

African Broiler Farming: Comparative, analytical and paradigmatic study.

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Abstract

In Africa, where more than 17 % of the world's population lives, poultry production amounts to only 4% of world production. In fact, the majority of African countries south of the Sahara, with the exception of South Africa, do not have sufficient food resources to allow for large-scale production of these birds, nor do they have the infrastructure and marketing organizations capable of supplying markets on a regular basis at competitive prices. As a result, African poultry supply still relies at a high rate on relatively rudimentary traditional production systems and this type of farming is therefore developing less rapidly than in other parts of the world.

Through this paper we will discuss the African production of chicken meat in its overall state, then the production in the Northern countries in general and the case of Algeria specifically with the delays and challenges of this industry.

Finally, we will provide some prospects for an improvement of the Scientific basis of this field in Africa.

Keywords: African, Chicken, Production, Statistics, Prospects.

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Introduction

White meat production changed dramatically after the Second World War, with more intensive methods based on mechanisation and greater use of inputs such as vitamin supplemented feed, antibiotics, lighted and heated barns, resulting in high production growth and higher yields per unit area.

Poultry is a valuable and economical source of animal protein, especially for developing countries, which has justified its rapid development around the world over the past 50 years (vranken et al., 2014; Ussery., 2011; Berghiche et al., 2018).

The poultry sector continues to grow and industrialise in many parts of the world. Population growth, increased purchasing power and urbanisation have been strong drivers of this growth (Steinfeld et al., 2006 ; Mcleod et al., 2009).

World production of chickens and poultry has continued to grow in recent years despite a slight slowdown due to various epizootics such as avian influenza.

But when we discuss this production in a continent like Africa, we notice that this sector is poorly exploited compared to other parts of the world, despite the importance of this production either in economic terms (short period production) or as a source of low cost protein (FAO., 2020 ; FAO.,2008).

Through this chapter we will focus on the poultry industry throughout the world with the available and most current statistics, then we will focus on the African continent, especially the northern region, ending with Algeria as a model to give the necessary perspectives to be applied to raise this sector to the level of an alternative and profitable sector compared to the red meat sector.

1. World production and consumption of poultry meat

In 2018, more than 100 million tons of poultry meat were produced worldwide (33% of the

world's meat production), 40% of which was produced in the United States, China, and Brazil; Broilers account for about 86% of world poultry production, but these data must be taken with caution as they are the result of aggregating data from multiple sources, collected according to varying methodologies. Nevertheless, they show the clear predominance of chicken among all poultry. (Malpel et al., 2014 ; Govoni et al., 2021 ; Magdelaine et al., 2008).

This is particularly marked in Brazil, where almost all poultry production is chicken (97%). In the United States, turkey production plays a significant role (17%), with chicken production dominating (82%).

In the European Union, chicken accounts for around 72% of production, the rest being made up largely of turkey (16%) and duck (4%). In China, chicken meat is also in the majority (68%), but palmipeds (ducks, geese) account for around 30%, in line with the importance of these species in the country's culinary traditions (FAO., 2020).

In 2020, global poultry production increased by 8% (from 25% to 33%), in response to a globally increasing demand. Growth has been particularly strong in Brazil, the United States and, to a lesser extent, China, such a growth in production may come as a surprise in a context where tensions on cereal markets have led to two consecutive years of rising production costs at the global level (Malpel et al., 2014; Pinstrup-Andersen et al., 1999).

The reason is probably the relative efficiency of poultry in transforming plant products into meat. In intensive production systems, the feed conversion ratio of poultry is much lower than that of pork. As a result, in the event of a price increase for cereals and protein crops, the production cost of poultry evolves less quickly than that of other meats, which gives it a relative advantage (Malpel et al., 2014).

Table 1: Major poultry producers [8-10, 13]

	Poduction (MT)	Evolution
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	2000/2008	2009/2018	2000/2008	2009/2018
Monde	101	180	28%	33%
USA	20	39.5	14%	18%
China	18	14.5	5.1%	4.9%
Brasil	17	14.9	6.3%	7%

In 2008, poultry meat consumption increased by 4%. With 18.6 million tonnes in 2008, China confirmed its position as the leading consumer of poultry meat. The level of individual consumption in this country, at 13.9% kg/hab/year, corresponds roughly to the world average. It remains low compared to that observed in the other countries considered here, but has tended to develop rapidly for several years. Table 1 (FAO., 2020) ET (Magdelaine et al., 2008). In the United States, consumption reached 16 million tonnes. The increase of 0.7% corresponds to stagnation or even a slight erosion of individual consumption, at 52.6 kg/capita/year (FAO., 2008; Govoni., 2021).

Individual consumption of poultry has also stagnated in the EU27 at 23.7kg/inhab/yr. Population growth was accompanied by a slight increase in consumption, which reached 11.8 million tonnes (+0.7%).

In Russia, the consumption of meat in general and of poultry in particular, seems to have significant margins for development, giving it the capacity to absorb the concomitant growth in production and imports.

Consumption has thus made a notable jump in this country. In relation to the number of inhabitants, it has reached a level equivalent to that observed in the European Union (FAO., 2020; Magdelaine et al., 2008).

In Brazil, individual consumption seems to be on the rise again, after having stalled for two years. It is estimated to have reached 37kg/capita/year, for a total consumption of over 7 million tonnes.

Table 2: Poultry consumption in different countries (Fao, 2020)

Country	KG/Capita/Year
USA	49,0

Saudi Arabia	42,0
Australia	38,7
Brazil	35,1
European Union	23,2
Russia	22,8

2. Poultry meat production in Africa

Currently in Africa, with 17.2 % of the world's population, poultry production is only 6% of global production. In fact, the majority of African countries south of the Sahara, with the exception of South Africa, do not have sufficient food resources to allow for large-scale production of these birds, nor do they have the infrastructure and marketing organisations capable of regularly supplying the markets at competitive prices. As a result, 80% of Africa's poultry supply is still based on relatively rudimentary traditional production systems, and poultry farming is therefore developing less rapidly than in other parts of the world.

In urban areas where the population has sufficient purchasing power, industrial units can replace small-scale farming, as in South Africa, Nigeria and Kenya (Alloui et al., 2013; Alloui et al., 2011)

Curiously, in North Africa, with its galloping urban population, industrial poultry production is growing by 5% per year despite the hot climate and low availability (drought) of feed. This means that the potential in Central Africa, where poultry production is insignificant, remains largely under-exploited and that the development of this type of livestock farming in peri-urban areas, to meet the needs of large cities, should be given the utmost attention. The fact remains that only countries that have been able to protect their producers have consistently developed their production (Alain, 2004).

The tariff aspect, i.e. the application of import duties or strict import quotas on cereals (especially maize) but also on poultry or frozen poultry offal, has a major impact on domestic poultry production in African

countries. This explains why South Africa, which developed its poultry industry during the embargo period, is now experiencing problems with imported products following the liberalisation of its economy (FAO., 2020; Magdelaine et al., 2008).

Nigeria is the other major producer in sub-Saharan Africa (170,000 tonnes), but taxes on maize and the disorganisation of the sector limit the development of modern farms (FAO., 2020; Magdelaine et al., 2008).

In West Africa, Senegal and Côte d'Ivoire are the main producers. Elsewhere, and particularly in Central Africa, poultry production can be described as marginal. The high cost of raw materials, which are largely imported, makes local farming uncompetitive; the few industrial companies that have tried have given up ((FAO., 2020; Magdelaine et al., 2008).

As a result, imports of poultry meat and offal provide the bulk of the needs of the major urban centres, particularly along the coasts, near the seaports. In Kinshasa, Gabon, Congo Brazzaville and Luanda, imported products account for 80-90% of consumption (FAO., 2020; Magdelaine et al., 2008).

Table 3: Poultry consumption in different countries in Africa (Alain ,2004)

Country	Poultry consumption per Kg/year/inhabitant
South Africa	11,6
Egypt	6,5
Senegal	7,1
Ivory Coast	3,6
Congo (Kinshasa, Bas-Congo)	2*
Gabon	9*(90% imported)

*Estimate based on import volumes of frozen poultry meat and offal.

3. Production and consumption of poultry meat in North Africa

- **Production and consumption of poultry meat in Tunisia**

The poultry sector has distinguished itself in Tunisia by its rapid evolution, allowing it to reach self-sufficiency in both eggs and white meat and to become increasingly involved in the agricultural and economic development of the country (Shaiek, 2001).

The production of broiler meat, which contributes to 35-40% of the total meat production in Tunisia, reached in 2010 nearly 100,000 tons, i.e. about 63% of poultry meat and with an increase rate of 9.5% compared to 2009 (90,000 tons), while the production of turkey meat reached in 2010 about 47,800 tons and an increase rate of 15.1% compared to 2009 (40,000 tons) (gipac, 2017).

In 2010, total poultry meat consumption reached 159 960 tonnes, i.e. a per capita consumption of 15.1 kg per year. It should be noted that in 2009, the level of consumption was 13.8 kg/inhabitant/year, i.e. a growth rate of 8.6%.

The contribution of poultry meat to total meat consumption has changed significantly. It represented approximately 51.6% in 2009 and in 2010, it reached approximately 53% of the total meat produced in Tunisia (gipac, 2017).

- **Production and consumption of poultry meat in Morocco**

The poultry sector is of great socio-economic importance in Morocco. It covers 100% of poultry meat needs, representing more than 50% of total consumption of all meats. (Alaoui, 2016).

Intensive poultry meat production increased from 8,500 tonnes in 1970 to 310,000 tonnes in 2006 (Barkok ,2007).

In 2014, 456,000 tonnes of broiler meat and 78,000 tonnes of turkey meat were produced in Morocco, ensuring an average consumption of 16.9 kg of poultry meat per inhabitant per year (Alaoui, 2016).

- **Production and consumption of poultry meat in Algeria**

The total Algerian meat production is 172 thousand tons in 2010 with an annual production growth index of 2% during the period 2003-2004-2005 (FAO,2005) (Table 4) (Allaoui, 2011).

Table 4: Evolution of white meat production in Algeria (In thousands tonnes)

Year	Productio (K tones)
2002	240
2003	236
2004	243
2005	253
2006	253
2007	253
2008	253
2009	254
2010	254
2011	254
2012	252
2013	258
2014	262
2015	267
2016	269
2017	266
2018	262
2019	264

In Algeria, the poultry sector is the one that has experienced the most spectacular growth since the 1980s thanks to state intervention.

This has made it possible to improve the food ration from the protein point of view and to provide a living for nearly two million people. (Allaoui, 2011).

Poultry production in 2000 was 169,182 tonnes of white meat and 1.49 billion eggs for consumption, and the poultry meat production sector will reach 264,000 (tonnes in 2019)

Products of animal origin, and particularly poultry, occupy a very modest place in the structure of the Algerian diet.

Poultry production covered only a small part of the consumption of about 250g/inhabitant/year of white meat. In fact, the national survey of 1966-67 showed that the ration contained 7.8g/day of animal

protein, and the 1979-1980 survey estimated 13.40g/day of animal protein per ration, which is close to the FAO-WHO recommendations for developing countries (76g/day). This made it possible to improve the average animal protein ration of nearly 35 million Algerians. However, with 6kg of chicken meat per person per year.

Algerians remain among the lowest consumers, far behind Europeans (23.7kg), Brazilians (37kg), and Americans (52.6kg).[16-19]

Estimated world production of broiler production

We performed a statistical analysis of production data between 2000 and 2020, modelling the likely production estimates for the next decade (2020-2030) (Figure 1 and 2) (FAO., 2020).

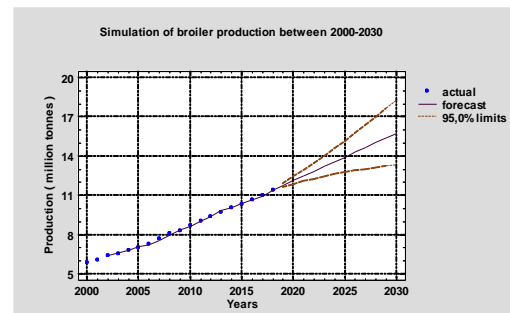


Figure 01: Time sequence plot of the production of broiler meat between (2000-2030).

This figure shows that broiler meat production has two possibilities: either to remain at the same rate of growth despite the increase in the world's population, or to increase in line with the number of inhabitants in the world.

It is noted that the evolution will know several phases with a fluctuation that can be explained by several parameters such as overpopulation and global climate changes.

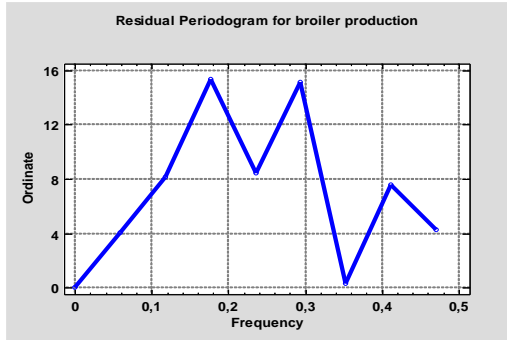


Figure 02: Periodogram of the evolution of the broiler production rate in relation to the evolution of the population of human in the next decade.

The detailed methodology of this statistical modelling is as follows:

- **Forecast Summary**

Forecast model selected: ARIMA (2,2,1)

Parameter	Estimate	Std. Error	t	P-Value
AR (1)	-1,17606	0,179783	-6,54158	0,000013
AR (2)	-0,762601	0,150999	-5,05039	0,000177
AR (3)	-0,738729	0,203936	-3,62236	0,002773

ARIMA Model Summary

Backforecasting: yes

Estimated white noise variance = 5,23383E11 with 14 degrees of freedom

Estimated white noise standard deviation = 723452,

Number of iterations: 9

This procedure will forecast future values of production and the data cover 19 time periods. 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 95,0% confidence level. The P-value for the AR (2) term is less than 0,05, so it is significantly different from 0.

The P-value for the MA(1) term is less than 0,05, so it is significantly different from 0. The estimated standard deviation of the input white noise equals 723452,.

The table also summarizes the performance of the currently selected model in fitting the historical data. It displays:

- (1) the root mean squared error (RMSE)
- (2) the mean absolute error (MAE)
- (3) the mean absolute percentage error (MAPE)
- (4) the mean error (ME)
- (5) the mean percentage error (MPE)

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.

- **Periodogram for residuals**

	frequency	Period	Ordinate	Cumulative Sum	Integrated Periodogram
0	0,0		9,96509E-21	9,96509E11	1,57612E-33
1	0,0588235	17,0	4,01505E11	4,01505E11	0,0635036
2	0,117647	8,5	8,14493E11	1,216E12	0,192327
3	0,176471	5,66667	1,53668E12	2,75268E12	0,435374
4	0,235294	4,25	8,40047E11	3,59273E12	0,568239
5	0,294118	3,4	1,51506E12	5,10779E12	0,807867
6	0,352941	2,83333	2,70975E10	5,13489E12	0,812152
7	0,411765	2,42857	7,58671E11	5,89356E12	0,932147
8	0,470588	2,125	4,29007E11	6,32256E12	1,0

This table shows the periodogram ordinates for the residuals. It is often used to identify cycles of fixed frequency in the data. The

periodogram is constructed by fitting a series of sine functions at each of 9 frequencies.

The ordinates are equal to the squared amplitudes of the sine functions. The periodogram can be thought of as an analysis of variance by frequency, since the sum of the ordinates equals the total corrected sum of squares in an ANOVA table.

4. Conclusion and perspectives

Modelling of world chicken meat production over a decade shows stable production in the most passive probabilities.

The situation of poultry farming in African countries is considered poor, and its development is very slow compared to developed countries, and also in relation to demographic development.

In view of this situation in Algeria, for example, and in the perspective of its accession to the World Trade Organisation, it would be advisable to upgrade these farms to enable them to compete.

To this end, considerable efforts should be made to support investment in the modernisation of workshops; public aid has been provided under the national agricultural development programme to improve the level of equipment on poultry farms, but these measures remain insufficient in view of the disinvestment in poultry buildings.

Support the institutions responsible for the development and adaptation of production techniques and identify ways and means of disseminating technical progress to the profession, as well as strengthening the monitoring system for the policies implemented.

Design regulatory policies involving all economic actors in the poultry sector and the rehabilitation of the poultry profession.

Noting that this model of perspectives is applicable in all African countries, as well as underdeveloped countries in general.

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In the memories of my father, brother and grandpa whose died by Covid 19.

Conflict of Interest

No conflict of interest to declared.

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