

**BEEF AND MUTTON CONSUMPTION IN KHARTOUM STATE:
DEMAND ANALYSIS (2000 – 2004)****By****Imad Eldin Elfadil Abdel Karim¹, Abda Abdalla Emam² and Somia Gafar**

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ABSTRACT

This paper aimed to analyze the impact of beef and mutton price increase on household consumption of beef and mutton and their substitute in Khartoum State and to identify the main factors affecting the demand for beef and mutton in Khartoum State. The study depends mainly on primary data, which was collected from three residential areas in Khartoum State that represent different income classes. Descriptive and analytical statistics, correlation and regression analysis were used. The findings of the research showed that income level affects the quantity of beef and mutton consumed by the family in different income levels. Low income household spends most of their income on food, therefore, their consumption of beef and mutton is very low due to its higher prices. Beef meat is preferred by low income households, while mutton is preferred by the middle and high income households. The demand for beef and mutton is inelastic with respect to income changes, which indicates that the proportion of income spent on food falls as the consumer become richer. Moreover, the level of education is an important determining factor for beef and mutton demand. This paper recommends conducting effective nutritional education for households about the importance of protein in the diet, and increasing the supply of substitute goods for beef and mutton. Also, beef and mutton prices can be reduced by removing brokers, reducing transportation cost and taxes.

KEYWORDS: Beef and mutton consumption, Khartoum state, Demand Analysis.

المخلص:

هدفت هذه الورقة لتحليل أثر ارتفاع اسعار لحوم الابقار والضأن وبدائلها علي استهلاك الاسر في ولاية الخرطوم ولمعرفة العوامل الاساسية التي تؤثر علي الطلب عليها: اعتمدت الدراسة اساساً علي المعلومات الاولية التي جمعت من ثلاث مناطق في ولاية الخرطوم والتي مثلت مستويات مختلفة من الدخل . تم استخدام التحليل الوصفي وتحليل الميزانية والانحدار لتحقيق اهداف الدراسة. أوضحت الدراسة ان مستوي الدخل يؤثر في كميات لحوم الابقار والضأن المستهلكة لمختلف مستويات الدخل وان الاسر ذات الدخل المنخفض تتفق معظم دخلها في الغذاء بينما استهلاكها من اللحوم الحمراء قليل جداً بسبب ارتفاع اسعارها وتعتبر لحوم الابقار هي المفضلة للاسر ذات الدخول المنخفضة ولحوم الضأن هي المفضلة لدى الاسر ذات الدخول المتوسطة والعالية .

الطلب علي لحوم الابقار والضأن غير مرن بالنسبة لتغيرات الدخل مما يعني كلما ازداد الدخل كلما انخفضت نسبة الانفاق علي الغذاء . كما يعتبر مستوي التعليم محدد هام للطلب علي لحوم الابقار والضأن. أوصت الورقة بتوجيه الاسر بأهمية اللحوم الحمراء كمصدر للبروتين في الوجبة الغذائية، كما اوصت بزيادة انتاج السلع البديلة للحوم الابقار والضأن ، وتقليل اسعارها من خلال ابعاد السماسرة وتقليل تكاليف النقل والضرائب.

INTRODUCTION

Sudan is rich in livestock, which are found all over the country. The number of cattle amount to 39.7 million, while sheep, goats and camels amount to 42.1, 48.9, and 3.5 million heads, respectively (Ministry of Animal Wealth 2004). Sudan has the second largest animal population in Africa and the first one in the Arab countries.

Livestock sector contributes to the national food security of Sudan by meeting domestic demand for meat, and about 70% of local milk supplies. In addition, it contributes about 20% of the country's agricultural export earnings (Ministry of Animal Wealth 2004). Animal production plays an important role in food security, since it supplies the local market annually with about half a million tons of beef and mutton for the majority of population in Sudan (AOAD, 1992).

Meat is considered as one of the most important food components, because it provides the body with proteins, which contains all the basic amino acids necessary for the growth of body. Meat also contains vitamin B12 which is important for growth and metabolism, and which is found only in animal proteins (Rashed, 1998). Better nutrition should not be regarded only as a mean to development, but a principal goal of development in itself and meat is one important part of nutrition and healthful body.

The supply and selling of animals in Sudan vary from one place to another and even from one animal to another. Available statistics indicated that the presence of frequent selling of animals do not exceed 59% (cows), 61% (sheep), 50% (goats) and 43% (camels) from total population. Large numbers of animals are available in the markets in Autumn and early months of Winter, when producers are found near markets. They decrease when producers move in summer searching for water and the difficulty of transportation results in seasonality of supply and fluctuation of prices (Nour, 2003). The peak periods for cattle supply is from mid August until March. The peak period for sheep supply occurs in December, January and February (Hassan, 2005).

Livestock prices are subject to forces of supply and demand in domestic and world markets. The price in most markets is determined by direct negotiation between the buyers and the sellers in the presence of brokers "the sababa". Another form of selling process is by secret auction.. Extra brokers commissions lead to increase in prices. Seasonality affects markets directly by increasing prices during scarce season and decreases it during abundance seasons in consumption regions. The seasonality can be reduced through regular transportation (Nour, 1997).

A study of comparative livestock markets function in Kenya, Ethiopia and Sudan, found that butchers control meat markets. In fact, they were the most powerful group in livestock market chain followed by brokers. Thus, butchers and brokers control the price of livestock in major domestic markets and extend volume of the national trade in meat in the three countries (Aklilu, 2002).

Livestock market suffers from seasonality of livestock supplies in production areas, which has consequent effect on consuming markets. Shortage of supply occurs during March till August, while abundance of supply takes place in

rainy season in producing areas and in Winter in consuming markets. Such latter delay refers to time span between movements of livestock from producing to consuming areas. Also, owners of livestock usually do not sell their animals except at dire need like drought and bad agricultural season. Also, they sell their animals to buy their basic needs, which are scanty and do not require the sale of large numbers of animals (Hassan, 2005). When most of owners of livestock have good agricultural season and pasture, they do not have a need to bring their animals to markets. Some states in Sudan suffer from armed looting and tribal conflicts, which hinder movement for grazing and livestock marketing.

One of the most persistence problems facing the supply of livestock is the extra fees and taxes, which taken by the States and the authority along the movement of livestock from production areas to final domestic or export markets. These taxes and fees sometimes reached about 20% of animal costs (Abdel Gader, 1996).

CONSUMPTION OF RED MEAT IN SUDAN

Sudan is self-sufficient in red meat and even there is a surplus for exports as shown in table 1. The local consumption of red meat in Sudan increased from 930 thousand tons in year 2000 to 1249 thousand tons in 2004. For example, the local consumption of beef increased from 658 thousand tons in 2000 to 860 thousand tons in 2004 (Table 1). The per capita consumption of beef and mutton in Sudan is about 49.4 kg/person/year, which make it the highest intake in the Arab countries. The recommended intake of meat by international organizations is about 18 kg/person/year (AOAD, 1998).

Table 1: Estimation of total red meat production and local consumption, 2000-2004 (Thousand Tons)

Year	Total production					Local consumption				
	Cattle	Sheep	Goat	Camel	Total	Cattle	Sheep	Goat	Camel	Total
2000	1058	258	125	81	1522	658	138	115	19	930
2001	1101	262	125	81	1569	701	142	115	19	977
2002	1146	274	126	81	1627	746	154	116	19	1035
2003	1159	282	138	84	1663	858	222	128	46	1254
2004	1160	285	139	88	1672	860	225	129	35	1249

Source: Khartoum State, Ministry of Agriculture, Department of Planning and Statistics (2004).

THE CONSUMPTION OF RED MEAT IN KHARTOUM STATE

Consumption of beef and mutton varies among families in Khartoum State according to their average income. The average consumption is approximately 21.9 kg per person per year for those with average annual income of 50 thousand SD and about 10 kg per person per year for those with annual income of 10 thousand SD. Consumption of white meat on the other hand, is high in urban areas compared to that of rural areas, the rate of consumption of white meat is about 4.5 kg person/year for families with high income, and about 1.44 kg/year for families with low income. Consumption of white meat represents about 26% of total meat consumption in Khartoum State (State Khartoum Ministry of Agriculture, 2004).

In spite of the large population of livestock endowment in Sudan, the price of beef and mutton has experienced rapid increases during the last years (Table 2). The increase in the beef and mutton price could be attributed to the increase in population of Khartoum due to huge influxes of migrants searching for jobs, better economic opportunities and social amenities. In fact the population of Khartoum State has grown by ten fold since 1956 and continues to grow by about 4% annually, faster even than national average of 2.8% (FAO, 2002). Also, livestock marketing in Sudan faces deficiency in infrastructure and lack of systematic research. Furthermore, the marketing system faces various obstacles which include seasonality of supply that leads to shortages and increase in prices, besides the long distances separating producing areas from consuming centers, which lead to an increase in transportation cost. Other obstacles include fodder shortages associated with high feeding cost, the complexity of the informal marketing institution, in addition to the very high marketing cost due to extra spending on broker, taxes and profits of retailers.

This paper aims to assess the impact of price rise on household's consumption of beef and mutton and its substitutes in Khartoum State. Also, the paper identified the main factors affecting household demand for beef and mutton like the effects of household income and taste on meat consumption under higher prices, and analyzed family budget plan with respect to meat consumption.

Table 2: Average consumer prices of beef and mutton in Khartoum State, 1990-2005 (SD/Kg)

Year	Mutton	Beef
1991	50	35
1992	75	70
1993	80	60
1994	90	70
1995	155	100
1996	215	140
1997	300	180
1998	457	369
1999	665	446
2000	772	572
2001	672	566
2002	783	597
2003	858	638
2004	1161	765

Source: Khartoum State, Ministry of Agriculture, Department of Planning and Statistics (2004).

METHODOLOGY

Methods of data collection and analysis

The study depends mainly on primary data in addition to secondary data. Primary data was collected through a field survey using structured questionnaire for household. Since it was difficult to cover a large number of beef and mutton consumers in Khartoum state, the study selected purposely three residential areas, Altayf, Alkhartoum Talata , and Dar Alsalam, which were considered to represent three classes of income group. The sample covered about 2.5% of total households from each of the three suggested sites. The size of sample is considered adequate to satisfy the statistical requirement for the analysis and avoids bias. The final sample size was about 105 respondents in the three selected area. Random sampling technique was applied in the selection of households.

Study area

The study was conducted in Khartoum State. Khartoum is located in the center of Sudan. It is the seat of government, the center of higher education and several commercial and industrial establishments, in addition it has the largest

terminal livestock market supply. Being the national capital, Khartoum has a better economic status compared to other cities and rural areas. Its population is estimated to be around 5.5 million (Sudan Central Bureau of Statistics web site), representing 16% of the total country population, and it has greatest demand for meat products. The social organization of population is typical to any other modern city “a pyramid”, which is composed of rich, the middle class and poor, most of them are urban. Accordingly, this study was carried out in three areas in Khartoum state:

- i. Altayf Shemal, where most of the population has a high level of income while the rest being of middle income level.
- ii. Al Khartoum Talata area, which is located in the center of Khartoum. The level of income of most of households in this area is expected to be of middle income.
- iii. Dar Alsalam which is a relatively new area that accommodates people from different parts of the country. Most of its residents originated from pastoral areas with similar standards of living. The population of this area has low level of income.

Analytical techniques

Family budget analysis and regression analysis were used in the analysis of collected data, in addition to descriptive statistics that includes cross tabulation. In family budget analysis, to facilitate the analysis of expenses record, the items were classified into food and non food groups. After that purchases for one month were recorded, and then each column was totaled and analyzed for expenditures. We kept in mind characteristics of cost differences among the various groups; foods in the meat groups for example, are more costly than those in bread group.

Regression analysis

A multiple regression model was applied to measure the relationship between the dependent variable, amount of beef and mutton consumed by a household and the independent variables that affect it such as income, taste, family size, substitute commodities and education level.

The general equation of multiple regression model used is as follows (see Rawling, et.al, 1998):

$$Y = B_0 + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + B_5X_5 \quad (1)$$

Y = amount consumed of beef and mutton (kg/person)

$B_1 \dots B_5$ = Coefficients

X_1 = Income (SD¹), X_2 = Education level, X_3 = Family size (number),

X_4 = Price of beef and mutton (SD), X_5 = Price of chicken (SD)

The variation in the dependent variables (Y) is due to the deterministic elements explained by the independent variables.

RESULTS AND DISCUSSION

Socio-economic characteristics of the household

Table (3) shows some characteristics of the household in the sample. It shows that high income household is found to have a male head (31.4%) compared to the other household groups. The middle income household reported to have higher percentage of female head (7.6%). Regarding age, the statistical analysis showed that 86.7% of the sample population are in productive age and economically active (between 25-60 years old), while 13.3% are over 60 years old which means a high dependency burden. The middle income group had a high proportion of economically dependants than other groups.

The family members in the sample ranged from 1-13 persons. Most of household (about 50%) had large family size with more than 7 persons, however about 27% of which (large family) was found in low income group. This result indicates that low income group had a higher proportion of economically dependents on one active person in the family that affects the purchasing power and the consumption of the household.

With respect to education attainment, the result shows about 33.3% of the household heads have low educational level. Most of these family head (85.5%) were found in low income group. The low level of education of household head may constrain them to find employment opportunities which lead to low level of income Table (4).

¹ Sudanese dinar (recently changed to Sudanese pound (SDG))

Table 3: Sex of the household heads, age and family size of the selected sample (in percent)

	Sex of the head of household		Age group		Family size		
	Male	Female	18-60	61-75	1-4	5-6	7-13
Low income	27.6	5.7	29.5	3.8	1.0	5.7	26.7
Middle income	26.6	7.6	27.6	6.6	11.4	12.4	10.5
High income	31.4	1.0	29.5	2.8	6.7	13.3	12.4
Total sample	85.7	14.3	86.7	13.3	19.0	31.4	49.5

Source: Field Survey (2005)

Table 4: Education of household heads (in percent)

	Education levels					
	Illiterate	Khalwa	Primary	Secondary	University	Post graduate
Low income	15.2	5.7	7.6	4.8	-	-
Middle income	-	1.0	3.8	13.3	14.2	1.9
High income	-	-	-	7.6	18.1	6.7
Total sample	15.2	6.7	11.4	25.7	32.3	8.6

Source: Field Survey (2005)

Household preference

Table (5) shows household preference for beef and mutton. Mutton is preferred by higher income group and middle income group as they can afford its relatively high price. However, over 50% of the respondents prefer beef.

Table 5: Household preference for beef and mutton (in percent)

	The preferred type of beef and mutton		
	Mutton	Beef	Nothing
Low income	2.8	29.5	-
Middle income	21.0	13.3	-
High income	22.9	8.6	1.0
Total sample	46.7	52.4	1.0

Source: Field Survey (2005)

Consumption of beef and mutton by household

With respect to the effects of income level on the consumption of beef and mutton, table (6) shows that about 65.7% of total respondents consume amount of beef and mutton ranging between 0.25-2 kg/week, most of these are found in low and middle income groups. About 37% of the low income group does not consume any amount of beef and mutton, while 61.7 of the high income group consumes more than 3 kg of beef and mutton per week. This indicates that income plays a greater role in the consumption of beef and mutton. The chi-square test and correlation for relationship between income and consumed beef and mutton showed a significant relation between the two variables.

Table 6: Amount of beef and mutton consumed weekly by the selected households (in percent)

	Amount of beef and mutton consumed (Kg/ week)				
	0	0.25-1	1.1-2	2.1-3	>3
Low income	37.1	60.0	9.2	-	-
Middle income	0.0	13.9	52.8	16.7	16.7
High income	2.9	2.9	23.5	8.8	61.7

Note: Chi-square = 97.105⁶ Correlation = 0.76

Source: Field Survey (2005).

Price increase and beef and mutton consumption

Out of the total respondents, 60% affirmed that higher prices had a negative effect on their meat consumption. Almost the entire low income group indicated that their purchases of beef and mutton had been affected by increases of prices, and about 58% of the middle income groups were affected, and 78% of the high income groups were not affected by the increase in price of beef and mutton. Chi-square test and correlation indicate a significant relationship between price increase and level of meat consumption (Table 7).

Table 7: The effect of price increase on beef and mutton consumption (in percent)

	Affected	Not affected
Low income	100.0	0.0
Middle income	58.0	41.7
High income	21.2	78.8

Note: Chi-square = 44.266
Source: Field Survey (2005).

Correlation = 0.65

Consumption of beef and mutton substitutes

Table (8) shows that about 54% of total respondents consume white meat, most of them were found among the middle and high income groups. All of the low income group and 33% of middle income group do not consume any amount of white meat, while 32.4% of the high income group consumes more than 3 kg of white meat per week. The low consumption of white meat is due to its high prices.

Table 8: Consumption of white meat as a substitute for beef and mutton (in percent)

	Amount of white meat consumed (Kg/ week)				
	0	0.25-1	1.1-2	2.1-3	>3
Low income	100.0	-	-	-	-
Middle income	33.0	38.9	22.2	2.8	2.8
High income	2.9	11.8	11.8	41.2	32.4

Source: Field Survey 2005.

Household budgets

Table (9) shows that the highest spending on food was found among low income group (75%), and it was relatively high for middle income group (49.8%), but in high income group the spending on food was relatively low (25%). The results confirmed that the low income group spends most of their income on food. They spend more on bread (24.3%) than on beef and mutton (7%). The spending of middle income group on beef and mutton is higher (11%) than other groups. The spending on education was relatively high (23.7%) among high income group compared to the other two groups. This can be attributed to high school fees as those with high income usually target private schools rather than public schools. Since high percentage of people among low and middle income groups own their houses, their spending on housing are low. Almost all of the households in general spend less money on health and clothing.

Table 9: Household's spending by items in percent

Items	Low income	Middle income	High income
Food	75.0	49.8	25.2
- Beef and mutton	7.0	11.0	7.0
- Bread	24.3	8.2	3.0
- Vegetables	10.6	6.3	2.7
- Other	33.1	24.3	12.5
- Education	4.0	7.8	23.7
- Housing	3.8	11.1	14.7
- Health	2.7	4.4	2.7
- Clothing	2.7	4.9	6.2
- Other activity	12.5	22.0	27.5
Total	100.0	100.0	100.0

Source: Field Survey (2005)

Factors affecting demand for beef and mutton in Khartoum State

Table (10) shows the results of multi-linear regression analysis for factors affecting demand for beef and mutton in Khartoum state. The F-test of the model is highly significant in explaining the variation in the amount of beef and mutton consumed. The coefficient of determination R^2 is 74.9%, which means that about 74.9% of the variation in amount of beef and mutton consumed is explained by factors included in the model. The correlation test showed that there is no multi-collinearity between independent variables and also there was no auto correlation (Table 11). The results of regression show that net income, education level, family size, price of beef and mutton and price of chicken significantly affect the consumption of the beef and mutton.

Table 10: The results of multi-linear regression analysis

Variables	Coefficients	t values	Sig.
Constant	-0.098	-0.242	0.810
Net income	0.628	3.192	0.002
Education level	0.150	1.897	0.061
Number of family size	0.204	1.915	0.050
Price of beef and mutton	0.00023	8.220	0.000
Price of chicken	-0.0046	-2.027	-0.040
Price of fish	0.0045	0.453	0.652

Adjusted $R^2 = 0.749$, Durbin Watson = 1.89

Source: Analysis results

The income variable has got a coefficient of 0.628 with positive sign, indicating a positive relationship with dependent variable. Income elasticity of beef and mutton from the above regression is calculated using the following formula:

$$\varepsilon = B_1 \cdot \frac{I}{Q}$$

where,

B_1 = Coefficient of net income variable

I = average net income

Q = average consumption of beef and mutton

It was found that income elasticity of beef and mutton is less than one (0.29), which indicates inelastic demand for beef and mutton with respect to income changes. That means the percentage change in income would be associated

with less than one percent change in quantity consumed. As Goodwin (1977) stated that "the quantity of beef and mutton purchased would increase as income rises, but at a decreasing rate, but the proportion of income spent on food falls as the consumer becomes richer".

Family size has a positive coefficient of 0.2. This indicates that with large family size, the consumption of beef and mutton is expected to increase. The model result shows that there is a positive relationship between education level and beef and mutton consumption. This result reflects the importance of education in increasing the employment opportunities for the family. Beside that it would affect their knowledge about the nutritional importance of beef and mutton as an important source of protein. Price of chicken meat has a small negative coefficient meaning that a negative relationship exists between amounts consumed of beef and mutton and price of chicken meat. If the price of chicken falls, people will shift a small part of their income from beef and mutton to chicken. However, the small coefficient value may be due to the higher prices of chicken in the Khartoum State as a result of limited quantity of chicken meat production compared to beef and mutton.

The coefficient of beef and mutton price had wrong expected sign. This can be attributed to a higher demand is found in the higher income residential area despite of higher price, while within the low income group there was a low demand and the price is relatively lower. Thus, the price of meat could not be used to indicate the effect of price level on consumption since the data was collected from cross-sectional sample for one year. In this respect price changes are minimal and are not captured by the model.

Table 11: Correlation matrix of factors affecting demand for beef and mutton.

	X1	X2	X3	X4	X5
X1	1.000	0.359	-0.249	0.231	0.329
X2		1.000	-0.456	0.387	0.542
X3			1.000	0.025	0.154
X4				1.000	0.461
X5					1.000

Source: Analysis results

CONCLUSION

Sudan is endowed with large population of livestock, but the price of beef and mutton has experienced rapid increases during the last years. Livestock marketing in Sudan faces deficiency in infrastructure and lack of systematic research. The marketing system faces various obstacles such as seasonality of supply that leads to shortages and increase in prices, long distances separating producing areas from consuming centers also represent another major problem facing the system leading to an increase in transportation cost. Seasonality affects markets directly by increasing prices during low supply period and decreasing it during large supply period in consumption regions. There is no way to avoid such price changes unless seasonality effect is reduced through regular transportation that enables continuous livestock supply throughout the year.

The findings showed that income level affects the quantity of beef and mutton consumed by the family, when the income increases the purchase power of household would increase and consumption of beef and mutton increase specially in the low income household. In spite of their low income, the low income household spends most of their income on food and their consumption of beef and mutton is very low due to higher prices. Beef meat is the preferred type of beef and mutton by low income households while mutton is preferred by middle and high income households. The demand for beef and mutton is inelastic with respect to income changes, which indicate that the proportion of income spent on food falls as the consumer become richer.

The level of education is an important factor for beef and mutton demand as higher level of education increases awareness of consumers about the nutritional value of beef and mutton and improves household income. White meat is a good substitute for beef and mutton but it has lower competition due to its higher price and low production.

RECOMMENDATION

Conducting effective nutritional education for households about the importance of protein in the diet, and increasing the supply of substitute goods would improve the situation of household health. Also, beef and mutton prices can be reduced by removing unjustified brokers expenses, and reducing transportation cost and taxes.

REFERENCES

1. **Abdel Gadir, s. (1996).** Constraints of Livestock Marketing in Sudan. Unpublished M.Sc. Thesis, University of Khartoum, Sudan.
2. **Aklilu, y. (2002).** An audit of Livestock Marketing Status in Kenya, Ethiopia and Sudan. Community Based Animal Health and Participatory, Epidemiology Unit (CAPE), OAU, in <http://PC3\F/MM.htm>.
3. **AOAD (1992).** Project for Beef and mutton Production in Sudan: Feasibility Study. Arab Organization for Agricultural Development (AOAD), Khartoum, Sudan.
4. **AOAD (1998).** Development of Beef and mutton Production in Arab Countries. Arab Organization for Agricultural Development (AOAD), Khartoum, Sudan
5. **FAO (2002).** Diary Sub-Sector Development Project: Socio Economic Marketing Study. Rome, Italy.
6. **Goodwin, J. (1977).** Agricultural Economics. Reston Publishing Company. Apprentice Hall Company, Reston Virginia, USA.
7. **Hassan, H. (2005).** Multi-Market Policy of Mutton Export of Sudan. Unpublished Ph.D. Thesis, University of Khartoum, Sudan.
8. **Khartoum State Ministry of Agriculture (2004).** Food Consumption and Nutritional Situation in Khartoum State. Khartoum, Sudan.
9. **Nour, M. (1997).** Livestock Exports of Sudan. Ministry of Animal Wealth Reports, Khartoum, Sudan.
10. **Nour, M. (2003).** Marketing of Livestock: Constraints and Solution. Ministry of Animal Wealth Reports, Khartoum, Sudan.
11. **Rashed, N. (1998).** Real Situation of Beef and mutton Production in Arab Countries and Required Technology for Development. Arab Organization for Agricultural Development (AOAD), Khartoum, Sudan.
12. **Rawlings, J., Sastry, G. and David, A. (1998).** Applied Regression Analysis as A Research Tool. Second Edition, Springer – Verlag New York, USA.
13. **Sudan Central Bureau of Statistics: www.cbs.gov.sd/**
14. State Ministry of Animal Wealth Statistics (2004).