SPATIAL PERSPECTIVE: LIVE BIRTH REGISTRATION IN ONDO STATE, NIGERIA

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ABSTRACT

Birth statistics is significantin the measurement of health inpopulations, it provides data forcalculating development indicatorssuch as infant mortality and child mortality rates. It is also usedto measure the quality of health care in a country and the level of access to health carein the population. Birth registration is generally acceptable as the official recording of the birth of a child by some administrative level of the state. This work focused on the spatial perspective of live birth registration in Ondo State, Nigeria considering the geographical variation in the state and the level of importance attached to live birth registration. The data used was obtained from the National Population Commission of Nigeria. Maps were drawn to show the variations in levels of registration across the local governments. The Deviance Information Criterion was used to ascertain the variations that exist in the registration of birth.

Key Words: Credible interval, Infant mortality, Geographical variation

1.0 Introduction

Birth registration is a fundamental right that affords children the opportunity to bedocumentedand establish their nationality. Unfortunately, this right is denied to manychildren, especially in less developed countries (Makinde, *et al*., 2016). Indeed, anestimated 230 million children worldwide have never had their births registeredthereby exposing them to various rights abuses (Bambas, 2005; Bequele, 2005; Cappa, *etal.,* 2014; Brito *et al* 2013; Dow, 1998; UNICEF, 2013). Like

otherglobal health challenges, Africa lags behind in the registration of births and is onlybetter than Asia (Makinde, *et al*., 2016; UNICEF, 2013; 2014a). Lessthan 10% of Africa's population live in countries with complete (above 90% coverage) birth registration (Mahapatra, *et al*., 2007). There is evidence that the rate of birthregistration stagnated between 1995 and 2004 (Mahapatra, *et al.,* 2007; Makinde, *et al*., 2016).

The National Population Commission of Nigeria (NPopC) in 1992 has been responsible for the registration ofbirths in Nigeria. In situations whereby an individual is not born in a hospital, say a child born in a house, in this case, there will not be anyone available to register them with the National Population Commission; however, the parent can obtain a sworn affidavit from the local government, stating the child was born in that local government area. This sworn affidavit can then be taken to the National Population Commission, where the child will be registered and issued a birth certificate.However, the Vital Events Registry is a state-wide datasystem responsible for collecting information onall births that occur in Nigeria. The VitalEvents Registry is one of the Vital StatisticsCo-operative Program (VSCP) administered bythe National Center for Health Statistics (NCHS).

Birth statistics is a significantdata source in the measurement of health inpopulations, providing the denominator data for calculating development indicatorssuch as infant mortality and child mortality rates. These are also indicators that are usedto measure the quality of health care in a country and the level of access to health carein the population (Alarcón and Robles 2007). Poor data on these parameters can bemisleading and drive suboptimal investments in the healthsystem. Additionally, birthstatistics is important for monitoring policies and programs on fertility in a country.

It can be a significant yardstick for assessing the impact of interventions aimed atcontrolling population growth and determining the need for an increased intensity ofintervention. Furthermore, birth registration is an important source of data for planning social services such as schools, housing, and security. During the very first month of children's life, birth registration is another important aspect for their protection because it gives them an identity, name andnationality for their lifetime. Nigeria is a signatory to the Convention on the Rights of the Child (CRC), which establishes the rights of the child.However, the country had struggled to

ensurecompliance with birth registration,with uncertainties as to the level of progress that has beenmade (Makinde*et al*., 2016). The data used for this work is the registration made from year 2014 to 2016.

2.0 Methodology

Spatial autocorrelation is a situation where the dependent variables or error term at each location is correlated with observations on the dependent variable or values for error term at each location.
However, it can be expressed as follow:

$$Y = pwy + x\beta + u$$
$$U = \lambda we + e$$

where is the spatial error
p is the spatial-log
y is correlated in each location and e is correlated in each location, by associating Poisson Model and Bayesian Model to the Spatial Regression.

For models of type:

$$y_i = f(y_j) + x_{i\beta} + \varepsilon_i \quad (1)$$

Least-squares estimates for β are biased and inconsistent, similar to the simultaneity problem.

$$y_i = x_{i\beta} + u_i, u_j = f(u_j) + \varepsilon_i \quad (2)$$

Least-squares estimates for β are inefficient, but consistent, similar to the serial correlation problem.

Equation 1 and 2 follows:

$$(I_n - \rho W)y = X\beta + \varepsilon$$
$$y = \rho Wy + X\beta + \varepsilon$$
$$y = (I_n - \rho W)^1 X\beta + (In - \rho W)^1\varepsilon \quad (3)$$

Here, equation 3 implies the spatial autoregressive model.
Also, Spatial Error Model (SEM) can be used:

$$y = X\beta + u$$
$$u = \rho W + \varepsilon$$

Substituting u in the above equation, we have

$$y = X\beta + (In - \rho W)^1\varepsilon \quad (4)$$

The Poisson distribution models the probability of y events that is, the live birth registration of each Local government with the formula:

$$\Pr(Y = y/\mu) = \frac{\theta^{-\mu}\mu^{y}}{y!}(\mathrm{y} = 0,1,2,\ldots) \quad (5)$$

It is to be noted that the Poisson distribution is specified with a single parameter μ, the mean of live birth registrations. Exposure is the months, this is due to the fact that exposure is often a period of time, the symbol t represent the exposure. When no exposure value is given, t is assumed to be one.

The parameter μ may as well be interpreted as the risk of a new occurrence of the event during a specified exposure period$t$. The probability of $y$events is thus given as:

$$\Pr\left(Y = \frac{y}{\mu}\right)\frac{\theta^{-\mu}\mu^{y}}{y!}(\mathrm{y} = 0,1,2,\ldots)$$

Suppose there is a set of regression observations (y_i, s_i) where $y_i$the regression for is live birth registration and s_i is the number of Local Governments Areas. The regression model is considered on the basis of the count variabley_i, which can be modelled using the Poisson regression model, written as:

$$Y_i|\ \beta; \mu_i\ ; s_i \sim Poisson\ (\ \mu_i)$$

Whereμ_i is the mean number of registration per local government and β is the vector of fixed effect of regression coefficients. The months and the local governments are represented by $t_i$and s_i.

Given the observation data Y, it isappropriate to choose a statistical model p(y/θ) in describing the distribution of Y given θ.

In updating beliefs about θ by combining information from the prior distribution and the data through the calculation of the posterior distribution, p(θ/y).

The latter is carried out using Bayes' theorem. The theorem enable the combination of the prior distribution and the model such as:

$$p(\theta/y) = \frac{p(\theta,y)}{p(y)} = \frac{p(y\ |\theta)\pi(\theta)}{p(y)} = \frac{p(y\ |\theta)\pi(\theta)}{\int p\ (y|\ \theta)\ \pi(\theta)d\theta}$$

Where the quantity $p(y) = \int p\ (y|\ \theta)\ \pi(\theta)d\theta$ is the normalizing constant of the posterior distribution. It is also the marginal distribution of Y.

The likelihood function of θ is any function proportional to$p(y/\theta)$, that is, $L(\theta) \propto p(y/\theta)$.

Hence, Bayes' theorem can be rewritten as:

$$P(\theta/y) = \frac{L(\theta)\pi(\theta)}{\int L\ (\theta)\pi(\theta)d\theta} \quad (6)$$

The marginal distribution $p(y)$ is an integral; therefore, provided that it is finite, the particular value of the integral does not yield any additional information about the posterior distribution. Thus,$p(\theta/y)$ can be written up to an arbitrary constant, which is presented in proportion form as:

$$P(\theta/y) \propto L(\theta) \propto \pi(\theta)$$

2.1 Deviance Information Criterion (DIC)

DIC which is particularly useful in Bayesian model selection problems where the posterior distributions of the models have been obtained by Markov chain Monte Carlo (MCMC) simulation. DIC usually select the structurally appropriate model, and the point estimates from the best model or the model average were relatively unbiased. The distributions of point estimates about true values from DIC – based, the best model (lowest DIC) gives the best fit of the model.
Like AIC and BIC it is an asymptotic approximation as the sample size becomes large. It is only valid when the posterior distribution is approximately multivariate normal. The Deviance $D(\theta)$ can be defined as:

$$D\,(\theta) \;=\; -2log(p(y|\;\theta)) \;+\; C \qquad (7)$$

where y are the data, θ are the unknown parameters of the model and $p(y|\;\theta)$ is the likelihood function. C is the constant that cancels out in all calculations that compare different models and which therefore need to be known.

The Expectation$\overline{D} \;=\; E[D(\theta)]$ is a measure of how well the model fits the data; the larger this is, the worse the fit.

Common usage for the effective number of parameters of the model are:
$PD \;=\; \overline{D} - D(\bar{\theta})$. Here $\bar{\theta}$= the expectation of θ.

$PD \;=\; pv \;=\; \frac{1}{2}\; var\big(D(\;\theta\;)\big)$.
Thelarger the effective number of parameters, the easier it is for the model to fit the data, and so the deviance needs to be penalized.

Deviance information criterion is then calculated as;

$$DIC \;=\; PD \;+\; \overline{D} \qquad (8)$$

The quantitative interpretation of the live birth registration data was done by using statistical software program – R with BayesX and R2BayesX packages. Results are

presented as maps and as well as showing the significance of live birth registration across the eighteen (18) Local Government Areas in Ondo State, Nigeria.

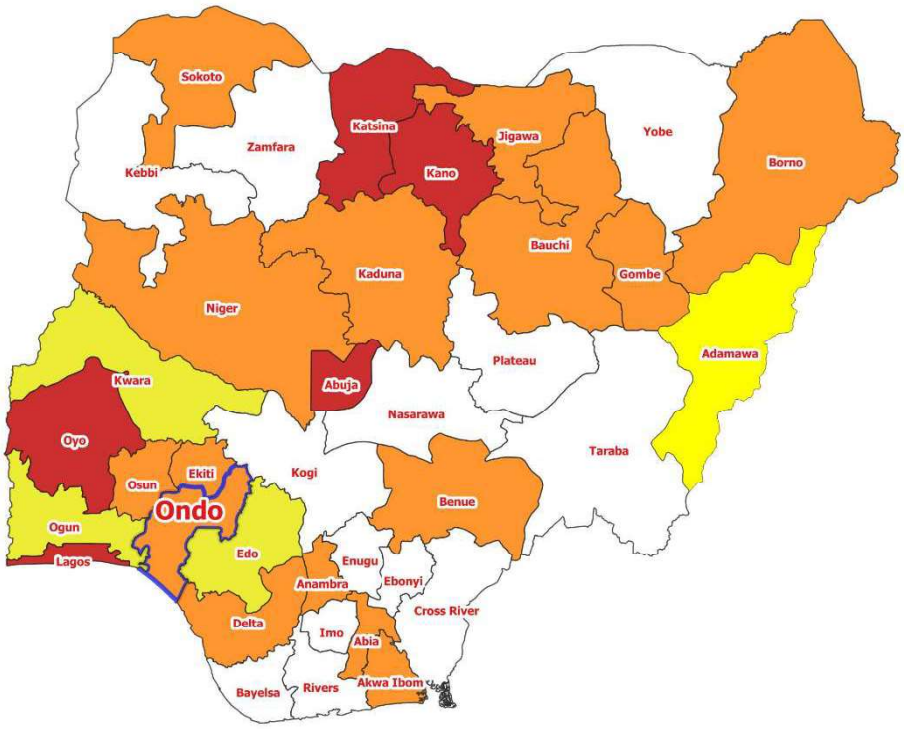

Figure 1: Map of Nigeria showing the 36 States.

Table 1: Numbering/List of Local Government Areas in Ondo State

Numbering on Ondo State Map	Local Government Areas
1	Akoko North West
2	Akoko North East
3	Akoko South West
4	Akoko South East
5	Akure North
6	Akure South
7	Owo
8	Ose
9	Ifedore
10	Idanre
11	Ile-Oluji/Oke Igbo
12	Ondo East
13	Ondo West
14	Odigbo
15	Okitipupa
16	Irele
17	Ilaje
18	EseOdo

Note: The numbering is applicable to all the figures on Ondo State.

3.0 Results and Discussions

It is imperative to note from the map across the years that – colour White and Black indicate significantly high and significantly low respectively at credible interval 95%.

a) Age group under 1 year:

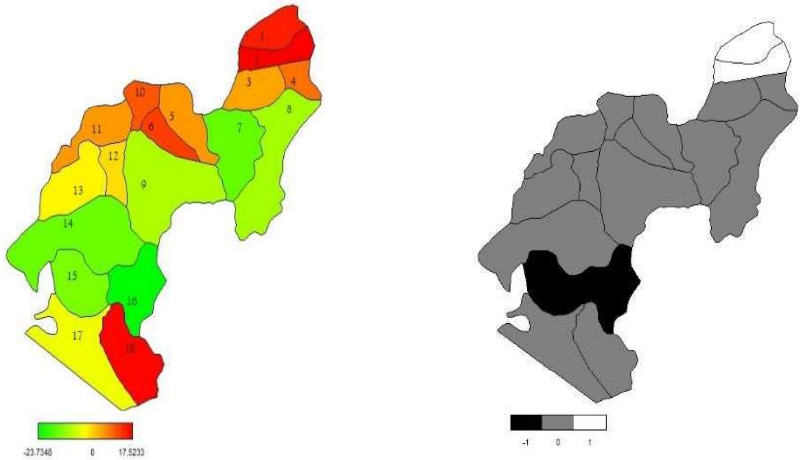

Figure 2: Estimated mean of birth registration for 2014 for under 1 year with the credible interval 95%.

Discussion: Registration of birth in year 2014 for age group under 1 is significantly high in AkokoNorth West and Akoko North East. Also, the registration is significantly low in Okitipupa and Odigbo. While the remaining fourteen (14) other local government areas did not show either high or low birth registration for the period.

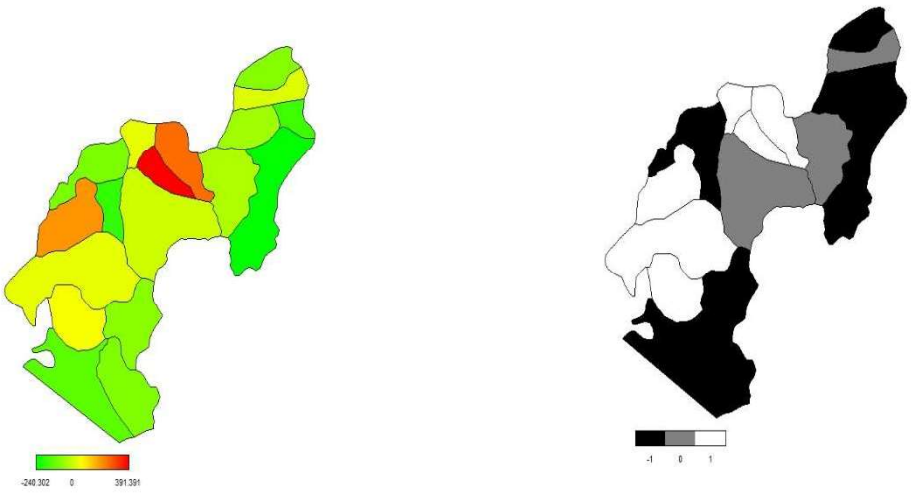

Figure 3: Estimated mean of birth registration for 2015 for under 1 year with the credible interval 95%.

Discussion:Registration of birth in year 2015 for under 1 year is significantly highinAkure North, Akure South, Ifedore, Ondo West, Odigbo and Okitipupa.Also, significantly low birth registration in Akoko North West, Ose, Akoko South West, Akoko South East, Irele, Ilaje and EseOdo. While only three local governments did not show their levels of significance to birth registration for the period.

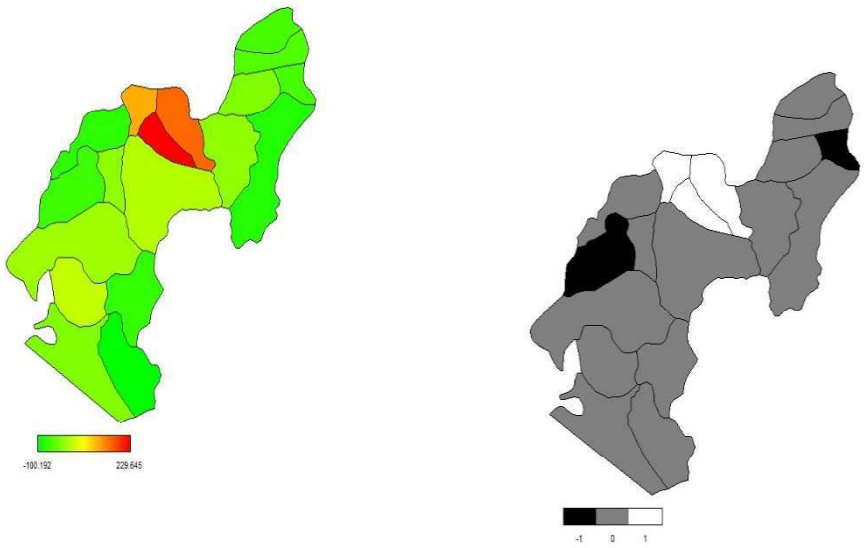

Figure 4: Estimated mean of birth registration as at 2016 for under 1 year with the credible interval 95%.

Discussion: Registration of birth in the year 2016 for under 1 year is significantly high in Akure North, Akure South and Ifedore.Also, it was significantly low in Akoko South East and Ondo West.While the remaining thirteen (13) local governments did not show their levels of significance to birth registration.

b) Age group 1 to 4 years

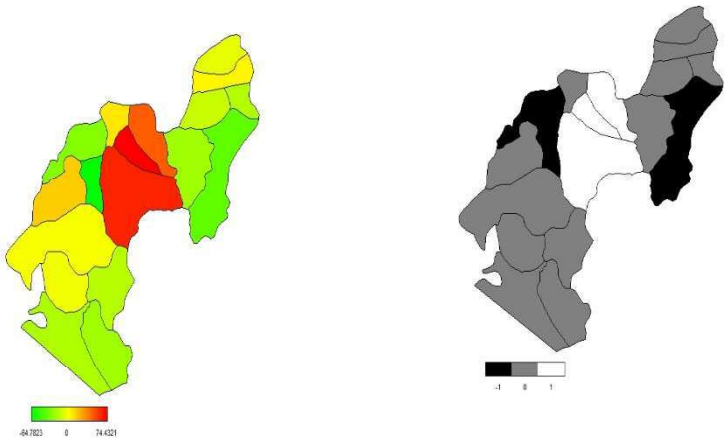

Figure 5: Estimated mean of birth registration as at 2014 for 1 to 4 year with the credible interval 95%.

Discussion: Registration of birth in year 2014 between age group 1 and 4 years is significantly high in Akure North, Akure South and Idanre.Also, the registration is significantly low in Ose, Ondo East and Ile-Oluji/Oke Igbo. While the remaining twelve (12) local governments did not show their levels of significance to birth registration.

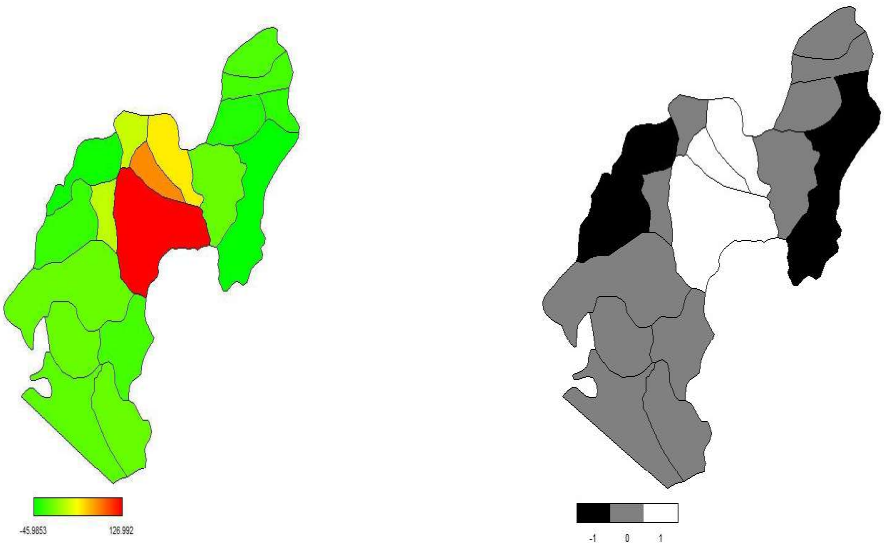

Figure 6: Estimated mean of birth registration as at 2015 for 1 to 4 year with the credible interval 95%.

Discussion: Registration of birth in year2015 for children between the age group 1 and 4 years is significantly high in Akure North, Akure South and Idanre.Also, registration is significantly low in Akoko South East, Ose, Ile-Oluji/Oke Igbo and Ondo West. While the remaining thirteen (13) local governments did not show their levels of significance to birth registration for the period.

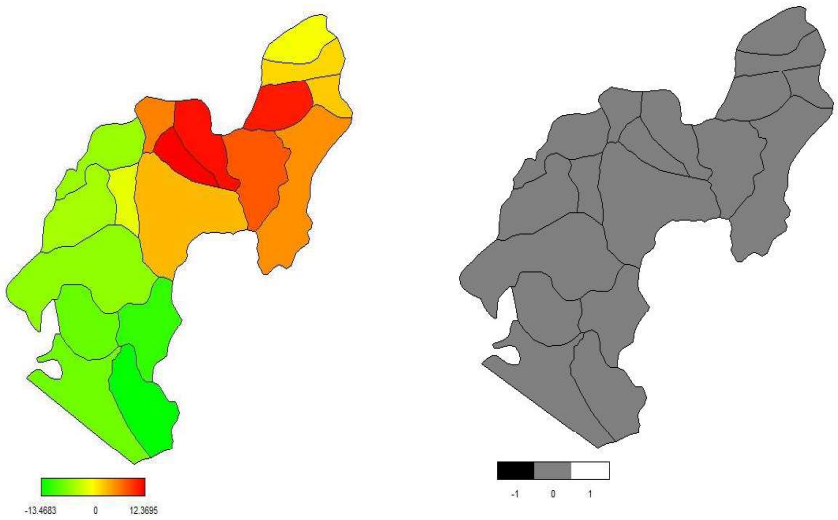

Figure 7: Estimated mean of birth registration as at 2016 for 1 to 4 year with the credible interval 95%.

Discussion: No particular local government area shows high or low significance to birth registration in Ondo State, they all show a moderate level of significance. That is in 2016, registrations of live birth for age group 1 to 4 years across the LGAs were neither high nor low.

c) Age group above 5 years

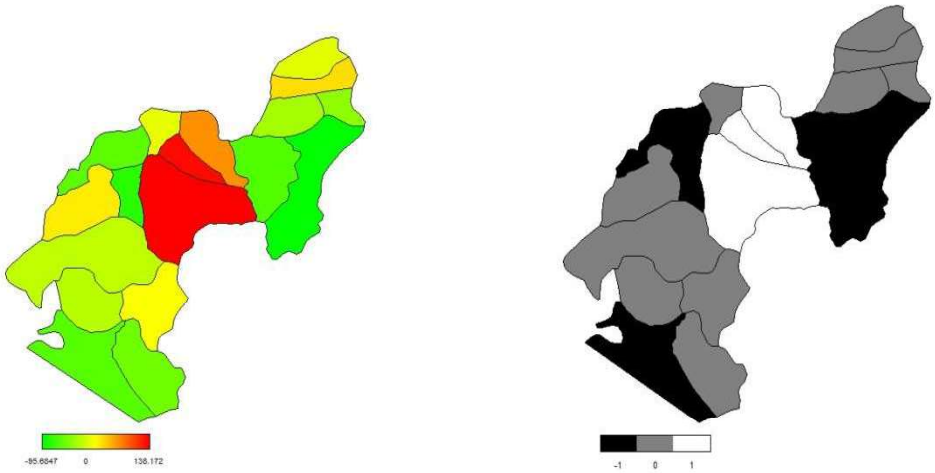

Figure 8: Estimated mean of birth registration as at 2014 for above 5 year with the credible interval 95%.

Discussion: Registration of birth in year 2014 for age group above 5 years is significantly highin Akure North, Akure South and Idanre.Also, registration is significantly low in Owo, Ose, Ile-Oluji/Oke Igbo, Ondo East and Ilaje. While the remaining twelve (12) local governments did not show their levels of significance to birth registration for the period.

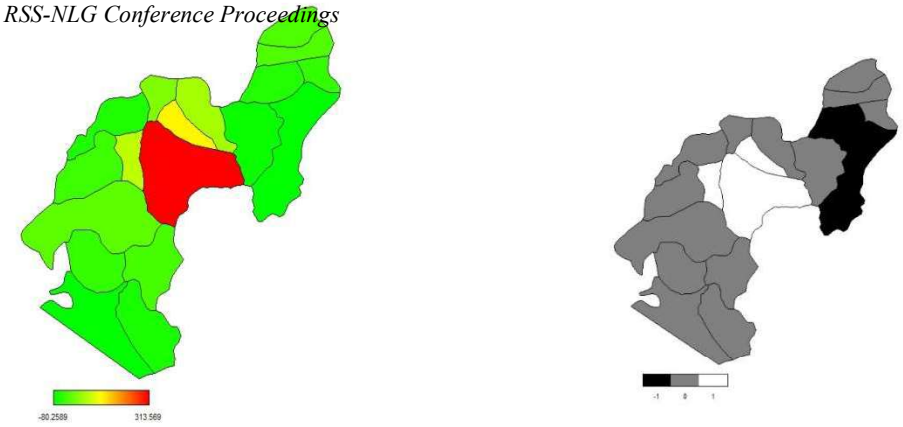

Figure 9: Estimated mean of birth registration as at 2015 for above 5 year with the credible interval 95%.

Discussion: Registration of birth in year 2015 for age group above 5 yearsis significantly high in Akure South, Idanre and Ondo East.Also, significantly low in Ose, and Akoko South West. While the remaining thirteen (13) local governments did not show their levels of significance to birth registration for the period.

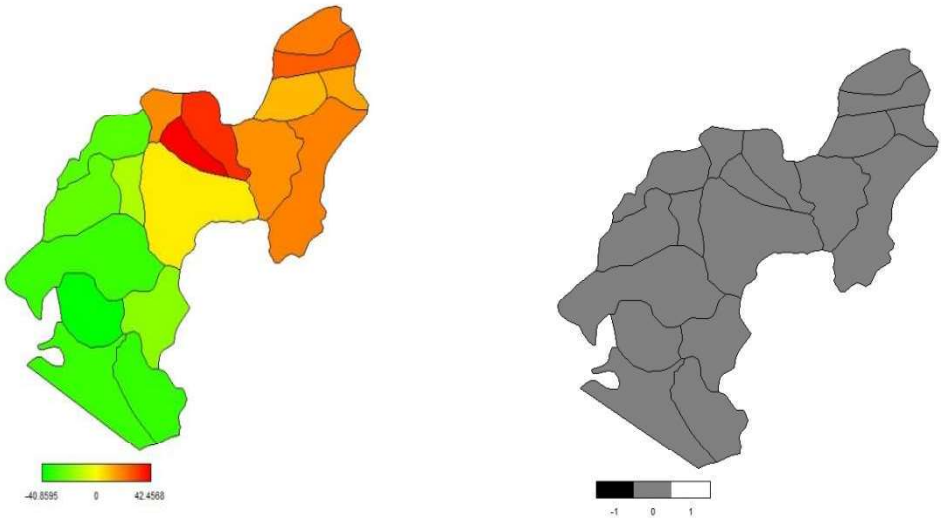

Figure 10: Estimated mean of birth registration as at 2016 for above 5 year at credible interval 95%.

Discussion: No particular local government area shows high or low significance to birth registration in Ondo State, they all show a moderate level of significance. That is in 2016, registrations of live birth for age group above 5 years across the LGAs were neither high nor low.

3.1 The Deviance Information Criterion (DIC)

Table 1: DIC for birth registration below 1 year

AGE – GROUP	YEAR	D BAR	P_D	DIC
UNDER 1	2016	449.5382	14.4318	4506.97
UNDER 1	2015	11138.9500	13.3500	11152.30
UNDER 1	2014	3262.9780	14.3320	3277.31

Discussion: It can be deduced from the Deviance Information Criteria (DIC) in estimated mean and the confidence intervals in the above that the fitness of each of the data will be best fit in the year 2014 since it has the minimum value.

Table 2: DIC for birth registration for age group 1 – 4 years

AGE – GROUP	YEAR	DBAR	P_D	DIC
1 – 4 YEARS	2016	5574.2824	13.3376	5587.62
1 – 4 YEARS	2015	7740.2842	13.6358	7753.92
1 – 4 YEARS	2014	7739.2384	13.6312	7725.60

Discussion: It can be deduced from the Deviance Information Criteria (DIC) in estimated mean and the confidence intervals in the above that the fitness of each of the data will be best fit in the year 2016.

Table 3: DIC for birth registration for age group above 5 years

AGE –GROUP	YEAR	DBAR	P_D	DIC
ABOVE 5 YEARS	2016	5895.3153	14.7247	5910.04
ABOVE 5 YEARS	2015	3363.9005	13.3795	3377.28
ABOVE 5 YEARS	2014	2790.7937	13.1163	2803.91

Discussion: It can be deduced from the Deviance Information Criteria (DIC) in estimated mean and the confidence intervals in the above that the fittness of each of the data will be best fit in the year 2014.

4.0 CONCLUSION

Birth registration is a fundamental human right of a child and major way of collating data for infrastructural development plan in any country. Nigeria like many Africa country is lagging behind in this, hence the need to appraise the perspective of the people on the importance of birth registration through spatial analysis. The results from Figures 2-10 which arethe estimated mean of spatial regression model with Poisson regression and Bayesian model showed that Akure South andAkure North areconsistently significantly high in the number of live birth registrations among the local government areas in Ondo state. This reveals the level of awareness of the importance of birth registration among the residence of these areas compared to other local government areas. Also,it was noted that except for the under 1 year group birth registration, the remaining two age groups considered in this work, year 2016 did not reveal any specific local government area with significantly high or low registration of birth. This means that the level of awareness of birth registration in the State is improving and receiving attention by the people, thereby, a higher percentage of coverage is expected in the future. However, based on the Deviance Information Criterion (DIC), it can be shown that the fitness of data into the age groups differs by

year. For Under 1 year, 2014 has the best fit with 3277.31 DIC. For age group 1 – 4 years, 2016 has the best fit with 5587.62 DIC. While for age group above 5 years, 2014 has the best fit with 2803.91 DIC. This shows the need for proper and early registration of birth for yearly robust database.

REFERENCES

Alarcón, D. and Robles, M. (2007). The challenges of measuring child mortality when birth registration is incomplete. *Global Forum on Gender Statistics*. http://millenniumindicators.un.org/unsd/Demographic/meetings/wshops/Gender_Statistics_10Dec07_Rome/docs/8.1_Alarcon.pdf.

Bambas, L. (2005). Integrating equity into health information systems: A human rights approach to health and information. PLoS Med 2(4):e102. doi:10.1371/journal.pmed.0020102.

Bequele, A. (2005). Universal birth registration: The challenge in Africa. http://www.riatt-esa.org/sites/default/files/get_file_8f4d1fe7.pdf

Brito, S.Corbacho, A. and Osorio, R. (2013). Birth Registration: The Key to Social Inclusion in Latin America and the Caribbean, Inter-American Development Bank, Washington. Journal of Birth Registration, Vol 66 (4), pg 228 – 240

Cappa, C., Gregson, K., Wardlaw, T., and Bissell, S. (2014). Birth registration: A child's passport to protection. *The Lancet Global Health* 2(2):e67–e68. doi:10.1016/S2214-109X(13)70180-3.

Dow (1998), Op. cit. EOHCS, 2000, cited in Multiple Indicator Cluster Survey (MICS2),Tajikistan,2000.Foundation http://www.childinfo.org/MICS2/natlMICSrepz/Tajikistan/micsfeb16tadafinal.pdf.

Mahapatra, P., Shibuya, K., Lopez, A. D., Coullare, F., Notzon, F. C., Rao, C., and Szreter, S. (2007).Civil Registration Systems and Vital Statistics: Successes and Missed Opportunities. The lancet, Volume 370, ISSUE 9599, P1653-1663.DOI:https://doi.org/10.1016/S0140-6736(07)61308-7

Makinde, O. A. Olapeju, B., Ogbuoji, O. and Babalola, S. (2016). Trends in the completeness of birth registration in Nigeria: 2002–2010. *Demographic*

Research: Volume 35, article 12, pages 315−338. DOI: 10.4054/DemRes.2016.35.12

National Population Commission. Report on live-births, deaths and still-births registration in Nigeria (1994–2007) Abuja, Nigeria: National Population Commission; 2008. National Population Commission. http://www.population.gov.ng.

UNICEF (2013). A passport to protection: A guide to birth registration programming, UNICEF, New York. Journal of Birth Registration, Vol. 16 (2), pg. 11.

UNICEF (2014a). 25 Years of the Convention on the Rights of the child: Is the world a better place for children? [electronic resource]. http://www.unicef.org/publications/index_76027.html.