

EMISSION OF CARBON WARMING THE CLIMATIC CHANGE ADVERSELY AFFECTS THE LIVESTOCK SECTOR: AN EMPIRICAL STUDY OF PAKISTAN

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Abstract

Purpose: The paper explores how livestock reveals the warming climatic variations particularly in farming and poultry subsectors of agriculture. The rising average temperature of the region has been a challenge during the last two decades which has created many complications and health problems in animals as stress, low reproduction, its consequence as draught, adverse effects on milk and meat production. More consumption of water increases the cost of livestock products. It has altered the temperature of the sea and rivers, emerges the negative effects on the species and creatures of water.

Methodology: To conduct the empirical study on this economic issue the data has been assumed from 1980 to 2014 due to constraints of statistics. Auto-Regressive Distributive Lag model to cointegration (ARDL) was applied on the time series data and the other econometric tests as Error Correction Mechanism, Cumulative sum of Recursive Residual CUSUM and CUSUM sum of Square Test, Bound Test and Diagnostic tests were operated to conclude the results of the research study.

Main findings: The finding of the study is that CO2 emission from electricity, gases fuel consumption, and urban population growth raised the average temperature of the region which is discouraging the livestock. Production, and increasing the costs of livestock output.

Application of the study: The study is the most appropriate and applicable for this subcontinent especially for Pakistan.

Originality and novelty of the study: The research study contributes to the agricultural economics literature with advanced information. It suggests the government utilize the planet Badar-1 climatic information and more advanced technology about temperature to formulate comprehensive policies to combat the climatic and environmental changes and more resources are allocated so that international standard of production of livestock can be achieved.

Keywords: Livestock, Carbon Emission from Gas Fuel Consumption, Urban Population Growth.

INTRODUCTION

The specific mixture of gases in the form of nitrogen N_2O , CO_2 methane, and chlorofluorocarbons presents naturally in the atmosphere, making the earth protective and warmer (<u>Whiticar, 1994</u>; <u>Delucchi, 2003</u>). In the absence of these specific gases, the world temperature could be slipped down up to -15 0C, sustaining life on earth becomes impossible. This composition of gases in natural amounts is termed the Green House effect. The unwanted growth of emission of gases from industrialization, transportation, and fuel consumption of gas kilo tons (Kt) in the atmosphere has raised Green House Effect, increasing the global temperature on the earth. The disturbance in the natural Green House Effect is causing global warming or climatic variation in broader terms (Kweku, 2017; Rosenzweig, 1998</u>). The greenhouse gas emission by different sources is presented as.

The report of IPCC presents the emission contribution comprised of different sources, the industry is the biggest source of emission, and the second is agriculture and forestry. The third higher emission source is transportation, which contributes to direct emission in the air and warming the globe.

Intergovernmental Panel on <u>Climate Change (2001)</u> reported that the world's average temperature has climbed up to 0.6 0C during the previous century. Soon, global warming is expected to remain in the limit of 1.40C to 5.8 0C but in the South Asian region, the annual temperature would exceed from the range of 3.5 0C to 5.5 0C by the end of the 21st century. The IPPC in 2007 again revealed that global warming could increase from 2 0C to 5.5 0C and it may exist in the current century.

The climatic change and rising temperature have been a threat and challenge for the world since 1990 (<u>IPCC, 2001</u>) and (IPCC, 2007).



Greenhouse Gas Emissions by Economic Sector







Source: IPCC Fifth Assessment Report (2007)

Figure 2: Average Temperature of the World

Source: NASA's Goddard Institute for Space Studies(2020)

In figure 2, the average annual temperature at the earth's surface has risen since the late 1880s, with year-to-year variations (shown in black) being smoothed out (shown in red) to show the general warming trend.

Pakistan is located in the South Asian region where one area's climate and environment have opposite characteristics (Latif, 2017; Saeed, 2009). The temperature in summer is scorching covers the long cycle than winter in the more significant part of the country. This rising heat and climatic change are attributed to carbon emission from gaseous and fuel consumption, gas consumption Kt and urban and rural population growth. The higher temperature and heat index has been persistently rising in this region and has been recognized as a challenge and threat for different economic sectors (Adger, 2003; Sperling, 2005). The rising temperature and climatic changes create the stress and diseases in human beings and in the agricultural sector, particularly in subsectors like livestock. Livestock production is associated with outdoor activity and is affected adversely by climatic changes (Adams et al., 1998; Chaudhary & Rasul, 2004; D'Amato, 2002).

In the world of climatic changes, the South Asian Region, particularly Pakistan, has severely affected environmental changes. Pakistan is on 12th among world ranking, facing the threat of warming climate (Fahad, 2018; Rasul, 2012). The temperature variation may bring a change in the bio-physical link for livestock, fisheries, and forest. It can also alter the growing periods of agriculture, water needs, species behavior, soil requirements, risk of worms and diseases. The warming climate will affect the livestock through stress on the psychology of animals, low productivity of milk and meat, and stress on the production of animals. The heat in temperature will also increase the water need of the animals and crops reduce the standard of forage (Martin, 2017). Further, the warming temperature has decreased the breeding grounds for cattle and hatching points. Due to the increase in the atmosphere's heat, the fisheries inhaled a low amount of oxygen adversely affected the production of fish. In the open fields, the reproduction and precipitation of fish, fish migration and change the



species of fish. The higher degree of temperature can also alter the temperature of oceans, sea, and rivers; causes adversely affect water creatures (<u>Saif, 2017; Hristov, 2018; Pörtner, 2012; Eissa, 2011</u>).

Carbon emission from population, gas, and fuel consumption has altered climatic factors like temperature, heat index, warming, and pollution. These unwanted environmental elements depressed the livestock precipitation, psychological stress, and pressure; increase the temperature of the sea, further use of water, low productivity of milk and meat. The study revealed the situation which becomes worse when emission from population growth and urbanization is included (<u>Amponsah et al.</u>, 2015; Bernard, 2012; Omer, 2008).

Climatic change in the form of warming temperature has threatened the agricultural sector particularly the livestock sector. The prices of livestock products like meat, milk, dry milk, yoghurt, poultry, chicken, eggs, fish, butter, and other products processed by a dairy farm and poultry good prices have increased persistently during the last two decades. The environmental changes harmed the livestock sector production negatively, unemployed the people from opportunities, increases the costs of livestock sectors, prices of livestock goods. Further, the effect on foreign exchange and income of the country was depressing (Bayraç and Dogan, 2016; Schnettler, 2009; Espinosa, 2020).

The climatic variation has become a challenge for the world, but Pakistan's agrarian and livestock sector is facing environmental change. This burning issue of the present decade demand to conduct empirical research(<u>Thornton et al.</u>, 2010; <u>Hanjra</u>, 2010; <u>Rasul</u>, 2014; <u>Porter</u>, 1996).

The adverse effect of climatic changes on the livestock sector has been reported from different studies (<u>Rojas-Downing *et*</u> *al.*, 2017; <u>Moreira</u>, 2016; <u>Miraglia</u>, 2009). The environmental variation reduced the livestock production through heat stress, more water consumption, diseases, the complication in precipitation and reproduction. The emission from fuel gas and higher growth population also caused the climatic change to decrease livestock costs and numbers.

The comparative disadvantages of the climatic changes on economic agriculture and livestock production has been discussed by the reviewers (Bayrac and Dogan, 2016; Alcamo, 2007; Liefert, 2002). It reduces the production of the agricultural sector and raises unemployment, inflation, and current account deficit. Due to climatic changes, the depressed agriculture sector due to climatic changes encourages the current account deficit and ultimately curtailed the economy's budget.

Climatic changes in the form of heat disturbed the health and production of livestock sector. The researchers have investigated the same phenomenon during the research on livestock (<u>Seerapu et al., 2015; Renaudeau, 2012; Scholtz, 2013</u>). The change in heat index due to climatic variation caused diseases, low productivity, and death of livestock.

Climatic change effect on agriculture and livestock sectors but the impact is associated with the earth characteristic of the parts has been examined by the researcher (Mishra and Sahu, 2014; Brunn, 2011; Brüschweiler, 2006). In one trigon, the warming climate can be harmful to crops, plants, and livestock, but it can benefit agriculture and animals in other regions.

Extremes directions of climatic changes which approach to economic consequences have been analyzed by (<u>Başoglu and Telatar, 2013</u>; <u>Arshad, 2016</u>; <u>Tallaksen, 2004</u>). These variations in the environment create economic losses in natural disasters, such as drought, floods, low water of the earth, storms, and low production stress.

The unwanted level of CO2 in the environment and changed the temperature of the earth has been pointed out by researchers (<u>Sanz-Saez *et al.*</u>, 2012; <u>Amsalu and Adem</u>, 2009; <u>Gomez-Zavaglia</u>, 2020). Further, the climatic change caused the unpredicted rainfall, damaged the agricultural sector and livestock production.

Climatic variation effect on the livestock sector especially in the emerging developing countries has been explored by the researcher (<u>Naqvi and Sejian, 2011; Garza, 2019</u>; <u>Sheffield, 2011</u>). The environmental changes create risks and dangerous effects, particularly for the livestock sector. Large numbers of researchers admit the hazard effect on the livestock sector.

The increased average temperature in the Mekong region of Cambodia due to co2 emission from fuel gas consumption and population growth has been interrogated by the researcher (<u>Tin, 2011; Dorico, 2018; O'Sullivan, 2021</u>). The temperature change caused unexpected rains during the period from 1960 to the present time. It creates the challenges and threats for agarics and animals.

The climatic changes caused by emission from population growth and fuel consumption of gas have been examined by the researcher (<u>Nardone et al., 2010; Lewis, 2009; Hussain, 2020</u>). Economic consequences of environmental variables are that 64% of the world population have to face the scarcity of water, water depletion, decreased the water level of the earth. The warming temperature has increased the water consumption, water distress, and scarcity of water pounds for the livestock sector.

Climatic change has a major effect on the agaric sector, but warming temperature connection to livestock sector is to be investigated has been pointed out by researchers (Thornton et al., 2010; Tomalak, 2011; Allison, 1973) pointed. The proper



studies on livestock production effects from climatic change cannot cover the negative consequences of warming temperature.

The CO2 emission from fuel consumption and population growth has created problems of environmental and climate changes has been discussed by the researcher (<u>Adams et. Al., 1998</u>; <u>Nardone, 2010</u>; <u>Salinger, 2005</u>). The variation in climatic components directly affected the livestock production negatively but indirect effects were also recorded like more water consumption and raise the temperature of sea and stress on livestock caused reduction of production.

The general objective of this study was to analyze the adverse impact of Climate on the Livestock sector due to the Emission of Carbon warming

MODEL FORMULATION AND SOURCE OF DATA

Theoretical Basis of the Model

The Auto-Regressive Distributed Lag approach was first time introduced by <u>Pesaran (1997</u>). Later, the other economists <u>Pesaran and Shin (1999</u>) refined and applied it on small and large sample size datasets. This technique is better than other approaches because of its many advantages. Engle-Granger technique includes limited variables only up to two; hence, it cannot be applied to this model because it included many variables. The other two techniques to co-integrate could be applied if the model had several explanatory variables. But theoretical background ARDL Technique confirmed preference of this technique over to Johnson Likelihood approach for many benefits.

- 1) The variables with different orders like at level or first difference I (0) and I (1) or both mixed, the ARDL technique can be applied. But Johnson Likelihood approach can be employed in the specific order of first difference I (1). ARDL technique has the characteristic of flexibility in ordering.
- 2) ARDL approach is more consistent, accurate, and reliable results in a small sample size of 30 to 80 values, and a large sample size of up to 500 observations than the Johnson Likelihood approach. Further results of the t-test are more reliable if it is estimated by the ARDL technique. Johnson technique is efficient only in the case of a large sample size.
- 3) ARDL technique is better in performing and efficient in estimating for coefficients and keeps us at distance from the problems caused by serial correlation and endogeneity. It also overcomes the problem of omitted variables and autocorrelation and provides an unbiased estimation of parameters.
- 4) The variables which are having different orders like at level or first difference I (0) and I (1) or both mixed, the ARDL technique can be applied to them. But Johnson Likelihood approach can be employed in a specific order of first difference I (1). ARDL technique has the characteristic of flexibility in ordering.

So because of such major qualities, the ARDL technique to cointegration is preferred to other techniques in the model.

LSI = $\beta 0 + \beta 1 \text{ LOG CLGFC} + \beta 2 \text{ LOG CEGCkt} + \beta 3 \text{ LOG CEE} + \beta 4 \text{ LOG UPR} + \epsilon i$

LSI = Livestock Index is Used to Measure the Livestock Production of the Country.

CLGFC = Carbon Emission from Liquid Gas and Fuel Consumption as % of the total is used for Stress.

CEGCkt = Carbon Emission from Gaseous Consumption in Kilo Ton (Kt) is used for Warming.

CEE = Carbon Emission from Electricity is Applied for Heat Measurement.

UPR = Urban Population Growth Rate Emission, the Proxy for Rising the Temperature in centigrade.

Data Source

The dataset 1980-2014 has been collected from world fame institutions named World Development Indicator (WDI).

Empirical Interpretation of Results

Unit Root Test

It is not a precondition to check the stationary of the data in the application of ARDL model estimation. But the compulsory condition for ARDL is that none of the variables should be at I (2) difference. This method can be applied in mixed stationary order or at level or first difference I (1).

Cointegration

The error-correction version of the ARDL approach equation is attributed to (Pesaran, M.H., and Pesaran, B. 1997), and



(<u>Pesaran, M.H. and Y. Shin, 1999</u>). The co-integration of variables among economic performance, livestock, Average Productivity of labor per Worker, inflation, and exchange rate are expressed through mathematical equation as

$$\Delta LLSI_{t} = \alpha_{0} + \sum_{i=1}^{N} \alpha_{1} \Delta LLSI_{t-i} \sum_{i=0}^{N} \alpha_{2} \Delta LCLGFC_{t-i} + \sum_{i=0}^{N} \alpha_{3} \Delta LCEGCkt_{t-i} + \sum_{i=0}^{N} \alpha_{4} \Delta LCEE_{t-i} + \sum_{i=0}^{N} \alpha_{5} \Delta LUPR_{t-i} + \beta_{1}LLSI_{t-1} + \beta_{2}LCLGFC_{t-1} + \beta_{3}LCEGCkt_{t-1} + \beta_{4}LCEE_{t-1} + \beta_{5}LUPR_{t-1+}\mu$$

The bound test is launched to analyze the long-run relationship among variables on differenced coefficients. The Error Correction Mechanism is conducted to evaluate the joint significance of the coefficients of the lagged level of the variables.

$$\Delta LLSI = \propto_0 + \sum_{i=1}^N \propto_1 \Delta LLSI_{t-i} + \sum_{i=0}^N \propto_2 \Delta LCLGFC_{t-i} + \sum_{i=0}^N \propto_3 \Delta LCEGCkt_{t-i} + \sum_{i=0}^N \propto_4 \Delta LCEE_{t-i} + \sum_{i=0}^N \propto_5 \Delta LUPR_{t-i} + \mu_t$$
.....(B)

The first difference of the variables is added in the equation and the bound test is applied to express the joint signing of the lagged variables.

Table 1: Bound Tests

F-Calculated	95% confidence interval		90% confidence interval	
0 224	Lower Limit	Upper Limit	Lower Limit	Upper Limit
8.324	3.338	4.703	2.739	3.942

Source: Author's Own Calculation

The above value of bound test statistics is 8.324 crosses the lower and upper bound critical limit values, bears the cointegration among LCLGFC, LCEGC_{kt}, CEE, and LUPR while the LLSI production is estimated as the dependent variable. <u>Pesaran, M.H., and Pesaran, B. (1997)</u> constructed two sets of critical bound values for a large sample up to 500 which have different standard distributions. Lower values are associated with the variables at the level and upper critical values of the bound test are nexus to the variables at the first difference I (1). The calculated value of statistics runs over the critical values, rejects the null hypothesis (no cointegration among variables exists), and accepts the alternative hypothesis (cointegration among variables exists). If the value of bound statistics lies in between critical values, not support the co integrations among variables in long run.

 Table 2: Dynamic ARDL Short Run Estimation of the Model, the Livestock is Dependent Variable

Variables	Coefficients	T-Ratios	P-Values
LSI(-1)	.770	13.983	(.000)
LCLGFC	271	-4.040	(.000)
LCEGC _{kt}	134	-3.042	(.005)
LCEE	013	.511	(.613)
LUPR	244	-2.669	(.012)
С	.385	3.665	(.013)

Source: Author's Own Estimation

Table 2 portrayed the findings of short-run results that 1% increases in stress due to carbon emission from liquid gas fuel consumption, depressed the livestock production by 27%. As 1% rises in warming, the negative change in livestock production by 13.4% and 1% expansion in heat from carbon emission from electricity caused a reduction in livestock production by 1.3%. Further against a 1% rise in urban population, livestock production decreased by 24.4%.

Table 3: Explanation of Good fit of the Model

\mathbf{R}^2	73.254
Adjusted R ²	.721
D.W-Statistics	2.134
F(6,21)	19.712

Source: Author's Own Calculation



The R^2 value is 0.721 explains the 72.1 % variation in the model is attributed to the explanatory variables; the other 28% variation in the model is the result of other factors. The Durban statistics value is close to 2, with no problem with autocorrelation. The value of F-statistics value is higher represents that all variable's effect on the model reflects good fit of the model.

P.V)

Table 4: Application of Diagnostic Test	Table 4:	Application	of Diagnos	stic Test
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Source: Researcher's Calculation

The p-value of LM-version and F-Version is higher than 10% or 0.1 percent, expressing that the error terms are not correlated. The expression is also elaborated by the Lagrange Multiplier test. Ramsey Reset test is attributed to the correct functional form of the model as the p-value of LM illustrates the same philosophy- Version and F-Version is above 10%. In the time series model, there are fewer chances of Heteroscedasticity.

Plot of Cumulative Sum of Recursive Residuals









The stability test of Cumulative Sum of square of Recursive residual and CUSUM sum of square tests are constructed by <u>Brown, Durbin, and Evans (1975)</u>. The CUSUM and CUSUM SQUARE lines adopt within a 5% critical bound limit, representing the model's stability in long-run variables attached with SR dynamics. A between 5% bound limit line shows the relationship among variables is stable and the model is not associated with structural breaks.

Variables	Coefficients	T-Ratios	P-Values
LCLGFCCGFC	-0.182	-6.477	(.000)
LCEGC _{kt}	248	-5.235	(.000)
LCEE	059	503	(.618)
LUPR	106	-3.002	(.006)

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CCCC 1.681	2.582	(.015)
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Source: Researcher's Own Calculation

The long-run results of the empirical study are somewhat different from the previous studies that express the negative impact of climatic change, warming, and heat on livestock production. The 1% increase in stress created by gaseous fuel consumption reduced the livestock production by 18.2 %. As 1% rises in warming from gas consumption in kilo tons depressed the livestock production by 24.8% and carbon emission from electricity affect the livestock production on negatively but is insignificant. The urban growth rate of population creates density caused the fall in livestock production by 10.6%. All variables except Electricity are statistically significant at 1%.

Variables	Coefficients	t-Ratios	P-Values
DLCLGFC	271	-4.040	(.000)
DLCEGC	.134	3.042	(.005)
DLCEE	013	511	(.613)
DLUPR	244	-2.669	(.012)
Ecm(-1)	379	-4.170	(.000)

Table 6: Mechanism of Error Correction

Source: Researcher's Own Calculation

The error adjustment coefficient ECM (-1) explains the short-run findings of the model. The negative value of the adjustment coefficient assures the convergence toward equilibrium and negative sign of adjustment coefficient, the model is highly significant. The adjustment value of the coefficient is .379 means 37.9% disequilibrium in the economy, which will convert to equilibrium in the next year.

As 1% rises in gas fuel consumption, alleviating livestock production by 27.1 % and 1% increases in warming from carbon emission from gaseous use reduces livestock production by 13.4 %. Against 1% expansion in heat from electricity and temperature from urban population growth depressed the livestock production by 1.3% and 24.3% respectively.

CONCLUSIONS

The large-scale emission from electricity, gaseous fuel consumption, and rapid urban population growth has a warming effect on climate. The rising average temperature of climatic change is a threat and challenge to the livestock production, poultry, and dairy farms of the agriculture sector. The empirical research concludes the economic effects of climatic variation which hurts meat, milk, fishing, dairy, and poultry production. Climate change created the problems of stress, diseases; complication in precipitation, more requirement of water which has decreased the statistics of livestock and increased the cost of animal production.

In the short run the stress due to carbon emission from gaseous fuel consumption, adversely decreased the livestock production by 27% and against 1% rises in warming from gaseous fuel consumption of kilo tons brings a negative change in animal production by 13.4% and further the livestock production by 1.3% against 1% increases in carbon emission from electricity. The long-run results also present a negative effect on the livestock production. The animal production reduced by 18.2% as 1% increases in stress from gaseous fuel consumption. The emission from electricity brings a negative change in livestock production by 5.9% but remains insignificant as t-value is less than 2 and 1% increases in warming, the emission from gaseous fuel consumption in kilo tons depressed the livestock animal by 24.8%. As 1% rises in temperature from carbon emission of urban W population growth adversely affect the livestock population by 10.6%. All the carbon emission variables except electricity are statistically significant at 1%. The study revealed that carbon emission from gaseous fuel consumption and urban population growth is generating the climatic change in the form of warming temperature which is a risk and threat for the growth of livestock production.

LIMITATION OF STUDY

The study is restricted only to the subcontinent and particularly to Pakistan during the mentioned dataset 1980-2014. The climatic situation is different from region to region in the same period hence it is not applicable all over the world.

CONTRIBUTION OF EACH AUTHOR

The principal author (Muhammad Shahid) develops the central theme of the empirical study and after applying different tests found the appropriate model to conclude the results. The second author (Farhat Parveen) contributed all mathematical equations and interpretations. While the third author (Rana Khalid Mehmood) analyzed the research and concisely and concluded the finding of the study. The fourth and fifth authors made formatting and proof reading of the research study.



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