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Measuring the Impact of Livestock Exports on GDP during the Period 2010-2020 in Sudan

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ABSTRACT

This study is conducted to measure the impact of livestock exports on GDP during the period from 2010 to 2020 in Sudan. In fact, based on mathematical models, we predicted livestock exports and we adopted the descriptive analytical approach in order to analyze the results using secondary data collected from the Ministry of Animal Resources and Fisheries and the Central Bank of Sudan for different years.

The study used the (linear regression model and some nonlinear models) Autoregressive Distributed Lag Mode methodology to investigate livestock export data (sheep - goats - camels - cows) and to find out the nature of the relationship between the variables of the study for the Sudanese economist, as well as relying on the standard approach to estimate the relationship and its nature between livestock exports and GDP in Sudan. the results supported the validity of the hypotheses of the study stating that there is a positive link between livestock exports and GDP.A set of economic models were constructed to contain the best model with a given level of confidence which is the double logarithmic model that leads to the best statistical standards and match its estimated features of economic theory after relying on the coefficient of determination - the significance of the model - the significance of the model parameters - standard problems - the number of factors or variables included in the model . The study reached a number of results, the most important of which is that there is a positive relationship between livestock exports (lamb - goat - camel - cow) and GDP which is explained by the fact that there is a very large convergence between the real and predicted values Thus, this finding indicates the quality of reconciling the logarithmic model to reconcile livestock exports data and GDP in Sudan and therefore can rely on the results of this study in addition to its recommendations for the purposes of analysis, policy evaluation and decision-making. The significant recommendation for this research is to develop laws that prevent the export of raw materials when minimal manufacturing infrastructure is available. We should give more attention to providing a network of permanent water sources and their access to the maximum areas of animal presence and improving the general infrastructure of road networks, transportation lines and services, which facilitates the access of veterinary care and extension services.

Keywords: Exports, GDP, Livestock, Camels, Sheep, Goats, Cows, Sudan.

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1- Introduction :

Sudanese foreign relations have an effective impact in all fields, especially trade relations with some Arab countries and other countries in Europe and Africa. What distinguishes these relations is that they represent a bridge of communication between Sudan and other countries. Among these relations is international trade, which is a group of activities through which products are traded across regional or international borders. International trade is considered an important part of the economy, as it makes an effective contribution to the gross domestic product. Sudan, like other countries, aims to encourage Sudanese exports and enhancing competitiveness in global markets, as livestock exports in Sudan represent approximately half of its exports, meaning they are considered one of the most important components of the Sudanese economy. As it represents a large percentage of the domestic product, Sudan is satisfied with meat, and its surplus is available for export. This activity also provides job opportunities, and many civilians live in traditional production areas to take care of His animals And take care of it. Take care Sudan attention Since the beginning of the twentieth century, quarries have been established throughout Sudan to help exports, especially livestock exports. Where it is It has come a long way for all countries of the world, especially the Gulf countries, as they are considered among the largest exporters of livestock Live stock in Sudan includes (cows, sheep, camels, and goats).

2- The problem of the study

The American sanctions imposed on Sudan put negative pressure on all sectors in the country and completely isolated the Sudanese economy from the global market. There is an urgent need to raise growth rates in this vital sector to a higher level than expected to increase production to meet internal demand and increase the volume of exports. The following question arises to clarify the problem of the study.

Does the value of livestock exports (cows, sheep, camels, goats) during the study period lead to an increase in the GDP?

3- Objectives of the study

The aim of this study is to what extent Livestock exports (cattle, sheep, camels, goats) Contribute in both GDP and Build standardized and predictable models for the value of livestock exported from Sudan in the coming years..

4- The importance of the study

The practical importance of this study comes to reach the best standard model for livestock exports and their impact on the Sudanese economy through the application of the latest measurement methodologies, in order to benefit from this study in the service of economic decision-makers in the appropriate and Develop an appropriate policy economic policy for how to address the challenges facing the livestock trade in Sudan.

5- Study hypotheses: The study contains the following hypotheses

is there is a direct relationship between livestock exports (cows, sheep, camels, goats) and the gross domestic product.

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Study Methodology:

The study depends on the descriptive analytical approach, where the descriptive aspect is used in graphs and descriptive statistics of livestock exports in Sudan, while the standard aspect is used in building mathematical models to analyze the results to prove the study's hypothesis and the accuracy of its predictions. Through the Use of linear regression model and some nonlinear models

6- Data sources

The study depended on secondary data obtained from reports for different years at the Central Bank of Sudan in Sudan and Ministry of Animal Resources and Fisheries during the period (2006-2021).

7- Study limitations:

Time limitations (2010-2021)

Place limitations (Sudan)

8- Theoretical framework and previous studies:

Previous studies

R Trevor Wilson 's study(2018)

This study aimed to analyze some major aspects of the livestock sector in the Republic of the Sudan. The study reached :-

The country has one of the largest livestock populations in Africa. Cattle, sheep, goats, and camels provide milk and meat for local consumption and meat and live animals for export. Ruminants also provide ancillary functions including draught and transport, produce manure and act as a store of wealth. In spite of their importance to the national economy livestock do not receive sufficient attention in government policies and financing. Almost all animals are owned by smallholder farmers or traditional pastoralists. Livestock feed is often in deficit in relation to needs and crop by-products ad range vegetation are fibrous and of low nutritional value. Livestock are affected by a multitude of diseases but receive little health care. Access to finance by producers is difficult and credit is limited and expensive if obtainable. Services to the sector are not adequately funded and are generally poorly equipped. Livestock output is low in relation to numbers and to the sector's potential. Some suggestions are made for the improvement of performance that will add value to the sector and contribute to people's livelihoods.

Abdel Ghaffar M. Ahmed 's study2014

This study aimed to study the impact of livestock on the economy of SudanThe study found that its social uses within the pastoral sector are of great importance in the future development of the country. The role of livestock is that of a food system and store of value, wealth, power, and authority in areas where pastoralists practice their daily life without being reached by modern banking systems and market economy. There are four major uses of livestock in Sudan; namely, domestic, economic, social, and political. A key aspect of the issue is the social significance of livestock and how the wealth it generates transforms itself with power and authority. Indigenous knowledge in land management as well as the pastoralists' use of different types of animals to satisfy their short- and long-term needs has to be understood in order to

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effectively implement any strategic planning. Elements that should be considered are the impact of drought in the
marginal areas of the northern part of the country, land grabbing in the central areas, and civil war in the southern region, specifically focusing on the contribution of the livestock sector to the Gross Domestic Product (GDP) under the pressure of the shrinking grazing areas. A brief attempt is made toward explaining issues of edification of pastoralists in order to transform the system. An advance in this direction can only come through education and creation of awareness towards the relevance of high quality livestock for the local, regional, and national economies of the state. This calls for creative engagement in processes of planning and developing the pastoral sector

Anjani Kumar 's study 2010

This study aimed to examined temporal changes in the composition of livestock exports, assessed the export competitiveness of different livestock products and analyzed the factors affecting the growth of livestock export. The performance of livestock export has been found noteworthy. The liberalization policy initiated in 1991 seems to have improved the performance of livestock exports. The study has revealed that India is competitive in export of meat products, except poultry. The export of buffalo meat has been increasing consistently and the poor domestic demand has further fueled its export. But, the export of mutton does not seem to have much prospects in the short-run, as even the domestic demand is not being met by domestic production. In milk and milk products, India has some advantage at the farm level, but is not competitive in export of milk and milk products under the prevailing world market situation. The domestic policy initiatives and increased production and productivity have been identified as the important factors in increasing the export of livestock products. The study has suggested that strengthening of export supply capacity domestically holds the key for enhancing export of livestock products rather than expanding world market.

Mohamed Mire Mohamed 's study 2015

The purpose of this study is to investigate the contribution of crops and livestock production on Somali exports, data found from world development indicators1980-2010 and analyzed in regression using OLS method in EViews7 Software. The study found that crops and livestock production have positive relationship with Somali exports, so an increase in crops and livestock production increases Somali exports and vice versa. Somalia since the collapse of central government had only an export of agriculture sector including livestock. While they account more than 65% of the country's GDP and more than 50% of the Somali export the productivity of crops and livestock is very important for the country's economic growth

Theoretical framework

Livestock in Sudan

Sudan is considered one of the largest Arab and African countries in the field of livestock and their products, which contribute to achieving food security Providing various types of meat and dairy products for local consumption and export (Bank of

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Sudan, 2009, p. 106). The livestock sector in Sudan is considered the most important supplier of foreign exchange, and this was confirmed by the Arab Organization for Agricultural Development. It also confirmed its ability to fill the red meat gap in some Arab countries, and Sudan has taken Strict procedures to increase production efficiency (Nazik Shamam, 2020)

The livestock sector plays an essential role in the economy of Sudan, as it contributes fundamentally to providing food security. It is also a major source of hard currency, and a means of transportation, transportation, and draft power in traditional agricultural operations. Its secondary products also provide inputs for other industries, such as leather industries, organic fertilizers, and others. All of this contributes to providing sources of work and subsistence and It employs 40% of the workforce directly and indirectly) and is therefore greatly relied upon to reduce poverty, improve the quality of life, and maintain environmental balance (,The social uses of livestock among pastoralists in Sudan: Food systems, stores of value, wealth, power, and authority,(Abdel Ghaffar M. Ahmed ,2014.P22)

And also he plays this sector plays a crucial role in the Sudanese economy and in the well-being of all residents .and It produces a basic flow of food, and brings in a large amount of foreign exchange from export earnings, where he is manure provides fertilizer and fuel It creates job opportunities. For all these reasons, especially from The justice and livelihoods perspective is important, even key ,It is considered Poverty alleviation component and export value. Wealth Animalist represents Just under 50 percent of exports all agricultural products Just under 30 percent of non-oil exports. Despite this Contributing to the national economy and allocating resources to livestock and animal health services but that Not proportional to revenue resulting from the sector. .and It contributes valuable animal protein to the diet of all the people of Sudan .and that to complement the already significant comparative advantage. Livestock is considered a strategic element in livelihoods and income generation. Food security and agricultural development. So it's contribute to The national economy, human well-being and livelihoods across four Core pillars: poverty alleviation, food security, and environment Conservation and gender equality. (R Trevor Wilson. 2018.p1)) System Marketing livestock in Sudan is complex and includes many aspects Challenges On a small scale. The Includes the livestock value chain and Pastoralists, small holder farmers, local traders, brokers and local meat and Processors and export are both private and semi-governmental entities. Farmers sell livestock to trader's locals, most of them are located at the village level. Local merchants carry Purchase livestock to major livestock markets and sell to brokers. The brokers then sell the cattle for local meat processors and exporters. (Sudan agriculture value chain analysis. 2020, P73)

Livestock exports in Sudan

Export is of great importance in the economies of various countries and is one of the basic factors for economic development. For a long period of time, commercial theorists considered it an effective means of achieving the desired growth rates. It was also considered a successful way to collect the largest possible amount of currency.

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importance is that it is an important resource of hard currency, and there are those who believe that export is linked to the size of the production market, which as it increases, various institutions and companies are forced to double production in order to cover this increase in the market, and then the surplus is discharged abroad through export.). Saghi Ray Iman. 2016, p. 53)

export markets and Sudanese products is crucial to increasing foreign currency and profits, reducing the trade deficit, and supporting companies' growth and gains. Productivity and enhancing economic growth (Joevas Asare. 2020. p. 14, and according to data from the World Agriculture Organization (FAO) as a basis for comparison between some African countries' exports of cows, sheep, and goats, we note that Sudan comes in second place among African countries exporting cows, and this calls for interest in increasing Exports of cows, goats, and sheep, and there is a large scope available for comparison with the actual export (wikipedia - Sudan's economy,)

Sudan raises large numbers of camels, cattle, sheep and goats. It exports live animals in large quantities, mostly sheep to Saudi Arabia and camels to Egypt. It also exports chilled and frozen meat, mainly to Saudi Arabia, the Gulf countries and Egypt. In the nearly 20 years since 2000, sheep and lamb exports have tripled or more times, with the trade now officially worth more than $400 million annually.((Alex Humphrey, 2020, p37) The proceeds of live animal exports in Sudan retained the second place among non-petroleum exports and recorded a high return from its contribution (Bank of Sudan, 2006, p. 125).

Contribution of livestock to the Sudanese economy

Livestock makes an effective and major contribution to global food system and a major source of livelihoods .nearly a billion poor people in developing countries they depend on it (Swanepoel et al. 2008, 3).It is considered so the largest sub-sector of domestic production in Sudan It is considered one of the sectors the fastest growing agricultural sub -sector in most developing countries, reaching 33% of (GDP) gross domestic product from one of the main reasons to grow population, It has led to urbanization and more importantly rising incomes are rapidly increasing demand for animal products. this trend is likely to continue in the future and it becomes even bigger than oil (Abdel Ghaffar M. Ahmed, 2018, p9)

The contribution of livestock exports to the gross domestic product

The basic data will be analyzed to determine the impact of total annual livestock exports on the gross domestic product in Sudan, based on annual data obtained from the Bank of Sudan and the Ministry of Livestock and Fisheries

(annual gross domestic product - total annual livestock exports) during the period (2010-2021)

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Table No (1) shows both the annual GDP and annual livestock exports during the period (2010-2021).

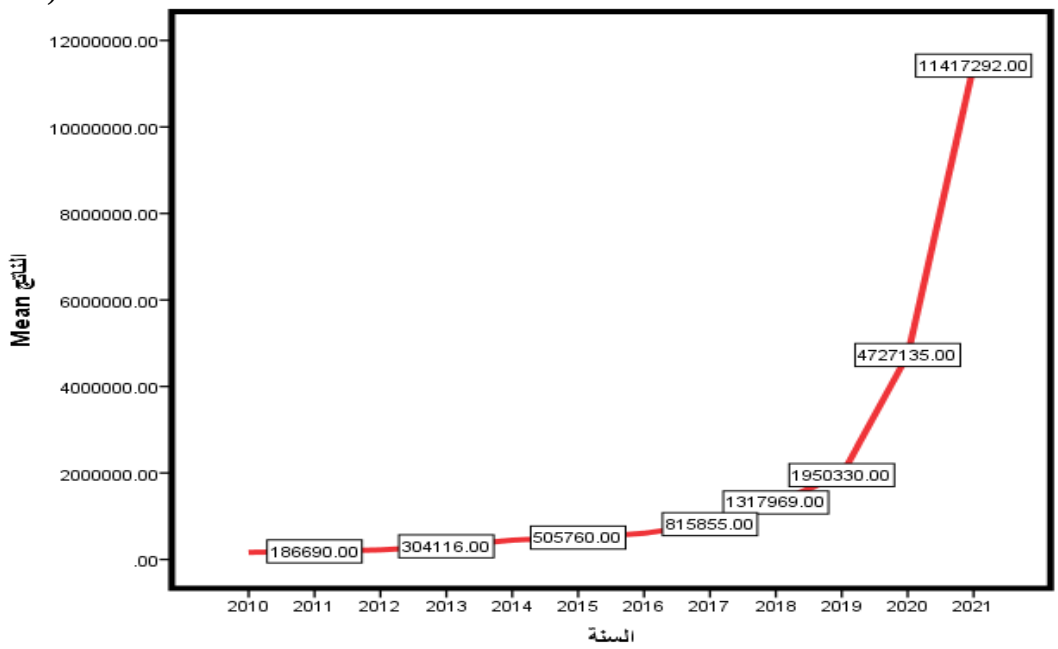
Cow	beauty	goat	Sheep	GDP	Livestock exports	Years
2,569	12,557	5174	146.4	162,203.9	20446.4	2010
5,170	39,020	8,420	115.6	186.689.9	52725.6	2011
14,611	62,211	9,120	285.6	222,548.0	86227.6	2012
6,666	98,010	10,684	477.5	304,116.0	115837.5	2013
10,474	207,850	22,302	549,782	447,999.6	790,408	2014
13,843	260,009	30,409	492,794	505,760.7	797,055	2015
54,889	271,898	18,391	363,699	605,408.6	708,877	2016
51,753	302,025	19,350	457,415	815,855.4	830,543	2017
63,426	216,843	16,987	467,129	1,317,968.8	764,385	2018
56,567	121,910	13,014	396,370	1,950,330.2	587,861	2019
30,875	138,224	1,933	195,300	4,727,134.7	366,332	2020
49,833	215,074	1,162	251,375	11,417,292.2	517,444	2021

Source: Ministry of Animal Resources and Fisheries and Central Bank of Sudan

Identify the general trend of livestock exports and their impact on the GDP in Sudan during the period (2010-2021**)**

1. Gross Domestic Product (GDP):

Figure No (1) shows the general trend of GDP in Sudan during the period (2010-2021)



Source: Prepared by the researcher from the data of the basic table 2023

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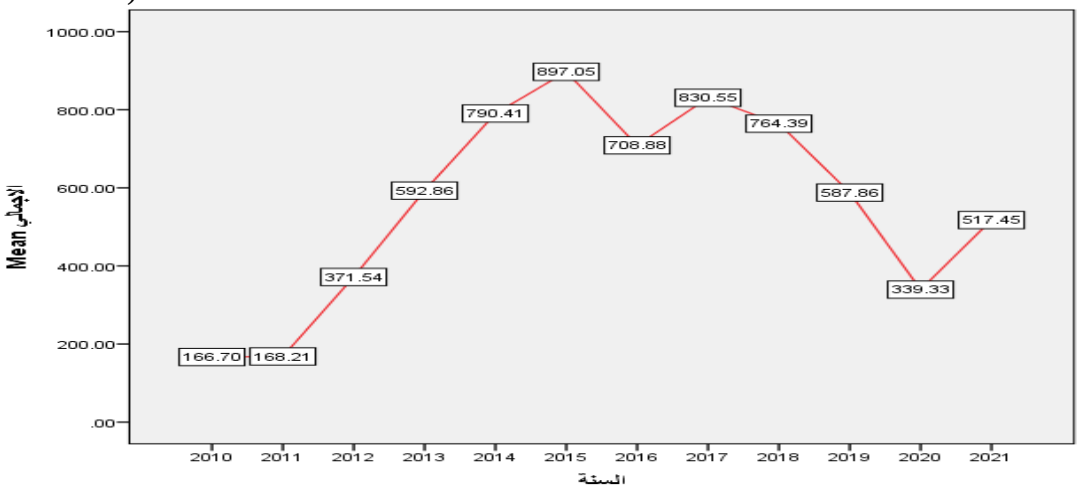
Through the previous graph, it is clear that the GDP in Sudan was stable during the period 2010-2021, then it began to increase at an accelerated pace and take a high incremental pattern during the period 2017-2021

2. **Total annual livestock exports in Sudan during the study period:**

Figure No (2) shows the general trend of annual livestock exports during the period (2010-2021)



Source: Prepared by the researcher from the data of the basic table 2023

Through the Figure No (2). it is clear that the total annual livestock exports increase at a steady pace during the period 2010-2014, then it has a decreasing pattern during the period 2015-2020, and it tends to increase again during the year 2021.

3. **Total annual lamb exports in Sudan during the study period**

Figure No (3) shows the general trend of annual lamb exports during the period (2010--2021)

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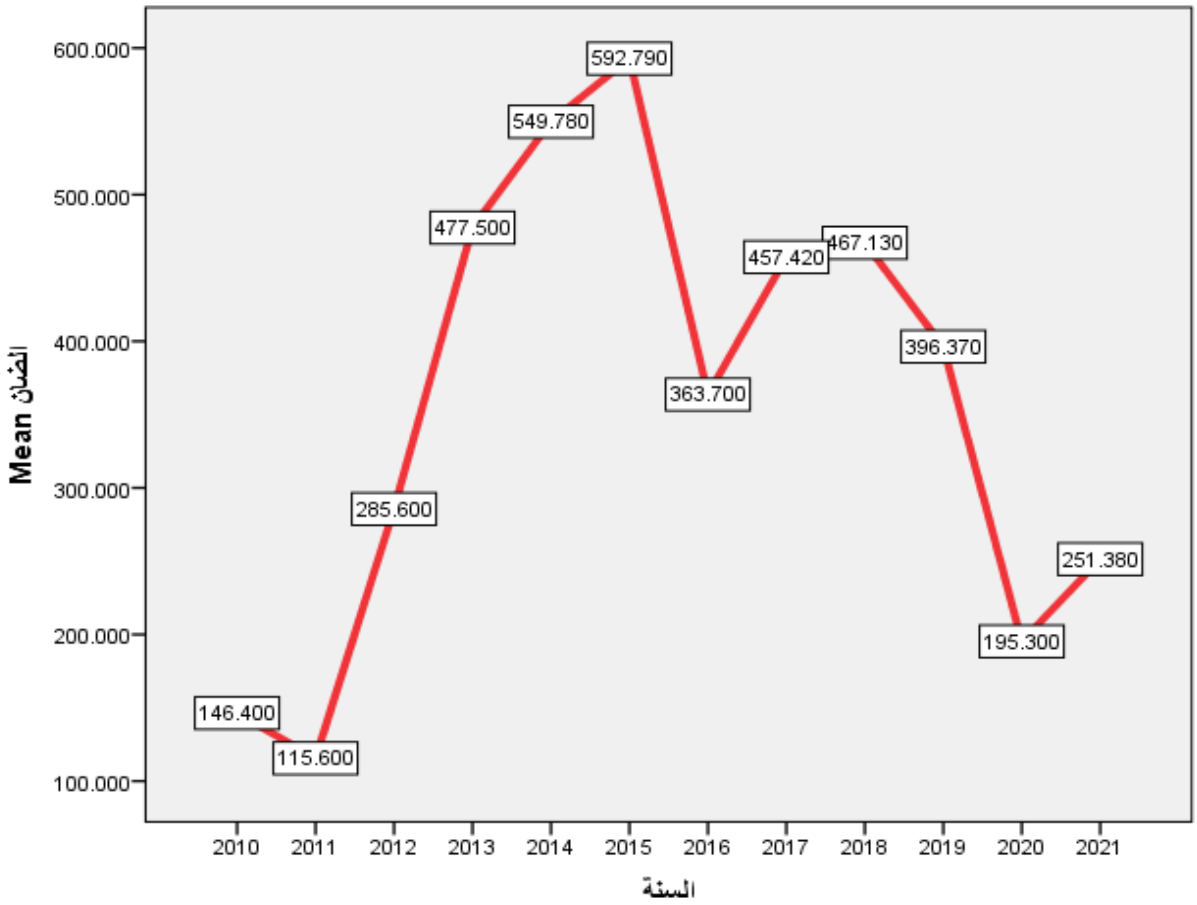

Source: Prepared by the researcher from the data of the basic table 2023

From the Figure No (3), it is clear that the total annual sheep exports increase at a steady pace during the period 2010-2014, then it becomes a decreasing pattern during the period 2015-2020, and it tends to increase again during the year 2021

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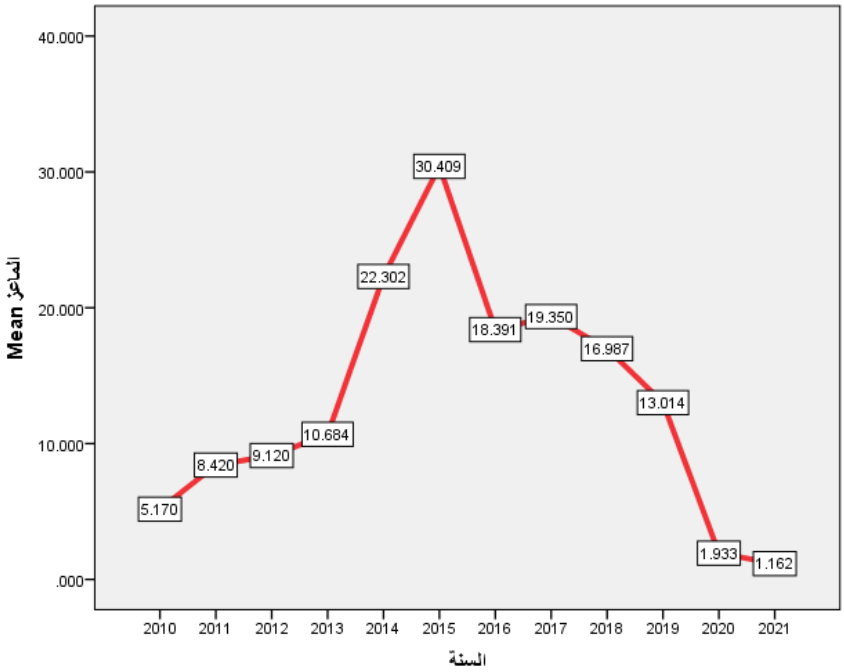
4- Total annual goat exports in Sudan during the study period

Figure No (4) shows the general trend of annual goat exports during the period (2010-2021)



Source: Prepared by the researcher from the data of the basic table 2023

From the Figure No (4), it is clear that the total annual goat exports increase at a steady rate during the period 2010-2015, then it becomes a decreasing pattern during the period 2016-2021.

5. Total annual camel exports in Sudan during the study period

Figure No (5) shows the general trend of annual camel exports during the period (2010-2021)

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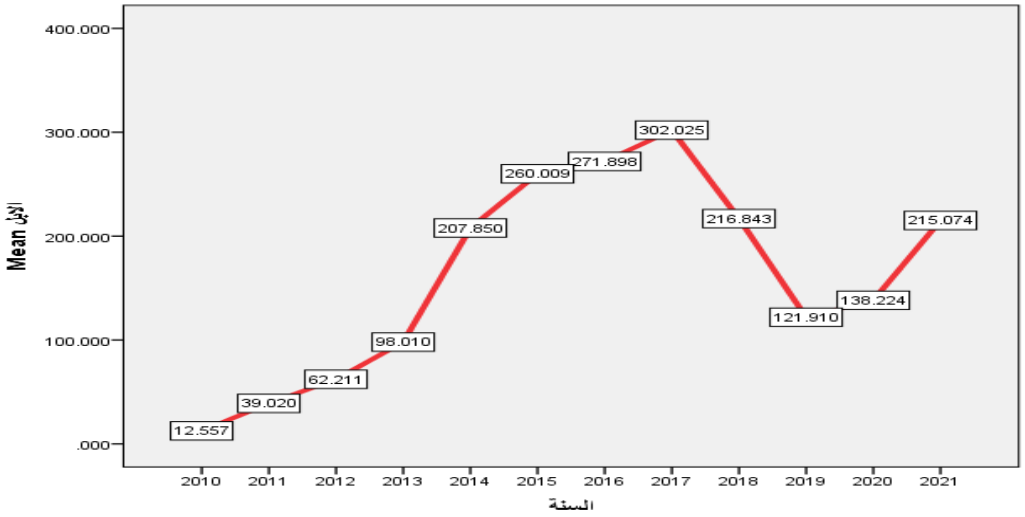

Source: Prepared by the researcher from the data of the basic table 2023

Figure No (5) it is clear that the total annual camel exports increase at a steady pace during the period 2010-2016, then it has a decreasing pattern during the period 2017-2019, and then increases again during the period 2020-2021

6. Total annual cattle exports in Sudan during the study period

Figure No. (6) shows the general trend in annual cow exports during the period (2010-2021)

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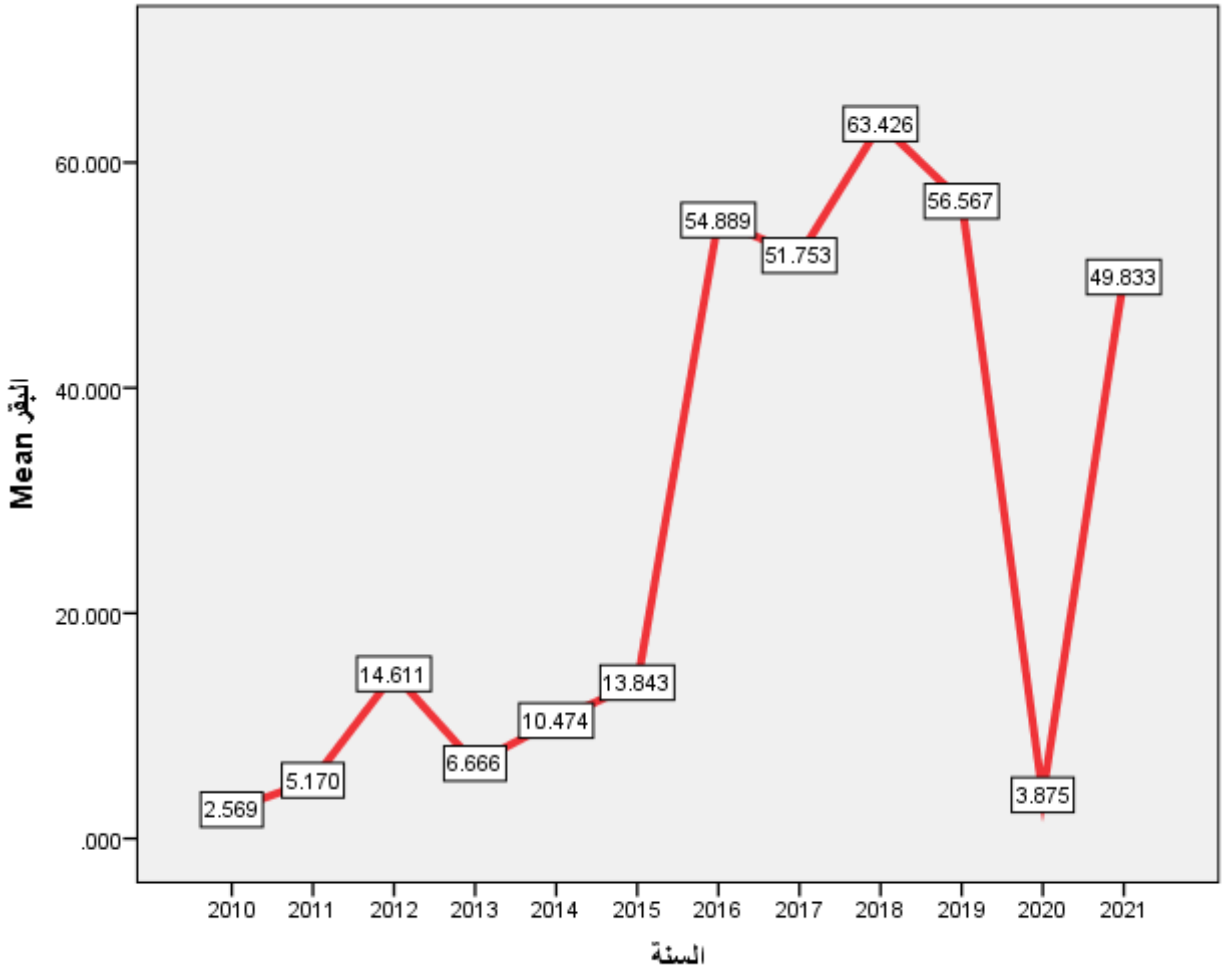

Source: Preparing the researcher from the basic table data 2023

Figure No. (6), it is clear that the total annual exports of cows increase at a fluctuating pace during the period 2010-2018, then it has a decreasing pattern during the period 2019-2020, and it tends to increase again during the year 2021

Investment in the fieldLivestock

ImportanceInvesting in this fieldrate of the increasing demand for Sudanese livestock, especially the Arab countrieswhereSome Sudanese cattle have been classified as primarily red meat-producing breeds, as have sheep, goats, and camels. And some of them as wellOf the dairy-producing breeds and the contribution of this sector The resulting the national level is large enough to provide the required production of meat for local consumption and export to a large extent and It provides opportunities to manufacture red meat products locally and globally, which creates opportunities for many projects that can be invested in, as follows:

-Raises Livestock on natural pastures (sheep - goats -.Cows).

- Pastoral farms for raising cows (sheep raising).

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- Cow and sheep fattening farms.
- Meat production dairy It has a large capacity and can be invested in in various forms.
- the slaughterhouses that serve and qualify exports and Meat storage. (Kenana Online Community Knowledge NetworksLivestock in Sudan, United Nations Development Program - Ministry of Communications and Information Technology)

Problems facing livestock exports

- Smuggling to some neighboring countries and the shortage of feed led to a reduction in exported quantities Due to the ban imposed by Saudi Arabia on exports of cows and their meat and the rise in their prices in foreign markets. As it is considered one of the largest markets for Sudanese exports

Weak consultations in importing countries, failure to secure track lines for livestock, and weak in frastructure (Musa Yusuf Muhammad Al-Barr, 2018, p. 13) Magazine, September 25, 2018, Bakht Al-Rida Scientific University, Court issues quarterly, issue 25.)

Sudanese traders who export live animals may be subject to price fixing by importing countries. This raises the question of whether slaughtering animals in Sudan and then sending chilled or frozen meat might be a better option. However, the economics of this have yet to be determined. This is also not an option for the millions of sheep sent for the Hajj, when the sacrifice requires live animals (Source URL: tps://www.sparc-knowledge.org/publications-resources/impacts-disruptions-livestock-marketing-Sudan)

-The 2020 Corvid pandemic the accompanying partial suspension of Hajj in Saudi Arabia and the resulting collapse in demand for exports also affected pastoralists severely .However, once the export ban was lifted, marketing returned to its previous levels, and grew even further. While exporting live animals from Sudan is a growing and lucrative business, the risks and disruptions faced by traders and herders remain significant. (Alex Humphrey Carmen Jacquez Simon Levine Chloe Stull-Lane Hussein Sulieman Steve Wiggins **)**

Analysis of the data of the impact of livestock exports on GDP during the period 2010-2020 in Sudan

illustrate model variables

Table N0 (2) shows the impact of livestock exports on the GDP in Sudan

Type	Icon	Variable
Dependent	Y	Gross Domestic Product (GDP)
independent	X_1	Lamb exports
Independent	X_2	Goat Exports
Independent	X_3	Camel Exports
Independent	X_4	Cow Exports

Source : Researcher Study variables 2023

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Table N0 (3) Estimation of the Multiple Linear Regression Model for the Impact of Livestock Exports on GDP

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	1830500.444	1695574.212		3.080	0.016		
X_1	4950.720	7970.355	0.240	2.621	0.026	0.264	3.786
X_2	458993.872	142714.068	1.229	-3.216-	0.015	0.271	3.693
X_3	27805.878	11348.411	0.824	2.450	0.044	0.350	2.860
X_4	7942.598	34575.993	0.060	-2.2297	0.046	0.576	1.736

Source: Prepared by the researcher

from the data of Table No 3 It is clear that the estimation of the linear regression model was significant in addition to that there is no problem of multiple overlap and significant for all variables of the model and thus the model is suitable for estimating the impact of livestock exports on the domestic product in Sudan is:

$$Y = 1830500.444 + 4950.720X_1 + 458993.872X_2 + 27805.878X_3 + 7942.598X_4$$

$$R^2 = 0.723$$

$$D.W = 1.876$$

From the results of the analysis

The relationship between livestock exports and GDP, i.e. whenever the value of goat exports increases by one unit, the GDP increases by 4950.720 tons. But if the export of lamb increased by one unit, the GDP increases by 458993.872, as well as there is a positive relationship with camel exports, if it increases by one unit, the GDP increases by 27805.878

As for cattle exports, if they increase by one unit, the GDP increases by 7942.598.

Table (4) shows the analysis of the Linear regression model to determine the impact of livestock exports on the GDP in Sudan:

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	84699508640767.330	4	21174877160191.832	4.570	.039[b]
	Residual	32431369279392.650	7	4633052754198.950		
	Total	117130877920159.970	11			

Source: Prepared by the researcher

From Table (4), it is clear that the linear regression models that were estimated are significant as well as the significance of livestock exports on GDP..

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Table No. (5) shows the estimate of the coefficient of determination and the adjusted coefficient of determination in the linear regression model

Model	R	R Square	Adjusted R Square	Change Statistics					Durbin-Watson
				R Square Change	F Change	df1	df2	Sig. F Change	
1	0.850[a]	0.723	0.565	0.723	4.570	4	7	0.039	1.876

Source: Researcher Preparation

From the data in the table above, we find that the coefficient of determination reached 72.30%, meaning that 72.30% of the change in the gross domestic product in Sudan is the result of the change in exports (goats, sheep, camels, cows), and the rest of the percentage, 27.70%, is due to other factors, which confirms the quality of the model that was done. Reaching it, we also find that the value of Durbin-Watson was 1.876, which is very close to 2, and this confirms that there is no problem of autocorrelation of errors in the model.

The double logarithmic model: It is one of the important non-linear models that converts data using either LOG or LIN. The most famous form of the model is the

Cobb- Douglas- function, which takes the following formula::

$$Y_1 = \beta_o X_{11}^{\beta_1} X_{22}^{\beta_2} X_{33}^{\beta_3} X_{44}^{\beta_4} e^{u}$$

The data was converted using the -LOG The estimation results were as follows:

Table (6) shows the impact of livestock exports on the GDP in Sudan using the double logarithm

Type	the transfer	code	Variable
continued	Log Y1	Y1	*Probabilistic GDP*
independent	log X1	X11	Lamb exports
independent	Log X2	X22	Goat exports
independent	Log X3	X33	Camel exports
independent	Log X4	X44	Cow exports

Source: Prepared by the researcher

Table (7) shows the estimation of the milestones of the double logarithmic model of the impact of livestock exports on GDP in Sudan

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	4.410	1.083		4.072	.005		
x11	.275	.648	.111	3.425	.044	.249	4.011
x22	1.119	.246	-.842-	4.551	.003	.502	1.993

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x33	.737	.342	.532	3.154	.048	.281	3.556
x44	.273	.207	.244	4.319	.049	.501	1.994

Source: Prepared by the researcher

From the table datanumber 7We find that the estimate of the double logarithmic model for the impact of livestock exports on the size of the GDP in Sudan was significant, in addition to the absence of a multiple interference problem and the significance of all variables at all stages. Thus, the appropriate model for estimating the impact of livestock exports on the GDP is:

$$Y_1 = 4.41 + 0.275X_{11} + 1.119X_{22} + 0.737X_{33} + 0.273X_{44}$$

$$R^2 = 0.88$$

$$D.W = 1.896$$

Through table data number 7We also note that there is a direct relationship between livestock exports and the gross domestic product. That is, if the value of goat exports increases by one unit, the gross domestic product increases.0.275 units. If sheep exports increase by one unit, the gross domestic product increases by 1.119 units. There is also a direct relationship with camel exports. If they increase by one unit, the gross domestic product increases by 0.737 units. As for cow exports, if they increase by one unit, the gross domestic product increases by 0. 273 units.

Table (8) shows the analysis of the double logarithmic model of the most important factors affecting GDP in Sudan:

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	3.165	4	.791	12.797	.002[b]
	Residual	.433	7	.062		
	Total	3.598	11			

Source: Prepared by the researcher

From the data of the previous table, we find that the double logarithmic models that were estimated are significant as a whole as well as the significance of livestock exports affecting the gross product in Sudan.

Table (9) shows the estimate of the coefficient of determination and the adjusted coefficient of determination in the double logarithmic model

Model	R	R Square	Adjusted R Square	Change Statistics					Durbin - Watson
				R Square Change	F Change	df1	df2	Sig. F Change	
1	0.938[a]	0.880	0.811	0.880	12.797	4	7	0.002	1.896

Source: Prepared by the researcher

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From the data in the table above, we find that the coefficient of determination reached 88.00%, meaning that 88.00% of the change in the gross domestic product in Sudan is the result of the change in exports (goats, sheep, camels, cows), and the rest of the percentage, 12.0%, is due to other factors, which confirms the quality of the model that was done. Reaching it, we also find that the value of Durbin-Watson was 1.896, which is very close to 2, and this confirms that there is no problem of autocorrelation of errors in the model.

The semi-logarithmic model: It is one of the important non-linear models where the data is transformed either using (LIN), which takes the following form:

$$Y_1 = e^{\beta_0 + \beta_1 X_1 + \beta_2 \ X_2 + \beta_3 X_3 + \beta_4 X_4}$$

The data was converted using the (LIN) formula, and the estimation results were as follows

Table No. (10) shows the impact of livestock exports on GDP in Sudan using the semi-logarithmic model

Type	the transfer	Code	Variable
continued	Lin Y1	Y1	*Probabilistic GDP*
independent		X1	Lamb exports
independent		X2	Goat exports
independent		X3	Camel exports
independent		X4	Cow exports

Table No. (11) shows the estimation of the semi-logarithmic model to determine the impact of livestock exports on the gross domestic product in Sudan:

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	12.675	0.670		18.919	.000		
	X1	0.003	0.003	0.380	1.003	.349	.264	3.786
	X2	0.171	0.056	-1.135-	-3.034-	.019	.271	3.693
	X3	0.011	0.004	0.807	2.449	.044	.three hundred fifty	2.860
	X4	0.006	0.014	0.120	.467	.655	.576	1.736

Source: Prepared by the researcher

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From the data in the previous table, we find that the estimate of the semi-logarithmic model for the impact of livestock exports on the size of the GDP in Sudan was significant, in addition to the absence of a multiple interference problem and the significance of all variables at all stages. Thus, the appropriate model for estimating the impact of livestock exports on the GDP is:

$$LinY = 12.675 + 0{,}003X_1 + 0.171X_2 + 0.011X_3 + 0.006X_4$$

$$R^2 = 0.735$$

$$D.W = 1.936$$

Through the table data, we also notice that there is a direct relationship between livestock exports and the gross domestic product. That is, if the value of goat exports increases by one unit, the gross domestic product increases.0.003 units. However, if sheep exports increase by one unit, the GDP increases by 0.171 units. There is also a direct relationship with camel exports. If they increase by one unit, the GDP increases by 0.011 units. As for cow exports, if they increase by one unit, the GDP increases by 0.003 units. 006 units.

Table (12) shows the analysis of the semi-logarithmic model of the impact of livestock exports on GDP in Sudan.:

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	14.014	4	3.503	4.843	.034[b]
	Residual	5.063	7	.723		
	Total	19.077	11			

Source: Prepared by the researcher

From the data of Table 12, we find that the quasi-logarithmic model that was estimated is significant as a whole as well as the significance of livestock exports affecting the gross product in Sudan.

Table (13) shows the estimate of the coefficient of determination and the adjusted coefficient of determination in the quasi-logarithmic model:

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.857[a]	.735	.583	.85050	.735	4.843	4	7	.034	1.936

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Source: Prepared by the researcher

From the data in the table above, we find that the coefficient of determination reached 73.5%, meaning that 73.5% of the change in the gross domestic product in Sudan is the result of the change in exports (goats, sheep, camels, cows), and the remaining 26.5% is due to other factors, which confirms the quality of the model that was done. Reaching it, we also find that the value of Durbin-Watson was 1.896, which is very close to 2, and this confirms that there is no problem of autocorrelation of errors in the model.

Comparison between different models to choose the best model:

At this stage, a comparison will be made between the different models (linear - logarithmic - semi-logarithmic) to reach the best model, based on the coefficient of determination - the significance of the model - the significance of the model parameters - standard problems - the number of factors or variables included in the model.

Table (14) shows the morale of the parameters and the existence of the problem of multiple linear interference

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
linear	(Constant)	1830500.444	1695574.212		3.080	0.016		
	Goat exports	4950.720	7970.355	0.240	2.621	0.026	0.264	3.786
	Lamb exports	458993.872	142714.068	1.229	-3.216-	0.015	0.271	3.693
	Camel exports	27805.878	11348.411	0.824	2.450	0.044	0.350	2.860
	Cow exports	7942.598	34575.993	0.060	-2.2297	0.046	0.576	1.736
Double logarithmic	(Constant)	4.410	1.083		4.072	.005		
	Goat exports	.275	.648	.111	3.425	.044	.249	4.011
	Lamb exports	1.119	.246	-.842-	4.551	.003	.502	1.993
	Camel exports	.737	.342	.532	3.154	.048	.281	3.556
	Cow exports	.273	.207	.244	4.319	.049	.501	1.994
Semi-logarithmi	(Constant)	12.675	0.670		18.919	.000		
	Goat exports	0.003	0.003	0.380	1.003	.349	.264	3.786

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c	Lamb exports	0.171	0.056	-1.135-	-3.034-	.019	.271	3.693
	Camel exports	0.011	0.004	0.807	2.449	.044	.350	2.860
	Cow exports	0.006	0.014	0.120	.467	.655	.576	1.736

Source: Prepared by the researcher

From the data in Table No. (14) above, we find that all the models that were reached have significant features and are free of the problem of multi-collinearity in the three models (linear - double logarithmic - semi-logarithmic), in addition to that the truncated part of the y-axis is consistent with economic theory in terms of For the linear model, the double logarithmic model and the semi-logarithmic model, we find that in terms of the number of significant factors present in the model, all models include annual livestock exports factors (goats - sheep - camels - cows). Thus, it is not possible to choose the best model except after comparing the determination coefficients in the three models. There is a problem of autocorrelation of errors

Table No(15) shows the coefficient of determination - the significance of the model and the existence of the problem of self-correlation of errors:

D.W	Sig	Coefficient of determination	Model
1.876	0.000	0.723	Linear
1.896	0.000	0.880	Double logarithmic
1.936	0.000	0.735	Semi-logarithmic

Source: Prepared by the researcher

Through the data of the previous table, we find that the highest coefficient of determination was in the linear model, in addition to that all models are significant as a whole and do not have the problem of autocorrelation of errors due to the Durbin-Watson value being close to 2. From the previous narrative, we find that the double logarithmic model is the best after applying The model's significance criteria and the presence of the problem of autocorrelation of errors and the coefficient of determination are consistent with what was reached from the criteria data of the previous table (13), and therefore the appropriate model that can be used in estimating the impact of livestock exports on the gross domestic product in Sudan is the double logarithmic model because it obtains The best statistical criteria and matching of its estimated features to economic theory, and the model is as follows:

$$Y_1 = 4.41 + 0.275X_{11} + 1.119X_{22} + 0.737X_{33} + 0.273X_{44}$$

$$R^2 = 0.88$$

$$D.W = 1.896$$

Finding the predictive values to the dependent variable (GDP) based on the appropriate linear model where the predictive values were found and compared with the real values as follows:

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Table 16 shows Predictive and real values of the dependent variable (GDP) and Residuals.

Residuals	Predictive values	Real Value	Year
0.08	5.13	5,21	2010
-0.04	5.31	5.27	2011
-0.30	5.65	5.35	2012
-0.21	5.69	5.48	2013
0.01	5.64	5.65	2014
0.10	5.60	5.70	2015
-0.19	5.97	5.78	2016
-0.09	6.00	5.91	2017
0.14	5.98	6.12	2018
0.40	5.89	6.29	2019
0.22	6.46	6.67	2020
-0.12	7.18	7.06	2021

Source: Prepared by the researcher

The data of Table (16) shows that there is a very large convergence between the real and predicted values, and this indicates the quality of the reconciliation of the logarithmic model for the reconciliation of livestock exports and GDP data in Sudan.

Study results

- Livestock trade is one of the most important components of the Sudanese economy, as it contributes significantly to the GDP, achieves self-sufficiency, and provides job opportunities.
- Livestock's contribution to the local economy is significant, as is its contribution to exports
- - Sudan has taken great interest in livestock because of its contribution to Sudanese exports.
- - Increase the value of goat exports by one unit, the GDP increases by 0.003 units,
- Increasing the value of lamb exports by one unit, the GDP increases by 0.171 units,
- Increase the value of camel exports, if they increase by one unit, the domestic product increases by 0.011 units
- Increasing the value of cattle exports, if they increase by one unit, the GDP increases by 0.006 units
- that the model that the double logarithmic is the best models that were used in the study
- A very significant convergence between true and predicted values during the study period

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Recommendation

- Orientation towards manufacturing and exporting finished products to make the most of the value of exports and remanufacturing by-products
- Establish laws prohibiting the export of raw materials when minimal manufacturing infrastructure is in place
- Tracking and identifying disease-free places and approving them from the relevant organizations and establishing "health boxes" that allow the export of animals and their products to European countries and benefiting from the large price difference compared to exporting to the Arab Gulf countries
- Improvement of the public infrastructure of road networks, transport lines and services, which facilitates access to veterinary and extension services and also provides for the migration of animals or their products to the local market and export outlets,
- Promoting investment in livestock and its various products
- Provide funding to improve the infrastructure needed to promote livestock
- To stimulate scientific research and intensify interest in modern technology in the field of livestock and livestock products

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