it measured household-based prevalence of reproductive morbidity using household surveys. This method has been shown to be a very good approach in estimating the prevalence of morbidity using different administration schedules that employed disease lists beyond symptom labels. It also classified





individuals within disease categories based on symptoms profiles. To measure morbidity, a maternal morbidity prevalence index was used to classify the population into three groups of roughly equal sizes. This was based on a proxy for morbidity determined by the prevalence of morbidity or symptom list. The three categories were good maternal health (0 report of symptoms of illness), moderate maternal health (1 report of symptom of illness) and poor maternal health (2 & above report of symptoms of the list of illnesses), this was done for self reported illnesses and diagnosed illnesses. This method was used by Mechanic & Newton, (1996; Zakpa et al., 1996; Woolsey, 1999; Sadana, 2000). The study explored maternal morbidity as an indicator rather than focusing on mortality because those situations in the childbearing women's lives that were threatening are the same problems that resulted in maternal death.

#### *Instrument administration*

Principally the researcher administered the research instrument with assistance from trained field assistants and supervisors who visited different parts of the sampled study area to administer the survey instrument. The researcher conducted the FGDs.

#### *Methods of data analyses*

The Focus Group Discussion (FGD) and the In-depth Interview were analyzed after being transcribed from the original language to English language. The analysis was focused on comparing the responses of the FGDs from each of the selected communities with others to see whether a similar pattern of responses existed among them. The analysis involved the categorization of data collected into the objectives of the study. This included arranging the information according to gender responses; the responses of the men and women were finally compared to see whether their responses were related. Manual content analysis was adopted for analyzing the data. This method involved the transcription of recordings followed by examination and isolation of various responses according to study objectives for the FGDs. Quantitative data were edited to eliminate inconsistencies that may undermine content validity. The analysis was undertaken at univariate, bivariate and multivariate levels.

## Results

### *Socio-demographic characteristics of respondents*

The sample for the quantitative survey was sex-specific given the nature of the phenomenon under investigation. However, since pregnancy is the result of the interaction of women and men, the latter were included in the qualitative aspect of the study. Out of 955 questionnaires administered among women aged 15 and above, 823 were found usable for the study.

The sample population has a mean age distribution of 33.6 years. From the table, 55 respondents, or 6.7 percent of the total sample population, belonged to age group less than 19 years. At the other extreme, that is, women of age 45+ comprised 16.9 percent of the total sample population.

**Table 4.1:**  
**Percentage distribution of respondents by selected socio-demographic characteristics**

Characteristics	Categories	Frequency	Percentage
Age	< 19	55	6.7
	20-24	103	12.5
	25-29	146	17.8
	30-34	148	17.9
	35-40	116	14.1
	41-44	116	14.1
	45+	139	16.9
	<b>Total</b>		<b>823</b>
Marital status	Single	89	10.9
	Married	580	70.5
	Divorced	52	6.3
	Separated	34	4.1
	Widowed	68	8.3
	<b>Total</b>		<b>823</b>
	No Schooling	193	23.5
	Primary	240	29.2

Education	Secondary	228	27.7
	Tertiary	162	19.7
	<b>Total</b>	<b>823</b>	<b>100.0</b>
Occupation	Trader	207	25.2
	Farmer	363	44.1
	Civil servant	199	24.2
	Others	54	6.6
	<b>Total</b>	<b>823</b>	<b>100.0</b>
Monthly income in Naira	<N1, 000	293	35.6
	N2, 000 – N5, 000	227	27.6
	N6, 000–N10, 000	160	19.4
	N11, 000–N15,000	87	10.6
	>N16, 000	56	6.8
	<b>Total</b>	<b>823</b>	<b>100.0</b>
Age at first Birth	No response	28	3.4
	< 15 yrs	94	11.4
	15 –19yrs	293	35.6
	20+	408	49.6
	<b>Total</b>	<b>823</b>	<b>100.0</b>

The table further indicates that more than 70 percent of the women are currently married. Another 10.4 percent are currently either divorced or separated, while 8.3 percent are widowed. Over ten percent of the women are single.

The table also indicates that 35.5 percent of the women have no schooling and 29.2 percent have only primary education. Nearly 28 percent of the women have some secondary school education, while about 20 percent have some tertiary education. In other words, nearly half of the women have some secondary education or above.

About 69 percent of the study respondents are either traders or farmers and only 24 percent are civil servants. Comparing the educational qualifications with occupation, women in the area of study engage in occupations that require marginal educational qualification. An examination of the monthly incomes of respondents shows that earnings are low in the study area. While 35.6 percent earn less than N1000 a month, 27.6 percent earn between N2000-

N5000. The mean income for the respondents is N2,854. This places an average woman in this area at less than three dollar a day.

The mean age at first birth is 18 years. Table 4.1 shows that 11.4 percent of women had their first babies when they were less than 15 years.

### **Household environmental conditions**

Different household environmental conditions affect people living therein differently. Data on the household environmental condition is crucial because the sources of drinking water affects and determine the health of the people that use it. The presentation of data relating to this is done with a view to assessing the likely effect of water sources on maternal health. Increasing access to improved drinking water is one of the Millennium Development Goals that Nigeria and other nations have adopted. Poor water sources have been indicated as causing different health hazards and their presentation helps in determining their relative effects on maternal health. The NDHS (2008) indicated that only 56 percent of households have access to improved sources of water. This implies that that about two fifth of households draw water from an unimproved source of water. Again, the survey found that the percentage of households using solid fuel is high (86 percent) and a majority of these households used firewood in an open fire. Toilet facilities are also issues related to health. Poor toilet facilities cause illnesses for those who use improper or poor facilities. These facilities are presented in order to examine their influence on maternal health just as poor cooking facilities negatively affect maternal health and these variables are presented to assess their influence on maternal health. These physical characteristics are important indicators of the socio economic and health status of households.

The source of water is an important determinant of the health status of household members. Sources of water expected to be relatively free from diseases are piped water and water drawn from protected wells and deep boreholes. Other sources like unprotected wells and surface water (rivers, streams ponds and lakes) are more likely to carry disease-causing agents. The table shows that over 46 percent of household members have access to clean water. It can be observed that the predominant source of drinking water is from the stream, mentioned by 46.3 percent of the respondents. Those whose source of drinking water is 'covered well and borehole' made up 31.0 percent and less than 10 percent rely on pipe borne water supply for domestic and other uses.



**Table 1:**  
**Percentage distribution of respondents by household environmental condition**

Household Condition	Frequency(N=823)	Percent
<b>Source of Drinking Water</b>		
Pipe-borne	77	9.4
Open well	65	7.9
Covered well/Borehole	255	31.0
Stream	381	46.3
Rain water	107	13.0
Others	31	3.8
<b>Toilet Facilities</b>		
Flush	100	12.2
Pit toilet	270	32.8
Traditional pit toilet	133	16.2
Latrine	89	10.8
Bush/field	205	24.9
River	21	2.6
Others	79	9.6
VIP	15	1.8
<b>Cooking Facilities</b>		
Electricity	56	6.8
Gas	20	2.4
Biomass	22	2.7
Kerosene	94	11.4
Coal	18	2.2
Charcoal	131	15.9
Firewood	550	66.8
Others	25	3.0
<b>Roofing Materials</b>		
Thatch	37	4.5
Bamboo	16	1.9
	16	1.9

Corrugated Sheets	733	89.1
Zinc	17	2.1
Asbestos		
<b>Percent using Mosquito Net</b>	471	57.2
<b>Sleeping Rooms Per Household</b>	252	30.6
1-4	424	51.5
5-9	147	17.8
10+		

Note: Multiple responses was allowed for categories

The lack of availability of toilet facilities poses a serious public health problem. Only 12.2 percent of households have a flush toilet while the majority (49 percent) uses traditional pit toilets. Nearly one in 5 women used bush or field for toilet, and another 3 percent use the river as source of toilet.

Almost 70 percent of the respondents use firewood as cooking facility in the study area. This is attributed to the fact that the area is rural where firewood is more readily available. The predominant material used for roofing among respondents is zinc. From table 4.2 above, 89.1 percent of the respondents use zinc in the roofing of their houses.

The table also shows that 57 percent of the respondents use mosquito net in their homes. The high level of usage of mosquito net is a function of the educational level of the women in the study area and the widespread "Roll back malaria programme" of the Government. Crowded conditions may affect health as well as the quality of life. The number of persons per sleeping room in the household is used as a measure of household room density. On average, there are 4.1 persons per sleeping room in Nigeria. Households in the study area have fewer persons per sleeping room than urban households. These characteristics are correlated with health and are also an indication of socioeconomic status.

### Incidence of illness

The incidence of illness is a function of the state of awareness among the people in the household. The presentation of the list of illnesses reported and diagnosed is done to show the

frequency with which each illness occur. This helps in identifying those with highest frequency and how each of them affects maternal health. A majority of these illnesses are transmitted from the sanitary condition of the environment where, women, as a result of their traditional roles work. It is therefore instructive that women's living condition predispose them to poor household environment that cause these illnesses.

Table 2 shows respondents' incidence of illness in their last/present pregnancy. Some 53.7 percent agreed that they suffered one illness or the other in their last/present pregnancies while 42.4 did not suffer any illness.

**Table 2:**  
**Percentage distribution of respondents by incidence and type of illnesses (N=823)**

	Frequency	Percent
<b>Did you fall sick in you last pregnancy</b>	442	53.7
<b>Illnesses Suffered</b>		
<b>{Self Reported}</b>	538	
Malaria	244	65.4
Typhoid	148	29.6
Ringworm	82	18.0
Guinea worm	71	10.0
Cough	56	8.6
Tuberculosis		6.8
<b>Diagnosed</b>	206	
Hypertension	183	25.0
Anemia	74	22.2
Others	66	9.0
Hemorrhage	64	8.0
Eclampsia	38	7.8
Sepsis		4.6

Note: Multiple responses was allowed for categories above



**Table 3:**  
**Distribution of respondent by type of accident**

	Frequency	Percent
No Response	224	27.2
A fall	290	35.2
Broken limb	109	13.2
Minor accident	200	24.3
Total	823	100.0

### Access to and utilization of maternal health facilities

Access and utilization of antenatal care facilities determines the health outcome of mothers. The source of this care also goes a long way to affecting the health outcome of expectant and/or lactating women. Patronising TBAs is negative health behaviour because it has been shown to be a poor health facility for women of reproductive age. The reason for the choice of maternal health facilities is also crucial to positive health outcome. The data presented here depicts that a majority of the respondents did not use modern health facilities because there is no viable alternative. This is likely to have negative effect on maternal health as a result.

Over 50 percent of the respondents indicate that they have not stopped giving birth and 46.3 percent indicated that they have stopped. It follows that the risk of pregnancy or childbirth complications is still common and they would be ready to do anything to protect themselves against these complications.

It is instructive that 80.3 percent of the respondents in the table above use Traditional Birth Attendants as their source of antenatal care. Those who use Government hospitals are only 16.5 percent. This is a very low maternal health attendance.

Table 4 shows those factors that determine respondents' choice of source of antenatal care. Some women are aware of these factors, their choices are therefore informed. The table further indicates that cost is the most important factor in the choice of antenatal care. Almost all the respondents (97.4 percent) were influenced by cost relative to other factors.





**Table 4:**  
**Distribution of Respondents by Source of Antenatal care (N=823)**

Source	Frequency	Percent
TBAs	661	80.3
Govt. hospital	136	16.5
Private hospital	26	3.2
Others: Faith Healing	97	11.8

Note: Multiple responses was allowed for categories above

**Table 5:**  
**Distribution of Respondents by Reason for choice of antenatal care facilities (N=823)**

Reason	Frequency	Percent
Cost	802	97.5
Distance	261	31.7
Culture	220	26.7

Note: Multiple responses was allowed for categories above

## Bivariate Analysis

### *Socio-Economic Status of Women and Maternal Health Status*

Table 6 presents information on the effects of socio economic status of women on their health status. The table indicates that about 40 percent of divorced, separated, or widowed (DSW) women have good health status compared with 32 percent of those who are currently married. The table indicates that ever married women have better maternal health status in

comparison to single mothers. The chi-square test of association shows that there is no significant relationship between marital status and maternal health outcome.

**Table 6:**  
**Distribution of respondents by socio economic status and maternal health outcome**

Socio economic Status	Maternal Health Status				X <sup>2</sup>	Df	P
	Good	Moderate	Poor	Total			
<b>Marital Status</b>	27	43	16	86	7.950	4	.068
Single	31.4%	50.0%	18.6%	100.0%			
Married	183	322	58	563			
	33.6%	57.7%	10.4%	100.0%			
DSW*	58	76	13	174			
	39.5%	51.7%	8.8%	100.0%			
<b>Total</b>	<b>263</b>	<b>441</b>	<b>87</b>	<b>791</b>			
	<b>33.6%</b>	<b>52.9%</b>	<b>12.6%</b>	<b>100.0%</b>			
<b>Educational Qualification</b>							
No schooling	68	95	22	185	3.639	6	.727
	36.8%	51.4%	11.9%	100.0%			
Primary	82	126	24	232			
	35.3%	54.3%	10.4%	100.0%			
Secondary	66	130	24	220			
	30.0%	59.1%	10.9%	100.0%			
Tertiary	47	90	17	154			
	30.5%	58.4%	11.0%	100.0%			
<b>Total</b>	<b>264</b>	<b>441</b>	<b>87</b>	<b>791</b>			
	<b>33.2%</b>	<b>55.8</b>	<b>11.0%</b>	<b>100%</b>			
<b>Occupation</b>							
Trader	52	123	24	199	13.804	6	.033
	26.1%	61.8%	12.1%	100.0%			
Farmer	119	196	32	347			
	34.3%	56.5%	9.2%	100.05			

Civil Servant	66 34.4%	102 53.1%	24 12.5%	192 100.0%			
Others	26 49.1%	20 37.7%	7 13.2%	53 100.0%			
<b>Total</b>	<b>263</b>	<b>441</b>	<b>87</b>	<b>791</b>			
	<b>35.0%</b>	<b>52.5%</b>	<b>12.5%</b>	<b>100.0%</b>			
<b>Last Month Income</b>							
<N1, 000	100 32.2%	148 52.1%	36 12.7%	284 100.0%	9.707	8	.30 1
N2,000-N5,000	70 31.5%	133 59.9%	19 12.4%	222 100.0%			
N5100-N10,000	43 28.1%	91 59.1%	19 12.4%	153 100.0%			
N10,100-N15,000	28 35.0%	46 57.5%	6 7.5%	80 100.0%			
>N16,000	22 42.3%	23 44.6%	7 13.5%	52 100.0%			
<b>Total</b>	<b>263</b>	<b>441</b>	<b>87</b>	<b>791</b>			
	<b>33.8%</b>	<b>54.5%</b>	<b>11.7%</b>	<b>100.0%</b>			
<b>Age at first birth</b>							
<15yrs	31 33.7%	48 52.2%	13 14.1%	92 100.0%	14.684	6	.00 8
15-19yrs	103 35.9%	161 56.1%	23 8.0%	287 100.05			
20yrs>	120 31.0%	224 57.9%	43 11.1%	387 100.0%			
<b>Total</b>	<b>254</b>	<b>433</b>	<b>79</b>	<b>791</b>			
	<b>33.5%</b>	<b>55.4%</b>	<b>11.1%</b>	<b>100.0%</b>			

\* Divorced, separated and widowed marital statuses were merged for the chi-square analysis to improve the reliability of the test.



The table further examines the relationship between educational qualification and maternal health status. There is no significant relationship between educational qualification and maternal health status. Though education influences people's perceptions and dispositions towards different activities including health activities and behaviour, the data did not support this assertion. It is obvious that depending on a particular environment, the relationship between education and maternal health status may produce different results.

The relationship between monthly income and maternal health status among women in the study area is also examined. Though there is no statistical association between monthly income and maternal health outcome yet, women with higher earnings perform better in terms of maternal health outcome relative to those with lower earnings. Women earning N16, 000 had the highest percentage of good maternal health status (42%) compared to about 30 percent of those earning less than N1, 000 monthly.

The displays of the relationship between age at first birth and maternal health status shows a progression from the least percent of age less than 15 to 20 years and above. Considering this graduation from the younger ages to older ones, it is obvious as indicated by the Pearson chi square test of association that there is a significant relationship between age at first birth and maternal health status.

### **Household environmental condition/structure and maternal health**

The household environmental condition is presented to show its statistical relationship with maternal health outcome. Most of the household variables show a consistent positive relationship with maternal health. The table below examines the effects of household environmental structure/condition on maternal health status. Households that used flush toilet facility have the best maternal health status with almost seventy percent of good maternal health. Households that use latrine, bush and river have the poorest maternal health status (31 percent of good health). This supports scholars who have stated that the type of toilet facility used affects maternal health (WHO, 2002).

The table also shows that households with 1 – 3 number of sleeping rooms have better health status relative to those who have 4 and above rooms. This finding indicates that the fewer the number of sleeping rooms, the better health status because there is a progression from one to three rooms with 43.2 percent to 17.9 percent of good maternal health for households with 8 rooms and above. Well water is the best source of drinking water in the

study area. Households that used well water have over forty percent of good maternal health status. The table also indicates that households that used electricity/gas have the best maternal health status with over 40 percent among cooking facilities variables. It is interesting to note that all the household variables show a significant consistent association with maternal health at .05 alpha level. Though roofing materials did not show any statistical association with maternal health yet households that used asbestos for roofing have the best maternal health status with almost fifty percent of good maternal health status against about thirty percent of other roofing materials.

From the qualitative data, some women could not relate clearly how these sources – water, toilet, cooking facilities affect morbidity and mortality among women. They rather observed that carelessness with these materials exposed women to harm. This assertion is in line with studies that indicated that lack of knowledge on the effects of some household activities is often responsible for poor health among women (UNICEF 2007). The women's emphasis was on lack of money to buy what is good for them, though a few disagreed stating that poverty should not be use as excuse for unhygienic living habits.

**Table 6:**  
**Distribution of respondents by household status and maternal health status**

Household facilities	Maternal Health Status				X <sup>2</sup>	Df	P
	Good	Moderate	Poor	Total			
<b>Toilet facilities</b>							
Latrine/Rivers/Others	95 31.0%	165 53.5%	46 15.9%	306 150.5%	15.780	4	.002
Flush	6 66.7%	2 22.7%	2 10.0%	9 100.0%			
Pit	194 38.8%	273 58.8%	40 7.9%	507 100.0%			
<b>Total</b>	<b>295</b> <b>44.0</b> <b>%</b>	<b>440</b> <b>45.0%</b>	<b>88</b> <b>11.0%</b>	<b>823</b> <b>100.0</b> <b>%</b>			

<b>Rooms for sleeping</b>							
1- 3	139 43.2%	158 49.1%	25 7.8%	322 100.0%	30.174	4	.000
4 - 7	135 35.2%	198 57.7%	50 13.1%	383 100.0%			
8 +	21 17.9%	84 71.8%	12 13.8%	1.7 100.0%			
<b>Total</b>	<b>295</b> <b>44.0</b> <b>%</b>	<b>440</b> <b>45.0%</b>	<b>88</b> <b>11.0%</b>	<b>823</b> <b>100.0</b> <b>%</b>			
<b>Source of drinking water</b>							
Well water	77 42.1%	80 43.7%	26 14.2%	182 100.0%	17.545	4	.002
Surface	146 32.2%	271 59.9%	37 8.1%	454 100.0%			
Piped/borehole	72 38.9%	89 48.1%	24 13.0%	188 100.0%			
<b>Total</b>	<b>295</b> <b>44.0</b> <b>%</b>	<b>440</b> <b>45.0%</b>	<b>88</b> <b>11.0%</b>	<b>823</b> <b>100.0</b> <b>%</b>			
<b>Cooking facilities</b>							
Firewood	91 31.0%	180 61.2%	23 7.8%	294 100.0%	32.110	4	.000
Grasses/Others	174 28.6%	212 45.7%	37 25.7%	423 100.0%			
Electricity/Gas	30 41.1%	48 50.1%	27 8.8%	105 100.0%			
<b>Total</b>	<b>295</b> <b>44.0</b> <b>%</b>	<b>440</b> <b>45.0%</b>	<b>88</b> <b>11.0%</b>	<b>823</b> <b>100.0</b> <b>%</b>			

<b>Roofing materials</b>							
Thatch/Others	102 34.8%	150 34.1%	41 49.1%	293 100.0%	8.560	4	.670
Zinc	171 34.5%	270 61.0%	41 8.5%	482 100.0%			
Asbestos	22 46.8%	20 42.6%	5 10.6%	47 100.0%			
<b>Total</b>	<b>295</b> <b>44.0</b> <b>%</b>	<b>440</b> <b>45.0%</b>	<b>88</b> <b>11.0%</b>	<b>823</b> <b>100.0</b> <b>%</b>			

### Sanitation/hygiene behaviours and maternal health status

Table 7 below indicates that sanitation and hygiene behaviour have significant effect on maternal health status. Respondents who reported that they have bushes around their houses reported poorer health status in comparative terms with those who reported no bushes around their houses. Possession and use of mosquito net is also shown as affecting maternal health outcome, since those who reported having mosquito net have better health status.

Sanitation and hygiene behaviour affects the health status of the household members. This section shows that household with bushes are harmful to maternal health as the owners of pets have poor maternal health status in comparison to those who have no pets. Sanitation and hygiene behaviour has negative effect on maternal health and this section presents data on how these behaviours affect maternal health.

From the table, it is obvious that there is a strong association among sanitation and hygiene behaviour variables because the chi square test is significant. Hence, the null hypothesis is rejected and the alternative hypothesis is accepted and it states that sanitation facilities and hygiene behaviour have a significant relationship with maternal health status.

**Table 7:**  
**Distribution by Sanitation/Hygiene Behaviour and Maternal Health Status**

Are there bushes around your house?	Maternal Health Status				X <sup>2</sup>	Df	P
	Good	Moderate	Poor	Total			
Yes	128 33%	166 46%	41 21%	335 100.0%	10.517	4	.033
No	126 39.3%	262 60.9%	42 0.8%	430 100.0%			
<b>Do you use a mosquito net?</b>							
Yes	162 35.8%	244 54.0%	46 10.2%	452 100.0%	10.478	4	.045
No	94 28.7%	193 58.8%	41 12.5%	328 100.0%			
<b>Do you have pets in the house?</b>							
Yes	153 29.8%	317 60.5%	51 9.7%	524 100.0%	16.539	4	.003
No	103 39.8%	120 46.3%	36 13.9%	259 100.0%			
<b>Total</b>	<b>263 33.2%</b>	<b>441 55.8%</b>	<b>87 11.0 %</b>	<b>791 100.0%</b>			

### Access to and utilisation of antenatal care and maternal health status

Table 8 shows that there is a strong association between the attendance of antenatal care and maternal health status. Those who attended antenatal care had lower maternal health status than those who did not. This finding shows that though attendance of antenatal services is important for good maternal health status but women in the present study area who did not attend antenatal have better maternal health.



There is a strong association between time and knowledge of illness and health outcome among women. Those who took one month to notice any sickness have the highest percentage of good maternal health outcome, while those who took two and three months to notice their clinical condition have comparatively poorer maternal health outcomes. It is indicative that a progressive decline in health outcome prevails as longer periods are taken to realize health conditions.

**Table 8:**  
**Distribution of respondents by antenatal attendance and maternal health status**

Did you attend antenatal care during your last pregnancy	Maternal Health Status				X <sup>2</sup>	Df	P
	Good	Moderate	Poor	Total			
Yes	28 23.7%	81 68.6%	9 7.6%	118 100.0%	21.704	4	.001
No	22 32.8	44 65.7%	1 1.5%	67 100.0%			
<b>How long did it take you to notice illness?</b>							
1 Month	118 42.8%	142 50.7%	20 7.1%	280 100.0%	85.403	6	.000
2 Months	79 38.3%	113 54.9%	14 6.8%	206 100.0%			
3 Months	30 35.3%	44 51.8%	11 12.9%	85 100.0%			
<b>Total</b>	<b>623</b> <b>33.2%</b>	<b>441</b> <b>55.8%</b>	<b>87</b> <b>11.0%</b>	<b>791</b> <b>100.0%</b>			

### Multivariate analyses

Data in this section are subjected to multivariate analysis involving logistic regression. Three sets of independent variables are regressed on the dependent variable (Maternal Health Status). This involves the recategorisation of the dependent variable into '0' and '1', where '1' is the likelihood of good maternal health and '0' is the likelihood of poor maternal health. The

odds ratio that is one or significantly greater than one indicates that women with the attribute(s) are likely to have or experience good maternal health than the reference category, while a relative risk odds ratio significantly lesser than one indicates that women with this attributes are likely to have poor maternal health status.

**Table 9:**  
**Logistic regression on cultural practices and maternal health**

<b>Variables/categories</b>	<b>Model 1</b>
<b>Source of drinking water</b>	
Well water (ref)	1.00
Surface water	1.152
Piped/Borehole water	1.065
<b>Toilet Facilities</b>	
Latrine/River/others (ref)	1.00
Flush	.647*
Pit	.463*
<b>Is Facility Shared?</b>	
Yes (ref)	1.00
No	1.288
<b>Cooking Facilities</b>	
Firewood (ref)	1.00
Charcoal/Biomass	.2050*
Electricity/Gas	.2093*
<b>Roofing Materials</b>	
Bambo/Thatch (ref)	1.00
Zinc	1.760*
Abesto	1.034*
<b>No. of Rooms for Sleeping in Household</b>	
1-3 (ref)	1.00
4-7	1.119
8+	1.939.
<b>Presence of Unused pots</b>	
Yes (ref)	1.00

No	1.034
<b>Marital status</b>	
Single (ref)	1.00
Married	.1.534
Formerly Married	1.298
<b>Age</b>	
< 25 (ref)	1.00
25-39	.998
40+	1.139
<b>Educational Qualification</b>	
No schooling (ref)	1.00
Primary school	1.077*
Secondary& above	.991*
<b>Monthly income</b>	
< N1,000 (ref)	1.00
N2000-N5000	1.194*
N6000+	.616*
<b>Age at first Birth</b>	
< 15 yrs (ref)	1.00
15-19 yrs	.388*
20+	1.854*
<b>Occupation</b>	
Farmer (ref)	1.00
Trader	.948
Civil Servant & Others	.885
<b>Access to Maternal Health</b>	
No access (ref)	1.00
Access	1.833

### Discussion of findings

The household environmental conditions were examined with a view to determining their structure and possible impingements on the health of women who live in it. The study found that the household conditions affect maternal health negatively. For instance, the major



source of drinking water is from the stream and these streams are located in swampy areas. This source of water is not safe and is in agreement with the United Nations (2004) statement that most sources of water in rural areas of developing areas are poor and unsafe. A woman in an FGD in Ubang corroborated this when she stated that:

The source of our drinking water is not good because the stream is very far away and not everybody can get there and is located in the swamps but is perennial and pure. The only borehole we have is the sign of government presence in our area and the water from it is not good because it has oil on it. (Ubang, 28/4/07)

Another woman stated further:

The problem of drinking water is so bad that in the months of March and April, we rarely have it and nothing has been done to improve on the source of water. The promises we have received are many yet nothing has been done. The stream is far and old women like me cannot afford to trek the distance. (Alege, 29/4/07)

Studies have shown that the source of drinking water in any community is an index of the quality of life and its health status. The World Health Organization (2002) identified unsafe drinking water as a second leading mortality risk in high mortality developing countries. This position was also identified by Policy Project (2002) as responsible for the poor health status of members of any community.

The predominant toilet facility in use in the study area is the pit toilet, an indication that women are exposed to the risk of contacting toilet-borne infections. Pit toilets have been identified as a poor toilet facility because it is not hygienic and exposes those who use it to the risk of contacting different diseases. Woldemichael (2000) and Balk et al., (2004) stated that the pit toilet is harmful to the health of its users. The bush and field are also facilities in use and they do not provide healthy and hygienic health.

The cooking facilities used in the study area are not safe. The commonest facility for cooking is firewood and the reason for its use was advanced by a 40 year-old woman that:

We use firewood because it is the only source that is readily available, affordable and easy to use. We cannot use electricity because we do not even have electric power. The only other facility that most people use is the charcoal because we have very big trees that can be burnt for charcoal. Besides, we go to the farm every day, it is easy for us to carry firewood from there and it makes life easy for village people (19/04/07).

Another woman observed that:

Firewood is commonly used because that is the only means by which we can cook our food and provide heating for the household/ there is no electricity and gas in the rural area is out of the question. Some of us know that this facility is harmful to health but there is no practical alternative hence we use what we have (20/04/07).

The widespread use of firewood exposes women to domestic combustion of wood during cooking. Smoke emanating from wood combustion has been found to be harmful to the health of the people, and women are most vulnerable when pregnant or lactating.

Writing on cooking facilities, Colosimo and Curlos (2004, p.23) indicated, "Some three billion people worldwide burn traditional biomass (e.g. wood, charcoal) indoors for cooking and heating". The World Health Organization (2000, p.34) also stated that "this widespread use results in the premature death of an estimated 1.6 million people each year from breathing elevated levels of indoor smoke, with women and children being most significantly affected." The organization went on to say that, "indoor air pollution from household energy ranks as the fourth leading health risk in poor developing countries. Besides, breathing elevated levels of indoor smoke from home cooking and heating more than doubles a woman's risk of serious respiratory infection and may also be associated with adverse pregnancy outcomes". WHO (2003) pointed out that women of reproductive age are at a higher risk of exposure to the smoke emitted from burning coals and firewood. It is because this category of women is more sensitive to this environmental health conditions because of their state (pregnancy) and traditional role of cooking. These findings are in line with the quantitative data that showed a significant relationship among the variables in the household and how they influence maternal health.

Findings on socio economic status show a comparatively high percentage of single mothers. As indicated, the age at first birth in the study area is predominantly young because in the opinion of one male interviewee in Wanokom "Ladies in the rural area tend to have children earlier than their counterparts in the urban centres". The reasons for this according to him are that:

They do not have any serious activities that occupy their time. They do not go too far in school and there are no opportunities here except the ones of getting a husband at the slightest opportunity and beginning childbirth in earnest.

The researcher also observed a high level of sexual permissiveness among the people because many young women of about 15 years reported to have given birth in the last one year. Most of these young women are still in their parents' house that is, not yet married.

The educational qualification of respondents showed a relatively high level of literacy among women in the study area compared to the national female literacy rate of 35 percent. The high proportion of the population with secondary school or higher qualification means that women in the study area are knowledgeable about maternal health issues. Besides, the high number of educated women indicates that they are potential change agents in the rural area hence advantageous to maternal health.

However, the analysis shows that there is no significant relationship between educational qualification and maternal health status. Though education influences people's perceptions and dispositions towards different activities including health activities and behaviour, the data did not support this assertion.

The age at first birth in the study area is very young and affects women's health status. This is obvious because the communities under study have people who have their first babies when they were below 15 years. The reason for this situation is that since the communities are predominantly poor, young women are often enticed by the financial assistance they are likely to receive or are receiving from the male folk, which predispose them to early pregnancy and poor maternal health. After a man impregnates a woman, he moves on to others who are readily available. This observation is further supported by an IDI respondent.

The data further indicates a strong and significant relationship between age at first birth and maternal health. Respondents who had first babies when they were above 20 years have better maternal health than those who had them earlier. Women who had their babies later are most likely to experience good maternal health status compared to those who had their babies later.

Women occupations have also been identified as having effects or influence on their health. A majority of the women in the study area are farmers. Kettle (1996) noted that women are subjected to precarious health conditions by the nature of their activities like farming and this affects their health. He noted further that the peculiar physiology of a pregnant/lactating woman makes her vulnerable to ill-health caused by the different activities she carries out in the environment.



## Accidents, sanitation/hygiene behaviour and maternal health

Almost all the women have had one form of accident or the other. This is indicative of the type of activities women engage in and these have implications for their health status.

One woman of age 45+ years in Ukpah, in an interview session stated:

In almost all the places we carry on our activities, we are at the risk of having accidents even when pregnant. We trek long distances to fetch water climbing hills and passing through swampy areas. We go to the farm and often it is located in mountainous areas. Even at home, we face the threat of accidents. We thank God that we are alive (Ukpah 14/03/06).

Another woman observed that:

The farms are located in mountainous areas and our efforts to different places we go in search of leaves and other income generating crops expose us to accidents (Alege,18/04/06).

These responses are in line with scholars like Akhtar (1987, in Kettel, 1997) who maintained that the household life space forms the primary arena within which women operate. They seek food, fuel, water, shelter, fodder, fertilizers, building materials, medicines, the ingredients of income generation and wages in support of their activities as individuals, wives and mothers. These different places and efforts become a “disease environment” – that is, aspects or place within women’s life spaces that support environmental illness. These different life spaces further reintroduce environmental illnesses through the disruption of the equilibrium in the biophysical environment. This is because while the woman struggles to provide for the need of her family, the diseases found in the different life spaces where she interacts, make her easy prey to these environmental risks.

Most of the respondents have a good knowledge of what is cleanliness by the way they arranged their homestead. A 39-year-old woman in Utanga stated:

It will be an eyesore if ones’ house is not at least kept clean by sweeping daily. This will keep away creeping insects that might be harmful to children. I try my best to see that my small house is habitable for my children.

Women with positive disposition towards cleanliness are more likely to have good maternal health outcome in comparison to those with negative disposition. This is because the



environment where one lives goes a long way to determining the health outcome of its inhabitants. This position was further extended by the World Health Organization (2002), which indicated that among the 10 leading mortality risks in high mortality developing countries, unsafe water, sanitation and hygiene ranked second and pregnant/lactating women are very susceptible to the harmful effects of these threats in their environments.

### **Attendance of antenatal care and maternal health**

Most of the respondents did not respond to the question "Did you attend antenatal care during your last pregnancy". One 45+year-old women indicated the reason for non attendance of antenatal care:

We do not even understand what antenatal care is all about. I cannot answer a question I am not sure of the meaning. There are no hospitals in our neighbourhood. The health centres that are here are rarely opened and they only treat wounds.  
(29/4/07)

The implication is that a majority of women do not attend antenatal care during pregnancy because the health centres are not available and this predisposes them to the risk of poor health. Hospital attendance, as a source of antenatal care is low and this is attributed to absence of hospitals or the people's beliefs and attachment to the normative practices and values relating to Traditional Birth Attendants (TBAs).

As indicated, there are no hospitals in the communities under study, there are few health centres in each local Government area but they do not have a doctor, and the health workers are rarely present at those centres. On investigation, it was found that there is an acute shortage of doctors/nurses in the area. Even the government hospitals in the local government headquarters rarely have a resident doctor. These factors therefore limit rural people from embracing modern maternal health care. These conditions explain the choice of TBAs for prenatal and delivery care. A 64 year-old TBA stated that:

Pregnant women are always here, many come either for medication to get pregnant or for advice on how to manage their pregnancies. You can go inside there and see some that are waiting for me (pointing to her consulting room). I have delivered several children that I can no longer keep count. They come here because the medicine is effective and affordable (TBA, 1/5/07).



The statement of the TBA clearly indicates that she has a large number of patients. When the researcher went into the room she earlier pointed at, there were four pregnant women and two others. One of the women said that her legs were swollen and she came to complain to *Mama*, as she is called. The other two said they have some movements within them and were there to see her too. The two women that were not pregnant said they had been coming there for months taking drugs that they hoped would make them get pregnant. When those who said they were feeling movements within them were asked whether they had gone to a hospital with this complain, one of the women said:

I do not need to go there because the place is far and very expensive. She (that is the TBA) has given this medicine to many women and these women have recovered. I do not see how my own case will be different.”

This shows the attachment of the people to TBAs and the attitude of the people towards modern maternal health facilities. The belief is that it worked for others; therefore it must work for them too. This impression can be dangerous for maternal health related cases.

## Recommendations

The study established that maternal health outcome among the people of Northern Cross River State is inadvertently tied to the household environmental condition. It is also tied to the community structural condition, that is, macro level (the social systemic factors). The implication, therefore, is that recommendations should be able to relate to the specific environmental condition and the community systems to improve on maternal health outcome. The recommendation flowing from the above is classified into three broad activities, which include sensitization and education, Government and communal intervention and academic dissemination of scientific information.

The household environment in the rural area is injurious to the health of child bearing women. There is an urgent need to change the present idea of relegating the rural areas in the location of health facilities. The infrastructural facilities in this area should be improved through the location of health centres to provide adequate health services to the inhabitants since a majority of the country population reside here.



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## Conclusion

The findings of this study have shown the links that exist between the household environmental condition and maternal health among rural women of Northern Cross River State by indicating and identifying individual household condition, communal values, attitudes and behaviours that impinge on maternal health.



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## Notes

There are no contending interests whatsoever. This is a part of my thesis for a higher Degree that has already been awarded.