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Modelling livestock production effects on Carbon dioxide emissions in Ghana

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Abstract

The current paper aims at contributing to the body of knowledge in the area of global climate change and global warming by examining the link between carbon emissions and livestock productions using ordinary least square model of regression in a bivariate analysis. The paper is based on quantitative, descriptive, and cross-sectional study using time series data obtained from World development indictors for the period of 1961-2010 for Ghana. The results indicate that livestock production is statistical significant contributor to carbon emissions during the period under discussions. Policy makers should incorporate the findings of the current study into strategies intended to ensure environmental quality. Future studies should consider the issue of causality using causality models such as Granger causality models Structural break should be considered in examining unit root properties of the series in future studies.

Keywords: Carbon dioxide; livestock production; global climate change warming
Jel Classifications: Q54; Q56; Q57

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1.0 Introduction

The issue of carbon dioxide emission has attracted and continue to attract attention in the literature as a result of its significant role in global climate change and the associated effects of global climate change (Reay et al. 2012; Herrero et al. 2011; Janzen 2011; Lesschen et al. 2011; O'Mara 2011; IPCC, 2007; Rahmstorf, 2007; Dressler & Parson 2006; Steinfeld et al. 2006; Emanuel, 2005; Feely et al, 2004; Caldeira & Wickett 2003; Reynaud et al, 2003; Hansen et al, 2000).Emissions of carbon dioxide into the atmosphere have various consequences such as death, protein, damage, organ dysfunction, skin diseases and flooding (Harley et al, 2006; Somero 2002; Hughes et al, 2003). The role of human activities in global climate change as a result of carbon emissions are well documented in literature in various economies (FFAO), 2010; Gill & Wilkinson, 2010; Thorton & Herrero, 2010; UNEP, 2010; Cerri et al., 2009; Garnett, 2009; Fiala, 2008; Garrnett, 2007; McMichael et al., 2007; IPCC, 2006;). Among human activities that contribute to emissions of gas responsible for global climate change is livestock production and consumption (Friends of the Earth, 2007; McMichael et al., 2007; Dressler & Parson 2006). UNEP (2012) reported that, carbon dioxide emissions results from animal husbandry. In UK agricultural activities accounts for about 11% carbon dioxide emissions (HMG, 2006). it is estimated that carbon emissions from livestock importations (poultry and pig meat) is equivalent to about $_1$ million tonnes. According to McMichael et al., (2007) "… livestock production, accounts for about a fifth of total greenhouse-gas emissions, thus contributing to climate change and its adverse health consequence, including the threat to food yields in many regions". According to Friends of the Earth (FOE), 2007 report, agriculture (crops production and livestock) contribute more significantly to global climate change than other aspect of agriculture. The FOE (2007) report indicates that meat and dairy significantly affect global climate change through provision of pasture for feeding animals; fertilizers for growing animal feed and the release of gasses by the animals. New Scientist (2007) states that beef production releases significant greenhouse gas than gas emissions from transportations. Empirical knowledge on the emissions of carbon dioxide provides baseline to develop mitigation projects for reducing emissions in all economies (Cornejo & Wilkie, 2010). However, enough empirical findings based on econometric investigations of livestock carbon emissions are limited in the literature, especially on developing economies. The current paper fills in the literature gap. The paper intents to model the relationship between livestock production and carbon dioxide emissions using time series data in order to provide accurate emissions information about the correlation between climate and agriculture. The findings of the current study will serve as reference material for research works on agriculture and climate change. Policy maker are provided with policy document in dealing with carbon emissions from agricultural activities. The general objective of the current paper is to contribute to the body of knowledge in the area of global climate change by examining stable long run relationship between carbon dioxides emissions and livestock productions empirically. Specifically, the paper examines the statistical significant relationship between carbon emission and livestock productions.

The study is based on the following research question. What is the effect of livestock production on carbon dioxide emission?The assumptions tested in the current study is, there is significant relationship between livestock production and carbon dioxide emissions and that Livestock production is a key factor in explaining CO2 emission trends. The study is based on secondary data obtained from World Bank database. The estimated model might suffer from errors in variables. Causality issues are not considered. Stationarity properties are not examined which might affect the robustness of the findings. The period for the study is between1970-2010. Single country level data is used in a time series analysis. Other gases such as methane are not considered for non-availability of data. The study is based on bivariate model might suffer for omitted variable bias.

The livestock sub-sector has contributed significantly to the growth of the agricultural sector of the Ghanaian economy over the years (2007-2011). According to the Institute of Statistical,

Social and Economic Research (ISSER, 2011), the contributors of the livestock sub-sector over the years are 4.7% (2007); 5.1% (2008); 4.4% (2009); 4.6% (2010); and 5.1% (2011). On an average, the livestock sub-sector since 2007 have outperformed (4.78%) the other sub-sectors such as crops (4.4%); cocoa (2.8%); forestry/logging (-2.12%) and fisheries (-0.54). The significant contributions of the livestock subsector are an indication that the subsector is worth studying in the current study. Livestock production requires priority attention in relation to its impact on global climate change through empirical studies to be able to provide policy makers with the appropriate information to address the challenges of climate change. The rest of the current study considers the methodology, empirical results (unit root; cointegration results; long run results; short run results); conclusions and policy implications.

2.0 Materials and methods

2.1. Research Design/Strategy

The current study is bivariate, quantitative, descriptive, and cross-sectional research. The study is based on annual time series data for Ghana for the period 1970-2011. The period was chosen for availability of data. The sample size is 41. Reviewed Articles were selected through purposive sampling method from journals on the internet. The data used are carbon dioxide emission (CO2) and livestock productions (proxied by livestock production index).

2.2 Data Analysis Models

The model is estimated in natural log form using ordinary least square (OLS). The OLS model estimated is assess for goodness for fit using various diagnostic test such as J-B Normality test, Breusch-Godfred LM test, White Heteroskedasticity test, Ramsy RESET. The stability of the model is tested using the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ).

2.3 The model

The conceptual model for the study states that carbon dioxide emission is a function of livestock production. That is InCO2=f (InLSP). The model is a bivariate model.

3.0 Results and discussion

3.1 Result of the relationship between Carbon emissions and Livestock production by OLS.

The study estimated the relationship between carbon emissions (CO2) and livestock productions (LPS) using OLS and reported in Table 6. The value of the coefficient of livestock production indicates that 1% increase in livestock production leads to about 41.28% increase in carbon emissions. The results shows that 1% increase in previous year's carbon emission leads to about 67.76% increase in current year carbon emissions. The diagnostic test of the estimated model to examine the reliability of the results is shown in Table 6. The RESET test showed evidence of incorrect functional specification of the model.

The estimated model passed the normality test. The model passed Heteroscadasticity test indicating the variance are constant over time. The estimated model passed the autocorrelation test. The R2 (0.925582) and the adjusted R2 (0.922120) in Table 6 are an indication of a very well behave model. The coefficient indicate approximately 92.56% of the variations in carbon dioxide emission are attributed to livestock production.

Table 1 OLS estimating using observations from 1964-2009 (46 observations). Dependent variable: InCO2

Variable	Coefficient	Std. Error	T -ratio	P -value
Constant	1.0313	0.394255	2.6158	0.01223**
InLSP _ 3	0.412827	0.146381	2.8202	0.00723***
InCO_ 3	0.677609	0.107426	6.3077	0.00001***
Overall Model Fit				
Test		**F-stats**		**P-value**
1.Hetroskedasticity		1.3066		0.520325
2.Ramsey reset test		3.52847		0.038554

3.Autocorreltion	1.83477		0.156365
4.Normality	2.63411		0.267923
Mean dependent var	8.228010	S.D. dependent var	0.530248
Sum squared resid	0.941565	S.E. of regression	0.147976
R-squared	0.925582	Adjusted R-squared	0.922120
F(2,43)	267.4075	P-value (F)	5.51e-25
Log-likelihood	24.17246	Akaike criterion	-42.34493
Schwarz criterion	-36.85900	Hannan-Quinn	-40.28987
Rho	0.254013	Durbin-Watson	1.450370

Note: * and ** indicates statistical significance at 1% and 5% levels**

The stability of the long-run estimates was determined by employing the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMG) procedures. The CUSUM test of stability determines the methodological arrangements of the estimates and its null hypothesis states the coefficients are stable. The null assumption is rejected when the CUSUM surpasses the given critical boundaries, which demonstrate unstable nature of the estimates. The CUSUMG determines the stability of the variance. Both tests as shown Figure 1 and 2 revealed that the estimates and the variance were stable as the residuals and the squared residuals fall within the various 5% critical boundaries. The null assumptions are rejected in both tests.

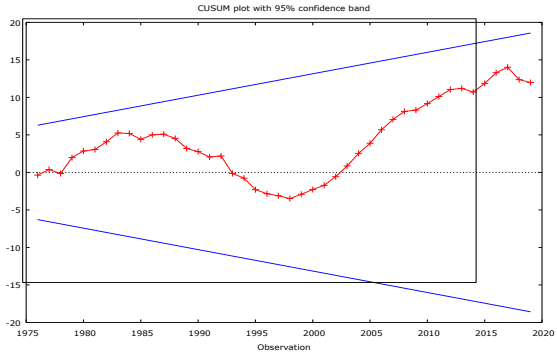

Figure 1

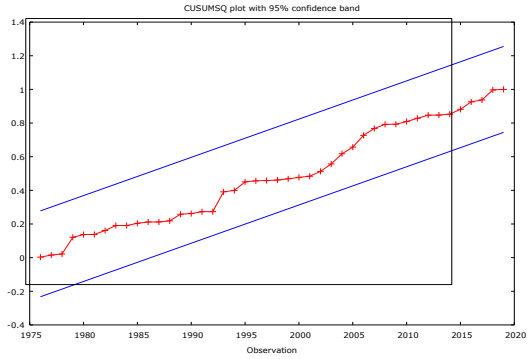

Figure 2

4.0 Conclusions

The objectives of the paper have been achieved. There is statistical significant link between carbon emissions and livestock production. The long run and short run elasticities are statistically significant. Carbon emissions are influenced positively by livestock production in

the model estimated. The results indicate that as livestock production increases, carbon emissions increase during the period under discussion. The findings are in support of the findings reported by researchers (UNEP, 2012; FOE 2007; IPCC, 2007; McMichael et al., 2007; New scientist, 2007; Steinfeld et al. 2006) that livestock production is positively related to carbon dioxide emissions. Policy makers should incorporate the findings of the current study into strategies intended to ensure environmental quality. To prevent increased carbon emissions and intensities of emissions from livestock production, consumption level of animal products should be reduced. Alternative source of meat such as fish should be intensified by incorporating climate change when determining fishery management plans.

Future studies should consider the issue of causality using causality models such as Granger causality model. Unit root analysis should take into consideration structural break. More explanatory variables should be considered in future studies in multivariate models. Models that are able to examine long run and short run relationship should be used in future studies. Comparative studies should be considered in the future studies.

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