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INSTITUTE OF SCIENCE

STATISTICAL ANALYSIS OF RED MEAT, WHITE MEAT AND EGG PRODUCTION AND CONSUMPTION IN NORTHERN IRAQ GOVERNMENT

MS THESIS

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THESIS ACCEPTANCE AND CONFIRMATION

The thesis study entitled "Statistical analysis of red meat, white meat and egg production and consumption in Northern Iraq Government" prepared by Hayman Murad Hasan has been accepted as a Master Degree thesis with unanimity / majority of votes by the following jury on the date of 08/09/2017 at Siirt University, Institute of Sciences, Department of Animal Science.

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I confirm the above conclusion

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THESIS DECLARATION

I hereby declare that all information in this document have been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results which are not original to this work.

Hayman Murad Hasan

PREFACE

I would like to extend my thanks to the Dean of the Faculty of Agriculture at the University of Sallahaddin/Erbil for providing the opportunity to continue studying.
It is my duty to fulfill my sincere thanks and appreciation to Dr. Mikail due to accepting my supervision.
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Hayman Murad Hasan
SİİRT-2017

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LIST OF ABBREVIATIONS AND SYMBOLS

Abbreviation	**Statement**
AIC	: Akaike Information Criteria
RMSE	: Root Mean Square Error
MAE	: Mean Absolute Error
MAPE	: Mean Absolute Percentage Error
MA	: Moving Average
AR	: Autoregressive
VAR	: Vector Autoregressive
ARIMA	: Autoregressive Integrated Moving Average
ARMA	: Autoregressive Moving Average
GARCH	: Generalized Autoregressive Condition Heterostadicity
ACF	: Autocorrelation Function
PACF	: Partial Autocorrelation Function
ESS	: Error Sum of Squares
R^2	: Determination Coefficient
SIC	: Schwarz Information Criteria
CV	: Coefficient of Variation
BIC	: Bayesian Information Criteria
MLE	: Maximum Likelihood Estimator
DF	: Degrees of Freedom
STD	: Standard Deviation
LT	: Linear Trend
QT	: Quadratic Trend
ET	: Exponential Trend
kg	: Kilogram

Symbol	**Statement**
ε	: error term
σ^2	: variance of population

ÖZET

YÜKSEK LİSANS TEZİ

KUZEY IRAK YÖNETİMİNDE KIRMIZI ET, BEYAZ ET VE YUMURTA ÜRETİM VE TÜKETİMİNİN İSTATİSTİKSEL ANALİZİ

Hayman Murad Hasan

Siirt Üniversitesi Fen Bilimleri Enstitüsü
Zootekni Anabilim Dalı

Danışman : Yrd. Doç. Dr. Nazire MİKAİL

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2017, 50 Sayfa

Bu çalışma, 2009 - 2015 dönemlerinde Kuzey Irak'taki kırmızı et, beyaz et ve yumurta üretim ve tüketiminin büyüme modelini en iyi tanımlayabilecek, uygun deterministik tip tahmin modelini bulmak için yapılmıştır.

Araştırma sonucunda, Akaike Bilgi Kriterini kullanarak kırmızı et üretimi için en uygun modelin ARIMA(0,1,1) modeli, tavuk eti üretimi için lineer modelin, balık eti ve yumurta üretimi için üstel modelin, kırmızı et, tavuk eti, balık eti ve yumurta tüketimleri için ise ikinci dereceden modelin olduğuna karar verilmiştir. Seçilen modeller, kırmızı et, beyaz et, yumurta üretim ve tüketimi için % 95 güven aralığı ile beş yıllık tahminlerde bulunulması için kullanılmıştır.

Bu çalışmanın bulguları, politika belirleyicilerin arz ve talebine göre kırmızı et, beyaz et ve yumurta üretiminin doğru yönetimi için gerekli önlemleri almalarına yardımcı olacaktır.

Anahtar Kelimeler: Kırmızı et, beyaz et, yumurta, üretim, tüketim, tahmin, zaman serisi analizi

ABSTRACT

MS THESIS

STATISTICAL ANALYSIS OF RED MEAT, WHITE MEAT AND EGG PRODUCTION AND CONSUMPTION IN THE NORTHERN IRAQ GOVERNMENT

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The Institute of Science of Siirt University
The Degree of Master of Science
In Animal Science

Supervisior : Asst. Prof. Dr. Nazire MİKAİL

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2017, 50 pages

The present study was undertaken to find out appropriate deterministic type forecasting model that could best describe the growth pattern of red meat, white meat and egg production and consumption in the Northern Iraq during the time periods 2009 to 2015.

The study revealed using Akaike Information Criteria, that the ARIMA (0,1,1) model is the best fitted model for red meat, linear model is the best for chicken meat and exponential models best for fish meat and egg production, whereas quadratic models best fitted for red, chicken, fish meat and egg consumptions. The selected models were used for succeeding five years forecast with a 95% confidence interval of red meat, white meat and egg production and consumption.

The findings of this study will help the policy makers to take necessary actions for proper management of red meat, white meat and egg production according to their demand and supply.

Keywords: Red meat, white meat, egg, production, consumption, forecasting, time series analysis

1. INTRODUCTION

Red meat and white meat productions have become the major problem faced by international organizations and Governments in relation to the world as it relates to human life and production capacity. The problem lies in the ability of the region to cover low production of red and white meat, on the basis of increased meat production and importing potential.

This study discussed the importance of the investigation in the selection of statistical analysis of the production of red and white meat in the Northern Iraq Government, especially after the high standard of the living population in the Northern part of Iraq Government. The hypothesis of the study discuss about the amount of production and consumption of red and white meat for the province in the future.

The study aims to determine the amount of meat and egg production and consumption in the province and includes Erbil, Dohuk and Sulaymaniyah and its consequences and the ways to address the problems and indicates the vision for the future 2020.

The study includes the spatial of the Northern Iraq Government, whether it is applicable from time to time, including the period of 2009-2015, as well as a vision forward to 2020.

There is no doubt that livestock in the Northern Iraq Government is underdeveloped by natural, human, financial and institutional constraints, resulting in a shortage of animal productions, especially red and white meat, eggs and livestock. All obstacles to reducing production must be removed. Therefore, an analytical study of meat production for previous periods was used as a basis for developing indicators to predict the use of time series models. Scientific research is concerned with the study of time series because the study of a particular phenomenon over a period of time helps to determine the nature of the changes that influenced the values of the phenomenon over time and the reasons that led to these ghettos and also predicted what will change the values of the phenomenon in the future in light of what happened in the past.

The present study has been undertaken to forecast the red meat, white meat and egg production and consumption in the near future in the Northern Iraq Government.

2. LITERATURE REVIEW

2.1. Red Meat, White Meat and Egg Production

In this paragraph, the following points would be reviewed: natural pasture area in the province, the number of projects for the production of red meat in the region, evolution of the number of livestock in the region and the development in the size of production of red meat in the province.

2.1.1. Natural pasture area in the province

In Table 2.1 the proportion of (37.7%) in natural grassland area to the total area in Northern Iraq Government could be seen . It shows that there are opportunities to increase animal husbandry, including sheep, goats, cows, and buffaloes. While the proportion of (62.3%) from other areas in the region is used for other economic activities (Anonymous a, 2016).

Table 2.1. Natural pasture area in comparison to the total area in Northern Iraq Government

Land type	Area (acres)	Proportion (%)
Natural pastures	6937769	37.7
The other to engage in other economic activities spaces	11462255	62.3
The total area	18400024	100

(Anonymous a, 2016)

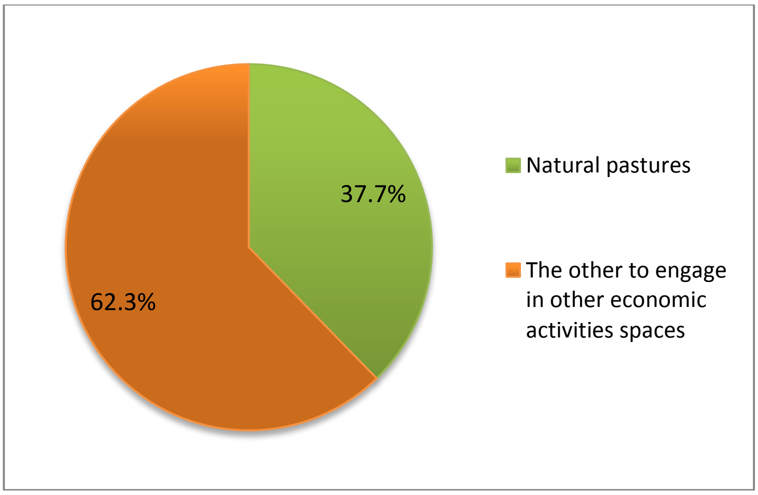

Figure 2.1. Proportion of natural pastures to the total area of the province valuable

Through Table 2.2, in which the exploited land ratio appears in contrast to the total area of natural pastures in the region for 2015, which shows that the area under actual natural pastures by (9.787%) for raising sheep, goats, cows, and buffaloes. While the percentage of (90.213%) about natural pastures shows it has not been exploited so far, as a result there is a possibility to double times of livestock in the province. Also this shows that instead of depending on the outside world for exporting red meat, especially by neighbouring countries and the Gulf Cooperation Council (GCC), we can provide it ourselves.

Table 2.2. Untapped for animal husbandry area relative to the total area of natural pastures in Northern Iraq Government

Animals	Area (acres)	%
Sheep	207525	2.99
Goats	81597	1.18
Cows	385499	5.55
Buffalo	4680	0.067
Area untapped natural pasture area	6258468	90.213
Total natural grazing area	6937769	100

(Anonymous a, 2016)

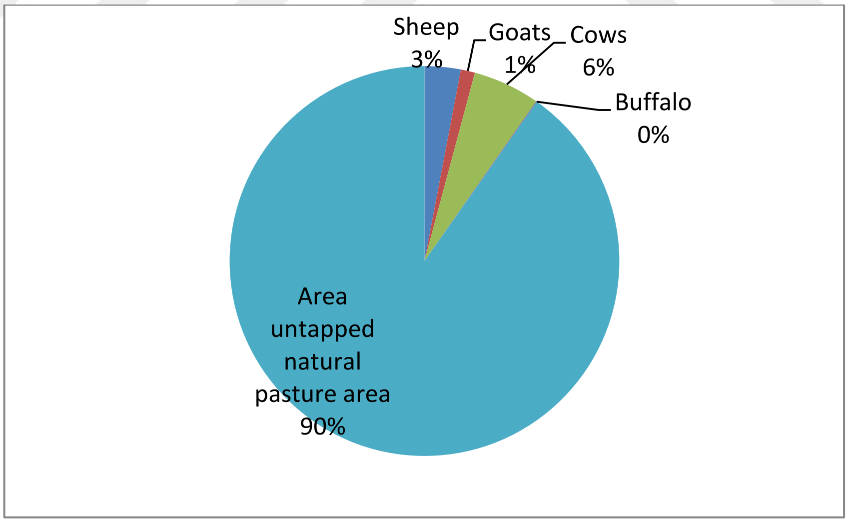

Figure 2.2. Clarify untapped area actually from natural pastures in the region

2.1.2. The number of projects for the production of red meat in the region

Through Table 2.3, in which you can see a number of projects working for the production of red meat in Northern Iraq Government, between 2009 to 2015, the highest annual rate of change falls in 2011 by (32%) and this goes back to encourage the Government to increase animal production, especially red meat because of the granting of agricultural loans without interest for owners of animal husbandry. While the lowest rate of annual change rate falls in 2012 (5.3%), and this goes back to stop the government from granting agricultural loans, where as in connection with the annual growth rate during the study period by (% 14.14) and this rise is due to the support of the Government for livestock projects. Also with respect to the years 2014 and 2015, which can be seen as a negative impact on the number of livestock projects for the production of red meat that decreased by (8.8%) and (8.09%), respectively, this decline is due to the financial crisis that happened in the region.

Table 2.3. The number of operating projects for the production of red meat in the Northern Iraq Government for the period of 2009-2015

Year	Change rate	Province	Feed plants	Breeding sheep meat	Breeding calf meat	Breeding cows and buffaloes	Raising sheep and goats
2009	-	86	6	7	31	24	18
2010	16.27	100	8	6	37	28	21
2011	32	132	13	6	40	35	38
2012	5.3	139	14	6	40	29	50
2013	14.38	159	14	6	34	48	57
2014	8.80	173	16	6	35	56	60
2015	8.09	187	22	6	37	61	61
Growth rate	14.14	-------	-----	-----	----	-----	----

2.1.3. The evolution in the number of livestock in the region

Through Table 2.4, which shows the evolution of the number of livestock in the Northern Iraq Government, between 2009 to 2015. It is clear that the highest annual rate of change is in 2011 (20.1%) due to the increasing number of projects, the production of red meat in the region, as well as the support of the provincial government for the owners of livestock. The same situation had happened in 2014 and 2015 years. Note the significant reduction and large proportions (-7.16%) and (10.94%) due to financial crisis in the region, with regard to the rate of growth during the period of the study by (8.74%). In addition, the relative importance of the number of animals differs between sheep, goats, cows, and buffaloes in the region (67.712%), (26.621%), (5.6%), and (0.068%), respectively.

Table 2.4. The numeral evolution of livestock in the Northern Iraq Government for the period 2009-2015

Year	Buffalo	Cow	Goats	Sheep	Total	Annual rate of change

2009	2527	207662	702978	1979169	2892336	-
2010	2686	199271	889172	2375969	3467098	19.87
2011	2811	236689	1000418	1943680	3183598	-8.17
2012	2779	287580	1109237	2423877	3823473	20.1
2013	2748	338471	1218056	2904075	4463350	16.89
2014	2763	313025	1163646	2663976	4143410	-7.16
2015	3120	256999	1223949	3112876	4596945	10.94
Growth rate	-	-	-	-	-	8.74
Relative importance of the public	0.068%	5.6%	26.621%	67.712%	100%	-

2.1.4. The development in the size of production of red meat in the province

Through Table 2.5, the evolution production size of red meat in the Northern Iraq Government between 2009 to 2015 can be seen obviously, the highest annual change lies in the rate of (8.9%) by 2012 (Anonymous b, 2016). As a result, it is likely to increase the number of sheep, goats, cows and buffaloes in the region, which also increases the number of projects for the production of meat. While the lowest annual rate of change is located in 2010 (-35.29) due to drought, lack of rain, and the smuggling of animals to neighbouring countries. While the growth rate of meat production during this study period increased by (16.11 %), and this is a good ratio, but when compared to the consumption of red meat in the region, then it is evident that the growth of the production of red meat is at a lower rate compared to the growth rate of consumed red meat, which creates a deficit in the red meat market. The gap created by this deficit is filled in by the increase of imports from abroad. Amazingly, the production of red meat in 2014 and 2015 increased significantly because the financial crisis reflected positively on increasing the production of red meat in Northern Iraq Government. As a result, the average share per capita per year in the province of Northern Iraq Government was 8.74 kg.

Table 2.5. The production size of red meat in the Northern Iraq Government between 2009-2015

Year	Share per capita (kg)	Annual rate of change	Production size (tons)
2009	7.29	-	34000
2010	4.58	-35.29	22000
2011	5.78	29.54	28500
2012	8.90	57.89	45000
2013	9.98	15.25	51865
2014	12.23	27.25	66000
2015	12.42	3.03	68000

2.1.5. The development in the chicken production size in the province

Table 2.6 shows the development of the production size of white meat (chicken) in the Northern Iraq Government between 2009 to 2015 (Anonymous b, 2016). As can be seen that the highest annual rate of change is located in 2011 by (28.16%) due to the increased number of poultry projects and the support from the Ministry of Agriculture by the provision of good loans, which increases poultry projects. While the lowest percentage of the annual rate of change is located in 2014 (6.15%), due to the financial crisis in the region. And also with what relates to the growth rate during the study period, the growth rate was (16.72%). Per capita white meat production amounted to (10.75) kg.

Table 2.6. The evolution of the production size of white meat (chicken) in the Northern Iraq Government between 2009-2015

Year	Share per capita (kg)	The annual rate of change	Production (tons)
2009	6.99	-	32635
2010	7.45	9.42	35712
2011	9.29	28.16	45772
2012	11.18	23.64	56595
2013	12.51	14.85	65000
2014	12.93	6.15	69000
2015	14.89	18.13	81513
Growth rate	10.75	16.72	

2.1.6. The development in the eggs production size in the province

Through Table 2.7 that shows the production size of eggs in development from 2009 to 2015, we can concur that the highest annual rate of change is in 2015, by (40.29%) and mostly due to increased production of eggs projects with support from the Ministry of Agriculture (Anonymous b, 2016). In contrary lesser change had happened in 2011 by (-12.66%) ,in comparison to the annual rate , and it was due to fierce price competition and inequality between the production of local eggs and foreign private production of the Turkish imports and about the growth rate (8.88%) during the study period. Regarding the impact of the financial crisis in the production of eggs table, which can be seen that in 2014 the crisis affected the production of eggs by (-12.54%), while the per capita share of eggs, and realize that the average per capita share of eggs during one year was (4.76) kg\per capita.

Table 2.7. The evolution of the size of the production of eggs in the Northern Iraq Government for the period 2009-2015

Years	Share of per capita (kg)	Annual rate of change	Production size (tons)
2009	4.50	-	21000
2010	4.61	5.23	22100
2011	3.91	-12.66	19300
2012	4.58	20.20	23200
2013	5.21	16.81	27100
2014	4.44	-12.54	23700
2015	6.07	40.29	33250
Growth rate		8.88	

2.1.7. The development in the fish production size in the province

Through Table 2.8, the development of the fishery projects in the province of Northern Iraq Government between 2009 to 2015 is shown (Anonymous b, 2016). It demonstrated that the highest annual rate of change is in 2012 by (233.33%). This is because of the promotion of investment projects on one hand, and the granting of agricultural loans by the Agricultural Bank in region in another. As well as providing the necessary facilities for starting up the fish ponds in the province. All these have increased the number of fish projects and has lowered the annual rate of change by (-64.7%) in 2011. The lack of affordable agricultural loans by the Agricultural Bank is due to the suspension of the provincial government from granting the balance of loans to economic sectors.

Table 2.8. The development projects of the fishery in the Northern Iraq Government between 2009-2015

Year	Change the growth rate	Province	Slemanya	Duhok	Erbil
2009	-	22	6	1	15
2010	-22.72	17	4	3	10
2011	-64.70	6	1	3	2
2012	233.33	20	14	2	4
2013	-20	16	8	4	4
2014	25	20	12	2	6
2015	0	20	14	5	1
Growth rate	25.09				

Through Table 2.9 the development of the production of white meat (fish) is shown in the Northern Iraq Government for the period from 2009 to 2015. Where it can be seen that the highest annual rate of change is located in 2013 (64.77%), due to the increasing number of fish farming projects, Since the provincial government through 2013 gives fish ponds owners interest-free agricultural loans. However, the lowest annual rate of change is in 2010 by (5.01%). Due to drought, lack of rain and increasing imports of frozen fish. As for the growth rate during the period of this study, it is to be noted that it was (30.26%). This rise in the production of fish meat was due to the presence of profitable quarter in fish breeding.

Table 2.9. The development of fish meat production in the Northern Iraq Government for the period 2009-2015

Year	Share per capita	Annual rate of change	Production (tons)
2009	0.12	-	598
2010	0.13	5.01	628
2011	0.14	11.46	700
2012	0.24	74	1218
2013	0.38	64.77	2007
2014	0.40	7.77	2163
2015	0.46	18.58	2565

2.1.8. The production of white meat (chicken) in the province

In Table 2.10 the number of operating poultry projects in the region can be seen, obviously highest annual rate of change lies in 2013 (13.37%). This is due to the support of the Ministry of Agriculture by the provision of interest-free agricultural loans. While the lowest annual percentage change is in (2012) (0.29%) and this is due to the orientation of consumers to imported white meats, as well as red meat as an alternative to white meat because of high prices in 2012, while the annual rate of growth for 2009-2015 was (7.6%) during this study. This indicates the presence of the impact of agricultural loans to increase the number of projects for the production of white meat in the province. With regard to the years 2014 and 2015, which are the years of the financial crisis and we can observe their reflection in a positive increase in the number of projects.

Tablo 2.10. The number of projects working for poultry in the Northern Iraq Government for the period 2009-2015

Year	Chicken meat	Total	Annual rate of change
2009	837	896	-
2010	879	933	4.83
2011	976	1029	10.28
2012	972	1032	0.29
2013	1115	1170	13.37
2014	1165	1229	5.04
2015	1264	1379	11.79
Growth rate			7.6

2.2. Red Meat, White Meat and Egg Consumption

2.2.1. Red meat consumption

The Data shown in Table 2.11 indicates the increasing amount size of the red meat consumption in the region. Reaching 67136.62 tons in 2009, which then increase to 72849.73 tons in 2012, an increase of 8.5% compared to 2009. And in 2015 the amount of disposable red meat consumption totalled to 78803.07 tons, an increase of 17.37% compared to 2009. The rise in this ratio is due to the increase in population, as well as the increase in the number of displaced people in the region because of the war on terror. The average consumption of red meat during the period of this study was 72905.04 tons.

Table 2.11. The evolution of meat consumption amount in the Northern Iraq Government for the period 2009-2015

Years	Red meat consumption (tons)
2009	67136.62
2010	69023.39
2011	70929.04
2012	72849.73
2013	74804.12
2014	76789.43
2015	78803.07
Annual average	72905.04

2.2.2. The white meat (chicken) consumption

Through Table 2.12 the data indicates that the consumption of white meat (chicken) is increasing in the region, reaching 111428.1 tons in 2009, and then increase to 114559.67 tons in 2010. An increase of 2.81% compared to 2009. In 2014 the availability of chicken meat consumption was 127449.13 tons, an increase of 14.37% compared to 2009, while in 2015 the volume of white meat consumption of chicken was 130791.21 tons. An increase of 17.38% compared to 2009. This increase in the amount of chicken meat consumed is due to the high growth of the province's population as well as the increasing number of displaced people in the region, especially after 2014. The average amount or volume of consumption of white meat (chicken) during this study period was 121002.15 tons.

Table 2.12. The evolution of white meat (chicken) consumption amount in the Northern Iraq Government period 2009-2015

Year	Chicken meat consumption (tons)
2009	111428.1
2010	114559.67
2011	117722.53
2012	120910.32
2013	124154.1
2014	127449.13
2015	130791.21
Average	121002.15

2.2.3. The egg consumption

Table 3.13 shows, the development of consumption of egg in the Northern Iraq Government between 2009 to 2015. Accordingly, the capacity reached 41960.38 tons in 2009 during growth and then increased to 49251.91 tons in 2012.which An increase of 17.38% compared to 2009. This increasing ratio is due to the growing population of the region and also the increasing number of displaced people in the region. The average consumption amount in the region was 45565.64 tons.

Table 2.13. The evolution of egg consumption amount in the Northern Iraq Government for the period 2009-2015

Year	Egg consumption (tons)
2009	41960.38
2010	43139.62
2011	44330.65
2012	45531.08
2013	46752.58
2014	47993.39
2015	49251.91
Average	45565.64

2.2.4. The white meat (fish) consumption

Through Table 2.14, we can see the development of white meat (fish) consumption amount in the province, where the data indicates the increasing amount of fish meat consumption in the region. In 2009 it reached 13520.55 tons and then increased to 15869.55 tons. An increase of 17.38% compared to 2009. This is due to the increase in population and the number of displaced people in the province. The average size of fish meat consumption in the region was 14682.07 tons.

Table 2.14. The evolution of white meat (fish) consumption amount in the Northern Iraq Government for the period 2009-2015

Year	Fish meat consumption (tons)
2009	13520.55
2010	13900.53
2011	14284.31
2012	14670.38
2013	15064.71
2014	15464.52
2015	15869.55
Average	14682.07

2.3. Time Series Analysis Applications

Bakari et al. (2013), investigated production and utilization of gas by means of time series analysis. In the study they used Box-Jenkins methodology to build ARIMA model for annual production and utilization of gas from Nigeria National Petroleum Company (NNPC) for the period from 1970-2004. After the model specification; the best model for production was ARIMA(1,1,1) and for utilization was ARIMA(0,1,1). These models were used to forecasting the production and utilization of gas for the upcoming 4 years to help decision makers establish priorities in terms of gas demand management.

Hossain and Hassan (2013), in their study tried to forecast milk, meat and egg production in Bangladesh. The study was undertaken to find out appropriate deterministic type growth model using latest model selection criteria that could best describe the growth pattern of milk, meat and egg production in Bangladesh during the time periods 1991-92 to 2011-12. The study revealed that the cubic model is the best fitted model for milk, meat and linear model is the best for egg production. The selected model was used for succeeding four years forecast with a 95% confidence interval of milk, meat and egg production.

Gathondu (2014), in his thesis titled ‘Modeling of wholesale prices for selected vegetables using time series models in Kenya’ was used three autoregressive models to predict and model the wholesale prices for selected vegetables in Kenya shillings per kilogram. The models were; ARMA, Vector Autoregressive (VAR), Generalized Autoregressive Condition Heterostadicity (GARCH) and the mixed model of ARMA and GARCH. This time series data for tomato, potato, cabbages, kales and onions for markets in Nairobi, Mombasa, Kisumu, Eldoret and Nakuru wholesale markets were considered as the classical national average. Based on the model selection criterion the best forecasting models in ARIMA were; Potato ARIMA (1,1,0), Cabbages ARIMA (2,1,2), tomato ARIMA (3,0,1), onions ARIMA (1,0,0), Kales ARIMA (1,1,0) . Further, the mixed model of ARMA (1, 1) and GARCH (1, 1) model is also identified best model in forecasting.

Manoj and Madhu (2014), applied time series ARIMA forecasting model for predicting sugarcane production in India. In this study, the ARIMA(2,1,0) was the best candidate model selected for making predictions for up to 5 years for the production of sugarcane in India using a 62 years' time series data. ARIMA was used for the reasons of its capabilities to make predictions using a time series data with any kind of pattern and with autocorrelations between the successive values in the time series. The study also statistically tested and validated that the successive residuals (forecast errors) in the fitted ARIMA time series were not correlated, and the residuals seem to be normally distributed with mean zero and constant variance. Hence, they could conclude that the selected ARIMA(2,1,0) seem to provide an adequate predictive model for the sugarcane production in India.

Nouman and Khan (2014), in their work tried to model and forecast beef, mutton, poultry meat and total meat production of Pakistan for year 2020 by using time series ARIMA models. In this regard, first they used data from 1971-72 to 2007-08 to estimate a time trend for beef, mutton, poultry meat and total meat production. This time trend was estimated by employing an exponential function of the form $Y_f = ce^{bt}$, where Y_f was for meat production and t depicts the year. The estimated parameters were highly statistically significant, while the overall explanatory power of the model was very high since $R^2 = 0.99$.

Chaudhari and Tingre (2015)'s study aimed to forecast the eggs production in India by using the eggs production data for the period from 1979- 80 to 2010-11. To forecast the eggs production ARIMA models were used. To test the reliability of model Determination coefficient (R^2), Mean Absolute Percentage Error (MAPE), and Bayesian Information Criteria (BIC) were used. ARIMA(0,1,0) was the best fitted model. Based on model results the estimated eggs production in India would increase from 64749.84 million during 2011-12 to 75104.87 million during 2017-18.

Tlegenova (2015), in her work tried to forecast exchange rates of the currency of Kazakhstan using time series analysis. ARIMA technique for forecasting currency exchange rates of Kazakh Tenge against three other currencies such as US Dollar (USD), Euro (EUR), and Singapore Dollar (SGD) was applied over the period from 2006 to 2014. The MATLAB software was utilized for prediction of the exchange rates. The ARIMA technique was presented and three main steps for constructing the model were identified, namely, Identification, Estimation, and Model checking. Furthermore, the forecast model was estimated and compared with the actual data for all three currencies. The effectiveness of the forecast model results was compared with Mean Absolute Error (MAE), MAPE and Root Mean Square Error (RMSE).

Akgül and Yıldız (2016), in their work tried to forecast red meat production and give policy recommendations in line with 2023 targets in Turkey. In this study, consumption of red meat to Turkey for estimation, Box-Jenkins forecasting models were used. Eviews software package was used for time series analysis application. Between the years 2016-2023 red meat production forecasts are made regarding Turkey in the framework of this model. In line with the objectives of 2023, Turkey to increase the consumption of red meat, is given to policy proposals.

3. MATERIAL AND METHOD

3.1. Material

The material of this study was the data of red meat, white meat (chicken and fish), egg production and consumption between 2009 to 2015 years in the Northern Iraq region.

3.2. Method

The analysis of experimental data that have been observed at different points in time leads to new and unique problems in statistical modelling and inference. The obvious correlation introduced by the sampling of adjacent points in time can severely restrict the applicability of the many conventional statistical methods traditionally dependent on the assumption that these adjacent observations are independent and identically distributed. The systematic approach by which one goes about answering the mathematical and statistical questions posed by these time correlations is commonly referred to as time series analysis. The impact of time series analysis on scientific applications can be partially documented by producing an abbreviated listing of the diverse fields in which important time series problems may arise. For example, many familiar time series occur in the field of economics, where we are continually exposed to daily stock market quotations or monthly unemployment figures (Shumway and Stoffer, 2011).

3.2.1. Regression

Often, on the basis of sample data, we wish to estimate the value of a variable y corresponding to a given value of a variable x. This can be accomplished by estimating the value of y from a least-squares curve that fits the sample data. The resulting curve is called a regression curve of y on x, since y is estimated from x. Regression analysis is a statistical technique for modelling and investigating the relationships between an outcome or response variable and one or more predictor or regressor variables. The end result of a regression analysis study is often to generate a model that can be used to forecast or predict future values of the response variable given specified values of the predictor variables.

The simple linear regression model involves a single predictor variable and is written as

$$y = \beta_0 + \beta_1 x + \varepsilon \qquad (3.1)$$

where y is the response, x is the predictor variable, β_0 and β_1 are unknown parameters, and ε is an error term. The model parameters or regression coefficients β_0 and β_1 have a physical interpretation as the intercept and slope of a straight line, respectively.

The slope β_0 measures the change in the mean of the response variable y for a unit change in the predictor variable x. These parameters are typically unknown and must be estimated from a sample of data. The error term ε accounts for deviations of the actual data from the straight line specified by the model equation. We usually think of ε as a statistical error, so we define it as a random variable and will make some assumptions about its distribution. For example, we typically assume that ε is normally distributed with mean zero and variance σ^2, abbreviated N(O, σ^2). Note that the variance is assumed constant; that is, it does not depend on the value of the predictor variable (or any other variable).

3.2.2. Time series

If the independent variable x is time, the data show the values of y at various times. Data arranged according to time are called 'time series'. The regression line or curve of y on x in this case is often called a trend line or trend curve and is often used for purposes of estimation, prediction, or forecasting.

3.2.2.1. Analysis of Time series

The analysis of time series is based on the assumption that successive values in the data file represent consecutive measurements taken at equally spaced time intervals. There are two main goals of time series analysis:

(a) identifying the nature of the phenomenon represented by the sequence of observations, and

(b) forecasting (predicting future values of the time series variable).

Both of these goals require that the pattern of observed time series data is identified and more or less formally described. Once the pattern is established, we can interpret and integrate it with other data (i.e., use it in our theory of the investigated phenomenon, e.g., seasonal commodity prices). Regardless of the depth of our understanding and the validity of our interpretation (theory) of the phenomenon, we can extrapolate the identified pattern to predict future events.

As in most other analyses, in time series analysis it is assumed that the data consist of a systematic pattern (usually a set of identifiable components) and random noise (error) which usually makes the pattern difficult to identify. Most time series analysis techniques involve some form of filtering out noise in order to make the pattern more salient.

Most time series patterns can be described in terms of two basic classes of components: trend and seasonality. The former represents a general systematic linear or (most often) nonlinear component that changes over time and does not repeat or at least does not repeat within the time range captured by our data (e.g., a plateau followed by a period of exponential growth). The latter may have a formally similar nature (e.g., a plateau followed by a period of exponential growth), however, it repeats itself in systematic intervals over time. Those two general classes of time series components may coexist in real-life data. For example, sales of a company can rapidly grow over years but they still follow consistent seasonal patterns (e.g., as much as 25% of yearly sales each year are made in December, whereas only 4% in August).

3.2.2.2. The Simple Moving Average (SMA):

Intuitively, the simplest way to smooth a time series is to calculate a simple, or unweighted, moving average. This is known as using a rectangular or "boxcar" window function. The smoothed statistic S_t is then just the mean of the k observations:

$$S_t = \frac{1}{k}\sum_{n=0}^{k-1} X_{t+\frac{k-1}{2}-n} \qquad \text{if k is odd}$$

$$S_{t+\frac{1}{2}} = \frac{1}{k}\sum_{n=0}^{k-1} X_{t+\frac{k}{2}-n} \qquad \text{if k is even}$$

Where the choice of an integer k > 1 is arbitrary, and we start with $t = \frac{k+1}{2}$ if k is odd (or $t = \frac{k}{2}$ if k is even) adding one to t for each step when we find the values of $\{S_t\}$. A small value of k will have less of a smoothing effect and be more responsive to recent changes in the data, while a larger k will have a greater smoothing effect, and produce a more pronounced lag in the smoothed sequence. One disadvantage of this technique is that it cannot be used on the k−1(or k for even) terms of the time series without the addition of values created by some other means. This means effectively extrapolating outside the existing data.

3.2.2.3. The Weighted Moving Average (WMA)

A slightly more intricate method for smoothing a raw time series $\{X_t\}$ is to calculate a weighted moving average by first choosing a set of weighting factors provide that the sum of weights equal one and then using these weights to calculate the smoothed statistics $\{S_t\}$ as described in SMA above after product each value $\{X_t\}$ by its weight.

In practice the weighting factors are often chosen to give more weight to the most recent terms in the time series and less weight to older data. Notice that this technique has the same disadvantage as the simple moving average technique, and that it entails a more complicated calculation at each step of the smoothing procedure.

3.2.2.4. The Exponential Moving Average (EMA)

Exponential smoothing is a rule of thumb technique for smoothing time series data, particularly for recursively applying as many as 3 Low-pass filters with exponential window functions. Such techniques have broad application that is not intended to be strictly accurate or reliable for every situation. It is an easily learned and easily applied procedure for approximately calculating or recalling some value, or for making some determination based on prior assumptions by the user, such as seasonality. Like any application of repeated low-pass filtering, the observed phenomenon may be an essentially random process, or it may be an orderly, but noisy, process. Whereas in the simple moving average the past observations are weighted equally, exponential window functions assign exponentially decreasing weights over time. The use of three filters is based on empirical evidence and broad application.

The raw data sequence is often represented by $\{X_t\}$ beginning at time $t= 0$, and the output of the exponential smoothing algorithm is commonly written as $\{S_t\}$, which may be regarded as a best estimate of what the next value of X will be. When the sequence of observations begins at time t=0, the simplest form of exponential smoothing is given by the following:

$$S_0 = X_0 \quad \text{or the average of } X_t$$
$$S_t = \alpha X_{t-1} + (1-\alpha)S_{t-1} \quad ; \ t > 0$$

where, α is the smoothing factor, and $0 < \alpha < 1$.

In other words, the smoothed statistic S_t is a simple weighted average of the current observation X_t and the previous smoothed statistic S_{t-1}. The term smoothing factor applied to α here is something of a misnomer, as larger values of α actually reduce the level of smoothing, and in the limiting case with α = 1 the output series is just the same as the original series. Simple exponential smoothing is easily applied, and it produces a smoothed statistic as soon as two observations are available.

Values of α close to one have less of a smoothing effect and give greater weight to recent changes in the data, while values of α closer to zero have a greater smoothing effect and are less responsive to recent changes. There is no formally correct procedure for choosing α. Sometimes the statistician's judgment is used to choose an appropriate factor. Alternatively, a statistical technique may be used to optimize the value of α. For example, the method of least squares might be used to determine the value of α for which the sum of the quantities $(S_{n-1} - X_{n-1})^2$ is minimized.

3.2.2.5. Measurement of trend

The increase or decrease in the movements of a time series is called trend.

A time series data may show upward trend or downward trend for a period of years and this may be due to factors like :

- Increase in population;
- Change in technological progress;
- Large scale shift in consumers demands.

The Mean, Linear Trend (LT), Quadratic Trend (QT), Exponential Trend (ET), and S-Curve models all fit various types of regression models to the data, using time as the independent variable.

The models are fit by least squares, resulting in estimates of up to 3 coefficients: a, b, and c. Forecasts from the models are as follows:

Mean model: $F_t(k) = \hat{Y}$ where $\hat{Y}$ is the average of the data up to and including time t.

Linear trend: $F_t(k) = \hat{a} + \hat{b}(t + k)$

Quadratic trend: $F_t(k) = \hat{a} + \hat{b}(t + k) + \hat{c}(t + k)^2$

Exponential trend: $F_t(k) = \exp(\hat{a} + \hat{b}(t + k))$

S-Curve: $F_t(k) = \exp(\hat{a} + \hat{b}/(t + k))$

Since they weight all data equally, regression models are often not the best methods for forecasting time series data.

The following methods are used for calculation of trend:

- Free hand curve method;
- Semi-average method;
- Moving average method;
- Least square method.

(a) Free hand curve method

In this method the data is denoted on graph paper. We take "Time " on X-axis and "data" on Y-axis . On graph there will be a point for every point of time. We make a smooth hand curve with the help of these plotted points.

(b) Semi-average method

In this method the given data are divided in two parts preferable with the equal number of years. For example, if we are given data from 1991 to 2008 , i.e. , over a period of 18 years , the two equal parts will be first nine years, i.e. 1991 to 1999 and from 2000 to 2008 . In case of odd number of years two equal parts can be made simply by ignoring the middle year. For example, if data are given for 19 years from 1990 to 2008 , the two equal parts would be from 1990 to 1998 and from 2000 to 2008 the middle year 1999 will be ignored.

(c) Moving Average method (MA)

It is one of the most popular method for calculating Long Term Trend. This method is also used for "seasonal fluctuation", "cyclical fluctuation" and "irregular fluctuation". In this method we calculate the "Moving Average " for certain years.

(d) Least Square method

This method is most widely in practice .When this method is applied, a trend line is fitted to data in such a manner that the following two conditions are satisfied:

- The sum of deviations of the actual values of Y and computed values of Y (Y_c) is zero:

$$\sum (Y - Y_c) = 0$$

- The sum of the squares of the deviation of the actual and computed values is least from this line. That is why method is called the method of least squares. The line obtained by this method is known as the line of best fit:

$$\sum (Y - Y_c)^2 \quad \text{is least}$$

The method of least square can be used either to fit a straight line trend or a parabola trend. The straight line trend is represented by the equation:

$$Y_c = a + bX$$

Where Y_c = trend value to be computed;

X = unit of time (independent variable);

a= intercept;

b= slope of the best fitting estimating line.

$$a = \overline{Y} - b\overline{X}$$

$$b = \frac{n \sum_{i=1}^{n} X_i Y_i - \sum_{i=1}^{n} X_i . \sum_{i=1}^{n} Y_i}{n \sum_{i=1}^{n} X_i^2 - (\sum_{i=1}^{n} X_i)^2}$$

3.2.2.6. ARIMA (p,d,q) forecasting equation

ARIMA models are, in theory, the most general class of models for forecasting a time series which can be made to be "stationary" by differencing (if necessary). A random variable that is a time series is stationary if its statistical properties are all constant over time. A stationary series has no trend, its variations around its mean have a constant amplitude, and it wiggles in a consistent fashion. The latter condition means that its autocorrelations remain constant over time, or equivalently, that its power spectrum remains constant over time. A random variable of this form can be viewed (as usual) as a combination of signal and noise, and the signal (if one is apparent) could be a pattern of fast or slow mean reversion, or sinusoidal oscillation, or rapid alternation in sign, and it could also have a seasonal component. An ARIMA model can be viewed as a "filter" that tries to separate the signal from the noise, and the signal is then extrapolated into the future to obtain forecasts. The ARIMA forecasting equation for a stationary time series is a linear regression equation in which the predictors consist of lags of the dependent variable and/or lags of the forecast errors. That is:

Predicted value of Y = a constant and/or a weighted sum of one or more recent values of Y and/or a weighted sum of one or more recent values of the errors.

If the predictors consist only of lagged values of Y, it is a pure autoregressive model, which is just a special case of a regression model. If some of the predictors are lags of the errors, an ARIMA model it is NOT a linear regression model, because there is no way to specify "last period's error" as an independent variable: the errors must be computed on a period-to-period basis when the model is fitted to the data. From a technical standpoint, the problem with using lagged errors as predictors is that the model's predictions are not linear functions of the coefficients, even though they are linear functions of the past data. So, coefficients in ARIMA models that include lagged errors must be estimated by nonlinear optimization methods ("hill-climbing") rather than by just solving a system of equations.

The acronym ARIMA stands for Auto-Regressive Integrated Moving Average. Lags of the stationarized series in the forecasting equation are called "autoregressive" terms, lags of the forecast errors are called "moving average" terms, and a time series which needs to be differenced to be made stationary is said to be an "integrated" version of a stationary series. Random-walk and random-trend models, autoregressive models, and exponential smoothing models are all special cases of ARIMA models.

A nonseasonal ARIMA model is classified as an "ARIMA(p,d,q)" model, where:

p is the number of autoregressive terms,

d is the number of nonseasonal differences needed for stationarity, and

q is the number of lagged forecast errors in the prediction equation.

The forecasting equation is constructed as follows. First, let y denote the d^{th} difference of Y, which means:

If d=0: $y_t = Y_t$

If d=1: $y_t = Y_t - Y_{t-1}$

If d=2: $y_t = (Y_t - Y_{t-1}) - (Y_{t-1} - Y_{t-2}) = Y_t - 2Y_{t-1} + Y_{t-2}$

Note that the second difference of Y (the d=2 case) is not the difference from 2 periods ago. Rather, it is the first-difference-of-the-first difference, which is the discrete analog of a second derivative, i.e., the local acceleration of the series rather than its local trend. In terms of Y, the general forecasting equation is:

$$\hat{Y}_t = \mu + \phi_1 Y_{t-1} + \cdots + \phi_p Y_{t-p} - \theta_1 u_{t-1} - \cdots - \theta_q u_{t-q}$$

To identify the appropriate ARIMA model for Y, it should be started by determining the order of differencing d needing to stationarize the series and remove the gross features of seasonality, perhaps in conjunction with a variance-stabilizing transformation such as logging or deflating. If it is stopped at this point and predict that the differenced series is constant, you have merely fitted a random walk or random trend model. However, the stationarized series may still have autocorrelated errors, suggesting that some number of AR terms ($p \geq 1$) and/or some number MA terms ($q \geq 1$) are also needed in the forecasting equation.

Some of the types of nonseasonal ARIMA models that are commonly encountered is given below:

ARIMA(1,0,0) is first-order autoregressive model, if the series is stationary and autocorrelated, perhaps it can be predicted as a multiple of its own previous value, plus a constant. The forecasting equation in this case is:

$$\hat{Y}_t = \mu + \phi_1 Y_{t-1}$$

which is Y regressed on itself lagged by one period.

If the slope coefficient ϕ_1 is positive and less than 1 in magnitude (it must be less than 1 in magnitude if Y is stationary), the model describes mean-reverting behaviour in which next period's value should be predicted to be ϕ_1 times as far away from the mean as this period's value. If ϕ_1 is negative, it predicts mean-reverting behaviour with alternation of signs, i.e., it also predicts that Y will be below the mean next period if it is above the mean this period.

ARIMA(2,0,0) is a second-order autoregressive model, there would be a Y_{t-2} term on the right as well, and so on. Depending on the signs and magnitudes of the coefficients, an ARIMA(2,0,0) model could describe a system whose mean reversion takes place in a sinusoidally oscillating fashion, like the motion of a mass on a spring that is subjected to random shocks.

$$\hat{Y}_t = \mu + \phi_1 Y_{t-1} + \phi_2 Y_{t-2}$$

ARIMA(0,1,0) is random walk , if the series Y is not stationary, the simplest possible model for it is a random walk model, which can be considered as a limiting case of an AR(1) model in which the autoregressive coefficient is equal to 1 , i.e., a series with infinitely slow mean reversion. The prediction equation for this model can be written as:

$$\hat{Y}_t - Y_{t-1} = \mu$$

or equivalently $$\hat{Y}_t = \mu + Y_{t-1}$$

where, the constant term is the average period-to-period change (i.e. the long-term drift) in Y. This model could be fitted as a no-intercept regression model in which the first difference of Y is the dependent variable. Since it includes (only) a nonseasonal difference and a constant term, it is classified as an "ARIMA(0,1,0) model with constant". The random-walk-without-drift model would be an ARIMA(0,1,0) model without constant.

ARIMA(1,1,0) is differenced first-order autoregressive model, if the errors of a random walk model are autocorrelated, perhaps the problem can be fixed by adding one lag of the dependent variable to the prediction equation: i.e., by regressing the first difference of Y on itself lagged by one period. This would yield the following prediction equation:

$$\hat{Y}_t - Y_{t-1} = \mu + \phi_1(Y_{t-1} - Y_{t-2})$$
$$\hat{Y}_t - Y_{t-1} = \mu$$

which can be rearranged to:

$$\hat{Y}_t = \mu + Y_{t-1} + \phi_1(Y_{t-1} - Y_{t-2})$$

This is a first-order autoregressive model with one order of nonseasonal differencing and a constant term.

3.2.2.6. Forecasting

Forecasting is the process of making predictions of the future based on past and present data and most commonly by analysis of trends. A commonplace example might be estimation of some variable of interest at some specified future date. Prediction is a similar, but more general term. Both might refer to formal statistical methods employing time series, cross-sectional or longitudinal data, or alternatively to less formal judgmental methods. Usage can differ between areas of application: for example,

in hydrology the terms "forecast" and "forecasting" are sometimes reserved for estimates of values at certain specific future times, while the term "prediction" is used for more general estimates, such as the number of times floods will occur over a long period.
For calculation Stat Graphics Statistical Packages were used.

3.2.3. Model selection criterion

It is important that the best model is selected from a set of models that were defined prior to data analysis and based on the science of the issue at hand. Ideally, the process by which a “best” model is selected would be objective and repeatable; these are fundamental tenets of science. The ideal model would be appropriately simple, based on concepts of parsimony. Furthermore, precise, unbiased estimators of parameters would be ideal, as would accurate estimators of precision. The best model would ideally yield achieved confidence interval coverage close to the nominal level (often 0.95) and have confidence intervals of minimum width. Achieved confidence interval coverage is a convenient index to whether parameter estimators and measures of precision are adequate. Finally, one would like as good an approximation of the structure of the system as the information permits. Thus, in many cases adjusted R^2 can be computed and σ^2 estimated as a measure of variation explained or residual variation, respectively. Ideally, the parameters in the best model would have biological interpretations. If prediction was the goal, then having the above issues in place might warrant some tentative trust in model predictions. There are many cases where two or more models are essentially tied for “best,” and this should be fully recognized in further analysis and inference, especially when they produce different predictions. In other cases there might be 4–10 models that have at least some support, and these, too, deserve scrutiny in reaching conclusions from the data, based on inferences from more than a single model (Burnham and Anderson, 2002). Some model selection criterion used in the study is given below:

a) Akaike Information Criterion

$$\mathbf{AIC} = \ln\left[\frac{1}{n}\sum_{t=1}^{n}\left(Y_t - Y_t\right)^2\right] + \frac{2p}{n-\left(p+1\right)} \ ,\left(\frac{\mathbf{n}}{\mathbf{p}} < \mathbf{40}\right)$$

b) Hannan-Quinn Information Criterion

$$\mathbf{HQC} = \ln\left[\frac{1}{n}\sum_{t=1}^{n}\left(Y_t - Y_t\right)^2\right] + \frac{2p}{n}\cdot\left[\ln\left(\ln n\right)\right]$$

c) Mean Percentage Error

$$MPE = \frac{\sum_{t=1}^{n}\frac{Y_t - Y_t}{Y_t}}{n}\times 100\%$$

d) Mean Absolute Percentage Error

$$MAPE = \frac{\sum_{t=1}^{n}\left|\frac{Y_t - Y_t}{Y}\right|}{n}\times 100\%$$

e) Mean Abolute Error

$$MAE = \frac{\sum_{t=1}^{n}\left|Y_t - Y_t\right|}{n}$$

f) Root Mean Squared Error

$$RMSE = \sqrt{\frac{ESS}{n}}$$

Where,

Y_t – the actual observation value at time t,

$\widehat{Y}_t$ – the forecasted observation value at time t,

n – the total number of observations,

p – the number of parameters,

ESS – the error of sum of squares.

4. RESULTS AND DISCUSSIONS

4.1. Red Meat Production

Estimated models were given in the table below (Table 4.1).

Forecast model selected: ARIMA (0,1,1) with constant

Table 4.1. Model comparison tests

Model	HQC	AIC	MPE	MAPE	MAE	RMSE
LT = 14571.4 + 7620.18t	18.3342	18.5252	-3.57344	16.0039	5029.49	7918.08
QT=27272.1+(-846.964)t+ 1058.39 t^2	18.3907	18.6772	-3.09858	15.0046	5363.78	7405.8
ET=exp(9.94438+0.174122t)	18.115	18.306	-1.79918	15.65	5414.84	7096.13
ARIMA(0,1,1) with constant	17.2193	17.4103	-8.65024	9.53124	3263.56	4534.28
ARIMA(0,1,0)	18.5882	18.5882	7.08706	25.2689	9666.67	10873.7
ARIMA(0,1,1)	18.6352	18.7307	5.10261	22.7291	8411.84	10122.3

This table compares the results of fitting different models to the data. Each of the statistics is based on the one-ahead forecast errors, which are the differences between the data value at time t and the forecast of that value made at time t-1. The last three statistics measure the magnitude of the errors. A better model will give a smaller value. A better model will give a value close to 0. The model with the lowest value of the AIC is model ARIMA(0,1,1) with constant, which has been used to generate the forecasts.

Table 4.2. Selected model summary

Parameter	Estimate	SE	t	p-value
MA (1)	1.64588	0.599013	2.74765	0.051498
Mean	7100.48	860.083	8.25558	0.001174
Constant	7100.48			

This procedure will forecast future values of Red meat production (Table 4.3). Currently, an autoregressive integrated moving average (ARIMA) model has been selected. This model assumes that the best forecast for future data is given by a parametric model relating the most recent data value to previous data values and previous noise.

The output summarizes the statistical significance of the terms in the forecasting model. Terms with p-values less than 0.05 are statistically significantly different from zero at the 95 % confidence level. The p-value for the MA(1) term is greater than or equal to 0.05, so it is not statistically significant. The p-value for the constant term is less than 0.05, so it is significantly different from 0.

The table also summarizes the performance of the currently selected model in fitting the historical data. It displays: Each of the statistics is based on the one-ahead forecast errors, which are the differences between the data value at time t and the forecast of that value made at time t-1. The first three statistics measure the magnitude of the errors. A better model will give a smaller value. The last two statistics measure bias. A better model will give a value close to 0.

Table 4.3. Forecasting values for Red meat production between the years 2009-2015

Year	Red meat production (tons)	Forecast (tons)	Residual (tons)
2009	34000		
2010	22000	25773.1	-3773.08
2011	28500	35310.5	-6810.52
2012	45000	46809.8	-1809.78
2013	51865	55079.2	-3214.16
2014	66000	64255.6	1744.39
2015	68000	70229.4	-2229.43

This table shows the forecasted values for Red meat production. During the period where actual data is available, it also displays the predicted values from the fitted model and the residuals. For time periods beyond the end of the series, it shows 95 % prediction limits for the forecasts. These limits show where the true data value at a selected future time is likely to be with 95 % confidence, assuming the fitted model is appropriate for the data (Table 4.4).

Table 4.4. Forecasting values for Red meat production between the years 2016-2020

Period	Forecast (tons)	Lower Limit (95 %) (tons)	Upper Limit (95 %) (tons)
2016	78769.9	60722.6	96817.1
2017	85870.3	64386.1	107355
2018	92970.8	68528.1	117413
2019	100071	72991.5	127151
2020	107172	77689.8	136654

ARIMA(0,1,0) and ARIMA(0,1,1) models also were used in the (Akgül and Yıldız, 2016) study for red meat production forecast between 2016-2023 period in Turkey. As in the present study ARIMA(0,1,1) with constant was selected the best suitable model. In another study (Hossain and Hassan, 2013) the cubic trend model was selected the best suitable red meat forecasting model in Bangladesh. The R^2 value was obtained as 0.922, however in present work R^2 value is calculated as 0.987.

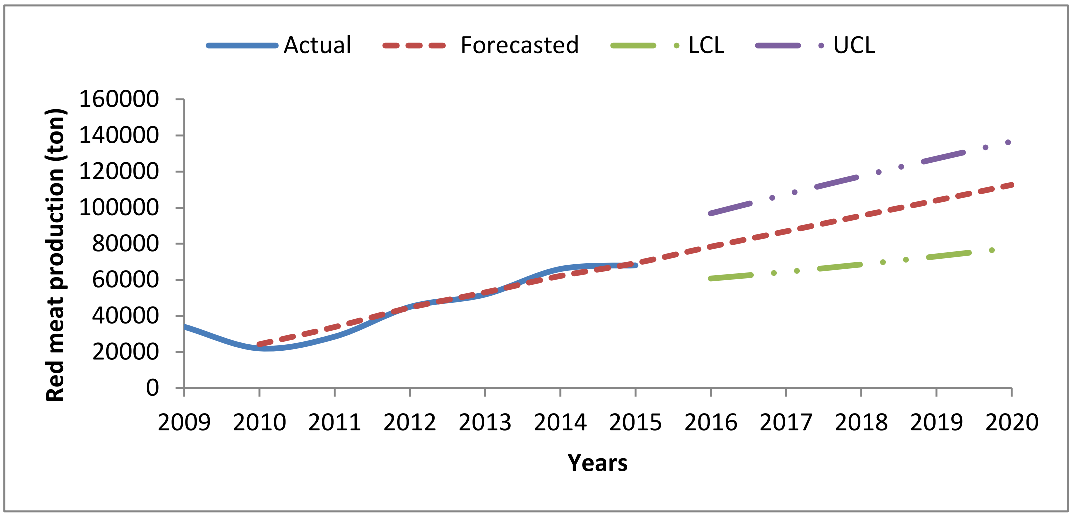

Figure 4.1. Red meat production forecasts

4.2. Chicken Meat Production

Estimated models were given in the table below (Table 4.5).

Forecast model selected: LT = 21969.9 + 8301.36 t

Table 4.5. Model comparison tests

Model	HQC	AIC	MPE	MAPE	MAE	RMSE
LT= 21969.9 + 8301.36 t	15.957	16.148	-0.084223	4.04253	1925.86	2412.19
QT=23690.4+7154.31t+ 143.381t^2	16.3092	16.5957	-0.150129	3.70812	1802.96	2615.65
ET = exp(10.2386 + 0.157646 t)	16.5601	16.7511	-0.120819	4.27519	2423.5	3261.09
ARIMA (0,1,1)	17.9227	18.0182	10.1216	10.1216	5665.58	7088.55

This table compares the results of fitting different models to the data. Each of the statistics is based on the one-ahead forecast errors, which are the differences between the data value at time t and the forecast of that value made at time t-1. The last three statistics measure the magnitude of the errors. A better model will give a smaller value. A better model will give a value close to 0. The model with the lowest value of the AIC is model LT= 21969.9 + 8301.36 t, which has been used to generate the forecasts.

Table 4.6. Selected model summary

Parameter	Estimate	SE	t	p-value
Constant	21969.9	2038.68	10.7765	0.000119
Slope	8301.36	455.862	18.2102	0.000009

The output summarizes the statistical significance of the terms in the forecasting model. Terms with p-values less than 0.05 are statistically significantly different from

zero at the 95 % confidence level. In this case, the p-value for the linear term is less than 0.05. so it is significantly different from 0.

This procedure will forecast future values of Chicken meat production (Table 4.7). Currently, a linear trend model has been selected. This model assumes that the best forecast for future data is given by the linear regression line fit to all previous data.

Table 4.7. Forecasted Chicken meat production between the years 2009-2015

Year	Chicken meat production (tons)	Forecast (tons)	Residual (tons)
2009	32635	30271.2	2363.79
2010	35712	38572.6	-2860.57
2011	45772	46873.9	-1101.93
2012	56595	55175.3	1419.71
2013	65000	63476.6	1523.36
2014	69000	71778.0	-2778.0
2015	81513	80079.4	1433.64

This table shows the forecasted values for Chicken meat production. During the period where actual data is available, it also displays the predicted values from the fitted model and the residuals. For time periods beyond the end of the series, it shows 95 % prediction limits for the forecasts. These limits show where the true data value at a selected future time is likely to be with 95 % confidence, assuming the fitted model is appropriate for the data (Table 4.8).

Table 4.8. Forecasted Chicken meat production between the years 2016-2020

Period	Forecast (tons)	Lower Limit (95 %) (tons)	Upper Limit (95 %) (tons)
2016	88380.7	80262.0	96499.4
2017	96682.1	87834.9	105529
2018	104983	95320.2	114647
2019	113285	102738	123831
2020	121586	110105	133068

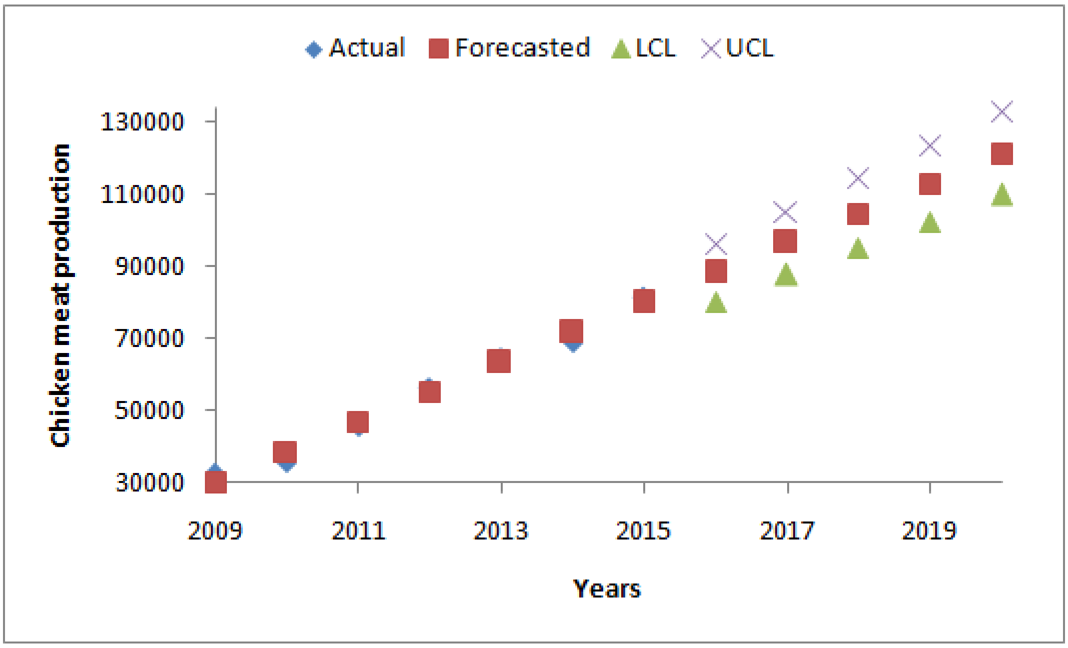

Figure 4.2. Chicken meat production forecasts

4.3. Egg Production

Estimated models were given in the table below (Table 4.9).

Forecast model selected: ET = exp(9.8157 + 0.0663507t)

Table 4.9. Model comparison tests

Model	HQC	AIC	MPE	MAPE	MAE	RMSE
LT= 17414.3 + 1705.36 t	16.4739	16.6649	-1.01853	9.79675	2346.43	3123.55
QT=23021.4+(-2032.74 t)+467.262 t^2	16.4157	16.7022	-0.684213	7.40072	1780.27	2758.75
ET=exp(9.8157 + 0.0663507 t)	16.4002	16.5912	-0.515306	9.1642	2228.47	3010.6
ARIMA(0,1,0)	16.9812	16.9812	6.00782	15.6257	4108.33	4868.82
ARIMA(0,1,1)	17.2181	17.3136	7.49955	13.3997	3601.78	4983.71

This table compares the results of fitting different models to the data. The model with the lowest value of the AIC is model ET=exp(9.8157 + 0.0663507t), which has been used to generate the forecasts.

Table 4.10. Selected model summary

Parameter	Estimate	SE	t	p-value
Constant	9.8157	0.100749	97.4268	0.000000
Slope	0.0663507	0.0225283	2.94522	0.032063

The output summarizes the statistical significance of the terms in the forecasting model. Terms with p-values less than 0,05 are statistically significantly different from zero at the 95,0% confidence level. In this case, the p-value for the slope term is less than 0,05, so it is significantly different from 0. Each of the statistics is based on the one-ahead forecast errors, which are the differences between the data value at time t and the forecast of that value made at time t-1.

This procedure will forecast future values of Egg production (Table 4.11). Currently, an exponential trend model has been selected. This model assumes that the best forecast for future data is given by the an exponential regression curve fit to all previous data.

Table 4.11. Forecasted Egg production between the years 2009-2015

Year	Egg production (tons)	Forecast (tons)	Residual (tons)
2009	21000	19575.8	1424.21
2010	22100	20918.7	1181.28
2011	19300	22353.8	-3053.77
2012	23200	23887.3	-687.274
2013	27100	25526.0	1574.02
2014	23700	27277.1	-3577.09
2015	33250	29148.3	4101.66

This table shows the forecasted values for Egg production. During the period where actual data is available, it also displays the predicted values from the fitted model and the residuals. For time periods beyond the end of the series, it shows 95 % prediction limits for the forecasts. These limits show where the true data value at a selected future time is likely to be with 95 % confidence, assuming the fitted model is appropriate for the data (Table 4.12).

Table 4.12. Forecasted Egg production between the years 2016-2020

Period	Forecast (tons)	Lower Limit (95 %) (tons)	Upper Limit (95 %) (tons)
2016	31148.0	20853.7	46524.0
2017	33284.8	21496.3	51537.9
2018	35568.1	22063.1	57339.9
2019	38008.2	22569.6	64007.4
2020	40615.6	23028.7	71633.3

ARIMA(0,1,0) model was used in the (Chaudhari and Tingre, 2015) study for egg production forecast between 2011-2012 to 2017-2018 period in India. In the

(Hossain and Hassan, 2013)'s study the linear trend model was selected the best suitable egg production forecasting model in Bangladesh. Comparing with these results it could be shown that the growth models of egg production just depends on country.

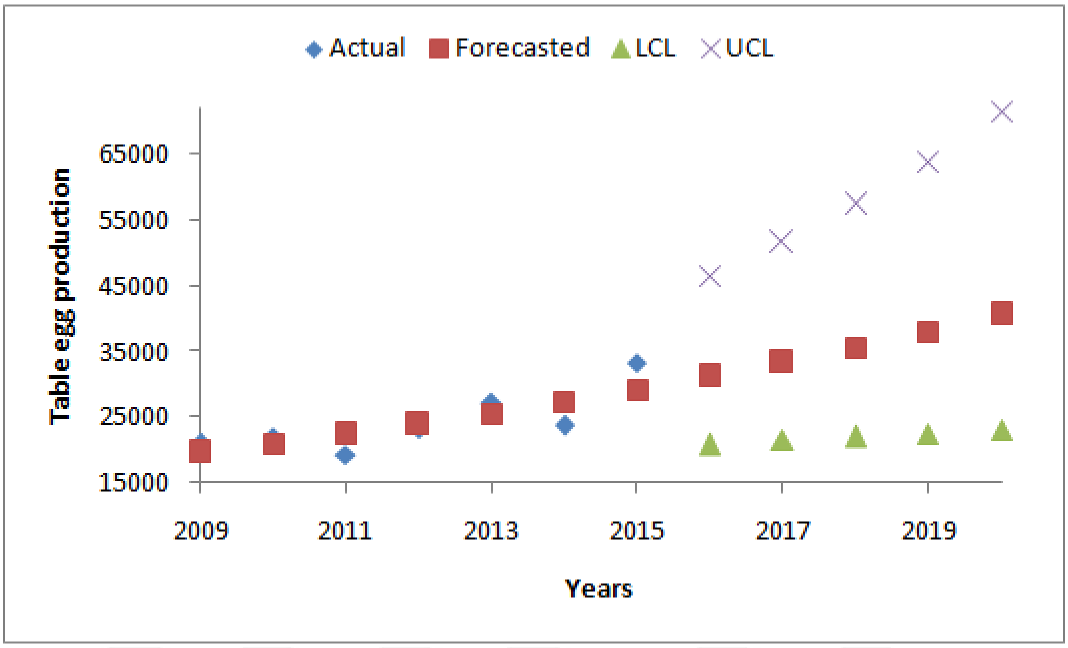

Figure 4.3. Egg production forecasts

4.4. Fish Meat Production

Estimated models were given in the table below (Table 4.13).

Forecast model selected: ET = exp(5.96149 + 0.281968 t)

Table 4.13. Model comparison tests

Model	HQC	AIC	MPE	MAPE	MAE	RMSE
LT= -57.0 + 367.071 t	11.3708	11.5618	-1.49541	19.324	167.612	243.517
QT=346.143+98.3095t+ 33.5952t^2	11.3989	11.6854	-2.09339	12.7463	133.415	224.554
ET= exp(5.96149 + 0.281968 t)	11.3197	11.5107	-1.13559	12.2329	151.825	237.375
ARIMA(0,1,0) with constant	11.5708	11.6663	-8.40585	22.2333	241.833	295.98
ARIMA(0,1,0)	12.1034	12.1034	19.9648	19.9648	327.833	424.827
ARIMA(0,1,1) with constant	11.9599	12.1509	-6.55744	21.5811	252.437	326.922

This table compares the results of fitting different models to the data. Each of the statistics is based on the one-ahead forecast errors, which are the differences between the data value at time t and the forecast of that value made at time t-1. The last three statistics measure the magnitude of the errors. A better model will give a smaller value. A better model will give a value close to 0. The model with the lowest value of the AIC is model ET = exp (5.96149 + 0.281968 t), which has been used to generate the forecasts.

Table 4.14. Selected model summary

Parameter	Estimate	SE	t	p-value
Constant	5.96149	0.150077	39.7227	0.000000
Slope	0.281968	0.0335583	8.40233	0.000391

The output summarizes the statistical significance of the terms in the forecasting model. Terms with p-values less than 0.05 are statistically significantly different from zero at the 95 % confidence level. In this case, the p-value for the slope term is less than 0.05, so it is significantly different from 0. Each of the statistics is based on the one-ahead forecast errors, which are the differences between the data value at time t and the forecast of that value made at time t-1.

This procedure will forecast future values of Fish meat production (Table 4.15). Currently, an exponential trend model has been selected. This model assumes that the best forecast for future data is given by the an exponential regression curve fit to all previous data.

Table 4.15. Forecasted Fish meat production between the years 2009-2015

Year	Fish meat production (tons)	Forecast (tons)	Residual (tons)
2009	598	514.635	83.3648
2010	628	682.271	-54.2706
2011	700	904.511	-204.511
2012	1218	1199.14	18.8568
2013	2007	1589.75	417.252
2014	2163	2107.59	55.4132
2015	2565	2794.1	-229.105

This table shows the forecasted values for Fish meat production. During the period where actual data is available, it also displays the predicted values from the fitted model and the residuals. For time periods beyond the end of the series, it shows 95 % prediction limits for the forecasts. These limits show where the true data value at a selected future time is likely to be with 95 % confidence, assuming the fitted model is appropriate for the data (Table 4.16).

Table 4.16. Forecasted Fish meat production between the years 2016-2020

Period	Forecast (tons)	Lower Limit (95 %) (tons)	Upper Limit (95 %) (tons)

2016	3704.25	2037.7	6733.8
2017	4910.85	2560.4	9419.03
2018	6510.5	3196.51	13260.3
2019	8631.21	3970.94	18760.7
2020	11442.7	4914.23	26644.2

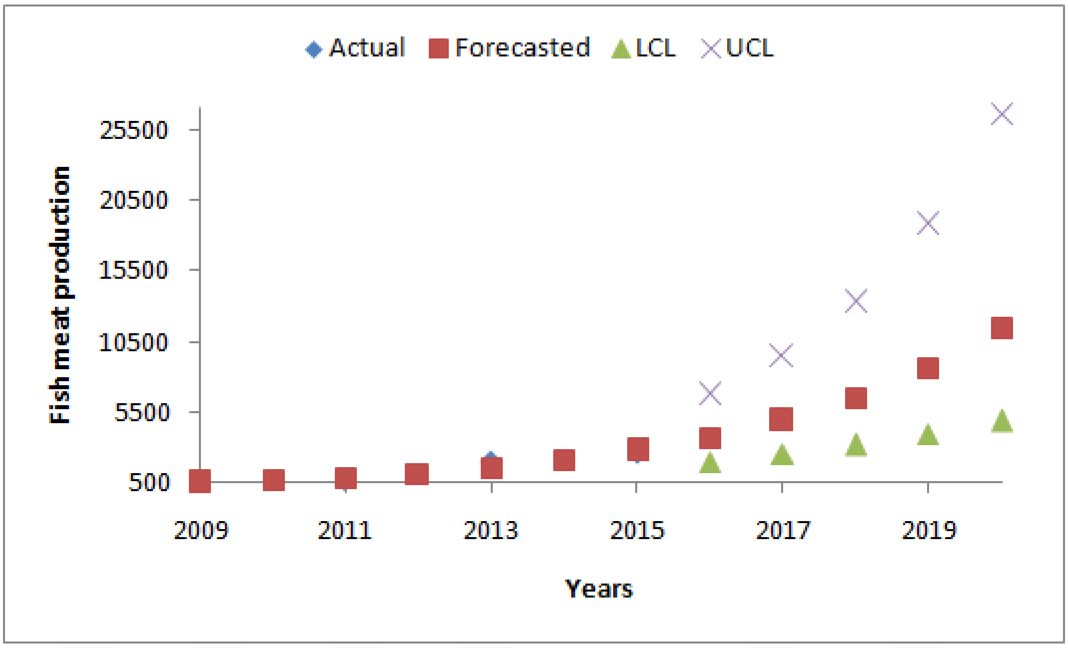

Figure 4.4. Fish meat production forecasts

4.5. Red Meat Consumption

Estimated models were given in the table below (Table 4.17).

Forecast model selected: QT = 65289.6 + 1838.41 t + 13.0881 t^2

Table 4.17. Model comparison tests

Model	HQC	AIC	MPE	MAPE	MAE	RMSE
LT= 65132.6 + 1943.11 t	8.35418	8.54519	0.000114598	0.0525638	38.3102	53.8866
QT=65289.6+1838.41t+13.0881t^2	4.0501	4.33662	-6.49867E-7	0.00567166	4.08027	5.69585
ET=exp(11.0888 + 0.0266826 t)	8.31454	8.50555	-0.0000190024	0.0521002	37.8089	52.829
ARIMA(0,1,1) with constant	7.33574	7.52675	0.00609531	0.0318556	23.7599	32.3839

This table compares the results of fitting different models to the data. The last three statistics measure the magnitude of the errors. The model with the lowest value of the AIC is model QT=65289.6+1838.41t+13.0881t^2, which has been used to generate the forecasts.

Table 4.18. Selected model summary

Parameter	Estimate	SE	t	p-value
Constant	65289.6	8.87635	7355.46	0.000000
Slope	1838.41	5.08694	361.398	0.000000
Quadratic	13.0881	0.621468	21.06	0.000030

The output summarizes the statistical significance of the terms in the forecasting model. Terms with p-values less than 0.05 are statistically significantly different from zero at the 95 % confidence level. In this case, the p-value for the quadratic term is less than 0.05, so it is significantly different from 0.

This procedure will forecast future values of Red meat consumption (Table 4.19). Currently, a quadratic trend model has been selected. This model assumes that the best forecast for future data is given by the a quadratic regression curve fit to all previous data.

Table 4.19. Forecasted Red meat consumption between the years 2009-2015

Year	Red meat consumption (tons)	Forecast (tons)	Residual (tons)
2009	67136.4	67141.1	-4.7119
2010	69023.4	69018.8	4.61429
2011	70929.0	70922.6	6.36429
2012	72849.7	72852.7	-2.9619
2013	74804.1	74808.9	-4.76429
2014	76789.4	76791.2	-1.84286
2015	78803.1	78799.8	3.30238

This table shows the forecasted values for Red meat consumption. During the period where actual data is available, it also displays the predicted values from the fitted model and the residuals. For time periods beyond the end of the series, it shows 95 % prediction limits for the forecasts. These limits show where the true data value at a selected future time is likely to be with 95 % confidence, assuming the fitted model is appropriate for the data (Table 4.20).

Table 4.20. Forecasted Red meat consumption between the years 2016-2020

Period	Forecast (tons)	Lower Limit (95%) (tons)	Upper Limit (95%) (tons)
2016	80834.5	80805.2	80863.8
2017	82895.4	82852.7	82938.1
2018	84982.5	84922.1	85043.0
2019	87095.8	87013.6	87178.0
2020	89235.2	89127.6	89342.8

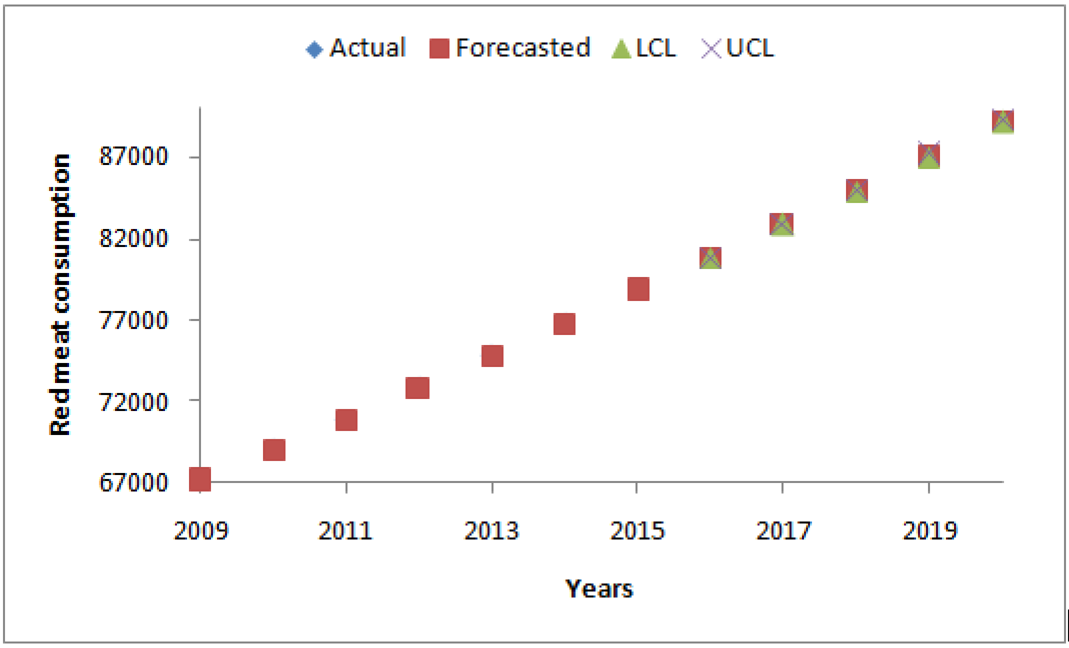

Figure 4.5. Red meat consumption forecasts

4.6. Chicken Meat Consumption

Estimated models were given in the table below (Table 4.21).

Forecast model selected: QT = 108363 + 3051.21 t + 21.7143 t^2

Table 4.21. Model comparison tests

Model	HQC	AIC	MPE	MAPE	MAE	RMSE
LT= 108102 + 3224.93 t	9.36708	9.55809	0.000114544	0.0525344	63.551	89.4189
QT=108363 + 3051.21 t + 21.7143 t^2	5.10284	5.38936	-6.6829E-7	0.00577847	6.89796	9.6418
ET=exp(11.5954 + 0.0266818 t)	9.32867	9.51969	-0.0000190221	0.0521241	62.7773	87.7181
ARIMA(0,1,1) with constant	8.34998	8.541	0.00616701	0.0319205	39.5218	53.7736

This table compares the results of fitting different models to the data. The model with the lowest value of the AIC is model QT = 108363 + 3051.21 t + 21.7143 t^2, which has been used to generate the forecasts.

Table 4.22. Selected model summary

Parameter	Estimate	SE	t	p-value
Constant	108363.	15.0257	7211.86	0.000000
Slope	3051.21	8.61104	354.337	0.000000
Quadratic	21.7143	1.05201	20.6408	0.000033

The output summarizes the statistical significance of the terms in the forecasting model. Terms with p-values less than 0.05 are statistically significantly different from

zero at the 95 % confidence level. In this case, the p-value for the quadratic term is less than 0.05, so it is significantly different from 0.

This procedure will forecast future values of Chicken meat consumption (Table 4.23). Currently, a QT model has been selected. This model assumes that the best forecast for future data is given by the a quadratic regression curve fit to all previous data.

Table 4.23. Forecasted Chicken meat consumption between the years 2009-2015

Year	Chicken meat consumption (tons)	Forecast (tons)	Residual (tons)
2009	111428	111436	-7.92857
2010	114560	114552	7.71429
2011	117723	117712	10.9286
2012	120910	120915	-5.28571
2013	124154	124162	-7.92857
2014	127449	127452	-3.0
2015	130791	130786	5.5

This table shows the forecasted values for Chicken meat consumption. During the period where actual data is available, it also displays the predicted values from the fitted model and the residuals. For time periods beyond the end of the series, it shows 95 % prediction limits for the forecasts. These limits show where the true data value at a selected future time is likely to be with 95 % confidence, assuming the fitted model is appropriate for the data (Table 4.24).

Table 4.24. Forecasted Chicken meat consumption between the years 2016-2020

Period	Forecast (tons)	Lower Limit (95 %) (tons)	Upper Limit (95 %) (tons)
2016	134162	134113	134212
2017	137583	137511	137655
2018	141047	140944	141149
2019	144554	144415	144693
2020	148104	147922	148287

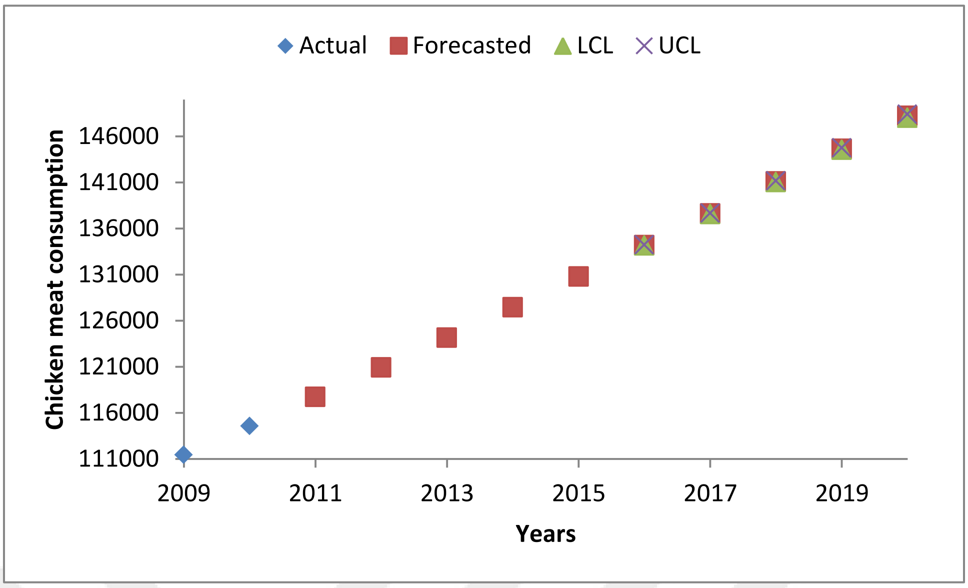

Figure 4.6. Chicken meat consumption forecasts

4.7. Egg Consumption

Estimated models were given in the table below (Table 4.25).

Forecast model selected: QT = 40806.1 + 1148.98 t + 8.18095 t^2

Table 4.25. Model comparison tests

Model	HQC	AIC	MPE	MAPE	MAE	RMSE
LT= 40708.0 + 1214.43 t	7.41421	7.60523	0.000114609	0.0525263	23.9265	33.6798
QT=40806.1 + 1148.98 t + 8.18095 t^2	3.09036	3.37687	-6.38808E-7	0.00560596	2.52109	3.52495
ET=exp(10.6188 + 0.0266822 t)	7.37407	7.56508	-0.0000189898	0.0520554	23.6117	33.0105
ARIMA(0,1,1) with constant	6.39139	6.5824	0.00616847	0.0317839	14.8186	20.196

This table compares the results of fitting different models to the data. Each of the statistics is based on the one-ahead forecast errors, which are the differences between the data value at time t and the forecast of that value made at time t-1. The last three statistics measure the magnitude of the errors. A better model will give a smaller value. A better model will give a value close to 0. The model with the lowest value of the AIC is model Quadratic trend = 40806.1 + 1148.98 t + 8.18095 t^2, which has been used to generate the forecasts.

Table 4.26. Selected model summary

Parameter	Estimate	SE	t	p-value
Constant	40806.1	5.49323	7428.44	0.000000
Slope	1148.98	3.14811	364.975	0.000000
Quadratic	8.18095	0.384603	21.2712	0.000029

The output summarizes the statistical significance of the terms in the forecasting model. Terms with p-values less than 0,05 are statistically significantly different from zero at the 95 % confidence level. In this case, the p-value for the quadratic term is less than 0.05, so it is significantly different from 0.

This procedure will forecast future values of Egg consumption (Table 4.27). Currently, a quadratic trend model has been selected. This model assumes that the best forecast for future data is given by a quadratic regression curve fit to all previous data.

Table 4.27. Forecasted Egg consumption between the years 2009-2015

Year	Egg consumption (tons)	Forecast (tons)	Residual (tons)
2009	41960.4	41963.3	-2.89048
2010	43139.6	43136.8	2.78571
2011	44330.7	44326.7	4.0
2012	45531.1	45532.9	-1.84762
2013	46752.6	46755.6	-2.95714
2014	47993.4	47994.5	-1.12857
2015	49251.9	49249.9	2.0381

This table shows the forecasted values for Egg consumption. During the period where actual data is available, it also displays the predicted values from the fitted model and the residuals. For time periods beyond the end of the series, it shows 95 % prediction limits for the forecasts. These limits show where the true data value at a selected future time is likely to be with 95 % confidence, assuming the fitted model is appropriate for the data (Table 4.28).

Table 4.28. Forecasted Egg consumption between the years 2016-2020

Period	Forecast (tons)	Lower Limit (95 %) (tons)	Upper Limit (95 %) (tons)
2016	50521.6	50503.4	50539.7
2017	51809.6	51783.2	51836.0
2018	53114.0	53076.6	53151.5
2019	54434.8	54384.0	54485.7
2020	55772.0	55705.4	55838.5

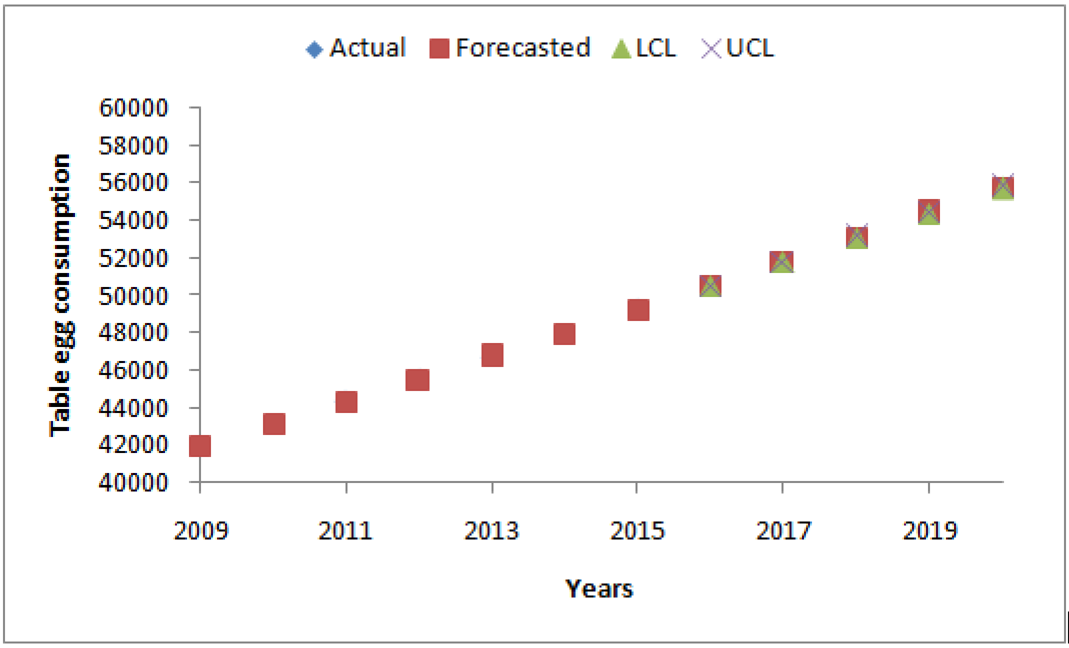

Figure 4.7. Egg consumption forecasts

4.8. Fish Meat Consumption

Estimated models were given in the table below (Table 4.29).

Forecast model selected: QT = 13148.8 + 370.083 t + 2.64762 t^2

Table 4.29. Model comparison tests

Model	HQC	AIC	MPE	MAPE	MAE	RMSE
LT= 13117.0 + 391.264 t	5.15879	5.3498	0.000114863	0.0525342	7.70612	10.9046
QT=13148.8+370.083t + 2.64762t^2	0.928716	1.21523	-6.55153E-7	0.00565195	0.813605	1.19607
ET=exp(9.48625 + 0.0266789 t)	5.10061	5.29162	-0.000018808	0.0516518	7.54901	10.592
ARIMA(0,1,1) with constant	4.19508	4.38609	0.00666482	0.033376	5.01398	6.73508

This table compares the results of fitting different models to the data. The model with the lowest value of the AIC is model QT = 13148.8 + 370.083t + 2.64762t^2, which has been used to generate the forecasts.

Table 4.30. Selected model summary

Parameter	Estimate	SE	t	p-value
Constant	13148.8	1.86395	7054.27	0.000000
Slope	370.083	1.06821	346.452	0.000000
Quadratic	2.64762	0.130502	20.2879	0.000035

The output summarizes the statistical significance of the terms in the forecasting model. Terms with p-values less than 0.05 are statistically significantly different from

zero at the 95 % confidence level. In this case, the p-value for the quadratic term is less than 0.05, so it is significantly different from 0.

This procedure will forecast future values of Fish meat consumption (Table 4.31). Currently, a quadratic trend model has been selected. This model assumes that the best forecast for future data is given by the a quadratic regression curve fit to all previous data.

Table 4.31. Forecasted Fish meat consumption between the years 2009-2015

Year	Fish meat consumption (tons)	Forecast (tons)	Residual (tons)
2009	13520.5	13521.5	-0.930952
2010	13900.5	13899.6	0.942857
2011	14284.3	14282.9	1.42143
2012	14670.4	14671.5	-1.09524
2013	15064.7	15065.4	-0.707143
2014	15464.5	15464.6	-0.114286
2015	15869.5	15869.1	0.483333

This table shows the forecasted values for Fish meat consumption. During the period where actual data is available, it also displays the predicted values from the fitted model and the residuals. For time periods beyond the end of the series, it shows 95 % prediction limits for the forecasts. These limits show where the true data value at a selected future time is likely to be with 95 % confidence, assuming the fitted model is appropriate for the data (Table 4.32).

Table 4.32. Forecasted Fish meat consumption between the years 2016-2020

Period	Forecast (tons)	Lower Limit (95 %) (tons)	Upper Limit (95 %) (tons)
2016	16278.9	16272.8	16285.1
2017	16694.0	16685.0	16703.0
2018	17114.4	17101.7	17127.1
2019	17540.1	17522.8	17557.3
2020	17971.1	17948.5	17993.7

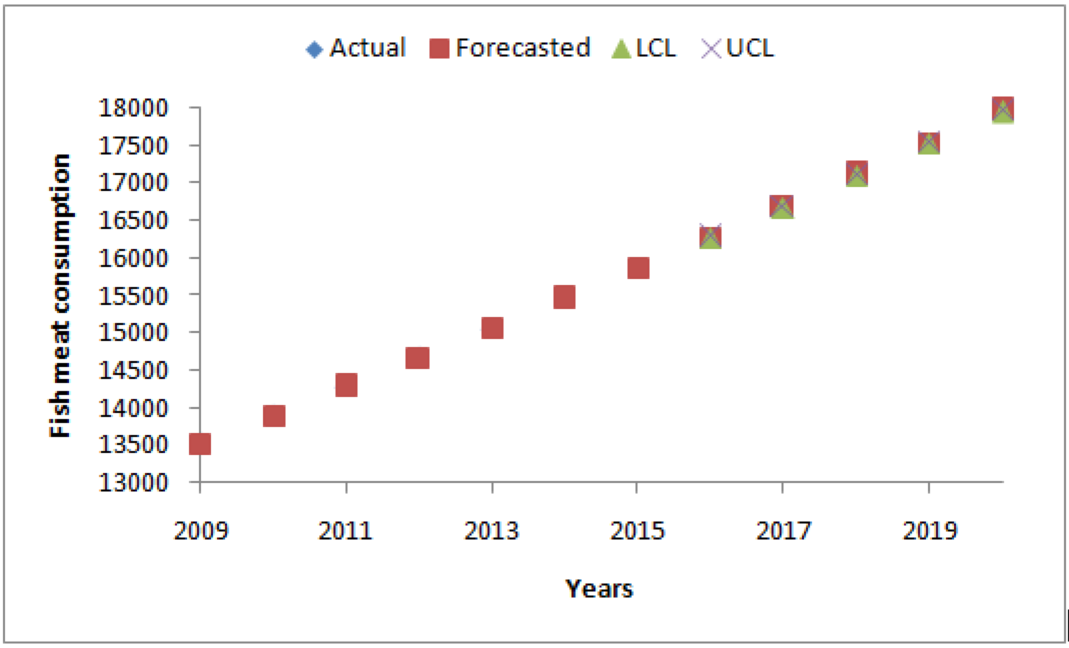

Figure 4.8. Fish meat consumption forecasts

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

Through the results the future prospects for the production of red meat through 2020, where it shows that in 2016 there is a shortage of meat production amounted to appear -2064.6 ton in the province and this rather than the adoption of the province on the red imported hovering from abroad. While expected in 2020 achieves a surplus region in the production of meat the size 17936.8 ton. There is a possibility to export red meat to neighbouring countries.

Future prospects for the production of white meat (chicken) up to 2020, in 2016 there is a shortfall in the production of meat was -45781.3 ton in the province. In 2020 expected gap -26518 ton due to run poultry projects as well as increased domestic production at least for each gap.

Future prospects for the production of white meat (fish) up to 2020 was shown, we can see that there is a shortfall in the production of meat in 2016 reached -12574.7 ton in the region and this rather than the adoption of the province on imported from abroad white meat. In 2020 expected gap is -6528.4 ton.

- We conclude that 37.7% of the total area is located within the natural pasture. This indicates that there is an opportunity to increase the breeding of animals, including sheep, goats, cows and buffalo, while 62.3% of other areas use other economical activities in the region. This shows that there is a possibility to double the livestock in the region, which is reflected positively on the economical development in the region.
- There are constraints either to the production of local eggs because of the fierce and unequal competition between the production of Turkish and Iranian eggs with domestic production of eggs.
- There is an increase in fish production in the region, due to the encouragement of investment projects and facilities necessary for the establishment of fish ponds in the region.
- There is an increase in the consumption of red and white meat in the region during the period of 2007-2015 due to an increase in the growth of housing and an increase in the number of displaced areas in the region.

- We conclude that the production of red and white meat is increasing yearly because of the increase in the number of projects, animal husbandry and breeding projects.
- We conclude that egg production increased because of the increased egg projects in the Northern Iraq Government.

Time series analysis comprises some methods for in order to extract meaningful statistics and other characteristics of the data. Time series forecasting is the use of a model to predict future values based on previously observed values. In this study different time series models are considered. The present study was undertaken to find out appropriate deterministic type forecasting model using Akaike Information Criteria that could best describe the growth pattern of meat and egg production and consumption in Northern Iraq during the time periods of 2009 to 2015. The study revealed that the ARIMA(0,1,1) model is the best fitted model for red meat, linear model is the best for chicken meat and exponential model is the best for fish, meat and egg production, whereas quadratic models best fitted for red, chicken, fish meat and egg consumptions. The selected models were used for succeeding five years forecast with a 95% confidence interval of red meat, white meat and egg production and consumption. The findings of this study will help the policy makers to take necessary actions for proper management of red and white meat and egg production according to their demand and supply.

5.2. Recommendations

In light of the findings of the research, it might propose the following:

- The government should take care of the science of statistics and all the data in order to help the government for future censuses.

- An increase in the number of animal husbandry in the unexploited area of natural pasture, that is, there is the possibility of doubling times of livestock.

- Livestock development by bringing good breeds of animals to the area to increase red and white meat in the area .

- Interest in agricultural research, especially the animal aspect by opening more agricultural research centers and cooperating with the region's universities, with a view to the development of livestock increase and the production of red and white meat in the region.

- The provincial government should facilitate the import of machinery related to livestock and exempt from customs taxes, aims to renew the agricultural sector in the Northern Iraq Government.

- Providing the necessary loans and facilities for the establishment of projects for the raising of calves, dairy cows, poultry projects and fish farming in the region.

- Interest in extension and agricultural training, especially the animal aspect, trying to benefit from international experiences in the field of livestock, especially the Turkish Government in the field of red and white meat service to the economy of the Northern Iraq Government.

- In order to communicate scientific research in the field of livestock, we propose a study (analysis) of factors affecting the production of red and white meat in the Northern Iraq Government.

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