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FERTILITY DETERMINANTS AMONG WOMEN IN WESTERN TANZANIA: A COMPREHENSIVE STUDY

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Abstract

Numerous studies in Sub-Saharan Africa during the 1990s highlighted alarmingly high fertility rates, leading to global concerns. Subsistence farming, a common practice in the region, heavily relies on children as a primary labor source. Consequently, parents often perceive the quality of their children's human capital as a substitute for quantity. This heightened the global awareness of fertility issues. Researchers have established a negative relationship between fertility and economic growth, emphasizing the potential for unchecked fertility to perpetuate poverty at both the household and national levels.

In 1992, the Tanzanian government introduced its initial population policy to address high fertility rates, subsequently revising it in 2006. Tanzania's current Total Fertility Rate (TFR) stands at 5.2, one of the lowest in Sub-Saharan Africa but significantly high compared to global TFR levels. The Kigoma Reproductive Health Survey of 2014 indicates a consistent decline in fertility rates across Tanzania. From 1989 to 1996, the Total Fertility Rate dropped from 6.3 births per woman to 5.8 births. The most recent data from the TDHS-MIS 2015-16 suggests a TFR of 5.2 children per woman. Notably, childbearing peaks among women aged 20-24 at 236 births per 1,000 women and steadily declines thereafter, reaching 15 births per 1,000 women among those aged 45-49. Therefore, an effective strategy to control fertility involves delaying the marriage of young women during their early and fertile reproductive years.

Keywords: fertility, economic growth, poverty, population policy, Tanzania.

1. Introduction

Several researches on fertility of Sub-Saharan Africa in the 1990‟s found fertility rates to be very high (Garenne, 2008). Peasant farming is commonly practiced in sub-Saharan Africa with parents relying on their children as a major source of labour, thus, making parents view the human capital of their children (quality) as a substitute for their number of children (quantity) (Cancian & Meyer, 2014). Consequently, fertility has become a global concern. Researchers have proved the existing negative relationship between fertility and economic growth (Luci-Greulich, et al. 2014) which consequently shows that fertility if left unchecked would pave way to poverty both at the household and national levels. In 1992, the government of Tanzania initiated its first population policy to tackle issues of high fertility rates which was later revised in 2006. Tanzania‟s Total Fertility Rate (TFR) of 5.2 as it is at present is considered to be one of the lowest in Sub-Saharan Africa, but very high compared to the

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world‟s TFR levels, (TDHS-MIS, 2015-16). Tanzania is experiencing a sustained decline in fertility according to the Kigoma Reproductive Health Survey (RHS, 2014). The Total fertility rate decreased from 6.3 births per woman in 1989 to 5.8 births in 1996. Currently, fertility measures calculated from the TDHS-MIS 2015-16 indicate that the Total Fertility Rate for Tanzania is 5.2 children per woman. Childbearing peaks at age 20-24 at 236 births per 1,000 women, and drops steadily thereafter, reaching 15 births per 1,000 women at age 45-49. This means, a good measure for controlling fertility is one that will delay marriage of females in their early and fertile reproductive ages.

This step will consequently reduce their fertility as they will start reproducing after their peak, thus reducing the number of children a prospective mother can afford within her reproductive life cycle. The total population in Tanzania as at 2012 was 44,928,923 with about 48.7% constituting the female population. With the population growth rate of 2.7 percent per annum, Tanzania‟s population is projected to rise up to 69.1 and 129.1 million in 2025 and 2050 respectively (PRB, 2013).

The decline in fertility rates and mortality rates has not only changed the size of population, but has also changed the age-structure of male and female populations across various countries including Tanzania. These changes in the age composition of the female population are anticipated to have an effect on the average fertility rates. There are differences in fertility performance between urban and rural areas of the country and equally there are regional and socio-economic differentials. These marked differentials affect fertility in different ways and require different measures to shape the population of various regions that will be beneficial to the populace in ways necessary to propel development.

Up to the year 2010, fertility was highest in the western zone of Tanzania where there was a TFR of 7.2 births for each woman and lowest in the eastern zone where there were 3.9 births for every woman. According to the TDHS-MIS 2015-16, the TFR in the country ranges from lows of 3.8 children in the Southern Zone and 3.9 children in the Eastern Zone to highs of 6.4 children in the Lake Zone and 6.7 children in the western zone. Evidence has suggested the existence of wide variations in total fertility rates among the nine geographical zones of the country. This is indicative that Tanzania‟s high fertility is largely driven by the TFR of the western zone. It could therefore be argued that the slow overall national fertility decline is mitigated by the persistently high fertility regimes of the western zone.

Since the adoption of the National Population Policy to improve the quality of life and standard of living of Tanzania‟s population of 54,199,163 (URT, 2018), the interest on goals 1, 2 and 3 of the document has attracted many researchers. The interest in the determinants of fertility in Africa has been considerable (Casterline, 2017) perhaps because it is an important developmental problem, which is related to economic growth and poverty (Škare & Družeta, 2016), as well as maternal and child health (Kalipeni, et al. 2017). The Fertility level of a population does not only determine the current size but also has a positive or negative effect on the future economic growth of a population and demographic dividend. It should be noted that high fertility and rapid population growth are hindrance to economic growth and development; meaning that rapid population growth can result into a persistent poverty cycle in a household, society or a country as a whole (Santos & Barrett, 2011).

While high fertility has been strongly related to mothers in terms of their level of education, age at marriage, age at first birth, place of residence, employment status etc., studies on fertility level, especially in the western zone of Tanzania have not been prominent such that, there is lack of quantitative information on determinants of high fertility. For this reason, it is important to centre research efforts on the contributing factors to high fertility level in Tanzania"s western zone where it is exceptionally high in order to achieve the goals set in the Tanzania National Population Policy.

Modeling the determinants of fertility may assist in designing effective interventions leading to controlled population growth, improved child and maternal well-being, economic growth and poverty reduction. A good conception of the dynamics of these factors is of great importance to policy makers at all levels. This study therefore seeks to explore the effects of individual fertility levels on population growth, poverty, economic growth and maternal and child health in the western zone of Tanzania. The specific objectives are twofold. First to model the fertility performance in western Tanzania using the Negative Binomial Regression model and secondly to examine those factors that drive high fertility level among women of reproductive age in western Tanzania. The need for this study arises from the contention that there is insufficient research in this methodological approach of which its principal aim is to increase understanding of fertility and its contributions to the social and economic spheres of mankind which may enable policy makers and practitioners to design and scale up promising programs for addressing rapid population growth.

2. Materials and Methods

2.1 Study design, sample size and data collection

The data on female populations used to estimate the fertility levels at the regional level was based on secondary data taken from the 2015-16 TDHS-MIS which was conducted at a national scale by the National Bureau of Statistics. The study used a quantitative approach to build the econometric fertility model. The 2015-16 TDHS-MIS had a stratified sample selected in two stages from the 2012 census frame. Of the three regions Kigoma, Tabora, and Shinyanga which constitute the Western Zone, the data used in this study were drawn solely from Tabora and Kigoma following the 2015 TDHS-MIS composition of the 9 geographical zones. Stratification was attained by delineating each region into urban and rural areas; the urban and rural areas of each region constituted a sampling stratum.

In this study, sub-samples were selected independently in each sampling stratum, by a two-stage selection. Using a stratified two-stage cluster design with a fixed number of 20 households selected per cluster, the total number of households selected for the Tabora region was 407 and 429 for Kigoma region, thus making a sample size of 836 of which 170 households were from urban areas, and 666 from rural areas. Following this distribution, responses of a total number of 836 women between the ages of 15-49 years were used for the analysis.

2.2 Analytic Framework

2.2.1 Variables

The main outcome variable (dependent) in this analysis was the level of fertility defined by the total number of CEB by women of childbearing age of 15-49 years which is a count variable that assumes a non-negative whole number value (greater than or equal to 0). The predictor variables which influence the level of fertility were divided into two categories: the selected proximate determinants of fertility included current marital status, polygyny, age at first marriage, age at first sexual intercourse, age at first birth, postpartum amenorrhea, abstinence, and infecundability, contraceptive knowledge as well as contraceptive use. The other category comprised selected socio-demographic variables found to significantly impact the level of fertility in Tanzania. These variables included place of residence (rural versus urban), region of residence, mother‟s work status, personal wealth index (Poor, Average, Rich), highest mother‟s educational level, husband‟s education, and husband‟s occupation. All women of reproductive age were included because; it was aimed at predicting fertility of women irrespective of their background characteristics. The variables were coded as presented in Table 1.

Table 1. Description of Variables

S/N	Variables	Description
1.	Region of residence	1= Tabora 2 = Kigoma
2.	Place of residence	1 = Rural 2 = Urban
3.	Mother‟s education	0 = No education 1 = Primary 2 = Secondary 3 High
4	Husband‟s education	0 = No education 1 = Primary 2 = Secondary 3 High
5	Husband‟s occupation	0 = Working 1 = Not working
6.	Wealth Index	1 = Poorest 2 = Poorer 3 = Middle 4 = Richer 5 = Richest
7.	Breastfeeding	0 = No 1 = Yes
8.	Contraceptive knowledge	0 = No 1 = Yes
9.	Contraceptive use	0 = No 1 = Yes
10.	Marital Status	0 =Single 1 = Married 2 = Divorced 3 =Widowed
11.	Age	1 =15-19 2 =20-24 3 = 25-29 4 = 30-34 5 = 35-39 6 = 40-44 7 = 45-49
12.	Age at first sex	1 = < 18 2 = 18-30 3 = 31-49
13.	Age at first birth	1 = < 18 2 = 18-30 3 = 31-49
14.	Age at marriage	1 = < 18 2 = 18-30 3 = 31-49
15.	Mother‟s work status	0 = Working 1 = Not working
16.	Polygyny	1 = polygynously married, 2 = Not polygynously married
17.	Abstinence and unsusceptibility	1=susceptible, 2=nonsusceptible

Source: Modeling Fertility Determinants, 2019

2.2.2 Model Specification and Estimation

The measure for fertility is the number of live children ever born during the respondent‟s lifetime. The fertility yardstick is a count data model. Poisson regression, a member of the class of models known as generalized linear models (GLM), is the standard method used to model and analyze count data (Kazembe, 2009; Ismail & Zamani, 2013**;** Abdulkabir et al, 2015**).** However, when there is

heterogeneity in the data, it is likely that the Poisson model is over dispersed. Such over dispersion is indicative of the variance of the response being greater than its mean. Prefatory diagnostic tests normally demonstrate that the data are susceptible to over dispersion. Assessment with
Negative Binomial regression specifically addresses the problem of over dispersion in the data. Log negative binomial (LNB) regression is most effectively used to model count data which violate the Poisson assumption of the equality of mean and variance.
The Negative binomial model is one of the paradigms or frameworks used to examine the relation between the number of children ever born and the socio-economic and demographic variables of women derived from the survey. LNB regression is one of the robust models for the analysis of discrete data that are based on the assumption that the dependent variable (number of live births to a woman) is distributed as Poisson, and its logarithm is a linear function of the covariates. In a Poisson regression analysis, the dependent or response variable, namely, the number of events, i.e., the number of children ever born is a non-negative integer and has a Poisson distribution with a conditional mean that depends on the characteristics (the independent variables) of the women. The model therefore includes observed heterogeneity according to the following structural equation:

$\mu i = \exp(\alpha + X_{1i}b_1 + X_{2i}b_2 + \ldots + X_{ki}b_k)$..(1)

where: μ_i is the expected number of children ever born for the ii^{th} woman; X_1i, X_2i … X_{ki} are her characteristics; and a, b_1, b_2 … bk are the Poisson regression coefficients. A selection of (characteristics) independent variables is used which reflects socio-economic and locational characteristics that have been shown to be associated with fertility. The independent variables pertain to age, education, residence, regional location, and marital status. Some are estimated as an indicator or qualitative variables, and others as interval. The Poisson regression model is a non-linear model, predicting for each individual woman the number of children she has had ever born to her, $\mu_{i.}$ The X variables are related to μ non-linearly.
It is noted at the earliest stage that the Poisson regression model accounts for observed heterogeneity (i.e., variation/differences among cases which are not measured) by stating explicitly the predicted count, μ as a result of the observed independent variables (Long & Freese, 2006). Often, however, the Poisson regression model does not fit the observed data because of over-dispersion. In the negative binomial regression model, variation in μ is due both to variation in the independent variables among the individuals (in the sample population) and to unobserved heterogeneity introduced by „ε‟ (Hilbe, 2014). The term ε is a random error that is taken to be unconnected to the independent variables … It may be considered either as the joint effects of latent variables that have been omitted from the model or as another source of pure randomness (Cameron & Trivedi, 2013).
Finally, this study modelled the children born as a function of socioeconomic and demographic factors. Children ever born, is a count variable taking a non –negative value. The econometric model of the determinants of fertility used the negative binomial regression for analysis. The negative binomial regression model consequently attaches to the Poisson regression model the error term ε according to the structural equation specified below:

$\mu i = \exp(\alpha + X_{1i}b_1 + X_{2i}b_2 + \ldots + X_{ki}b_k + \varepsilon_i)$..(2)

Where:
X_1 is region with two dummy variables namely Tabora and Kigoma; X_2 is residence with two dummy variables rural and urban; X_3 represents education with four dummy variables representing the levels of education of the women, namely, no education; primary education; secondary education; and higher education. X_4 is for wealth with five dummy variables namely poorest, poorer, middle, richer and richest. X_5 is breastfeeding with two dummy variables, yes and no and also X_6 is contraceptive knowledge with the same two dummy variables X_7 is contraceptive use with two same dummy variables again.
X_8 is marital status with four dummy variables namely single, married, divorced and widowed. The predictors
follow the pattern displayed in table 1.

2.2.3 Test of Over Dispersion and Goodness of Fit

To investigate the presence of dispersion in the count data, estimates of a Poisson regression model were taken along with a Negative Binomial regression model, and an estimate of the similarities and dissimilarities of the results of the two models was made. The Pearson Chi-square value was divided by the degrees of freedom. A value greater than 1.0 indicates over-dispersion and a value less than 1.0 suggests under-dispersion. As regards goodness of fit; *Measures* of *goodness of fit* typically summarize the discrepancy between observed values and the values expected under the *model* in question. Both candidate models were therefore considered in the process of selecting the one which fits the data well.

2.2.4 Criteria for Best Model Identification

This study determined the appropriate model by using the following tests: Deviance (likelihood ratio) statistic. Akaike information criteria (AIC) and Bayesian information criterion (BIC) for model evaluation and to assess the best model. Comparison of the values obtained was done for each of the two candidate models. The model with a lower value of AIC or BIC suggests a better fit. The AIC is estimated as:

$$AIC = -2^{*}\ loglikelihood + 2^{*}\ nupar$$

Where nupar is the number of parameters in the fitted model. The models were examined using the HYBRID (encompassing both Fisher and Newton-Raphson methods) procedure of the SPSS GENLIN with a strong covariance (standard error) estimator in the IBM SPSS software (version 20).

2.2.5 Multicollinearity

The problem of multicollinearity arises when two or more explanatory variables are highly correlated which undermines their statistical significance. The presence of multicollinearity among the variables in the model was checked by first examining the tolerance and variance inflation factors (VIF) and secondly the correlation matrix. One of the aims of examining these correlations is to identify collinearity. High pair-wise correlations could be the first indicators of collinearity problems.

3. Results

3.1 Socio-economic and Demographic Characteristics of Women by Mean number of Children Ever Born

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Preliminary summary statistics of proximate, socio-economic and demographic characteristics of respondents are presented in tables 3 and 5. A total of 836 records of women within childbearing age (15-49 years) were extracted and produced a mean of total CEB = 3.06 and standard deviation (SD) = 3.02. The weighted average age of the research respondents was 28.8 years (SD = 9.6 years). About 9% of the population had not been exposed to coitus and the mean age at first coitus was 16.9 years (SD= 3.7 years). Approximately two-fifth of the population had their first birth before 18yrs with a mean age of 19.4years (SD= 4.4 years), 38.4% were married while 26.7% were not in a union. About 62.6% of the population were found not using any contraceptive; however these women were aware of either a modern method of contraception or traditional method. Approximately two out of three of the respondents recruited were from the Kigoma region. 76.8% of all respondents lived in rural communities. About 16.9% belong to the poorest and none of them qualified to belong to the richest wealth quintile, however, those who fell in the middle quintile were 27.1 %.

Table 2. Frequency Distribution of Determinants of Fertility and Mean number of Children Ever Born by Selected Socio-demographic Characteristics

Proximate Characteristics	**Socioeconomic and Demographic Characteristics**
Variables Frequency Percentage CEB SE	**Variables Frequency Percentage CEB SE**
Total 836 100	Total 836 100
Age	**Region**
15-19 221 26.4 1.13 0.1061	Tabora 407 48.7 3.7 0.0813
20-24 166 19.9 1.46 0.0692	Kigoma 429 51.3 3.6 0.0821
25-29 133 15.9 2.15 0.0841	**Total 836**
30-34 102 12.2 2.66 0.0929	**Education**
35-39 83 9.9 3.51 0.1038	No Education 125 15.0 3.7 0.1086
40-44 76 9.0 3.72 0.0833	Primary 391 46.77 3.7 0.1179
45-49 55 6.6 3.76 0.0825	Secondary 252 30.14 3.2 0.7245
Mean ± **σ 28.8±9.6**	Higher 68 8.13 2.7 0.5741
Age at First Sex	**Total 836**
Not had sex 75 9.0 - -	**Wealth Index**
<18 years 471 56.3 - -	Poorest 141 16 .9 3.3 0.5453
>18 years 290 34.7 - -	Poorer 147 17.6 2.3 0.5111
Mean ± **σ 16.897+3.656**	Middle 227 27.1 2.1 0.4977
Age at First birth	Richer 176 21.3 2.1 0.4384
<18years 304 36.3 2.54 0.2034	Richest 143 17 .1 2.1 0.3945
18-30years 407 48.7 2.89 0.0445	**Place of Residence**
>30years 125 15.0 3.72 0.0607	Urban 194 23.2 2.1 0.7506
Mean ± σ 19.35+4.365	Rural 642 76.8 3.8 0.8342
Age at First Marriage	**Total 836**

<19years 172 20.6 2.02 0.2034 20-30years 468 56.0 3.21 0.0445 >30years 196 23.4 3.52 0.0843 **Mean ± σ 19.27+4.246** **Current Marital Status** Single 323 38.6 2.08 0.0919 Married 421 50.4 3.53 0.0815 Widowed 48 5.7 2.40 0.0165 Divorced 44 5.3 2.42 0.0623 **Contraceptive Knowledge** Knows no method 516 61.7 - - Only folkloric method 43 5.2 - - Only traditional method 204 24.4 - - Knows modern method 73 8.7 - - **Ever used contraceptives** Yes, ever used 105 12.5 2.34 0.0814 Currently using 208 24.9 2.19 0.0746 Never used 523 62.6 3.51 0.0908 **Currently Breastfeeding** No 212 25.4 2.43 0.0822 Yes 624 74.6 2. 61 0.0902 **Polygyny** Polygynously married 250 29.9 2.39 0.0877 Not polygynously married 586 70.1 3.45 0.0963 **Abstinence and Insusceptibility** Susceptible 537 64.2 3.02 0.0833 Insusceptible 299 35.8 2.67 0.0792	**Employment** Not working 184 22.0 2.3 0.3453 Working 652 78.0 3.7 0.7706 **Total 836**

Source: Modeling Fertility Determinants, 2019

Table 2 presents the percent distribution of women with a summary of mean number of children ever born (CEB). The maximum (26.4%) women belong to age group 15-19 years. Most (47%) of the mothers received primary education. The proportions of employed and not-employed respondents were 78% and 22% respectively.

The proportion of women who gave first birth in the age group of 18-30 years was 48.7%. The mean CEB (3.8) in rural areas was higher than in urban settlements. The mean CEB by women‟s age 15-19 years was 1.13 while it was 3.76 for those aged 45-49 years. As expected the mean CEB was more for mothers with no education (3.7), married (3.53), and not employed (2.3) among their respective groups. Women currently using contraceptives had the lowest (2.19) CEB to those who ever or never used.

3.2 Model selection

The score test statistic (Pearson Chi-square value divided by the degrees of freedom) for over dispersion was χ2=4791.381 ($p<0.001$) for the Negative Binomial model, indicating that there was over-dispersion and thus the Poisson model was inappropriate.

For checking the overall goodness of fit, the deviance (likelihood ratio) statistic was applied separately to the poisson model. Accordingly, the deviance-based chi-square test provided a chi-square value of (χ^2 = 10532.401 with *p*value <0.001) which would imply good fit for the fitted Poisson model. Next the negative binomial regression model with the same explanatory variables was fitted. Again the deviance (likelihood ratio) test was used to compare the fit of the standard Poisson with Negative Binomial regression model. The statistical value obtained was significant, indicating that the Negative Binomial regression model was a better fit to the data than the standard Poisson regression model (χ^2 = 9294.304 with *p*-value <0.001) as table 3 shows.

Table 3. Results for Goodness of Fit and Model Comparison Between Poisson and Negative Binomial

Type of Test	Estimate	Poisson	Negative Binomial (NB)
Pearson Chi-square	Value	10532.4	9294.3
	Df	9879	9879
	Value/df	1.0459	0.9508
Akaike Information Criteria (AIC)		17236	16955.829
Bayesian Information Criterion (BIC)		17504	17236.707
Loglikelihood		-8494	-8438

Source: Modeling Fertility Determinants, 2019

Thus, the observed data are better explained by the Negative binomial than the Poisson model.

3.3 Diagnostic Tests

3.3.1 Test of Collinearity

3.3.1.1 Tolerance and Variance Inflation Factor

Multicollinearity test of 17 independent variables found in the original data set was conducted. Table 4 presents the results of tolerance and variance inflation factors (VIF).

Table 4. Test of Collinearity

Variable	Collinearity Statistics	
	Tolerance	VIF

Multidisciplinary International Journal of Finance and Accounting
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Age of the respondent (AR)	0.007	1.414
Age at first sex (AFS)	0.915	10.093
Age at first Marriage (AFM)	0.087	1.128
Age at first birth	0.031	1.241
Region of residence (RR)	0.073	1.134
Place of residence (PR)	0.066	1.546
Mother‟s Employment (ME)	0.060	1.163
Marital Status (MS)	0.066	1.154
Mother‟s Education Level (MEL)	0.026	1.211
Husband‟s educational level (HEL)	0.021	1.123
Husband‟s occupation (HO)	0.145	10.675
Abstinence and insusceptibility (ABS)	0.179	10.674
Wealth Index (WI)	0.092	1.262
Contraception knowledge (CK)	0.042	1.252
Use of Contraception (UC)	0.011	1.636
Duration of breastfeeding (DB)	0.057	1.233
Polygyny (P)	0.091	1.692

Source: Modeling Fertility Dterminants, 2019

For VIF values greater than 10 and tolerance values greater than 0.10, multicollinearity is deemed to be present (Bager, 2017). Examination of the tolerance and variance inflation factors shows that there is no existence of multicollinearity between the independent variables as variance inflation factor (VIF) was less than 10 and the tolerance was less than 0.10 for all the explanatory variables except three namely age at first sex, husband‟s occupation and abstinence and insusceptibility.

3.3.1.2 Pearson bivariate correlation

This study also used a Pearson bivariate correlation matrix to measure the existing relationships in terms of both magnitude and direction among the various explanatory variables. Table 5 presents the results.

Table 5. Pearson's bivariate correlations between the variables

AR AFS AFM ME MS ABS MEL HO HEL WI CK UC DB RR P

	**	-**	-1.00
P 0.41** 0.90 -0.25** -0.01 -0.04 0.85 -0.23** 0.92 0.04 0.16 -0.06 -0.23	0.36	0.12	
RR 0.22* 0.86 -0.18** -0.02 -0.13 0.82 0.11 0.83 0.20 0.14 -0.02 -0.17** -	0.22	1.00	
DB 0.00 0.89 0.27** 0.09 -0.16 0.86 0.11 0.92 0.16 0.02 0.12 -0.05	1.00		
UC -0.05 0.87 0.06 0.13 0.18 0.84 -0.10 0.97 -0.18* 0.04 -0.09 1.00			
CK 0.20* 0.89 0.08 0.11 -0.10 0.87 0.03 0.83 0.10 0.12 1.00			
WI 0.12 0.82 -0.10 0.01 -0.24** 0.83 0.09 0.94 0.24 1.00			
HEL -0.06 0.82 -0.03 -0.09 -1.00** 0.84 0.63** 0.92 1.00			
HO 0.42 0.86 0.51 0.37 0.63 0.88 0.35 1.00			
MEL -0.42** 0.81 0.04 -0.14 -0.63** 0.85 1.00			
ABS 0.48 0.86 -0.93 0.16 0.19 1.00			
MS 0.619** 0.87** 0.0001 0.046 1.00			
ME 0.108** 0.86** 0.055* 1.00			
AFM 0.619** 0.85 1.00			
AFS -0.078**1.00			
AR 1.00			

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

The strength of the association among these variables was explored whereby strongly and weakly correlated variables were measured by the coefficients close to absolute value of one and zero respectively. When the absolute value of Pearson correlation is greater than 0.8, collinearity is very likely to exist (Gujarati, 2014). Examination of the results showed coefficients of less than 0.8 indicating absence of collinearity except the three variables indicated in table 4. From these two diagnostic tests, the explanatory variables age at first sex, husband‟s occupation and abstinence and insusceptibility were removed in the analysis due to the problem of inconsistency, multi collinearity and singularity.

3.3 Negative Binomial Regression of Mean number of CEB

Results in Table 6 provide estimates of the effect of some selected characteristics of women of childbearing age on Children ever born in Kigoma and Tabora regions.

Table 6: Negative Binomial Regression Output
Dependent variable – Children Ever Born (CEB

Variable	Coefficient	standard error
Age		
1 =15-19	-.0455713***	.169153 2= 20-24 -.0320314*** .151167
3 = 25+ (Reference)		
Age squared	-.0023413***	.0001034 Age at first marriage

< 19 (Reference)
20-30 -.0407652*** .0021983
>30 -.0307351*** .0346223 Age at first birth
> 19 (Reference)
20-24 0.865362*** .0251422
25+ 0.734177 .0213112
Mother's education level
No education (Reference)
Primary -.0036028 .0176182
Secondary -.0650916*** .0241347 Higher -.2857603*** .0486499
Husband's educational level
No education (Reference)
Primary .093625 .0176956
Secondary -.08115 .039796
Higher -.092003 .015127
Wealth
Wealth quintile 1 (Poorest, Reference)
Wealth quintile 2 (poorer) .0200405 .0175337
Wealth quintile 3 (middle) -.0525027*** .0185794
Wealth quintile 4 (richer) -.112399*** .0234494
Wealth quintile 5 (richest) -.1840651*** .0309043
Region of residence
Kigoma (reference)
Tabora 0.071023 .0245556
Place of residence
Rural (Reference)
Urban .2287094*** .057998
Rural x Age -.0064212*** .0016785 **Contraceptive Knowledge**
Knows modern method (Reference)
Knows no method .032451** .0225346
Only folkloric method .224111 .0614522
Only traditional method .314237 .0681621 **Ever use of contraceptives**
Never used (Reference)
Not currently used .3117935 .0628631
Ever used .2849672*** .0613797 **Duration of Breastfeeding**
≥6 months (Reference)
>6 months .5113332 *** .0167283
Mother's work status -.03406** .0135323
Working (Reference)

Not working		
Husband's work status (Not salaried: Reference)		
Salaried	-.062376***	.0152433
Marital Status (Never married: Referenc**e)**		
Married	.1244543***	.059972
Widowed	-.0287172*	.0163072
Divorced	-.0334054**	.0129519
Constant	-.2452259***	.1225767
Polygyny		
Polygynously married (Reference)	-.2617323**	.0163523
Not polygynously married	.2349152**	.0589461

Log likelihood = -9449.8933
Pseudo $R^2 = 0.2460$
LR χ^2 (33) = 6167.61,
Prob > $\chi^2 = 0.0000$
* p<0.1, ** p<0.05, *** p<0.01

Source: Modeling Fertility Determinants, 2019

Empirical results pertaining to age reaffirm the expectation of the variable in the model. Individual-level controls include the age of the woman measured in years and an age squared variable accounting for the non-linearity associated with age-related variables. The study found that the coefficients have the correct signs, indicating that the number of children increases with age. The age of women is one of the most important biological and demographic determinants of fertility. It is natural that an older woman has more number of children as compared to her younger counterpart. This study revealed that age was positively related to the number of children ever born. An increase in a woman‟s age by one year increased the expected number of children ever born by 21% ($e^{.22} = 1.25$), holding the other variables in the model constant. The study shows that the women in the age group 45-49 had the highest number of kids than any other age groups starting at 15 years.

Age at first marriage had a negative relationship with the number of children ever born, as it was expected. An increase in the age at first marriage by one year decreased the number of children ever born by 4% ($e^{-.04} = 0.96$) when all other factors were held constant. Age at first marriage also affects the childbearing period with those who enter marriage unions late having shorter periods of child bearing. Following the results of the analysis, taking the poorest in wealth as the reference, being poorer increases fertility by 2% ($e^{0.02} = 1.02$), holding all other variables in the model constant. Compared to the poorest females, respondents in the middle wealth category have a lower fertility by 5% ($e^{-0.05} = 0.95$), keeping all other variables in the model constant. For those women in the richer category compared to the poorest, there is a further decline in fertility. Fertility is lower by 11% ($e^{-0.11} = 0.89$), all other aspects being equal. The richest have the furthest decrease in fertility, according to the results.

Being richest is found to have the lowest decline in fertility by 16.5% ($e^{-0.18}$ =0.835), keeping all other factors in the model constant. In this regard, wealth is highly significant in explaining fertility.

In comparison to those women respondents with no education, women who have primary education have fertility lower by 0.4% ($e^{-0.004}$ =0.996), those having secondary were found to have lower fertility further by 6.3% ($e^{0.065}$=0.937).

In the same line, the fertility of those women with higher education compared to those with no education, decreases furthest by 25.2% ($e^{-0.29}$ =0.748), all other factors being equal. These coefficients were found to be highly significant.

Another aspect explored was husband"s education. Results show that only one of the husband's education dummies is statistically significant (the highest level of education attained is more than primary but less than secondary schooling), though the sign is positive. Taking Kigoma region as a reference, the results show that fertility in Tabora region was found insignificantly related to children ever born from the fertility performance of Kigoma region ($e^{0.07}$ = 0.19), holding all other variables in the model constant. Despite the relationship between fertility and regions being found positive but its effect on fertility is statistically insignificant.

The results of the negative binomial regression model on place of residence indicate that fertility is much higher in the rural areas than in the urban in both regions. For women living in the rural area compared to those living in the urban area, their fertility is higher by 22% ($e^{0.22}$ =1.25), holding all other variables in the model constant. This coefficient is highly significant in explaining fertility.

Correct knowledge of a woman"s ovulatory cycle as measured by the variable contraceptive knowledge, was found to be positive and statistically significant at 0.05 percent level. Its coefficient suggests that if a woman has knowledge of ovulatory cycle, the likelihood of contraceptive use increases by 4% (e^{04} =1.04). This suggests that women who know when they are likely to conceive are more likely to exercise contraception in case they do not intend to get pregnant. With regard to ever use of contraceptives, the women who have ever used any form of contraception, compared to those who have never used, have a higher fertility by 24.8% ($e^{0.285}$ =1.33), holding all other variables in the model constant. This coefficient is highly significant in explaining fertility behaviour.

Based on duration of breastfeeding, analysis shows that majority of the rural women in Kigoma and Tabora regions practice longer duration of breastfeeding as compared to their urban counterparts. The table shows a high degree of association between place of residence and duration of breastfeeding as depicted by the level of significance (p = 0.01). The results also indicate that mothers who breastfed for more than six months had a longer duration of Postpartum Amennorhea (PPA) by 51% ($e^{.51}$ = 1.66) than mothers who breast fed for six months or less (p=0.01).

Work status of a woman is believed to affect the number of children ever born. The model results confirm that compared to those women who are not working, those who are working have their fertility lower by 3.4% ($e^{-0.034}$ =0.967), all other factors kept constant. Although the coefficient could be undermined by high unemployment in the country, it supports the quality-quantity-tradeoff and is considered as one of the factors influencing fertility in the nation. This coefficient is significant at 5%.

Marital status significantly influenced the total number of children ever born. Women who were or had ever been in marriage had 12% ($e^{0.22}$ =1.13) more births than those who had never been in a marital union. Women in marital unions stand a higher chance of producing many children due to the high coital frequency. They are also likely to have a higher frequency of engaging in sex without contraceptives due to the perceived trust of one another. The widowed and divorced had respectively -2.8% ($e^{-0.028}$ =0.972) and -3.3% ($e^{-0.033}$ =.972) lower fertility than never married women. Turning to polygyny, the study revealed that being married polygynously has an effect on children ever born. In Western Tanzania woman had 26% (e^{-261} = 0.77) less children ever born when polygynously married compared to those married non polygynously.

4. Discussion

The general objective of this study was to examine the factors responsible for the prevailing levels of women of childbearing age in Western Tanzania through modelling their fertility experience using the Negative binomial regression model. Fertility level is a very important developmental factor that is directly related to the growth of the country"s economy. The negative binomial model was used to handle over-dispersion after running descriptive statistics on the fertility levels of women, which naturally comprises count data (Cameron & Trivedi, 2013., Hilbe, 2014). The results of the study indicated that women who reside in rural areas in both regions are more vulnerable to higher fertility levels than their counterparts living in urban areas. This is consistent with past studies conducted in Tanzania and other parts of the world (Ushie, et al. 2011; Akpandjar, et al. 2018). In the rural areas, children can help on the farm and this reduces their cost and increases their quantity demanded and therefore families in rural areas should have higher fertility since farming is the main economic activity.

Journal of Economics and Development Studies, Vol. 8, No. 1, March 2020

Palamuleni (2010) reported that the age at marriage has a negative effect on fertility. This implies that late marriage reduces the fertility. Early marriage on the other hand, is a major determinant of high fertility levels in rural areas. This finding is consistent with the finding by (Casterline, 2010); Oyefara, 2010). According to Bongaarts (1978), marriage is one of the four key intermediate determinants of children ever born. This is so because it"s through marriage that the number of children born is determined. This study finding agrees to this, since the results show that children ever born are more in the categories of women who were currently married or formerly married as opposed to women who had never been married. Parsons, et al. (2015) submit that marriage customs, norms about marriage and marriageable age determine the entry into childbearing period hence early childbearing is associated with more children ever born. This is in line with the findings of this study.

The results of the study also show that more educated women have fewer children. Relative to the reference category of the woman having no formal education, women with more than primary schooling (but less than secondary schooling) have significantly fewer children as do women with more than secondary schooling and it is worth noticing that the effect of education is stronger the more educated the woman is. So there is evidence of some sort of threshold level of education that must be attained before education starts having a significant effect on the number of children. This result is consistent with studies such as Bongaarts (2010); Güneş (2013); and Kim (2016) who show that female secondary education has a significant effect on fertility.

The highest educational level attained by the husband has a positive and statistically significant effect on total fertility. Interestingly husband's education beyond secondary schooling does not have a statistically significant effect on total fertility. It is not surprising that higher education (and hence higher earning capacity) of the husbands does not significantly increase the price of children as women's education does. Moreover husband's education is very often a proxy for household income and therefore what we could be capturing is an income effect that is particularly strong when the husband is educated but has less than secondary schooling.

Male occupation is highly associated with the socio-economic status of the family. In particular, a woman's socio-economic status is determined by the occupation of her husband. The present study has established that women whose husbands are engaged in salaried employments have lower fertility. Ud-din and Burfat (2014) also found that husband's occupation in the modern sector was negatively related to fertility in Pakistan. Likewise, the study conducted by Upadhyay and Bandhari (2017) on factors associated with children everborn in Nepal found that the women having their husband engaged in agriculture (referred hereto as non salaried) have about 84% more odd of having more than 2 CEB as compared to those having their husband with sales and services (salaried) occupational status. In Western Tanzania, in addition to the factors already stated, high fertility patterns in the rural areas have been found to be associated with polygyny in which women compete regarding the number of children. This finding is consistent with the findings of Akpan-Iquot, E. (2008) who affirms that polygyny tends to reduce fertility through the intermediary of a comparatively wider age differential between the polygynists and their wives and also because of the decreasing exposure to coitus, assuming that all coitus occurs in marriage.

Although polygamy tends to increase the average duration of the union and therefore the exposition to the risk of having a baby, most of the studies, particularly Upadhyay, Ushma D. and Deborah Karasek. (2010) and also Bove, R, Vala-Haynes, E and Vaallegia, C (2013), confirm that the individual fecundity of women in a polygamous union is lower than that of a monogamous union. The negative relationship between polygyny and fertility is also attributed to the evidence that the older the polygynist and the wider the age gap between him and each of his wives, the lower the fertility of successive wives (everything else being equal).

With respect to marital status, Garenne (2016); McAllister, et al. (2012) mentioned that once a woman is married, she is expected to give birth and continue childbearing for as long as she is married. Results of the present study revealed some association between marital status and non marital fertility because most of the respondents were exposed to the risk of pregnancy by virtue of their marital status. These women being unmarried and sexually active, and with their erratic use of contraceptives, there is a likelihood of them to conceive out of wedlock, thus increasing the cases of non-marital births in the zone. Overall, results from the Negative Binomial model confirm that marital status was associated with age at marriage, total children born, place of residence, and education level.

Any type of contraception restrains the natural process of procreation consequently suppressing fertility levels. In Western Tanzania, knowledge and awareness of different methods of contraception were high among the study population. However, the high knowledge did not translate into high-frequency use of contraception. The findings of the analysis show that women who ever used contraceptives had more children than those who never used. The reason for this contradicting result could be that most women who used contraceptives might not have been persistent in their use. Data analyzed is about ever use of contraceptives not currently using contraceptives, which is more effective in reducing births. It is also possible that women who used contraceptive methods had already completed their family sizes which were high (Huda, et al. (2017).

The results of the study have established that poorer women are more likely than their rich counterparts to be at risk of high fertility. Wealth negatively impacts on the level of fertility, This finding corroborates Gudbrandsen (2010) in his study about the impact of wealth and female autonomy in fertility decisions in Nepal who found that women in the richest quintile households are likely to give their children quality education, thereby giving birth to just the number of children they can manage. The finding of the present study is also in agreement with many other studies, including Skirbekk (2008); Kamaran and Goldstein (2010) and Ajala, (2014) who found that factors such as high income/wealth; high occupation/social class encourage a smaller family size relative to other classes.

Overall, the results from this study make two contributions to the literature. First, socio-economic, and demographic factors are important determinants of children ever born in western Tanzania. With the help of the Negative binomial regression model, the study established that marital status, wealth index, education level, age, age at first birth, age at first marriage, residence, mother‟s work status, husband‟s occupation, and contraceptive use influence the number of children ever born. Second, the results confirm that premarital childbearing is more common in western Tanzania as the widowed and divorced have exhibited lower fertility than never married women.

Beyond its substantive contributions, the study also illuminates the importance of complete data on women‟s marital histories and circumstances surrounding high fertility in western Tanzania. Besides regions of Kigoma and Tabora, high fertility was observed in rural areas than urban areas. According to the present study, women who are less educated have more kids. Based on the economic status of the women in this part of Tanzania, women who are richer tend to have lower fertility. This implies that in areas where traditional social and economic systems continue to hold a strong position, the level of fertility continues to be high.

5. Conclusion

The aim of the analysis of this study was to obtain the simplest model that reasonably explains the variation, i.e., over-dispersion in the data used. The paper has presented the Negative binomial regression model for data on women of child bearing age in western Tanzania. Several measures of goodness-of-fit and the Pearson Chisquare test for over-dispersion have indicated that the Negative binomial regression model accommodates overdispersion in count data.

The empirical results have also indicated that the application of the Negative binomial regression model is more appropriate than the Poisson regression model for the present fertility data and leads to more efficient parameter estimates.

Modeling of fertility is an important concern for the Tanzania nation as it helps to identify the current and future trends of population size, growth, and its composition. This statistical modelling approach provides more insight into studying determinants of fertility in Tanzania. Therefore, it is hoped that this approach will assist in future cross-national researches on fertility performance. It is also recommended that the identified determinant factors will assist in intervention programmes directed towards a downward shift in the fertility levels in Western Tanzania. The findings can also be used for developing integrated support tools for the government, health policy-makers and international agencies interested in fertility-related issues and development.

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Journal of Economics and Development Studies, Vol. 8, No. 1, March 2020

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