

Key Market Signals in the Egg Industry

For the
third quarter of 2020

3Q 2020

Disclaimer: *Information in this report reflects assumptions and also actual data. The projections presented in the report are based upon specific production standards and indicate historic and forecasted trends only.*

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1. EGG SUPPLY AND DEMAND 3Q 2020

1.1 Egg production

Day-old pullet production:

A total of 6 512 300 day-old pullets was produced during the third quarter of 2020 (3Q 2020). This was 9.4 % more than 2Q 2020 but 5.2 % less than 3Q 2019.

The weekly average number of day-old pullets hatched for 3Q 2020 was 492 440; 7.6 % more than 2Q 2020 but 5.4 % less than 3Q 2019 (monthly figures given in *Figure 1*).

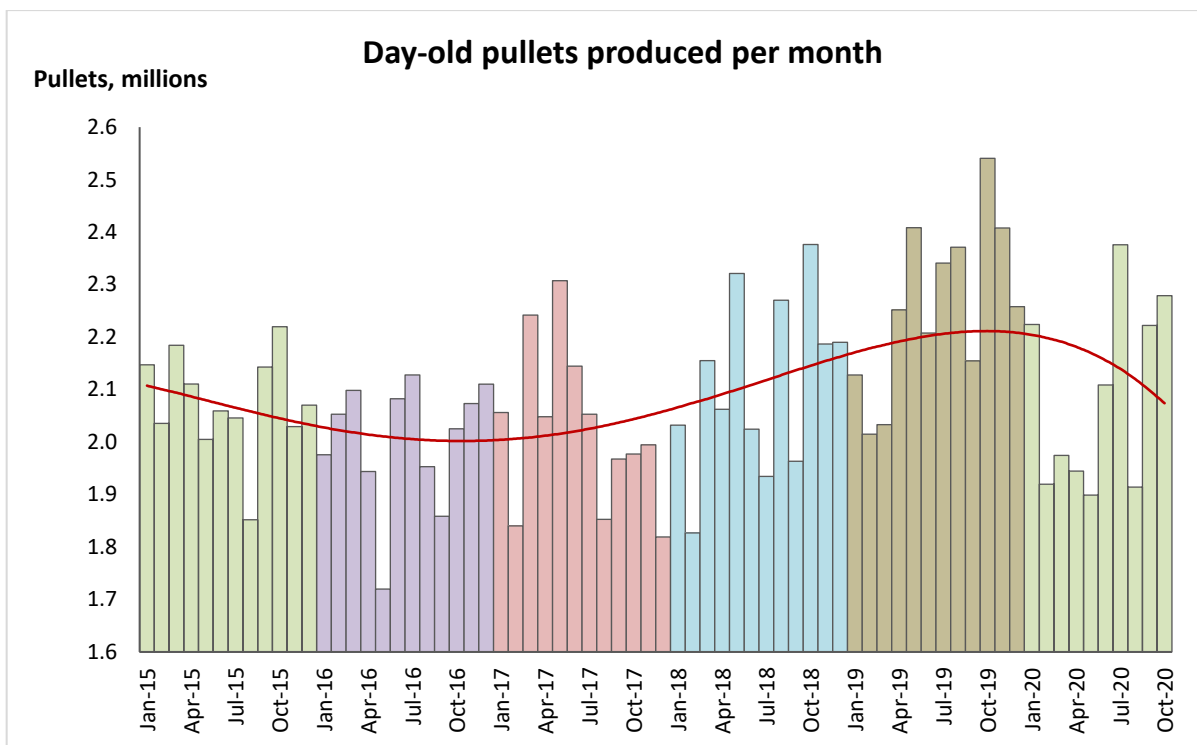


Figure 1: The number of day-old pullets produced per month.

Projected laying flock:

The average number of laying hens during 3Q 2020 was 28 793 840. This was a decrease of 1.8 % compared to 2Q 2020 but an increase of 3.1 % compared to 3Q 2019.

The projected laying flock for October 2020 is 28 478 110 hens; a 0.6 % year-on-year increase (*Figure 2*).

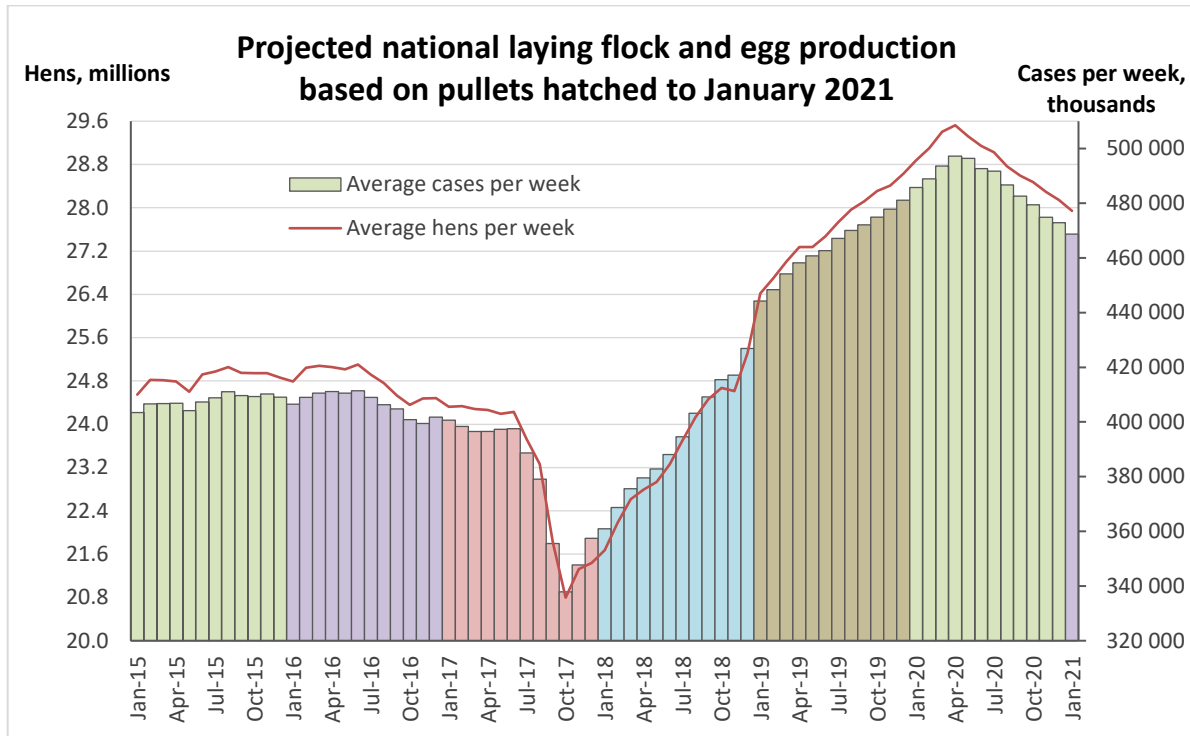


Figure 2: Projected national laying flock and egg production

Forecasted egg production:

Total egg production during 3Q 2020 was 6 401 010 cases. This was a 0.6 % decrease compared to 2Q 2020 but a 3.7 % increase compared to 3Q 2019.

The average production per week for 3Q 2020 was 486 990 cases. Compared to the 2Q 2020, there was a 1.7 % decrease but compared to 3Q 2019 there was a 3.7 % increase

Table 1: Egg industry: key results (September 2020)**EGG INDUSTRY: KEY RESULTS - SEPTEMBER 2020****(Projections are based on day-old pullets placed per week to September 2020)**

	Hatch days	Calendar Days	Day-old Pullets placed		Laying hens	Eggs Produced (Cases)	
Month on Month	/Month	/Month	/Month	/Week	Average	/Month	/Week
September 2020	22	30	2 222 335	505 076	28 592 943	2 068 268	482 596
August 2020	21	31	1 913 929	455 697	28 764 670	2 155 247	486 669
Change			308 406	49 379	-171 727	-86 979	-4 073
% Change			16.11%	10.84%	-0.60%	-4.04%	-0.84%
Year on Year	/Month	/Month	/Month	/Week	Average	/Month	/Week
September 2020	22	30	2 222 335	505 076	28 592 943	2 068 268	482 596
September 2019	21	30	2 154 578	512 995	28 119 985	2 023 248	472 091
Change			67 757	-7 919	472 958	45 020	10 505
% Change			3.14%	-1.54%	1.68%	2.23%	2.23%
Year to date	/Period	/Period	/Period	/Week	Average	/Period	/Week
	January-September		January-September		Jan-Sept	Jan-Sept	
2020	196	274	18 582 971	473 648	29 084 088	19 204 387	490 623
2019	195	273	19 910 239	510 932	27 334 003	17 932 762	459 814
Change			-1 327 268	-37 284	1 750 086	1 271 624	30 809
% Change			-6.67%	-7.30%	6.40%	7.09%	6.70%
Full year forecasts	/Period	/Period	/Period	/Week	Average	/Period	/Week
Jan-Dec 2019	261	365	27 116 566	519 762	27 614 913	24 214 408	464 386
Jan-Dec 2018	261	365	25 343 047	485 410	23 535 903	20 526 488	393 659
Change			1 773 519	34 352	4 079 010	3 687 920	70 727
% Change			7.00%	7.08%	17.33%	17.97%	17.97%

NOTE:

Month or Period: Refers to a calendar month or period

Week: Refers to an average 7 day week of which all 7 days fall within the specified month or period

ASSUMPTIONS

- 1: All surviving day-old pullets placed will be transferred to the laying flock at 18 weeks of age.
- 2: Depopulation age: Nov 2013 - 74 weeks; Nov 2017 - 78 weeks
- 3: No deviation from the accepted production standards and procedures, due to disease, changes in production planning, etc. is expected.

1.2 Egg imports

In 3Q 2020, egg imports were recorded on the following tariff lines:

106 639 kg	fertile chicken eggs > R1.50 (tariff line 0407.1190)
40 505 kg	dried egg yolks (tariff line 0408.1100)
23 341 kg	dried egg albumins (tariff line 3502.1100)
11 624 kg	dried egg product (not including yolk; tariff line 0408.9100)

Total egg imports in the 3Q 2020 amounted to 182 tonnes; at a rand value of R15.3 million. Imports decreased by 5.2 % compared to 2Q 2020 but increased by 6.4 % compared to 3Q 2019. Quarterly volumes of total egg imports since 1Q 2015 are given in *Figure 3*. The quarterly imports of dried egg albumin are given in *Figure 4*. In the 3Q 2020, imports from the US accounted for 58.5 % of total egg imports (all fertile). Italy accounted for 12.1 % of total imports; whilst 11.6 % came from France; 11.1 % from the Netherlands; 4.2 % from Belgium; and 2.5 % from Denmark. The remainder (0.1 %) came from China, Germany, Taiwan and the UK, together.

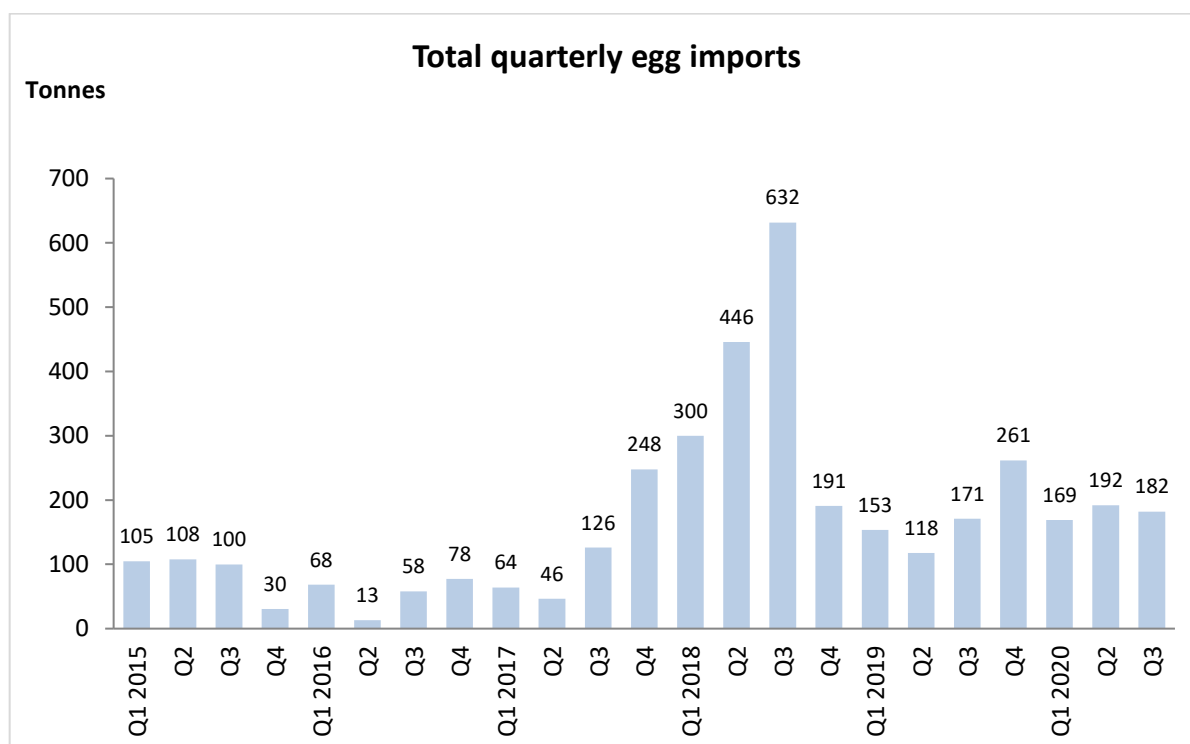


Figure 3: Total quarterly egg imports from 1Q 2015

Through 2019, egg imports into South Africa totalled 704 tonnes; down 55.1 % on 2018 levels (1 568 t). Egg imports were valued at R59.83 million (FOB) in 2019 (down 44.7 % on 2018 (R108.2 million)). Dried egg products (including albumins) accounted for 98.0 % of egg imports into South Africa in 2019, on three tariff lines. In addition to dried products, imports included 1.1 % liquid egg products and 0.9 % fertilised eggs (*Gallus domesticus*). Lesotho exported 750 kg of ostrich eggs (fresh, not fertilised) to South Africa in 2019. In 2019, 39.0 %

of egg imports arrived from the Netherlands; 23.8 % from France; 20.7 % from Italy; 9.6 % from Denmark and 3.5 % from Argentina. The percentage contribution by the major egg importers to total egg imports for 2019 is shown in *Figure 5*.

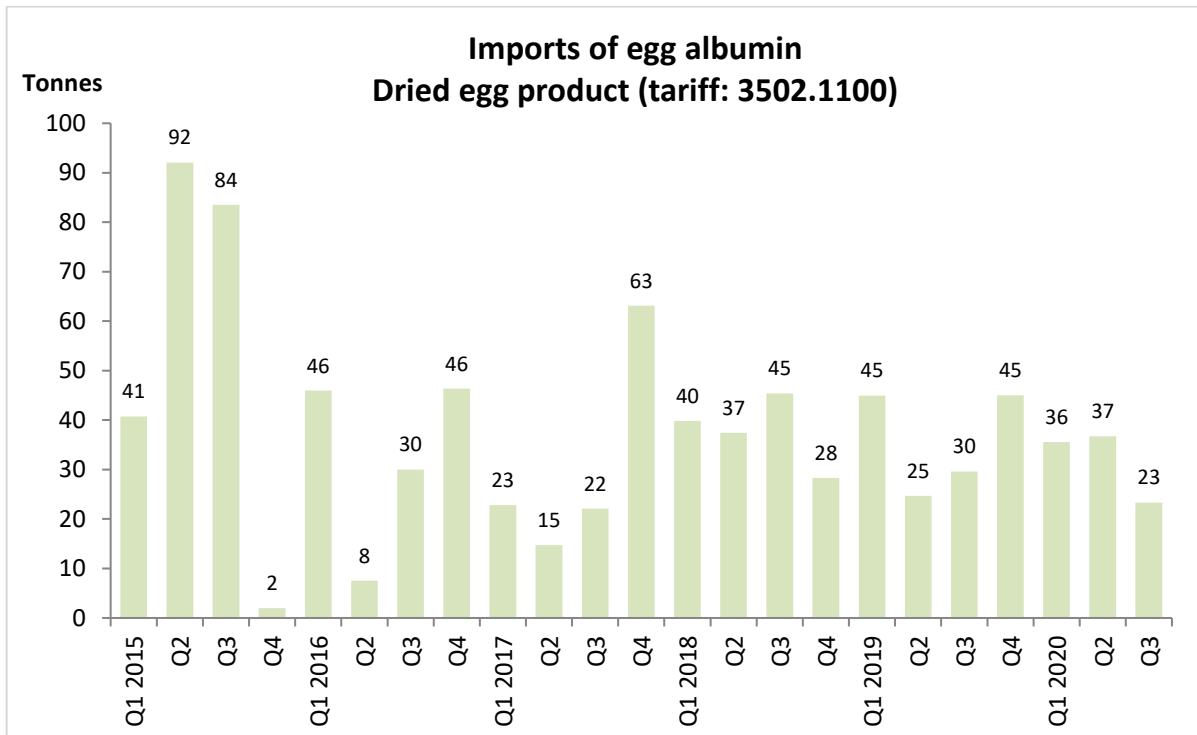


Figure 4: Quarterly imports of egg albumin from 1Q 2015

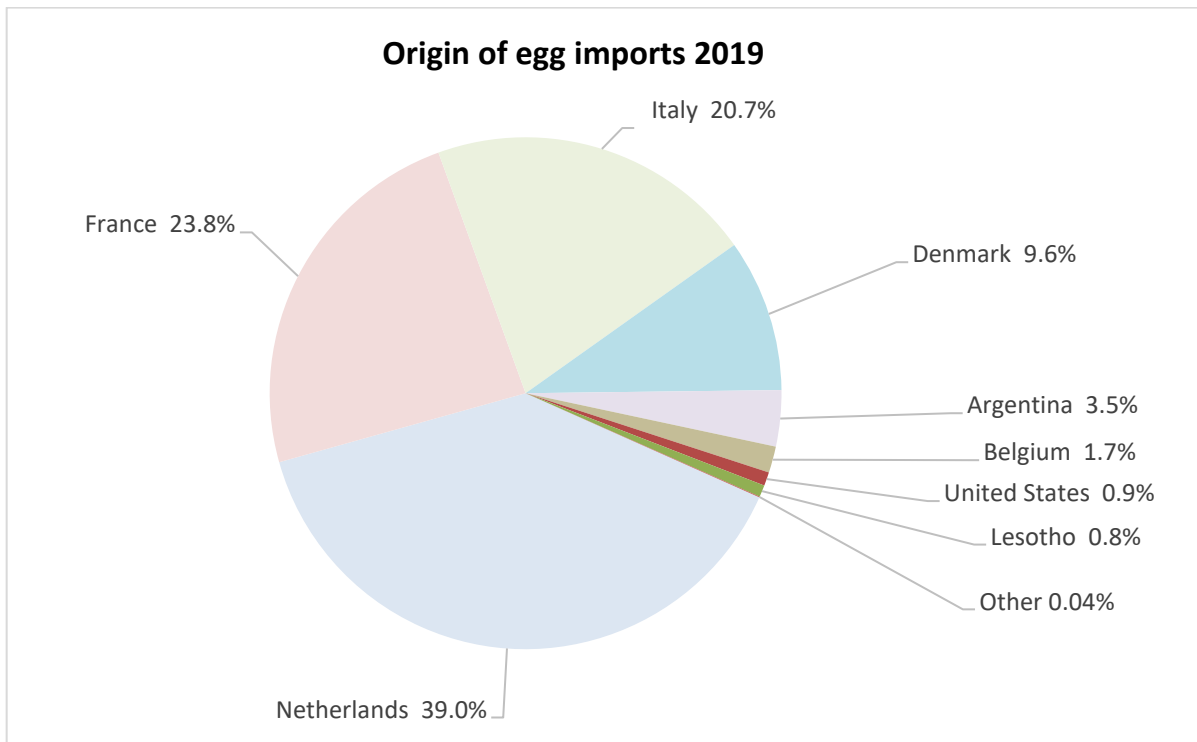


Figure 5: The main countries of origin for egg imports (2019; source: SARS).

1.3 Egg exports

During 3Q 2020, a total of 3 194 tonnes of eggs and egg products left South Africa, at a declared FOB value of R85.3 million. This tonnage increased by 16.9 % compared to the 2Q 2020 (+ 463 tonnes).

Of these total egg exports, fertile chicken eggs accounted for 1 236 t; 38.7 % of the total export tonnage. This is 361 t (+ 41.3 %) more than in the previous quarter and 111 t (+ 9.9 %) more than the same quarter in the previous year (3Q 2019). Fertile chicken eggs were exported under two tariff codes: 29 t and 1 207 t were exported under codes 0407.1110 and 0407.1190, respectively. The FOB value of fertile chicken egg exports in the 3Q 2020 was R50.6 million. In addition to fertile chicken eggs, SARS reports that 47 t of fertile eggs from ducks, geese or guinea fowl were exported. These strange, non-chicken volumes went mainly to Lesotho, Mozambique and Swaziland in this quarter.

The quarterly exports of fertile eggs under these two tariff codes since 1Q 2015 are shown in *Figure 6*.

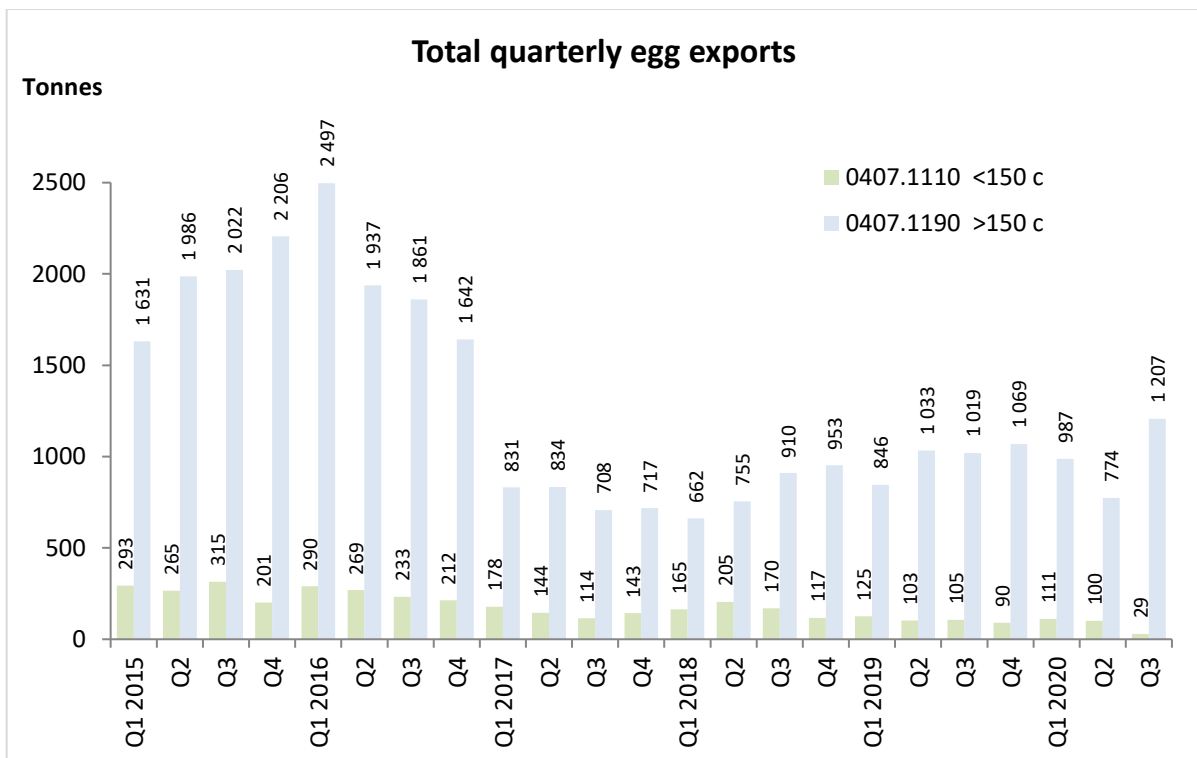


Figure 6: Quarterly export of fertile eggs

The amount of egg products exported during the 3Q 2020 under each of the most regularly used tariff codes (including fertile eggs and shell eggs (fresh, cooked or preserved)) is given in *Table 2*, along with the amounts exported in the previous quarter and in 3Q 2019.

Table 2. Quarterly exports of eggs and egg products from South Africa

	Tariff code	units	3Q 2019	2Q 2020	3Q 2020
Fertile eggs	0407.1110/1190	t	1 080	874	1 236
Fertile eggs (ostriches)	0407.1910	kg	0	0	0
Fertilised eggs (other: not chicken/ ostrich)	0407.1990	t	43.7	17.4	46.5
Shell eggs chicken (< 150 c)	0407.2110	t	0	0	< 0.01
Shell eggs chicken (>150 c)	0407.2190	t	429	188	312.8
Shell eggs (ostrich)	0407.2910	kg	0	0	0
Shell eggs (not chicken/ostrich)	0407.2990	t	48.0	339.9	312.3
Ostrich eggs	0407.9010	t	<0.01	85.1	93.0
Shell eggs: chicken (fresh, preserved cooked)	0407.9020	t	474	1 001	630
Shell eggs: other (fresh preserved, cooked)	0407.9090	t	442	200	563
Dried egg yolks	0408.1100	kg	86	136	0
Liquid egg yolks	0408.1900	t	25.8	12.4	<0.1
Dried egg product (not yolks)	0408.9100	t	69	0.94	0.26
Raw yolks/whites (chicken)	0408.9910	t	420	12.4	<0.01
Raw yolks/white (not chicken)	0408.9990	kg	2 148	25	0.25
Dried egg albumin	3502.1100	kg	538	560	<0.01
Liquid egg albumin	3502.1910	kg	0	0	0
Egg albumin, not dried but not liquid	3502.1990	kg	0	0	0.1

Besides fertile eggs, a total of 1 819 t of egg products (shell eggs, liquid and dried egg products included; *Figure 7*) were exported from South Africa in the 3Q 2020, at a declared FOB value of R 31.95 million. This is 64 tonnes more than in 2Q 2020 (+ 3.7 %); but 946 t less than in 3Q 2019 (- 34.2 %). Egg product exports during the 3Q 2020 comprised: 82.8 % shell eggs from chicken (0407.2120; 2190; 9020; 9090); 0.015 % dried egg product; 17.2 % shell eggs from other sources excluding ostrich (0407.2990; although this seems unlikely) and 0.024 % liquid egg product. The total tonnage and value of egg products above excludes 93 tonnes of ostrich eggs exported under tariff code 0407.9010 at an FOB value of R1.83 million.

In summary, total egg exports in 3Q 2020 comprised 1 236 t of fertile chicken eggs, 46.5 t of fertile eggs (not chickens or ostriches; questionable); 1 819 tonnes of egg products (shell eggs, dried and liquid product); and 93 tonnes of ostrich eggs.

The main countries of destination for South African exports of eggs and egg products during 3Q 2020 were Mozambique (96.4 % of exports), Botswana (2.2 %), Lesotho (0.6 %) and Swaziland (0.5 %).

Export destination countries for the year 2019 are shown in *Figure 8*. The main countries of destination during 2019 were Mozambique (86.2 % of exports), Swaziland (10.7 %), Botswana (2.0 %), Lesotho (0.3 %), Nigeria (0.3 %); and others (0.5 %).

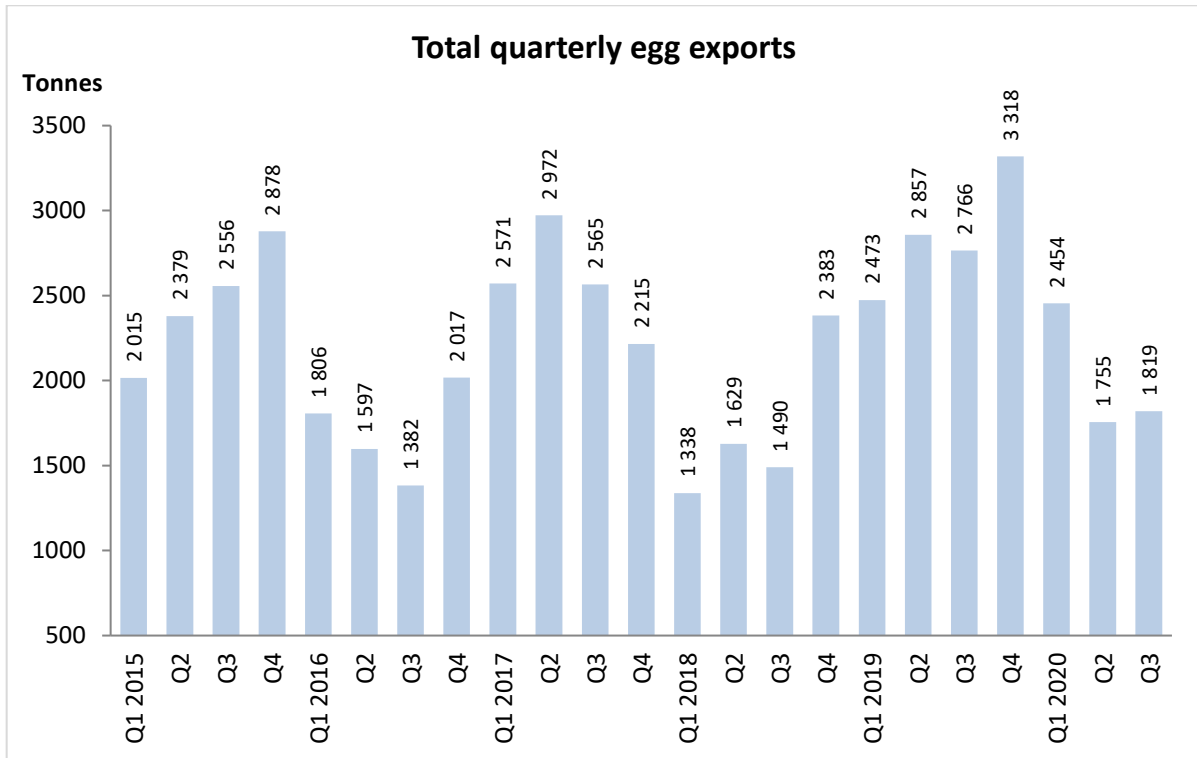


Figure 7: Quarterly total exports of shell eggs and egg product excluding fertile eggs and ostrich eggs (source: SARS)

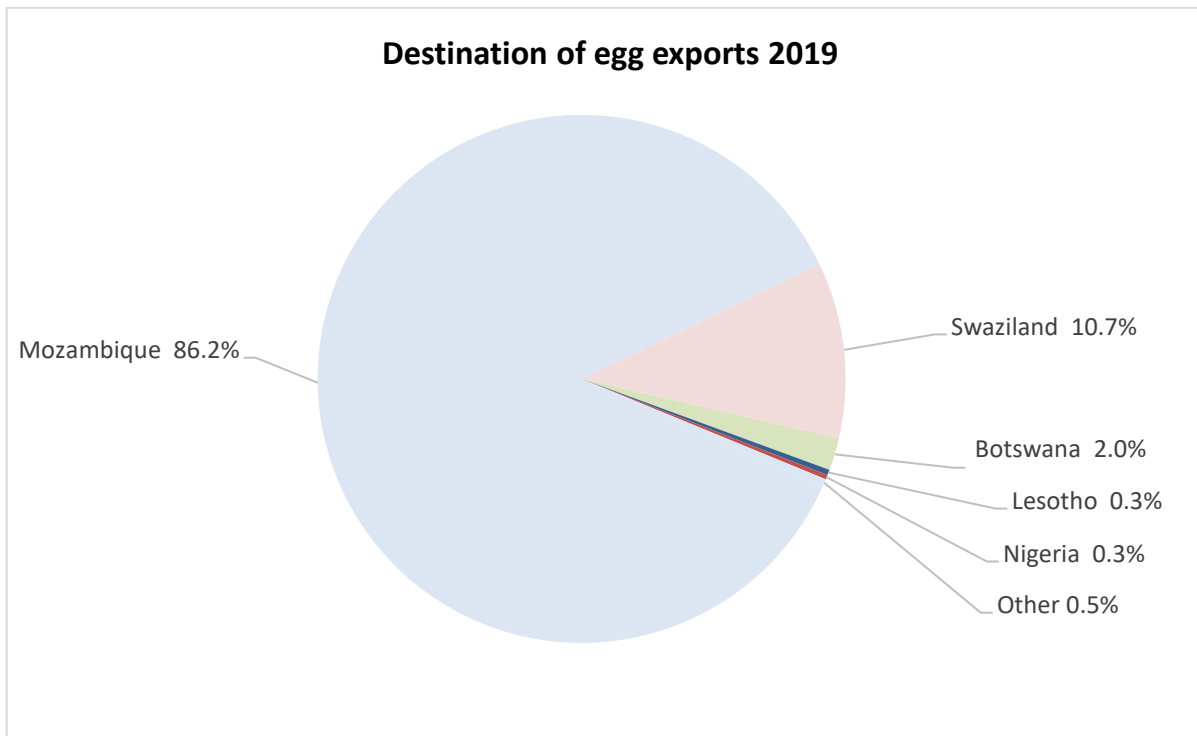


Figure 8: The main countries of destination for egg exports 2019

In 2019, South Africa exported a total of 15 983 tonnes of eggs and egg products from all species (excluding ostriches); including 4 391 t of fertile chicken eggs; 177 t of fertile eggs from other species (questionable); 2 753 t of fresh chicken eggs; 7 188 t of preserved/cooked chicken eggs; 1 344 t of fresh shell eggs (not chicken; questionable); 83 t of dried egg products and 46 t of liquid egg products. Total egg exports (excluding ostriches) for 2019 were valued at R358.4 million. Exports increased by 46.9 % over 2018 in tonnage terms (+ 5 100 tonnes) and by 24.9 % in rand value (+ R 71.3 million). South Africa also exported 7 847 kilogrammes of ostrich eggs in 2019, which under tariff 0407.9010. Ostrich egg exports were valued at R127 532.

2. EGG PRICE TRENDS

2.1 Producer prices

The monthly average egg producer price for September 2020 was R14.92 per dozen (*Figure 9*; source: SAPA). Compared to August 2020, the egg price decreased by 0.5 % but, on a year-on-year basis, it increased by 8.2 %. The quarterly average egg producer price for 3Q 2020 was R14.93 per dozen; an increase of just 0.1 % over 2Q 2020 prices and an increase of 6.0 % compared to the 3Q 2019.

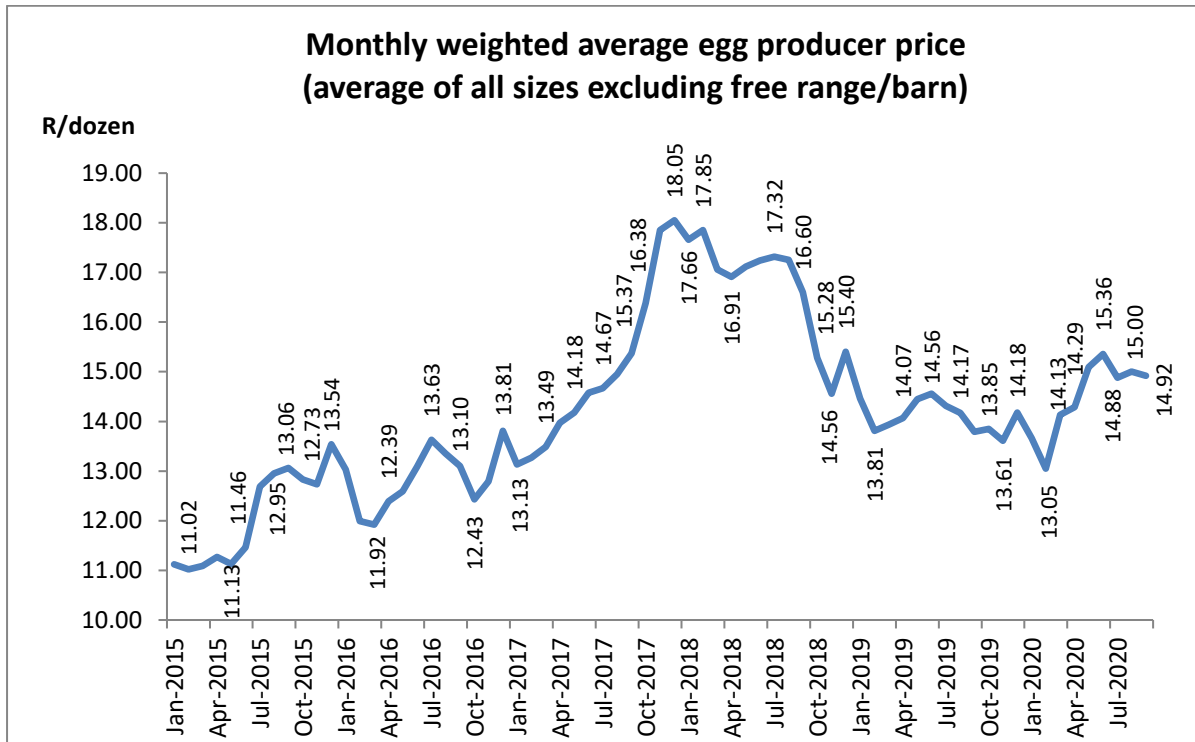


Figure 9: Monthly egg price from January 2015 to the end of the 3Q 2020

- Graded egg prices

During September 2020, the average egg price for *graded* eggs (excluding barn eggs and free-range eggs) was R15.30 per dozen, a decrease of 0.9 % in comparison with August 2020 but an increase of 6.8 % when compared to the same month in the previous year. The quarterly average egg producer price for *graded* eggs in 3Q 2020 was R15.33 per dozen; an increase of 0.6 % over 2Q 2020 prices and an increase of 4.6 % compared to 3Q 2019.

- Ungraded egg prices

The average egg price for *ungraded* eggs was R13.50 per dozen in September 2020, a 1.1 % increase when compared to August 2020 and an increase of 12.9 % on September 2019 prices. The quarterly average egg producer price for *ungraded* eggs in 3Q 2020 was R13.43 per dozen; a decrease of 1.4 % over 2Q 2020 prices but an increase of 10.4 % compared to 3Q 2019.

The average egg price (weighted) for 2019 was R14.10 per dozen; a decrease of 15.5 % over the average price for 2018 (R16.69); *Figure 10*. Graded eggs averaged R14.75 per dozen and ungraded eggs sold at R11.84 per dozen. During 2019, 78 % of eggs were sold graded and 22 % ungraded. In 1H 2020, the average producer egg price was R14.26 per dozen.

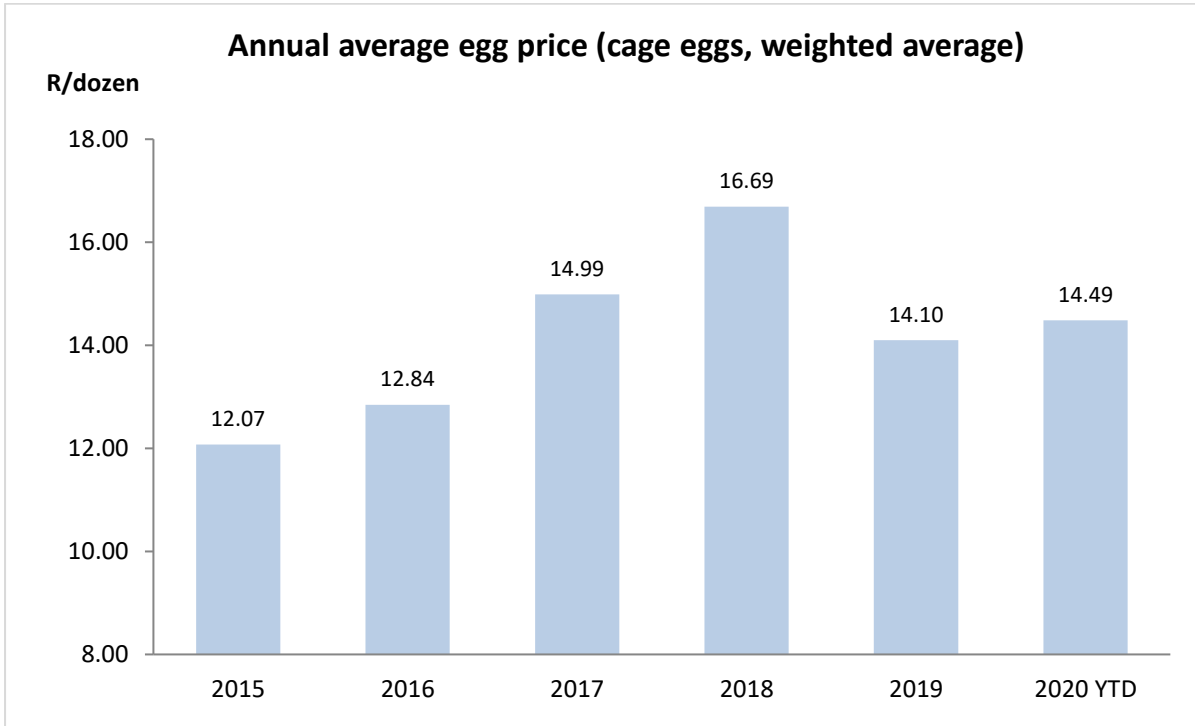


Figure 10: Average annual weighted egg producer price

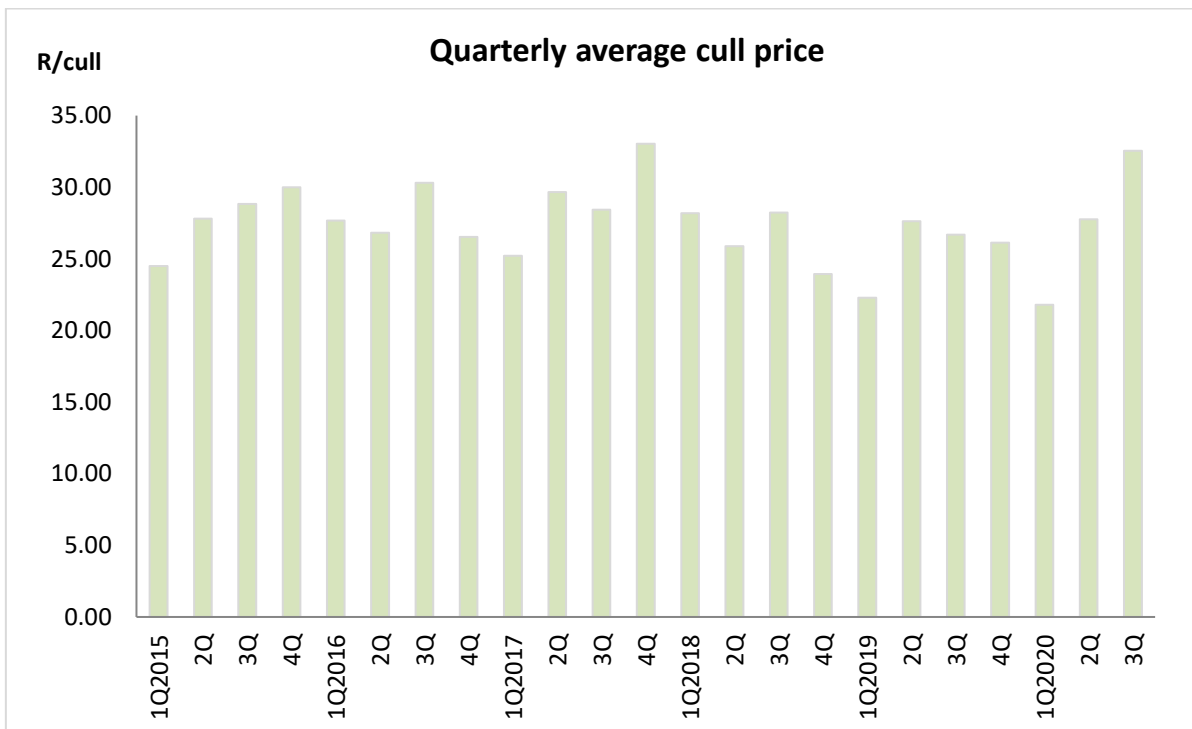


Figure 11: Average quarterly cull prices

Cull price

The average price for cull laying hens was R32.48 in September 2020, a 3.1 % increase when compared to August 2020 and an increase of 33.7 % on September 2019 prices.

The average price for cull laying hens in the 3Q 2020 was R32.55 (*Figure 11, above*). This is an increase of 17.3 % on 2Q 2020 prices (+ R4.80 per hen) and an increase of 21.9 % compared to 3Q 2019.

The average cull price for 2019 was R25.68; a decrease of 3.3 % over the average price for 2018 (R26.56). The average cull price in 1H 2020 was R24.77.

2.2 Retail prices

During September 2020, the average retail price for eggs, size large, was R31.15 per dozen and the average producer price was R14.42 (*Figure 12; note, **producer prices in this section are from Stats SA***). According to Stats SA, the mark-up between producer and retailer was 116 %, compared to 91.4 % in September 2019. The retail price increased by 15.0 % on a year-on-year basis, while the producer price increased by 7.8 %.

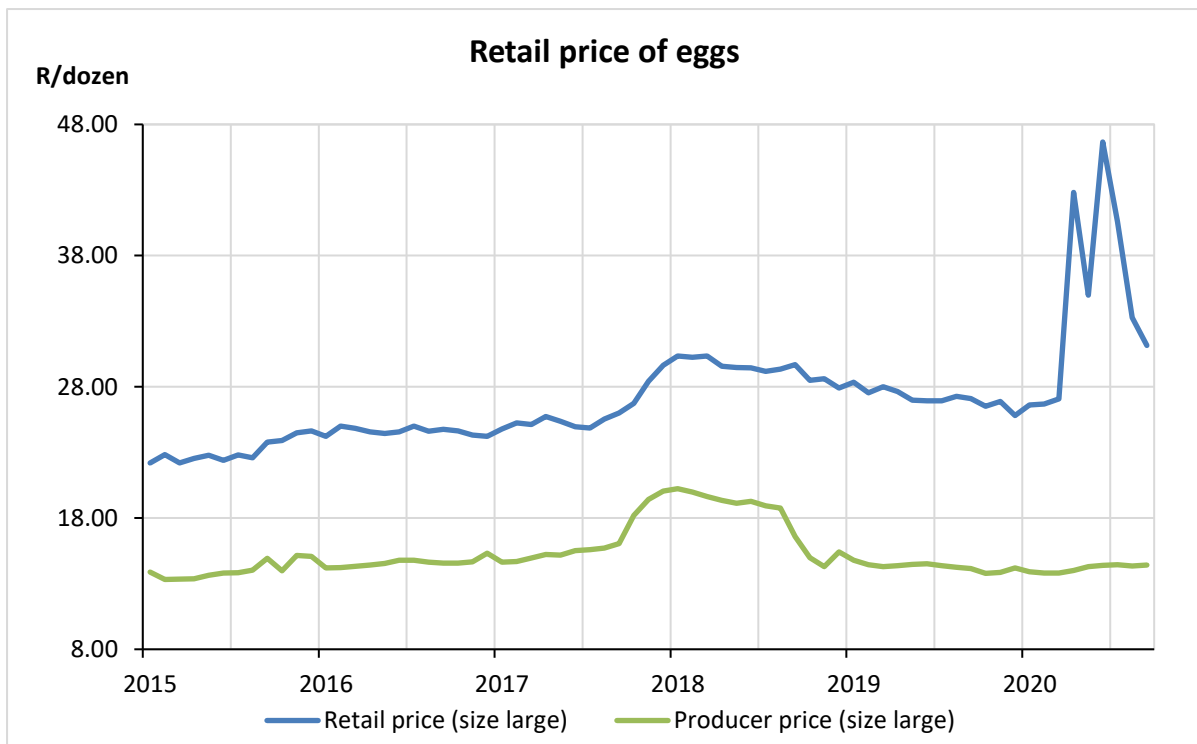


Figure 12: Production price and retail price of eggs (size: large; Stats SA)

On a quarterly basis, the average retail price for eggs, size large, was R35.01 per dozen and the average producer price was R14.41 (Stats SA). The retail mark-up on producer prices was 143 % (up from 90 % in 3Q 2019). The retail price decreased by 15.6 % on a quarterly basis, while the producer price increased by 1.2 %.

On an annual basis, the average retail price for eggs, size large, was R27.17 per dozen in 2019 and the average producer price was R14.29 (Stats SA). The retail mark-up on producer prices was 90.1 % in 2019, compared to 62.8 % in 2018. In 2019, the retail and producer price decreased by 7.6 % and 20.8 %, respectively, from 2018 prices (Source: Stats SA). In 1H 2020, the average retail price for large eggs was R34.15, compared to a producer price of R14.04.

The egg producer price index presented in *Figure 13* uses the average egg producer price at the end of 2016 as the index base (= 100). The egg producer price index (SAPA data) is compared to the SA food and non-alcoholic beverages (NAB) price index (base Dec 2016 = 100; Statistics SA). From January to December 2017, egg producer price inflation increased at a greater rate than food price inflation; accelerating further from mid-2017 when egg shortages resulted from the HPAI outbreaks in several provinces in South Africa. Through 2018 and 1Q 2019, there was an almost uninterrupted slide in the egg price inflation index, as farms repopulated, egg supplies increased, and the market was forced to absorb imports of shell eggs from Brazil. In 2018, the egg price index deflated by 17.6 % between January and November, whereas the food price index inflated by 1.6 %. In 2Q 2019, egg price inflation showed a level of recovery, closing the gap on the 2Q 2019 food inflation index. This recovery was not sustained in the 3Q and 4Q 2019: from June 2019 to November, the egg price index fell 6.5 % while the food price index climbed steadily in the same period (+ 0.6 %).

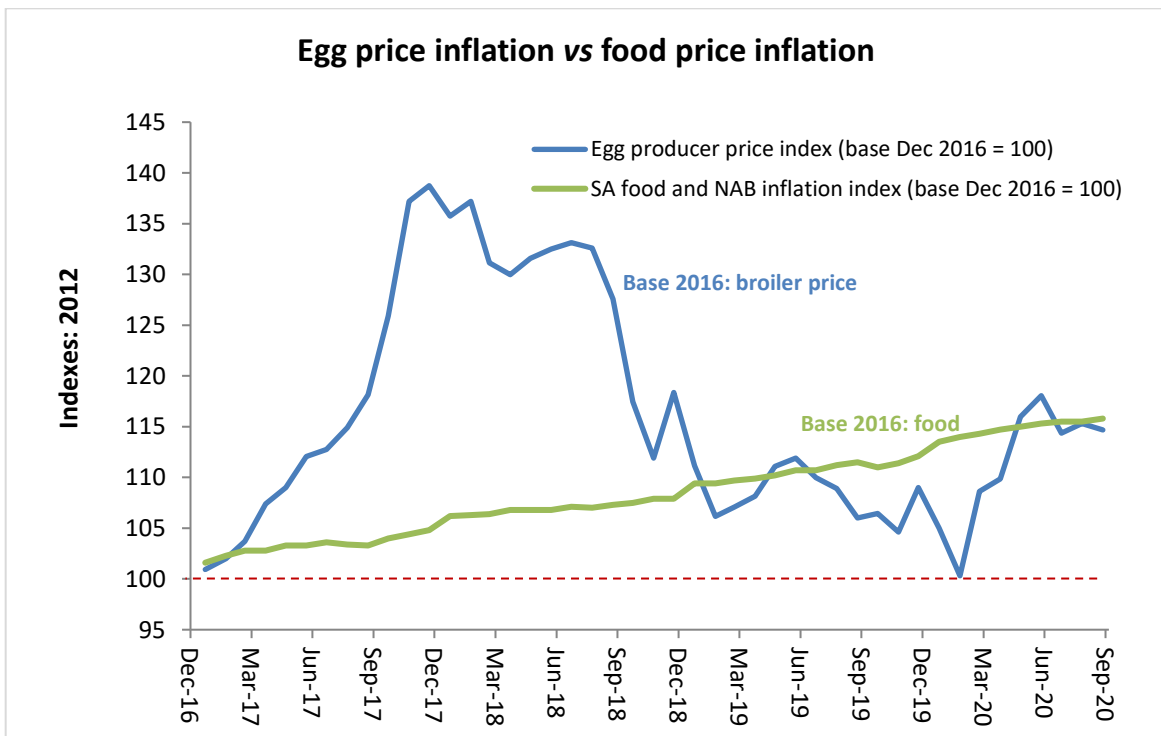


Figure 13: Production egg price index and food price inflation (base 2016 = 100)

Figure 13 shows clearly the pricing pressure producers were under from January 2018 to November 2019. Some of this pressure stemmed from a correction in prices after the HPAI events of late 2017 but, in 2H 2019, the egg price index dropped below index values seen in early 2017. This suggests a sustained period of over-supply in the industry. This downward trend in egg prices, relative to food price inflation, seemed set to continue after a brief Christmas 2019 uptick, but changes in consumer habits during COVID-19 lockdown increased demand for eggs from March and egg prices firmed dramatically through 2Q 2020. By May 2020, egg price inflation had recovered to match, and then exceed, general food price inflation. In 3Q 2020, egg price inflation has dropped back down to the same level as food price inflation.

2.3 Egg prices in comparison with chicken, beef and pork

In comparison with pork, beef and chicken: 2019 and 1H 2020

Eggs and poultry meat remain the most affordable of all protein sources described in the graph below (Figure 14). Please note that the mean egg weight used to calculate egg prices per kilogramme has been increased in SAPA models from 55 g to 58.2 g for 2014; 58.3 g for 2015; 58.5 g for 2016; 58.4 g for 2017; 60.2 g for 2018; 61.2 g for 2019, and 61.3 g for 2020 YTD.

The average egg producer price for 2019 was R19.20 per kg (R14.10 per dozen (SAPA; all sizes). The egg producer price decreased by 16.9 % compared to the 2018 price (R23.12). In 1H 2020, the egg producer price averaged R19.41 per kg (R14.26 per dozen; SAPA); up 0.26 % over 1H 2019. In September 2020, the egg producer price was R20.22 per kg (R14.92/dozen); an increase of 8.2 % on a yearly - and kilogramme – basis (Figure 15).

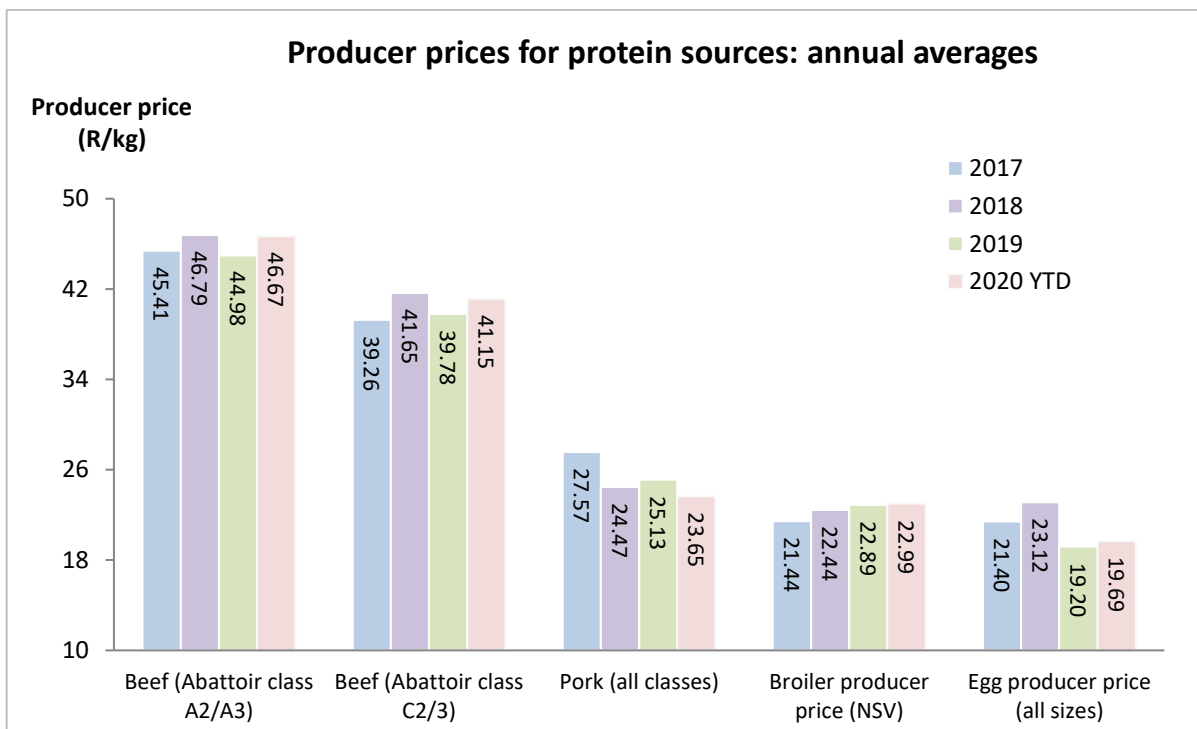


Figure 14: Comparison of annual producer prices of protein sources: 2017 to 2020 YTD

The average beef producer price at the abattoir (class A2/A3 carcass price, excluding the fifth quarter) for 2019 was R44.98 per kg (- 3.9 % on 2018). In 1H 2020, the beef price for class A2/A3 carcasses averaged R46.83 per kg; up 6.9 % on 1H 2019 prices. In September 2020, beef classes A2/A3 fetched R48.02 per kg; a year-on-year increase of 3.8 % (cf September 2019).

The average producer price of class C2/C3 beef was R39.78 in 2019 (- 4.5 % on 2018). In 1H 2020, the beef price for class C2/C3 carcasses averaged R41.34 per kg; up 3.4 % over 1H 2019 prices. In September 2020, class C2/C3 beef fetched R41.39 per kg; a year-on-year increase of 4.8 % (Source: Stats SA; SAPA).

The average pork price (all classes) was R25.13 per kg in 2019 (+2.7 % on 2018). In 1H 2020, the pork price averaged R22.87 per kg; down 4.1 % on the average pork price in 1H 2019. In September 2020, pork fetched R27.08 per kg, a year-on-year increase of 4.8 % (Stats SA).

The average producer price for broilers (total realisation) for 2019 was R22.89 per kg (+ 2.0 % over 2018). In 1H 2020, the broiler producer price averaged R22.99 per kg; up 3.0 % on the average broiler price in 1H 2019. In September 2020, the broiler producer price was R23.82 per kg; an increase of 2.6 % on a yearly basis.

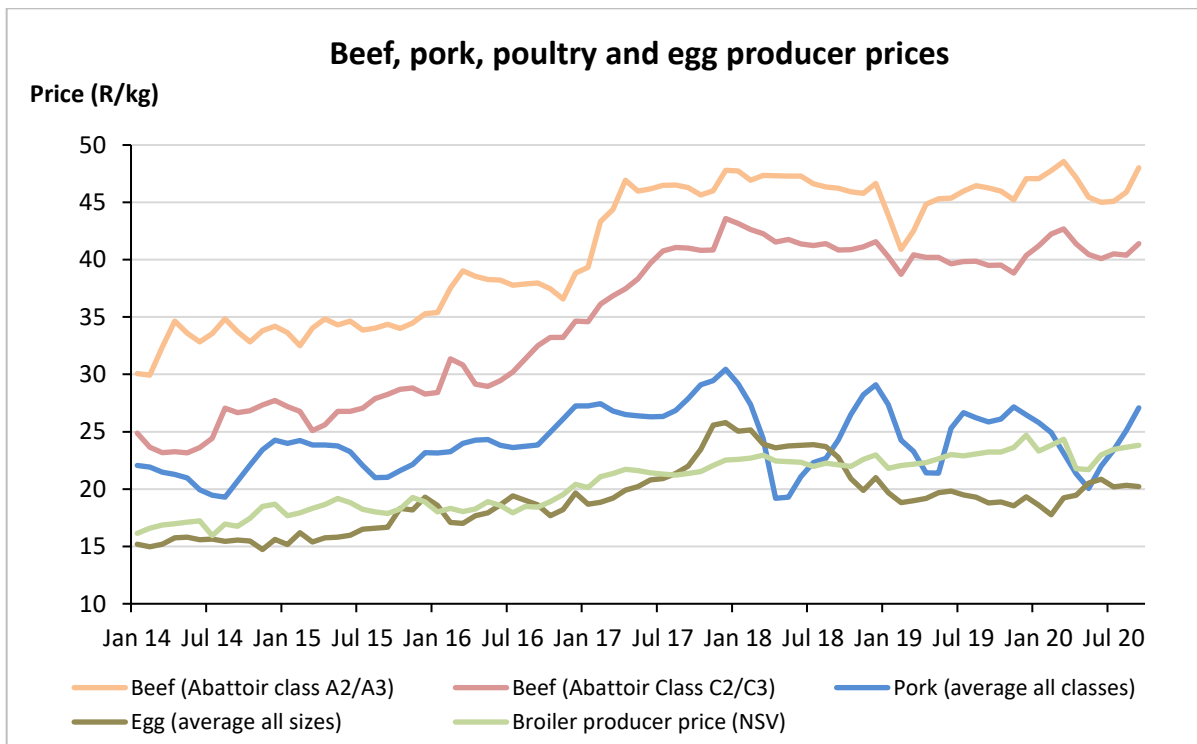


Figure 15: Monthly producer prices of protein sources

In comparison with pork, beef and chicken during the 3Q 2020

The average egg producer price for 3Q 2020 was R20.24 per kg (R14.93/dozen); a quarterly decrease of 0.2 %, but an increase of 5.5 % on a year-on-year basis (SAPA; average all sizes; kilogramme basis).

In comparison, the average beef producer price at the abattoir (carcass price excluding the fifth quarter) for 3Q 2020 was R46.34 per kg; a 1.0 % increase on a quarterly basis and a 0.2 % increase on a year-on-year basis.

The average producer price of class C2/C3 beef was R40.77 per kg for 3Q 2020; a 0.3 % increase on a quarterly basis and a 2.6 % increase on a year-on-year basis (source: SA Stats; SAPA).

The average price of pork (all classes) was R25.2 per kg in 3Q 2020; a quarterly increase of 19.3 %, but a year-on-year decrease of 4.0 %.

The average producer price for broilers (total realisation) for 3Q 2020 was R23.65 per kg; a quarterly increase of 6.8 %, and an increase of 2.5 % on a year-on-year basis (SAPA).

2.4 Feed price indicator

The weighted average feed price indicator includes distribution, excludes medication & additives and excludes VAT. Therefore, it should be treated as an indicator. The monthly average feed price indicator for September 2020 was R4 068 per tonne (*Figure 16*). It increased by 2.6 % on a monthly basis and increased by 5.9 % on a year-on-year basis.

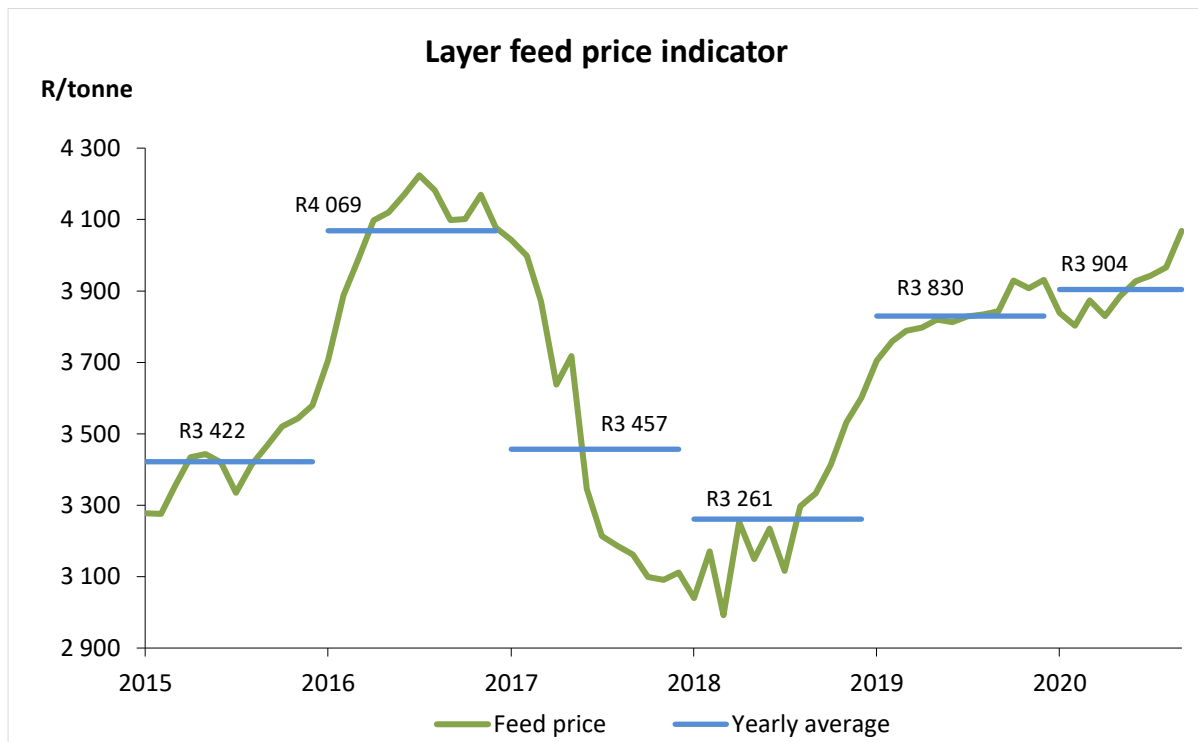


Figure 16: Monthly and yearly feed price indicator

The average layer feed price indicator for 3Q 2020 was R3 992 per tonne; an increase of 2.9 % in comparison with the previous quarter and an increase of 4.1 % in comparison with the same quarter in the previous year.

The average feed price indicator for 2019 was R3 830 per tonne (an increase of 17.4 % on the 2018 price indicator (R3 261/tonne; *Figure 16*).

3. ECONOMIC OVERVIEW

3.1 Economic data

South Africa began Q3 2020 in Level 3 lockdown, with international borders closed, inter-provincial travel severely curtailed and the alcohol ban still in place. The country's first wave of COVID 19 infections peaked in the last week of July, with 13 944 cases recorded in a single day, and over 420 000 people infected; a 180 % increase over 30 June numbers. By the end of the 3Q 2020, new cases were down to around 1 300/day but the total number of cases and deaths had ticked up to 674 339 and 16 734, respectively. The country eased down to Level 2 lockdown on 18 August and to Level 1 on 20 September. International borders have been open since 1 October 2020. By December, South Africa was grappling with a second wave, fuelled by complacent behaviour, super-spreader events (especially post-matric rave parties, and funerals) and a new, highly contagious variant of the COVID 19 virus. Average weekly cases rocketed to almost 12 000 in the last week of December, with daily peaks exceeding those experienced in July. On 28 December, the President pushed the country back into a modified Level 3 lockdown, banning alcohol sales, making mask wearing in public compulsory, and preventing indoor and outdoor gatherings. While vaccine programmes are beginning in Europe and the US, it is likely to be months still before the first doses are administered in South Africa.

In 2Q 2020, South Africa's GDP contracted dramatically in response to the Level 4 and 5 lockdowns experienced in autumn. In 3Q 2020, there was an inevitable rebound in economic figures, as lockdown was gradually eased. Stats SA reported an annualised increase in GDP of + 66 %. Stats SA have gone to great lengths to explain their reporting this quarter (<http://www.statssa.gov.za/?p=13849>) as they have been criticised for continuing to report on the basis of this misleading 'annualised GDP' during such exceptional times. Last quarter's contraction and this quarter's recovery need to be viewed in context - year-on-year and quarter-on-quarter (not annualised) GDP this quarter are closer to - 6.0 % and + 13.5 %, respectively. The Reserve Bank forecasts a reduction in GDP of 8.0 % in 2020. Agriculture grew by 18.5 % (annualised) in 3Q 2020; a third consecutive quarter of growth. All other sectors posted positive growth but from a low base, distorting performance. So, for example, GDP growth in mining and manufacturing exceeded 200 % (annualised) in 3Q 2020. In reality, only agriculture and government have weathered the pandemic when GDP for the first nine months of 2020 is compared to the same period in 2019. Sharply lower investments in both the public and private sectors will weigh on growth prospects.

At its November Monetary Policy Committee meeting, the South African Reserve Bank revised its forecast GDP growth of 3.9 % in 2021 to 3.5 %, dropping to 2.2 % in 2022. Risks to the inflation index remain balanced and well-contained in the medium term. The Reserve Bank Governor anticipates no further cuts in the repo rate in the near term and two increases of 25 basis points in 3Q and 4Q 2021. The November Monetary Policy statement ended yet again with a stern warning to Government to implement prudent macroeconomic policies

and structural reform that will lower costs, increase investment and create jobs. Wage settlements should align with projected inflation rates.

On 27 March, Moody's downgraded the country to below investment grade ("junk status") as the country began its Level 5 lockdown. Less than a week later, Fitch's credit rating agency downgraded South Africa further to BB, with a negative outlook. At the end of April, Standard and Poor reduced South Africa's long-term foreign currency rating from BB to BB-. In November, both Moody's and Fitch's pushed South Africa further into junk status, by downgrading the country's credit rating to BA2 and BB-, respectively. Both agencies left their rating outlook as 'negative'. An unreliable electricity supply, rigid labour market, challenging levels of debt and underperforming state-owned enterprises informed their decision to downgrade. Analysts fear further downgrades in February 2021 which will increase the cost of borrowing as tax revenues fall.

The rand devalued by 27.2 % to the US dollar between 1 January and 6 April, with \$1 costing R19.26; a record low for the rand. Lockdowns caused investors to flee emerging currencies and, in addition, the rand suffered through two credit rating downgrades in swift succession in March. Since then, the currency has ridden South Africa's junk status; removal from the FTSE World Government Bond Index; warnings of deep recession and catastrophic 2Q GDP figures; load shedding; and volatility in world markets linked to the US election, Brexit and COVID second waves - to finish the year 24.1 % stronger than during Level 5 lockdown. However, it remains 3.7 % below the rand value on 3 January 2020 and, year-on-year, some 5.4 % lower than the beginning of 2019. If the global roll-out of vaccines in 1Q 2021 is successful, investors will move away from currency safe havens such as the dollar, and the rand could strengthen further through 2021. In the near term, festive season lockdowns around the world are likely to weigh on the local currency through January.

The JSE All Share Index lost 35.7 % from January's highest level in response to Level 5 and 4 lockdowns but had recovered to 2.3 % below the January peak by early August. The Index then declined steadily to 30 October in reaction to second COVID 19 waves around the world, bottoming out at 12.4 % below January's peak. There has been a rebound in the Index over the last two months as investor sentiment towards riskier assets improved. The All Share Index reached a two-year high on 17 December, breaking back through the 60 000 level. South African stocks are likely to take a hit in the coming weeks as the economy battles through stricter festive season lockdown regulations.

Electricity load-shedding reached record levels in 2020 and instability in the network is set to continue into 2021 as maintenance, break downs, and environmental regulations force 10 – 20 % of generating capacity offline. Nevertheless, South Africans can expect a 15 % increase in electricity tariffs from mid-2021. January 2021 will see bidding open for the procurement of 4 800 MW of onshore wind and 2 000 MW of solar photovoltaic (PV), along with 513 MW of battery energy storage, 3 000 MW of gas or diesel power, and 1 500 MW of new coal.

Eskom has announced a shift in generation towards renewables, which could result in the decommissioning of 10 000 GW of outdated coal and gas-generated capacity and the addition, by 2030, of 30 000 GW renewable wind and solar energy generation.

At the height of global lockdowns in April, US oil prices dropped below zero for the first time ever. Brent crude prices averaged \$64 a barrel in 2019 (high \$ 75; low \$53) and will likely average \$41.43 a barrel in 2020 (EIA). The EIA expects smaller inventories to push the average price up to \$48.50/barrel in 2021. Crude prices have tracked steadily upwards through November and December, so that South African petrol and diesel prices are expected to increase by 39 c/litre and 54 c/litre, respectively, on 6 January 2021.

Parts of the country remain severely water-stressed; notably the Eastern Cape and areas of Limpopo and KwaZulu-Natal. Nationally, dam levels averaged 68 % capacity in December, up from 66 % in September and from 59 % in December 2019. The latest SAWS Seasonal Climate Watch report confirms that the El Niño-Southern Oscillation (ENSO) is in a La Niña state, which is predicted to strengthen though the summer months. This could support above-average rainfall in the summer rainfall areas of South Africa. The 2019/2020 maize crop is expected to be about 36.7 % higher than last year's crop, at 15.41 million tonnes (2019: 11.275 m tonnes). The domestic soybean harvest is also expected to be strong at 1.245 million tonnes (6.4 % higher than last year's yield of 1.17 million tonnes).

	Unemployment rate % Stats SA	Expanded unemployment % Stats SA	GDP growth (updated March 2020)						
			RSA Stats SA %	Agriculture	Mining	Manufacturing	Financials	Construction	Retail, catering, accommodation
3Q 2018	27.5	37.3	2.6	13.7	-8.9	7.5	2.1	-1.7	3.4
4Q 2018	27.1	37.0	1.4	7.9	-3.8	4.5	2.7	-0.7	-0.7
1Q 2019	27.6	38.0	-3.2	-16.8	-10.8	-8.8	1.1	-5.3	-3.6
2Q 2019	29.0	38.5	3.1	-4.9	17.4	2.1	4.1	-2.4	3.4
3Q 2019	29.1	38.5	-0.8	-4.5	-6.1	-4.4	1.6	-6.9	2.6
4Q 2019	29.1	38.7	-1.4	-7.6	1.8	-1.8	2.7	-5.9	-3.8
1Q 2020	30.1	39.7	-2.0	27.8	-21.5	-8.5	3.7	-4.7	-1.2
2Q 2020	-	-	-51.0	15.1	-73.1	-74.9	-28.9	-76.6	-67.6
3Q 2020	30.8	43.1	66.1	18.5	288.3	210.2	16.5	71.1	137.0

*annualised

Year	Annual GDP growth			
	Sub-saharan Africa y/y %	World y/y %	US y/y %	RSA y/y %
2018	2.6	3.0	3.0	0.8
2019	2.4	2.3	2.2	0.2
2020 (est)	-3.7	-4.3	-3.6	-7.8
2021 forecast	2.7	4.0	3.5	3.3
2022 forecast	3.3	3.8	3.3	1.7

<http://www.worldbank.org/en/publication/global-economic-prospects>

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	GDP growth														
	Tanzania	Botswana	Kenya	Ethiopia	Angola	Nigeria	Zambia	Zimbabwe	CDI	Namibia	Brazil	Argentina	Russia	EU CA†	China
2018	5.4	4.5	6.3	8.4	-2.0	1.9	3.5	4.8	6.8	0.7	1.8	-2.6	2.5	3.4	6.6
2019	5.8	3.0	5.4	9.0	-0.9	2.2	1.4	-8.1	6.9	-1.1	1.4	-2.1	1.3	2.3	6.1
2020 (est.)	2.5	-9.1	-1.0	6.1	-4.0	-4.1	-4.5	-10.0	1.8	-7.9	-4.5	-10.6	-4.0	-2.9	2.0
2021 forecast	5.5	5.7	6.9	0.0	0.9	1.1	1.1	2.9	5.5	2.2	3.0	4.9	2.6	3.3	7.9
2022 forecast	6.0	4.0	5.7	8.7	3.5	1.8	1.8	3.1	5.8	2.0	2.5	1.9	3.0	3.9	5.2

<http://www.worldbank.org/en/publication/global-economic-prospects>

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† Europe and central Asia

Maize harvest estimate	Crops Estimate Committee
	Million t
2015/16 Final	7.778
2016/17 Final	16.820
2017/18 Final	12.510
2018/2019 Final estimate	11.275
2019/2020 7th forecast	15.408

Eskom annual increase	%
2017/18	2.20
2018/2019	5.23
2019/2020	9.41
2020/2021 (NERSA approved; Eskom to challenge)	8.10
2021/2022 (NERSA approved; Eskom to challenge)	5.20

	Brent crude oil	FNB BER	Merchantec CEO confidence	Nielsen Consumer Confidence Index	
	\$/barrel statista.com	Consumer CI		RSA	Global
3Q 2018	75.22	7	51.0	90	106
4Q 2018	67.71	7	49.0	88	107
1Q 2019	63.17	2	43.3	90	106
2Q 2019	68.92	5	45.7	93	107
3Q 2019	61.93	-7	45.9	88	107
4Q 2019	61.92	-7	39.9	87	107
1Q 2020	50.44	-9	unavailable	88	106
2Q 2020	29.34	-33	unavailable	68	92
3Q 2020	42.96	-23	unavailable	unavailable	unavailable

EIA 2021 forecast: \$48.50

Long-term avg: +2

Neutral: 50

Neutral:100

Neutral:100

Credit rating: South Africa (foreign currency)										
	2016	Apr 2017	Jun 2017	Nov 2017	Mar - Dec 2018	Mar - Jul 2019	Nov 19	Mar 2020	Apr 2020	Nov 2020
Moody's	BAA2 negative	BAA2 under review	↓BAA3 negative	BAA 3 under review	BAA 3 stable	BAA 3 under review	BAA 3 negative	BA 1 negative	BA 1 negative	BA 2 negative
Standard & Poor's	BBB- negative	↓BB+ negative	BB+ negative	BB stable	BB stable	BB stable	BB negative	BB negative	BB- stable	BB- stable
Fitch	BBB- negative	↓BB+ stable	BB+ stable	BB+ stable	BB+ stable	BB+ stable	BB+ negative	BB+ negative	BB negative	BB - negative

www.countryeconomy.com/ratings/south-africa

	Investment grade
	Below investment grade

Month	Year	Exchange rate	Inflation	Food inflation	Repurchase rate	Fuel price (Reef)		SACCI Business CI
		ZAR:USD	%	%	%	Petrol	Diesel	
		x-rates.com	Stats SA/SARB	all urban Stats SA	MPC SARB	95 Automobile Association	500 ppm	
Jan	2019	13.87	4.0	3.0	6.75	14.01	13.16	95.1
Feb	2019	13.78	4.1	2.9		14.08	13.14	93.4
Mar	2019	14.38	4.5	3.1	6.75	14.82	14.05	91.8
Apr	2019	14.15	4.4	2.9		16.13	14.87	93.7
May	2019	14.40	4.5	3.2	6.75	16.67	14.88	93.0
June	2019	14.58	4.5	3.7		16.76	15.21	93.3
July	2019	14.06	4.0	3.4	6.50	15.81	14.46	92.0
August	2019	15.15	4.3	3.9		15.92	14.33	89.1
September	2019	14.87	4.1	3.9	6.50	16.03	14.59	92.4
October	2019	14.89	3.7	3.6		16.21	14.84	91.7
November	2019	14.81	3.6	3.5	6.50	16.08	14.68	92.7
December	2019	14.41	4.0	3.9		16.30	14.53	93.1
January	2020	14.37	4.5	3.7	6.25	16.16	14.62	92.2
February	2020	15.03	4.6	4.2		16.03	14.57	92.7
March	2020	16.63	4.1	4.2	5.25	15.84	14.03	89.9
April	2020	18.59	3.0	4.4	4.25	13.96	12.69	77.8
May	2020	18.19	2.1	4.4	3.75	12.22	11.08	70.1
June	2020	17.13	2.2	4.2		13.40	11.30	81.4
July	2020	16.78	3.2	4.3	3.50	15.12	13.03	82.8
August	2020	17.22	3.1	3.9		15.17	13.48	85.8
September	2020	16.73	3.0	3.9	3.50	15.18	13.27	85.7
October	2020	16.46	3.3	5.4		14.86	12.37	92.0
November	2020	15.55	3.2	5.8	3.50	14.59	12.25	93.4
	2018	13.21	4.6	3.6				
	2019	14.45	4.1	3.4				
	2020 forecast		3.2					
	2021 forecast		3.9					

Month	Year	Historic SAFEX prices			Global food price index (FAO)		
		WM R/t	YM R/t	Soyabean R/t	Food	Meat	Cereals
		http://www.sagis.org.za/safex_historic.html			http://www.fao.org/worldfoodsituation/foodpricesindex/en/		
Jan	2019	3 023	2 767	5 060	93.2	92.3	101.5
Feb	2019	2 886	2 710	4 997	94.0	93.1	100.6
Mar	2019	3 055	2 778	4 982	93.1	94.6	97.4
Apr	2019	2 781	2 661	4 978	93.6	97.8	94.5
May	2019	2 794	2 715	4 919	94.2	100.5	94.1
June	2019	2 953	2 894	5 461	95.3	101.2	98.7
July	2019	2 942	2 887	5 404	95.1	102.4	97.3
August	2019	2 887	2 780	5 647	94.0	102.3	92.3
September	2019	2 746	2 633	5 682	93.3	101.0	91.6
October	2019	2 833	2 751	5 856	95.2	101.6	95.7
November	2019	2 760	2 697	5 989	98.6	106.5	95.4
December	2019	2 664	2 618	5 998	101.0	106.6	97.2
January	2020	2 592	2 589	5 978	102.5	103.8	100.5
February	2020	2 484	2 539	5 888	99.4	100.6	99.4
March	2020	2 550	2 657	6 422	95.1	99.5	97.7
April	2020	2 698	2 788	6 932	92.4	96.9	99.3
May	2020	2 554	2 665	6 504	91.0	95.4	97.5
June	2020	2 580	2 665	6 590	93.1	94.8	96.7
July	2020	2 669	2 741	6 790	94.0	92.2	96.9
August	2020	2 909	2 928	7 130	95.8	92.2	99.0
September	2020	3 052	3 039	7 438	97.9	91.5	104.0
October	2020	3 201	3 188	7 594	101.0	91.1	111.6

2014 - 2016 base year; rebased

Dam levels	Dec 2019	Dec 2020
Western Cape	59	75
North West	63	64
Gauteng	101	97
Mpumalanga	72	67
Limpopo	58	57
KZN	54	56
Eastern Cape	47	51
Free State	66	75
Northern Cape	72	89

www.dwa.gov.za/hydrology/weekly/sumprovince.aspx

The data in the tables above are available in an associated Excel spreadsheet.

3.2 In the news

The links in this section are available in an associated Word document, with **hyperlinks** enabled, making the internet pages easy to access.

Avian influenza: European winter

Culls of commercial poultry are happening all over Europe in response to a new season of avian influenza outbreaks. Between 15 August 2020 and 7 December, there were 561 reported outbreaks in 15 European countries, and numbers are building. Hungary have reported 269 cases of HPAI on commercial farms from March 2020, under three reported events. These events were declared closed on 30 July 2020. Two variants of HPAI were circulating in Hungary: H5N8 and H5N2; one of which is a new reassortment. In a report to the OIE, dated 2 January 2020, Poland reported three HPAI events to the OIE in 1H 2020; all of which were declared resolved by 14 May 2020. Having declared the country HPAI-free in September, Poland has reported two further outbreaks of H5N8 in 4Q 2020; one on a laying farm in western Poland (25 November) and one on a turkey farm in east-central Poland (early December).

In early 2020, the Germans reported H5N8 HPAI in four separate events to the OIE. All of these events had been declared resolved and closed by 2 July 2020. Between 7 and 18 December 2020, the Germans reported H5N5 HPAI in one facility and H5N8 HPAI in eleven poultry facilities. In addition, there were almost 400 cases in wild birds in Germany in this period.

In November 2020, Denmark culled approximately 25 000 commercial layers in response to an outbreak of H5N8 HPAI. Poultry farmers and backyard poultry keepers have been instructed to house birds indoors through the winter months. Between 7 and 18 December 2020, Denmark reported 75 cases of HPAI in wild birds. On 9 December, H5N8 HPAI was reported in captive birds (all culled) and, on 1 January 2021, an additional outbreak was confirmed in farmed game birds in Jutland.

In November 2020, Belgian farmers experienced the first outbreak of H5N5 HPAI in a commercial farm in almost three years (Western Flanders) and there have been over a dozen cases of HPAI in wild birds. The Netherlands have been amongst the worst hit of the EU countries, with over 50 cases of HPAI reported in wild birds and 9 cases on poultry farms. The affected farms include broiler breeders, broilers, laying hens and ducks, in the provinces of Friesland, South Holland, Utrecht, Gelderland and Groningen. Over 190 000 birds have already been culled in commercial flocks.

In November 2020, France reported two cases of HPAI in birds being sold at a garden centre and a pet shop. Since then, French farmers have culled hundreds of thousands of birds (mostly ducks) in a growing HPAI event. In 2021 alone, there have been 61 cases, with 48 of these in south-eastern Landes where pâté de fois gras is produced.

To the end of 2020, the UK reported 14 outbreaks of HPAI in commercial or backyard poultry flocks. Outbreaks have been recorded in Cheshire, Herefordshire, Gloucestershire, Norfolk, Leicestershire, North Yorkshire, Worcestershire, Derbyshire and Dorset – and Orkney in Scotland. Affected birds include rearing turkeys, ducks, free range flocks and various captive birds. Most of the cases in the UK are H5N8 but there has been one report of H5N1 HPAI in Norfolk. There have been 241 cases in wild birds in England, Wales and Scotland to 20 December 2020.

Irish farmers have been on high alert since November, as cases of HPAI have been reported in wild birds in counties Cork, Limerick, Monaghan and Mayo. In December, five cases were found in a flock of free-range turkeys in County Wicklow (H5N8 HPAI). China moved swiftly to ban imports from Ireland, effective 25 December 2020.

<https://www.wur.nl/en/Research-Results/Research-Institutes/Biovetinary-Research/show-bvr/Bird-flu-at-poultry-farms.htm>

<https://www.ecdc.europa.eu/en/publications-data/avian-influenza-overview-august-december-2020>

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/947487/hpai-europe-update10-201221.pdf

In April 2020, the US reported H7N3 HPAI in a commercial turkey farm in Chesterfield County, South Carolina; start date 6 April. The farm had links with other premises which had been infected with H7N3 low pathogenic AI. This single-outbreak event was declared closed in a report to the OIE dated 5 August 2020.

There were eleven reported outbreaks of H5N8 in South African commercial ostriches in 2019. South Africa's latest report to the OIE (14 December 2020) only details three outbreaks in 2020 YTD - in commercial ostriches in the Oudtshoorn district of the Western Cape (14 January 2020); the Blue Crane Municipality of the Eastern Cape (28 April 2020); and the Fraserburg Municipality of the Northern Cape (4 June 2020).

Quantum Foods: earnings down

In a story that will be all too familiar to egg producers across South Africa, Quantum Foods announced headline earnings were down 13 % in the year to 30 September. Despite a 15 % increase in sales, a 2.4 % drop in the egg price and escalating feed costs (linked to the weak rand) have squeezed margins. A lockdown baking frenzy helped South African egg producers survive harsh trading conditions, but will increased per capita consumption be maintained through 2021?

<https://www.iol.co.za/business-report/companies/quantum-foods-earnings-are-down-by-13-cd65f77c-515d-46af-be3f-3e48c927a2a2>

<https://retailbriefafrica.co.za/lockdown-baking-frenzy-pushed-out-trouble-for-sas-egg-industry-to-2021/>

SAPA to partner with APP to create opportunities for black farmers

SAPA and the recently formed AFASA Poultry Producers (APP) have committed to working together to create more opportunities for the development and expansion of chicken production by the country's black farmers.

https://www.webreach10-0.co.za/Retail/FMCG/FMCG_Retailer_6_2020/#p=8

<https://www.foodformzansi.co.za/new-body-to-stand-up-for-black-poultry-farmers/>

<https://www.scribd.com/article/469067765/Industry-Bodies-Unite-To-Promote-Smallholder-Chicken-Farmers>

Cage-free egg production: gaining traction in the US

The entire west coast of the US now has legislation in place to improve the welfare of laying hens. In addition, Compassion in World Farming's 'EggTrack' reports that, despite COVID 19 lockdowns, good progress has been made towards the cage-free commitments made by global, US and European companies over the past four years. Of the 210 companies surveyed in 2020, 63 % made progress in transitioning to cage-free egg supply. Only a handful of companies have withdrawn their pledges.

In the US, retail giant Costco has committed to transition to 100 % cage-free production across its global operations. This expanded commitment includes the building of a new 50 000-hen cage-free facility near Shanghai, to supply mainland China.

US egg producer, Calmaine, continues to invest heavily in cage-free production to meet corporate demand for higher welfare standards. Their most recent investment is in a \$40 million facility in Kentucky.

<https://www.bloomberg.com/news/articles/2020-10-29/egg-tracker-finds-companies-going-cage-free-despite-pandemic>

<https://www.eggtrack.com/>

<https://www.thepoultrysite.com/news/2020/12/costco-making-transition-to-cage-free-egg-policy>

https://www.just-food.com/news/cal-maine-foods-expands-cage-free-eggs-capacity-in-kentucky_id144915.aspx

Using offsets to spur changes in production methods: cage-free eggs in Asia

UK retail giant, Tesco, has committed to source all eggs sold in its Asian outlets from cage-free supply systems by 2028. The long transition period reflects the difficulties food service businesses face in sourcing cage-free product in markets where caged production

still dominates. Egg producers are often wary of changing their production systems, when demand is uncertain, and costs to do so are high. There may be a way to speed up this transition process. Global Food Partners, a multinational sustainability/welfare consultancy, have partnered with other sustainability organisations to form Impact Alliance in Asia. Impact Alliance will trade cage-free credits, to provide a temporary middle ground between the binary choice of caged or cage-free egg supply. Food service businesses will be able to purchase cage-free credits while still purchasing product from traditional caged suppliers. The money raised will be used to support the development of more cage-free facilities, underpinning a steady transition to cage-free production. Cage-free producers supported in this way will be subsidised initially, to sell their product without premiums, and market dynamics will move production steadily towards cage-free. Similar systems exist to encourage sustainable palm oil and soybean production. The cage-free scheme is expected to kick off in Singapore, Indonesia, Malaysia, Thailand, China, Philippines, Japan and South Korea.

<https://www.hsi.org/news-media/tesco-first-southeast-asia-cage-free-eggs/>

<https://www.eco-business.com/news/can-offsets-help-resolve-a-chicken-and-egg-problem-with-cage-free-eggs/>

<https://www.foodlogistics.com/sustainability/press-release/21201562/global-food-partners-global-food-partners-impact-alliance-create-cagefree-eggs-credit-system>

<https://globalfoodpartners.com/publications/making-impact-happen-accelerating-cage-free-egg-production-in-asia>

WATT Global Media introduces 'Egg Industry Insight'

WATT Global Media will offer a weekly emailed publication to egg producers and processors from January 2021. 'Egg Industry Insight' will report on developments in layer and pullet nutrition; health and management; egg and egg product marketing; and processing. For those not yet subscribers to WATT's offerings, registration to receive this weekly briefing is free. Their monthly 'Egg Industry' magazine is also available for free online (see below)

<https://www.wattagnet.com/blogs/50-the-chicken-and-the-egg/post/41887-egg-industry-insight-to-provide-more-egg-content-in-2021>

https://www.eggindustry-digital.com/eggindustry/november_december_2020/

Upcycling eggshell waste

Ever wondered what happens to eggshell waste from hatcheries and egg processing plants? Perhaps not as much as should or could be happening. It seems there is value to be derived from the shell and its membrane. Eggshell membranes contain hyaluronic acid and collagen, which are of considerable value to the cosmetics, pharmaceutical and nutritional supplements industries, and in plastic surgery. In another application, a UK mayonnaise and

egg snack producer has partnered with industrial chemists to channel the calcium carbonate waste eggshells into a filler for plastics. The reviews below make for interesting reading.

<https://www.theguardian.com/sustainable-business/2016/jun/30/scotch-egg-company-cracked-eggshell-waste-problem-recycling-plastic>

<https://www.agriculturejournals.cz/publicFiles/253128.pdf>

<https://cordis.europa.eu/article/id/93064-a-little-extra-value-from-eggshells>

<https://cordis.europa.eu/project/id/286910/reporting/fr>

Egg shell membranes: arthritis

One of the applications for upcycled eggshell membranes is in the relief of arthritic joint pain. The value of the eggshell membrane nutraceutical industry is expected to reach almost \$170 million by 2025.

https://www.nutraceuticalbusinessreview.com/news/article_page/Study_shows_natural_eggshell_membrane_relieves_joint_pain/170096

<https://www.nutraingredients.com/Article/2018/11/08/Biova-secures-first-of-a-kind-EU-approval-for-eggshell-membrane>

<https://www.foodnavigator.com/Article/2019/07/19/Eggshell-membrane-a-high-potential-ingredient-for-healthy-boost>

<http://www.digitaljournal.com/pr/4935823>

American Egg Board: Innovation Centre

The American Egg Board have included an Egg Innovation Centre in their 5-year strategic plan, aimed at encouraging egg consumption and driving the egg industry forwards. The centre will test ideas for products, packaging, production techniques and menu items on behalf of the entire egg industry.

<https://www.wattagnet.com/articles/41588-aeb-announces-egg-innovation-center-as-part-of-its-5-year-plan?v=preview>

Forced housing in avian influenza response: UK

With UK producers forced to keep birds inside through the UK winter, as HPAI cases escalate across Europe, farmers are looking for ways to keep birds entertained and stress-free. One Leicestershire producer has added cheap soccer balls into the mix. Surprisingly, there may be some scientific basis to this attempt to relieve boredom.

<https://www.bbc.com/news/uk-england-leicestershire-55315242>

<https://www.frontiersin.org/articles/10.3389/fvets.2020.00480/full>

Crackd, plant-based egg replacer, launches in UK

Crackd, the 'no egg egg', was launched in the UK in December 2020 but, as the review below shows, the product fares better as an emulsifier and binder in baked products than it does in vegan scrambled 'egg' or omelettes. A real egg can contribute 22 separate functions to cookery – it will be some time before plant-based alternatives come close to delivering the whole package.

<https://thespoon.tech/crackd-to-launch-its-plant-based-egg-in-the-u-k/>

<https://theveganreview.com/crackd-vegan-egg-review/>

<http://america.aljazeera.com/watch/shows/techknow/articles/2014/4/3/the-chicken-egg-served22differentways.html>

The power of eggs

As part of the war against COVID 19, researchers at Stanford University are trialling SARS-CoV-2 antibodies cultured in chicken eggs and delivered as a nasal spray. Clinical trials are underway in Australia. The spray would offer short-term protection against COVID 19 infection, in high-risk environments.

<https://www.sciencemag.org/news/2020/11/can-nose-full-chicken-antibodies-ward-coronavirus-infections>

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