



UDC 636.



DOI <https://doi.org/10.15673>

Alltech, <https://www.alltech.com/>

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GLOBAL FEED PRODUCTION REMAINS STEADY IN 2022



Pet feed shows most significant growth while reduction in beef feed production begins to moderate

An assessment of compound feed production and prices was conducted using information gathered by Alltech's global sales team in partnership with local feed associations.

The Alltech Agri-Food Outlook also offers a holistic view of the state of the industry, using responses from our corresponding qualitative survey to identify trends and technologies impacting the agri-food industry, highlight growth opportunities and assess expectations for 2023.

The Alltech Agri-Food Outlook estimates global forage tonnage at 1.266 billion metric tons (BMT) in

2022, down less than half a percent from 2021. The study includes data from 142 countries and more than 28,000 feed mills.

Globally, increases in feed tonnage were reported in the aquaculture, broiler, layer and pet food sectors, while decreases were reported in the beef, dairy and pig sectors.

Although it experienced a narrow reduction in feed production, China remains the largest feed-producing country in the world, followed by the United States and Brazil.

Consumer trends making the biggest impact on agri-food



Product prices/
the economy*



Food security



Dietary
trends

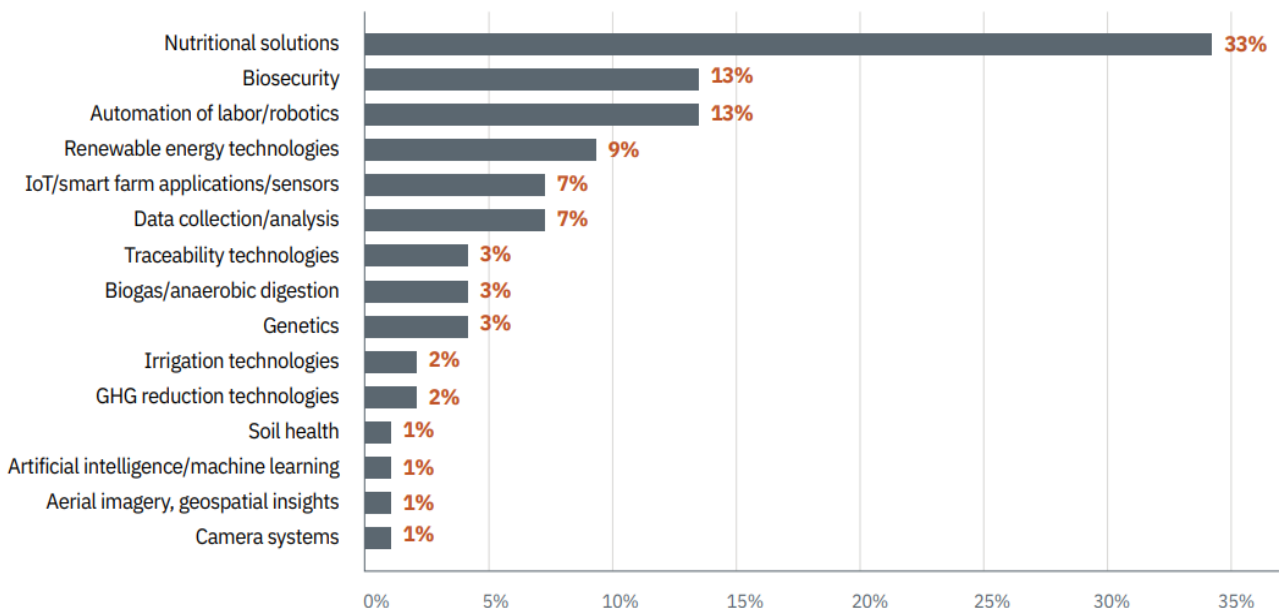


Animal welfare

* 72% of Agri-Food Outlook respondents said product prices/the economy is the consumer trend that is making the biggest impact on the agri-food industry

Technologies making the biggest impact

Survey respondents said these technologies are providing exciting opportunities for growth





The role of technology

A variety of technologies are providing growth opportunities for the agri-food industry, survey respondents said. Among the technologies making the biggest impact are nutritional solutions, biosecurity and the automation of labor/robotics. Of nutritional solutions, respondents noted enzymes (32%), technologies impacting rumen function (14%) and the management of mycotoxins (14%) as being the most significant to their market. The use of enzymes to improve the digestibility of nutrients, decrease the cost of production and reduce the environmental impact of agriculture are having a significant positive impact, said

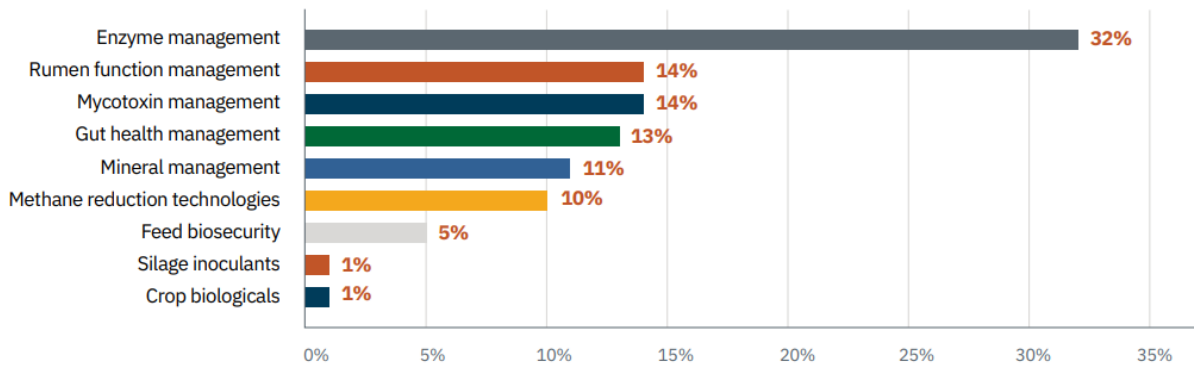
one respondent from Spain. Innovative technologies that increase efficiency and improve sustainability were cited by many participants as being highly promising and important. "The biggest opportunities for growth are sustainable solutions for production costs, research and development for more durable and productive agricultural products [to mitigate] climate change, and new agricultural production technologies," said a respondent from Turkey.

Becoming more efficient with new-to-market technologies will improve profitability and help mitigate environmental impacts, a Canadian representative said.

FEED, QUALITY, TECHNOLOGY AND ANIMAL FEED

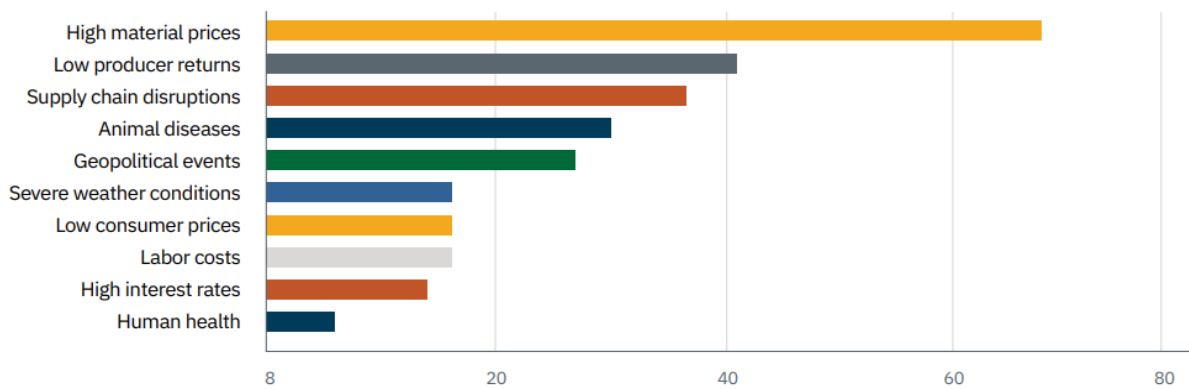
Top nutritional opportunities

Survey respondents said these nutritional solutions are most pertinent to feed production in their region



Top challenges to feed production*

Survey respondents identified the biggest ag-related challenges in their country

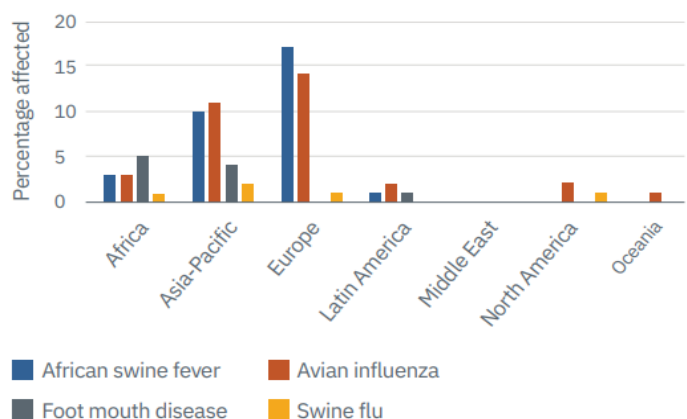


*Multiple choice question: Numbers indicate number of times the option was selected.

Biggest challenges

Inflation and the overall state of the economy — particularly the increased prices of raw materials, feed and food — have been the biggest challenges affecting the agri-food sector in 2022, respondents said. The state of the economy will remain one of the biggest factors influencing the success of the industry, said a participant from South Africa. Changes in consumer habits such as point of purchase and dietary trends are also making an impact. "Due to the (COVID-19) epidemic, consumers' behavior has changed significantly and continuously, and they have taken a more proactive approach to health," said a survey respondent from

Diseases that impacted feed demand in 2022





China. Supply chain disruptions remain an obstacle for the agrifood industry across all regions. Many regions reported that geopolitical tensions — particularly the invasion of Ukraine — have affected imports and exports, the supply chain and raw materials prices. “The war in Ukraine has had a significant impact on raw material supplies across the region,” said a survey participant from Belgium. The direct impact of the war was reported in Moldova and in Ukraine, where feed production fell by over 35%. The invasion of Ukraine also indirectly affected feed production throughout the rest of the world.

Disease disruptions

Animal diseases have disrupted feed production in more than 80% of countries. Avian influenza affected all regions’ feed production in 2022. In Africa, this disease manifested most significantly in Egypt, Morocco and South Africa. In Asia, nearly all countries were affected. In Europe, the affected countries included Belgium, Bosnia and Herzegovina, Bulgaria, France, Ireland, Moldova, the Netherlands, Poland, Russia, Serbia, Turkey, the U.K. and Ukraine. In Europe, African swine fever (ASF) has most significantly affected Ireland and countries in the East. In the Americas, the Dominican Republic was affected most significantly. In Asia, ASF has played a significant role in China, Indonesia, Malaysia, Myanmar, Nepal, the Philippines, Singapore, South Korea, Thailand and Vietnam. In Africa, Kenya, Mozambique and Namibia were affected. Foot and mouth disease (FMD) was an issue in Africa, particularly in Egypt, Mozambique, Namibia and South Africa. In Asia, Indonesia, Mongolia, South Korea and Thailand were affected. Finally, in the Americas, FMD was an issue in Bolivia. Swine flu was an issue in Namibia, China, Myanmar, Belgium and the U.S. Overall, Latin America and the Middle East did not report many instances of disruption due to animal diseases.

Sustainability insights

Efforts to improve environmental sustainability are impacting the feed/animal agriculture sector in most regions, survey respondents said. The majority of respondents said sustainability efforts are being driven by the government (50% of respondents), food producers and processors (47.27%), consumers (44.74%) and retailers/ food service companies (39.47%). The top sustainability measures being implemented include reducing antibiotic usage and antimicrobial resistance (AMR), improving animal welfare, producing food more efficiently, reducing water pollution, creating renewable energy, reducing greenhouse gas emissions, and enhancing nutritional value and food security. Survey respondents said that some of the biggest agrerelated opportunities are new technologies like smart-farm applications, increasing efficiency, incorporating more nutritional solutions and continuing to make efforts to become more sustainable.

AGRI-FOOD OBSERVATIONS

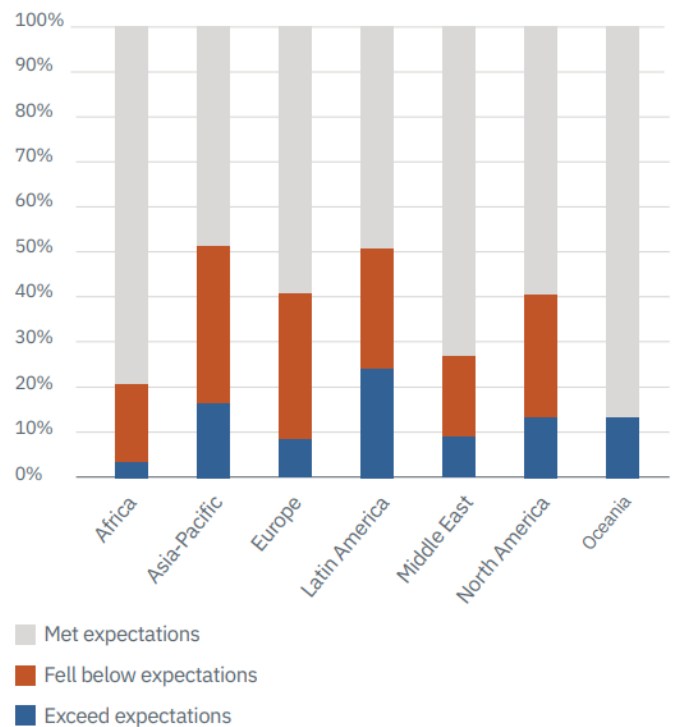
Animal diseases have disrupted feed production in more than **80%** of reporting countries.

Feed tonnage by region

Based on data collected in November 2022, Alltech estimates that the total global feed tonnage in 2022 decreased slightly — by 5.381 million metric tons (MT), or 0.42% — to approximately 1.266 billion MT. The survey showed a 3.86% decrease in feed tonnage in Africa, mainly because of reductions reported in Egypt, Morocco, Kenya and Nigeria. South Africa, on the other hand, saw an increase of more than 2%, and Namibia also reported higher feed tonnage in 2022. The Asia-Pacific region was flat. Reductions in China, Pakistan, Thailand and Malaysia were offset by increases reported by Vietnam, the Philippines, Mongolia and South Korea. Despite the challenges faced there, Vietnam has been a growth market for feed in Asia. The biggest retreat in feed tonnage was seen in Europe, where it was down nearly 5%, or over 12 million metric tons (MMT). Some of the primary factors for this decreased production include the invasion in Ukraine and the spread of animal diseases, such as ASF and avian influenza. Among the big four regions, Latin America came out on top this year as the winner in terms of growth in feed tonnage, with an increase of over 3 MMT. Most of this growth was reported by Mexico, Brazil and Chile.

2022 expectations

59% of Alltech Agri-Food Outlook respondents said feed production in their region met their expectations



According to the materials of the Alltech company



| Region | Sum of 2021 total feed production (MMT*) | Sum of 2022 total feed production (MMT) | Growth (MMT) | Growth (%) |
|--------------------|--|---|----------------|---------------|
| Africa | 44.506 | 42.788 | -1.718 | -3.86% |
| Asia-Pacific | 467.922 | 465.540 | -2.382 | -0.51% |
| Europe | 276.114 | 263.232 | -12.882 | -4.67% |
| Latin America | 187.904 | 190.910 | 3.006 | 1.6% |
| Middle East | 25.484 | 31.785 | 6.301 | 24.73% |
| North America | 259.367 | 261.639 | 2.272 | 0.88% |
| Oceania | 10.433 | 10.466 | 0.033 | 0.32% |
| Grand Total | 1,271.731 | 1,266.350 | (5.381) | -0.42% |

*Million metric tons

**Latin America includes all Central American countries, including Mexico

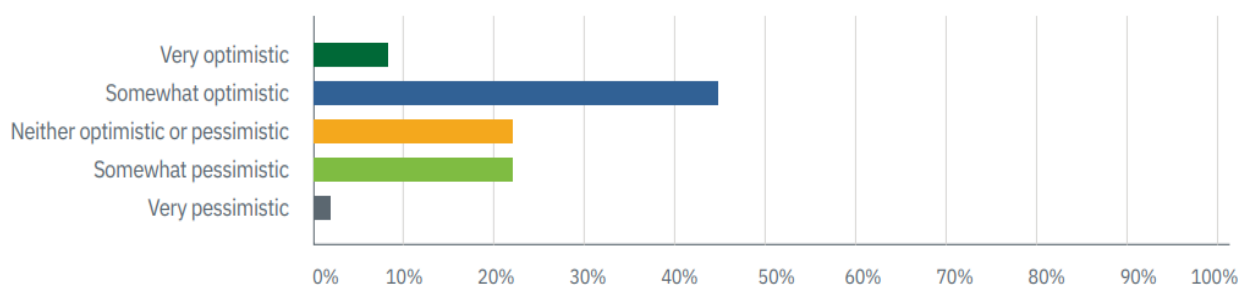
***North America includes Canada and the U.S.

The Middle East region is also up significantly, as a result of more accurate reporting and efforts by the Saudi Arabian government to increase broiler production as part of its Vision 2030 plan. North America (the U.S. and Canada) reported an increase of more than 2.4 MMT (all in the U.S.). Growth was reported in the broiler, beef and pet food sectors. The region of Oceania was flat, with a small reduction reported by Australia

that was offset by a slight increase reported by New Zealand. The majority of respondents, 59%, said that feed production in their country met their expectations in 2022. Feed tonnage fell below expectations for 28% of survey respondents and exceeded expectations for 13%. Looking ahead, over half of respondents (52.5%) said they are optimistic that feed production in their country will grow in 2023.

Outlook for 2023

Over half of respondents said they are optimistic that feed production will grow in 2023



Feed production estimates by sector

Globally, feed tonnage increased in the broiler, layer, aquaculture and pet food sectors. Volume growth in feed tonnage came predominantly from the broiler feed sector.

Percentage wise, the biggest growth was in pet food. The pig, dairy and beef sector experienced decreased feed tonnage.

| Sector | 2021 feed tonnage (MMT*) | 2022 feed tonnage (MMT) | Growth (MMT) | Growth % |
|----------------------|--------------------------|-------------------------|----------------|---------------|
| Broiler | 359.387 | 363.960 | 4.573 | 1.27% |
| Pig | 329.185 | 319.383 | (9.802) | -2.98% |
| Layer | 161.356 | 161.849 | 0.493 | 0.31% |
| Dairy | 135.616 | 133.823 | (1.793) | -1.32% |
| Beef | 118.441 | 118.042 | (0.399) | -0.34% |
| Aqua | 51.510 | 52.914 | 1.403 | 2.72% |
| Pets | 32.884 | 35.270 | 2.430 | 7.25% |
| Equine | 8.091 | 8.159 | 0.068 | 0.83% |
| Grand Totals* | 1,271.731 | 1,266.350 | (5.381) | -0.42% |

*Million metric tons

**Grand total includes listed species as well as calf, other ruminants, turkeys, other poultry and other species.

*According to the materials of the Alltech company, 2022



A closer look at the top 3 countries

China



- Overall feed production dropped by nearly 3%
- Pig feed dropped by 5%
- Broiler feed production was down 3%
- Layer feed production decreased by 3%
- **On the upside:** China reported a 10% (2 MMT) increase in feed tonnage for aquaculture
- **Tech:** Artificial intelligence/machine learning is making the biggest impact on agriculture, according to the survey
- **Consumer trends:** Changes in eating habits for environmental and health reasons are the biggest consumer trend affecting agriculture in China, the survey found
- **Challenges:** High ingredient prices, low producer returns, supply chain disruptions, animal diseases, geopolitical events
- **Outlook:** Somewhat pessimistic that feed production will grow in 2023



- Beef feed grew by nearly 1%, and equine was up 0.67%
- **Tech:** Biosecurity measures are making the biggest impact on agriculture
- **Consumer trends:** Product prices/the economy are the number-one consumer trend affecting the industry
- **Challenges:** High material prices, low producer returns, supply chain disruptions
- **Outlook:** Somewhat optimistic that feed production will grow in 2023



Brazil



- Overall feed production was up 0.87%
- Dairy feed tonnage was down 3%
- Beef feed tonnage was up 3%
- Layer tonnage decreased 4%
- Broiler feed tonnage increased 1%
- **Tech:** Data collection and analysis is the technology making the most impact on agriculture.
- **Consumer trends:** Product prices/economy was the biggest consumer trend affecting the industry.
- **Challenges:** Supply chain disruptions, severe weather conditions, geopolitical events
- **Outlook:** Somewhat optimistic that feed production will grow in 2023.

United States



- Overall production was up 1.02%
- Pet feed grew by 6.12%
- Broiler feed production rose by 3.5%
- Layer feed increased 3%
- Aquaculture feed was up 2.15%



Feed production estimates by sector



AGRI-FOOD OBSERVATIONS

Survey respondents said the **top 3 technologies** making the most impact on agri-food are:

- Nutritional solutions, 33%
- Biosecurity, 13%
- Automation of labor/robots, 13%

Globally, feed tonnage increased in the broiler, layer, aquaculture and pet food sectors. Volume growth in feed tonnage came predominantly from the broiler feed sector. Percentage wise, the biggest growth was in pet food. The pig, dairy and beef sector experienced decreased feed tonnage.

The broiler sector had the highest global feed production, with nearly 364 million metric tons.

In areas affected by avian influenza, the availability of breeding poultry was limited, limiting the growth and expansion of production. Disease, macroeconomic difficulties and prolonged periods of high production costs limit poultry growth worldwide.

In total, we saw about 1.32% less compound feed produced in the global dairy sector.

*According to the materials of the Alltech company, 2022



| Region | 2021 broiler feed tonnage (MMT*) | 2022 broiler feed tonnage (MMT) | Growth (MMT) | Growth % |
|--------------------|----------------------------------|---------------------------------|--------------|--------------|
| Africa | 13.956 | 13.126 | (0.830) | -5.95% |
| Asia-Pacific | 153.404 | 153.532 | 0.128 | 0.08% |
| Europe | 54.938 | 54.169 | (0.769) | -1.40% |
| Latin America | 66.717 | 67.561 | 0.845 | 1.27% |
| Middle East | 8.217 | 11.401 | 3.184 | 38.75% |
| North America | 58.200 | 60.132 | 1.932 | 3.32% |
| Oceania | 3.956 | 4.039 | 0.083 | 2.10% |
| Grand Total | 359.387 | 363.960 | 4.573 | 1.27% |

| Region | 2021 layer feed tonnage (MMT*) | 2022 layer feed tonnage (MMT) | Growth (MMT) | Growth % |
|--------------------|--------------------------------|-------------------------------|--------------|--------------|
| Africa | 9.545 | 9.224 | (0.321) | -3.36% |
| Asia-Pacific | 76.481 | 75.940 | (0.541) | -0.71% |
| Europe | 30.988 | 30.672 | (0.316) | -1.02% |
| Latin America | 23.629 | 24.506 | 0.877 | 3.71% |
| Middle East | 4.621 | 4.977 | 0.356 | 7.70% |
| North America | 15.120 | 15.530 | 0.410 | 2.71% |
| Oceania | 0.972 | 1.001 | 0.029 | 2.98% |
| Grand Total | 161.356 | 161.849 | 0.493 | 0.31% |

| Region | Sum of 2021 pig feed tonnage (MMT*) | Sum of 2022 pig feed tonnage (MMT) | Growth (MMT) | Growth % |
|--------------------|-------------------------------------|------------------------------------|----------------|---------------|
| Africa | 3.319 | 3.317 | (0.002) | -0.05% |
| Asia-Pacific | 143.537 | 140.377 | (3.159) | -2.20% |
| Europe | 81.871 | 75.117 | (6.754) | -8.25% |
| Latin America | 35.450 | 36.167 | 0.717 | 2.02% |
| Middle East | 0.007 | 0.007 | 0.000 | 0.50% |
| North America | 63.600 | 62.984 | (0.616) | -0.97% |
| Oceania | 1.401 | 1.414 | 0.013 | 0.93% |
| Grand Total | 322.266 | 319.383 | (9.802) | -2.98% |

| Region | Sum of 2021 dairy feed tonnage (MMT*) | Sum of 2022 dairy feed tonnage (MMT) | Growth (MMT) | Growth % |
|--------------------|---------------------------------------|--------------------------------------|----------------|---------------|
| Africa | 5.580 | 5.071 | (0.509) | -9.12% |
| Asia-Pacific | 24.136 | 24.154 | 0.018 | 0.07% |
| Europe | 43.416 | 42.199 | (1.217) | -2.80% |
| Latin America | 25.738 | 25.461 | (0.277) | -1.08% |
| Middle East | 6.528 | 6.992 | 0.464 | 7.11% |
| North America | 28.700 | 28.500 | (0.200) | -0.70% |
| Oceania | 1.518 | 1.446 | (0.072) | -4.74% |
| Grand Total | 135.616 | 133.823 | (1.793) | -1.32% |



*Million metric tons

*According to the materials of the Alltech company, 2022



| Region | Sum of 2021 beef feed tonnage (MMT*) | Sum of 2022 beef feed tonnage (MMT) | Growth (MMT) | Growth % |
|--------------------|--------------------------------------|-------------------------------------|----------------|---------------|
| Africa | 2.479 | 2.575 | 0.095 | 3.84% |
| Asia-Pacific | 13.810 | 14.279 | 0.469 | 3.40% |
| Europe | 17.542 | 15.765 | (1.776) | -10.13% |
| Latin America | 15.642 | 16.015 | 0.373 | 2.39% |
| Middle East | 1.456 | 1.556 | 0.100 | 6.89% |
| North America | 66.772 | 67.355 | 0.429 | 0.64% |
| Oceania | 0.740 | 0.650 | (0.090) | -12.16% |
| Grand Total | 118.441 | 118.042 | (0.399) | -0.34% |

| Region | Sum of 2021 aqua feed tonnage (MMT*) | Sum of 2022 aqua feed tonnage (MMT) | Growth (MMT) | Growth % |
|--------------------|--------------------------------------|-------------------------------------|--------------|--------------|
| Africa | 1.484 | 1.449 | (0.035) | -2.38% |
| Asia-Pacific | 37.350 | 38.340 | 0.990 | 2.65% |
| Europe | 4.605 | 4.687 | 0.082 | 1.78% |
| Latin America | 5.652 | 5.922 | 0.271 | 4.79% |
| Middle East | 0.500 | 0.566 | 0.066 | 13.14% |
| North America | 1.730 | 1.750 | 0.020 | 1.16% |
| Oceania | 0.190 | 0.200 | 0.010 | 5.26% |
| Grand Total | 51.510 | 52.914 | 1.403 | 2.72% |

| Region | Sum of 2021 pet feed tonnage (MMT*) | Sum of 2022 pet feed tonnage (MMT) | Growth (MMT) | Growth % |
|--------------------|-------------------------------------|------------------------------------|--------------|--------------|
| Africa | 0.454 | 0.342 | (0.111) | -24.57% |
| Asia-Pacific | 2.267 | 2.478 | 0.212 | 9.33% |
| Europe | 11.587 | 11.778 | 0.191 | 1.65% |
| Latin America | 7.434 | 8.863 | 1.429 | 19.22% |
| Middle East | 0.090 | 0.106 | 0.016 | 17.25% |
| North America | 10.600 | 11.200 | 0.600 | 5.66% |
| Oceania | 0.452 | 0.502 | 0.050 | 11.06% |
| Grand Total | 32.884 | 35.27 | 2.386 | 7.25% |

| Region | Sum of 2021 equine feed tonnage (MMT*) | Sum of 2022 equine feed tonnage (MMT) | Growth (MMT) | Growth % |
|--------------------|--|---------------------------------------|--------------|--------------|
| Africa | 0.078 | 0.079 | 0.001 | 1.25% |
| Asia-Pacific | 0.494 | 0.536 | 0.042 | 8.51% |
| Europe | 2.129 | 2.152 | 0.023 | 1.09% |
| Latin America | 1.093 | 1.043 | (0.050) | -4.54% |
| Middle East | 0.137 | 0.139 | 0.002 | 1.47% |
| North America | 3.778 | 3.800 | 0.022 | 0.58% |
| Oceania | 0.383 | 0.410 | 0.027 | 7.05% |
| Grand Total | 8.091 | 8.159 | 0.068 | 0.83% |

*Million metric tons

*According to the materials of the Alltech company, 2022

Cite as Vancouver Citation Style

Global feed production remains steady in 2022. Grain Products and Mixed Fodder's, 2022; 22 (3, 87): 12-18.

Cite as State Standard of Ukraine 8302:2015

Global feed production remains steady in 2022// Grain Products and Mixed Fodder's. 2022. Vol. 22, Issue 3 (87). P. 12-18.

