Supplementary information for Report

Food Not Feed - How to stop the world's biggest form of food waste

Contents

Section 1. Comparison of food wasted in EU in the conventional sense and food wasted by feeding grain to animals due to poor conversion of grain into meat, milk and eggs

Over 59 million tonnes of food waste (132 kg/inhabitant) were generated in the EU in 2022.[1] [2] Most of this is produced by households, retailers, restaurants, food service and food manufacturers.

However, much more – **124 million tonnes** per year – is wasted by using grain such as wheat, barley, oats and maize as animal feed. This figure does not refer to the total grain fed to animals; it is the amount that is *wasted* due to several plant-derived calories or grams of protein being needed to produce one calorie or one gram of protein in meat, milk and eggs.

On an individual level, the European Commission states that on average food waste per EU inhabitant amounts to 132 kg of food per year[3] (this includes not just the food wasted by households but the food wasted by food businesses and in primary production). In contrast to this, the 124 million tonnes of grain wasted each year in the EU by feeding these crops to animals translates into an average of 275 kg of grain being wasted annually per EU inhabitant. Clearly we waste twice as much food by feeding grain to farm animals as we waste in the conventional sense by consumers and retailers and other food businesses discarding unwanted food.

The European Commission states that nearly two thirds of EU cereals are used as animal feed.[4] Feeding grain to animals is inefficient. Cassidy *et al.* (2013) have calculated calorie and protein conversion rates for different types of animal products when human-edible grain is fed to animals.[5] They conclude that for every 100 calories of grain fed to animals, we get only about 40 new calories of milk, 22 calories of eggs, 12 of chicken, 10 of pork, or 3 of beef.

Regarding the conversion of grain protein into meat, milk and egg protein, Cassidy *et al*. report that for every 100 grams of grain protein fed to animals, we get only about 43 new grams of protein in milk, 35 in eggs, 40 in chicken, 10 in pork, or five in beef.

Table 1: Livestock conversion efficiencies of grain in calories and protein calculated by Cassidy *et al.*, 2013 [6]

	Dairy	Eggs	Chicken	Pork	Beef
Calorie conversion efficiency (%)	40	22	12	10	3
Protein conversion efficiency (%)	43	35	40	10	5

More recently Fry *et al*. (2018) have calculated the protein and calorie conversion rates when grain is fed to animals. Their conversion figures are set out in Table 2.

Table 2: Livestock conversion efficiencies of grain in calories and protein calculated by Fry *et al.*, 2018 [7]

	Chicken	Pork	Beef
Calorie conversion efficiency (%)	25	11	5
Protein conversion efficiency (%)	34	15	10

Method for calculating the inefficiencies involved in feeding grain to farmed animals

The European Commission produces data showing the amount of grain used as animal feed in the EU.[8] These data show that in the period 2021-2024 the amount of cereals used as animal feed was 158,033,333 tonnes on average per year.

Next, the amount of cereals used as animal feed was allocated to each species on the basis of figures published by FEFAC - *Fédération Européenne des Fabricants d'Aliments Composés* - which represents the European compound feed industry. FEFAC shows that in 2023 compound feed was used by the various farm animal species as shown in Table 3.

Table 3: FEFAC data showing use of compound feed in EU by main farmed species[9]

Species	Proportion of EU compound feed used by this species
Pigs	34%
Poultry: meat & eggs	33%
Cattle	28%
Others: includes sheep, goats, fish, horses, game, rabbits	5%

The figure for cattle was then allocated separately to beef cattle and dairy cows on the basis that 73% of EU cattle are beef animals with 27% being dairy cows.

Next, the amount of EU grain used annually as animal feed was allocated to each species on the basis of the proportions of compound feed used by each species set out in Table 3. The results of this process are set out in Table 4. As indicated earlier, in the period 2021-2024 the amount of grain used as animal feed was 158,033,333 tonnes on average per year.

Table 4: Amount of EU grain used as animal feed annually by each species

Species	Amount of EU feed used (metric tonnes)
Beef cattle	32,302,013
Dairy cows	11,947,319
Pigs	53,731,333
Poultry	52,150,199
Other	7,901,666

Next, the rate at which each species converts the calories and protein in grain into meat, milk or eggs was taken from Cassidy *et al.* and Fry *et al*. In each case the more efficient conversion rate provided by Cassidy or Fry was used to avoid overstating the loss of calories and protein in feeding grain to animals. The counterpart of the

conversion ratio is the waste ratio which shows the proportion of grain fed to animals that is wasted in the sense that it does not produce any protein or energy for human consumption. Finally, the waste ratio was used to calculate the amount of grain wasted annually in the EU as result of them being fed to animals.

Table 5 shows the conversion and waste ratios for each species and the amount of grain wasted each year due to poor protein and calorie conversion rates.

Table 5: Protein and calorie conversion rates for each species and the amount of grain wasted annually in the EU by being fed to animals

Species	**Protein conversion (C) & waste (W) ratios**	**Calorie conversion (C) & waste (W) ratios**	**Amount of grain lost looked at through poor protein conversion lens (metric tonnes)**	**Amount of grain lost looked at through poor calorie conversion lens (metric tonnes)**
Beef cattle	C:10% (Fry) W: 90%	C: 5% (Fry) W: 95%	29,071,811	30,686,912
Dairy cows	C: 43% (Cassidy) W: 57%	C: 40% (Cassidy) W: 60%	6,809,971	7,168,391
Pigs	C: 15% (Fry) W: 85%	C:11% (Fry) W: 89%	45,671,633	47,820,886
Poultry	C: 40% (Cassidy) W: 60%	C: 25% (Fry) W: 75%	31,290,119	39,112,649
Other *	C: 28% (Fry) W: 72%	C: 25% (Fry) W: 75%	5,689,199	5,926,249
Total			118,532,733	130,715,087

* The conversion rates for 'Other' are taken from Fry *et al.*'s figures for Atlantic salmon; some of the species included in 'Other' may have better conversion ratios than salmon while other may have poorer ratio.

Finally, the total amount of grain lost looked at through both poor protein and calorie conversion lenses were combined and then divided by two to produce one overall figure which is that 124,623,910 metric tonnes of grain are lost annually in the EU due to the poor conversion of the protein and energy in grain into meat, milk and eggs.

July 2025

Section 2. Comparison of food wasted in the U.S. in the conventional sense and food wasted by feeding grain to animals due to poor conversion of grain into meat, milk and eggs

The U.S. Department of Agriculture states: 'In the United States, food waste is estimated at between 30-40 percent of the food supply. This is based on USDA estimates of 31 percent food loss at the retail and consumer levels. This added up to approximately 133 billion pounds [66.5 million tons] and $161 billion worth of food in 2010.'[10]

However, the U.S. wastes much more – **160 million tons** per year - by using grain as animal feed. This figure does not refer to the total grain fed to animals; it is the amount that is *wasted* due to several plant-derived calories or grams of protein being needed to produce one calorie or one gram of protein in meat, milk and eggs.

Our World in Data calculates that 50.25% of U.S. grain is used as animal feed.[11] Feeding grain to animals is inefficient. Cassidy *et al*. (2013) have calculated calorie and protein conversion rates for different types of animal products when human-edible grain is fed to animals.[12] They conclude that for every 100 calories of grain fed to animals, we get only about 40 new calories of milk, 22 calories of eggs, 12 of chicken, 10 of pork, or 3 of beef.

Regarding the conversion of grain protein into meat, milk and egg protein, Cassidy *et al*. report that for every 100 grams of grain protein fed to animals, we get only about 43 new grams of protein in milk, 35 in eggs, 40 in chicken, 10 in pork, or five in beef.

Table 1: Livestock conversion efficiencies of grain in calories and protein calculated by Cassidy *et al.*, 2013 [13]

	Dairy	Eggs	Chicken	Pork	Beef
Calorie conversion efficiency (%)	40	22	12	10	3
Protein conversion efficiency (%)	43	35	40	10	5

More recently Fry *et al.* (2018) have calculated the protein and calorie conversion rates when grain is fed to animals. Their conversion figures are set out in Table 2.

Table 2: Livestock conversion efficiencies of grain in calories and protein calculated by Fry *et al.*, 2018 [14]

	Chicken	Pork	Beef
Calorie conversion efficiency (%)	25	11	5
Protein conversion efficiency (%)	34	15	10

Method for calculating the inefficiencies involved in feeding grain to farmed animals

A 2025 report prepared for the Institute for Feed Education and Research (which has been established by the American Feed Industry Association) estimates that in 2023 the amount of grain used as animal feed in the U.S. was 202,764,885 tons.[15] Corn comprises the vast majority of grain used as feed in the U.S.[16]

The amount of grain used as animal feed was allocated to each species on the basis of figures in the report prepared for the Institute for Feed Education and Research. These show that in 2023 grain used as feed by the various farm animal species as shown in Table 3.

Table 3: Use of compound feed in U.S. by main farmed species

Species	Amount of U.S. grain used in 2023 as animal feed
Pigs	49,073,805
Broiler chickens	38,345,087
Egg laying hens	10,931,529
Turkeys	7,430,952
Beef cattle	68,624,468
Dairy cows	25,896,993

Next, the rate at which each species converts the calories and protein in grain into meat, milk or eggs was taken from Cassidy *et al.* and Fry *et al*. In each case the more efficient conversion rate provided by Cassidy or Fry was used to avoid overstating the loss of calories and protein in feeding grain to animals. The counterpart of the conversion ratio is the waste ratio which shows the proportion of grain fed to animals that is wasted in the sense that it does not produce any protein or energy for human consumption. Finally, the waste ratio was used to calculate the amount of grain wasted annually in the U.S. as result of them being fed to animals.

Table 4 shows the conversion and waste ratios for each species and the amount of grain wasted each year due to poor protein and calorie conversion rates.

Table 4: Protein and calorie conversion rates for each species and the amount of grain wasted annually in the U.S. by being fed to animals

Species	Protein conversion (C) & waste (W) ratios	Calorie conversion (C) & waste (W) ratios	Amount of grain lost looked at through poor protein conversion lens (tonnes)	Amount of grain lost looked at through poor calorie conversion lens (tonnes)
Beef cattle	C:10% (Fry) W: 90%	C: 5% (Fry) W: 95%	61,762,021	65,193,244
Dairy cows	C: 43% (Cassidy) W: 57%	C: 40% (Cassidy) W: 60%	14,761,286	15,538,195
Pigs	C: 15% (Fry) W: 85%	C:11% (Fry) W: 89%	41,712,734	43,675,686
Broilers	C: 40% (Cassidy) W: 60%	C: 25% (Fry) W: 75%	23,007,052	28,758,815
Turkeys*	C: 40% (Cassidy) W: 60%	C: 25% (Fry) W: 75%	4,458,571	5,573,214
Laying hens	C: 35% (Cassidy) W: 65%	C: 22% (Cassidy) W: 78%	7,105,493	8,526,592
Total			152,807,157	167,265,746

* Conversion rates for turkeys are not available so the conversion rates for broilers have been used as a proxy.

Finally, the total amount of grain lost looked through both poor protein and calorie conversion lenses were combined and then divided by two to produce one overall figure which is that 160,036,451 tons of grain are lost annually in the U.S. due to the poor conversion of the protein and energy in grain into meat, milk and eggs.

July 2025

Section 3. Comparison of food wasted in UK in the conventional sense and food wasted by feeding grain to animals due to poor conversion of grain into meat, milk and eggs

A UK Parliament research briefing states that the organisation Waste and Resources Action Programme WRAP estimated that in 2021 food waste in the UK amounted to 9.1 million tonnes (Mt); this does not include waste on farms. Food waste comes from

households (6.4Mt), followed by manufacturing (1.4Mt) hospitality and food service (1.1Mt) and retail (0.2Mt).[17]

However, we waste almost as much – **8.3 million tonnes** per year - by using grain such as wheat, barley and oats as animal feed. This figure does not refer to the total grain fed to animals; it is the amount that is *wasted* due to several plant-derived calories or grams of protein being needed to produce one calorie or one gram of protein in meat, milk and eggs.

Calculations based on the Defra report *Agriculture in the UK 2024* show that 52.8% of UK grain – wheat, barley and oats - are used as animal feed.[18] Feeding grain to animals is inefficient. Cassidy *et al*. (2013) have calculated calorie and protein conversion rates for different types of animal products when human-edible grain is fed to animals.[19] They conclude that for every 100 calories of grain fed to animals, we get only about 40 new calories of milk, 22 calories of eggs, 12 of chicken, 10 of pork, or 3 of beef.

Regarding the conversion of grain protein into meat, milk and egg protein, Cassidy *et al*. report that for every 100 grams of grain protein fed to animals, we get only about 43 new grams of protein in milk, 35 in eggs, 40 in chicken, 10 in pork, or five in beef.

Table 1: Livestock conversion efficiencies of grain in calories and protein calculated by Cassidy *et al.*, 2013 [20]

	Dairy	**Eggs**	**Chicken**	**Pork**	**Beef**
Calorie conversion efficiency (%)	40	22	12	10	3
Protein conversion efficiency (%)	43	35	40	10	5

More recently Fry *et al.* (2018) have calculated the protein and calorie conversion rates when grain is fed to animals. Their conversion figures are set out in Table 2.

Table 2: Livestock conversion efficiencies of grain in calories and protein calculated by Fry *et al.*, 2018 [21]

	Chicken	**Pork**	**Beef**
Calorie conversion efficiency (%)	25	11	5
Protein conversion efficiency (%)	34	15	10

Method for calculating the inefficiencies involved in feeding grain to farm animals

Agriculture in the UK 2024 produces data showing the amount of grain used as animal feed in the UK. These data show that in the period 2022-2024 the amount of grain used as animal feed was 11,445,333 tonnes on average per year.

Next, the amount of grain used as animal feed was allocated to each species on the basis of figures produced by *Mordor Intelligence.* These show that in 2023 compound feed was used by the various farm animal species as shown in Table 3.

Table 3: Use of compound feed in UK by main farmed species

Species	Proportion of UK compound feed used by this species
Pigs	14%
Poultry	42%
Ruminants	28%
Others	16%

Next, the amount of UK grain used annually as animal feed was allocated to each species on the basis of the proportions of compound feed used by each species set out in Table 3. The results of this process are set out in Table 4. As indicated earlier, in the period 2021-2023 the amount of grain used as animal feed was 11,682,000 tonnes on average per year. The figure for cattle was allocated to beef cattle and dairy cows on the basis of figures in *Agriculture in the UK 2024*.

Table 4: Amount of UK grain used as animal feed annually by each species

Species	Amount of UK feed used (tonnes)
Poultry	4,807,039
Pigs	1,602,346
Beef cattle	1,388,273
Dairy cows	1,816,420
Others	1,831,253

Next, the rate at which each species converts the calories and protein in grain into meat, milk or eggs was taken from Cassidy *et al.* and Fry *et al*. In each case the more efficient conversion rate provided by Cassidy or Fry was used to avoid overstating the loss of calories and protein in feeding grain to animals. The counterpart of the conversion ratio is the waste ratio which shows the proportion of grain fed to animals that is wasted in the sense that it does not produce any protein or energy for human consumption. Finally, the waste ratio was used to calculate the amount of grain wasted annually in the UK as result of them being fed to animals.

Table 5 shows the conversion and waste ratios for each species and the amount of grain wasted each year due to poor protein and calorie conversion rates.

Table 5: Protein and calorie conversion rates for each species and the amount of grain wasted annually in the UK by being fed to animals

Species	Protein conversion (C) & waste (W) ratios	Calorie conversion (C) & waste (W) ratios	Amount of grain lost looked at through poor protein conversion lens (tonnes)	Amount of grain lost looked at through poor calorie conversion lens (tonnes)
Beef cattle	C:10% (Fry) W: 90%	C: 5% (Fry) W: 95%	1,249,445	1,318,859
Dairy cows	C: 43% (Cassidy) W: 57%	C: 40% (Cassidy) W: 60%	1,035,359	1,089,852
Pigs	C: 15% (Fry) W: 85%	C:11% (Fry) W: 89%	1,361,994	1,426,087
Poultry	C: 40% (Cassidy) W: 60%	C: 25% (Fry) W: 75%	2,884,223	3,605,279
Other *	C: 28% (Fry) W: 72%	C: 25% (Fry) W: 75%	1,318,502	1,373,439
Total			7,849,523	8,813,516

* The conversion rates for 'Other' are taken from Fry *et al.*'s figures for Atlantic salmon; some of the species included in 'Other' may have better conversion ratios than salmon while other may have poorer ratios.

Finally, the total amount of grain lost looked at through both poor protein and calorie conversion lenses were combined and then divided by two to produce one overall figure which is that 8,331,519 tonnes of grain are lost annually in the UK due to the poor conversion of the protein and energy in grain into meat, milk and eggs.

August 2025

Section 4. Comparison of food wasted in France in the conventional sense and food wasted by feeding grain to animals due to poor conversion of grain into meat, milk and eggs

The European Commission states that food waste amounted to 9.5 million tonnes in France in 2022 and amounted to 133kg per person in 2020.[22] This includes food loss

and waste from primary production, processing and manufacturing, retail and other distribution of food, restaurants and other food services, and households.

However, more is wasted – 15.4 million tonnes per year - by using grain such as wheat, maize and barley as animal feed. This figure does not refer to the total grain fed to animals; it is the amount that is *wasted* due to several plant calories or grams of protein being needed to produce one calorie or one gram of protein in meat, milk and eggs.

FranceAgriMer, that operates under the authority of the French Ministry for Agriculture, states that 9,2 tonnes of grain were used annually by compound feed manufacturers in France in the period 2021-2024.[23] However, the inclusion of grain in compound feed is not the only way in which grain is used as animal feed. Rather than buying ready-mixed feed from compound feed manufacturers, some animal producers grow the grain they need for feed themselves or they buy grain and mix it into feed on the farm.

The French Ministry of Agriculture states that French cereal production in 2023 was 64.900.000 tonnes.[24] The French organisation Réseau Action Climat states that 31,4% of French production, which equates to 20.378.600 tonnes, is used as animal feed.[25]

Feeding grain to animals is inefficient. Cassidy *et al.* (2013) have calculated calorie and protein conversion rates for different types of animal products when human-edible grain is fed to animals.[26] They conclude that for every 100 calories of grain fed to animals, we get only about 40 new calories of milk, 22 calories of eggs, 12 of chicken, 10 of pork, or 3 of beef.

Regarding the conversion of grain protein into meat, milk and egg protein, Cassidy *et al*. report that for every 100 grams of grain protein fed to animals, we get only about 43 new grams of protein in milk, 35 in eggs, 40 in chicken, 10 in pork, or five in beef.

Table 1: Livestock conversion efficiencies of grain in calories and protein calculated by Cassidy *et al.*, 2013 [27]

	Dairy	**Eggs**	**Chicken**	**Pork**	**Beef**
Calorie conversion efficiency (%)	40	22	12	10	3
Protein conversion efficiency (%)	43	35	40	10	5

More recently Fry *et al.* (2018) have calculated the protein and calorie conversion rates when grain is fed to animals. Their conversion figures are set out in Table 2.

Table 2: Livestock conversion efficiencies of grain in calories and protein calculated by Fry *et al.*, 2018 [28]

	Chicken	Pork	Beef
Calorie conversion efficiency (%)	25	11	5
Protein conversion efficiency (%)	34	15	10

Method for calculating the inefficiencies involved in feeding grain to farm animals

The proportion of grain used as animal feed was allocated to each species on the basis of figures produced by La Coopération Agricole, Nutrition animale.[29] These show that compound feed is used for the various farmed animal species as shown in Table 3.

Table 3: Use of compound feed in France by main farmed species

Species	Proportion of France compound feed used by this species
Pigs	22%
Poultry	41%
Cattle	28%
Others	9%

Next, the amount of French grain used annually as animal feed was allocated to each species on the basis of the proportions of compound feed used by each species set out in Table 3. The figure for cattle was allocated to beef cattle and dairy cows on the basis that France has 3,2 million dairy cows and 3,7 million suckler cows.[30] The results of this process are set out in Table 4. As indicated above, 20.378.600 million tonnes of grain per year are used as feed in France.

Table 4: Amount of French grain used as animal feed annually by each species

Species	Amount of French feed used (tonnes)
Pigs	4.483.292
Poultry	8.355.226
Beef cattle	3.059.561
Dairy cows	2.646.446
Others	1.834.074
Total	20.378.600

Next, the rate at which each species converts the calories and protein in grain into meat, milk or eggs was taken from Cassidy *et al.* and Fry *et al*. In each case the more efficient conversion rate provided by Cassidy or Fry was used to avoid overstating the loss of calories and protein in feeding grain to animals. The counterpart of the conversion ratio is the waste ratio which shows the proportion of grain fed to animals

that is wasted in the sense that it does not produce any protein or energy for human consumption. Finally, the waste ratio was used to calculate the amount of grain wasted annually in France as result of them being fed to animals.

Table 5 shows the conversion and waste ratios for each species and the amount of grain wasted each year due to poor protein and calorie conversion rates.

Table 5: Protein and calorie conversion rates for each species and the amount of grain wasted annually in France by being fed to animals

Species	Protein conversion (C) & waste (W) ratios	Calorie conversion (C) & waste (W) ratios	Amount of grain lost looked at through poor protein conversion lens (tonnes)	Amount of grain lost looked at through poor calorie conversion lens (tonnes)
Beef cattle	C:10 (Fry) W: 90%	C: 5% (Fry) W: 95%	2.753.604	2.906.582
Dairy cows	C: 43% (Cassidy) W: 57%	C: 40% (Cassidy) W: 60%	1.508.474	1.587.867
Pigs	C: 15% (Fry) W: 85%	C:11% (Fry) W: 89%	3.810.798	3.990.129
Poultry	C: 40% (Cassidy) W: 60%	C: 25% (Fry) W: 75%	5.013.135	6.266.419
Other *	C: 22% W: 78%	C: 14% W: 86%	1.430.577	1.577.303
Total			14.516.588	16.328.300

* The conversion rates for 'Other' are the average of the conversion rates for beef cattle, pigs and poultry.

Finally, the total amount of grain lost looked at through both poor protein and calorie conversion lenses were combined and then divided by two to produce one overall figure which is that 15.422.444 tonnes of grain are lost annually in France due to the poor conversion of the protein and energy in grain into meat, milk and eggs.

June 2025

Section 5. Food wasted globally by feeding grain to animals due to poor conversion of grain into meat, milk and eggs

The International Grains Council (IGC) states that 1016.7 million tonnes of grain was used globally as animal feed in 2022-23.[31] However, IGC does not specify how use of this grain was divided up between the main farmed species.

In order to calculate how the grain used as feed is allocated among the different species, we looked at the Alltech Agri-Food Outlook 2023[32] which shows how the use of compound feed is allocated to the main farmed species. It reports that globally in 2022 the amount of compound feed used by pigs, broiler chickens, laying hens, beef cattle and dairy cows was 1,097,057,000 metric tonnes. This figure is higher than that of the International Grains Council as compound feed includes other ingredients as well as grain.

Feeding grain to animals is inefficient. Cassidy *et al.* (2013) have calculated calorie and protein conversion rates for different types of animal products when human-edible grain is fed to animals.[33] They conclude that for every 100 calories of grain fed to animals, we get only about 40 new calories of milk, 22 calories of eggs, 12 of chicken, 10 of pork, or 3 of beef.

Regarding the conversion of grain protein into meat, milk and egg protein, Cassidy *et al*. report that for every 100 grams of grain protein fed to animals, we get only about 43 new grams of protein in milk, 35 in eggs, 40 in chicken, 10 in pork, or five in beef.

Table 1: Livestock conversion efficiencies of grain in calories and protein calculated by Cassidy *et al.*, 2013 [34]

	Dairy	Eggs	Chicken	Pork	Beef
Calorie conversion efficiency (%)	40	22	12	10	3
Protein conversion efficiency (%)	43	35	40	10	5

More recently Fry *et al.* (2018) have calculated the protein and calorie conversion rates when grain is fed to animals. Their conversion figures are set out in Table 2.

Table 2: Livestock conversion efficiencies of grain in calories and protein calculated by Fry *et al.*, 2018 [35]

	Chicken	Pork	Beef
Calorie conversion efficiency (%)	25	11	5

Protein conversion efficiency (%)	34	15	10

Method for calculating the inefficiencies involved in feeding grain to farm animals

As indicated above, the International Grains Council states that 1016.7 million tonnes of grain was used globally as animal feed in 2022-23.[36]

The Alltech Agri-Food Outlook, 2023[37] shows that globally in 2022 the amount of compound feed used by pigs, broiler chickens, laying hens beef cattle and dairy cows was 1,097,057,000 metric tonnes. The Alltech figures show that of this figure the proportion of compound grain used by each species was as set out in Table 3.

Table 3: Alltech Agri-Food Outlook data showing use of compound feed globally by main farmed species in 2022

Species	Amount of compound feed provided	Proportion of global compound feed used by this species
Pigs	319,383,000	29.11%
Broiler chickens	363,960,000	33.18%
Laying hens	161,849,000	14.75%
Beef cattle	118,042,000	10.76%
Dairy cows	133,823,000	12.20%

Next, the amount of global grain used annually as animal feed was allocated to each species on the basis of the proportions of compound feed used by each species set out in Table 3.

Table 4: Amount of global grain used as animal feed in 2022-23 by each main species

Species	Amount of global feed used (metric tonnes)
Pigs	295,961,370
Broiler chickens	337,341,060
Laying hens	149,963,250
Beef cattle	109,396,920
Dairy cows	124,037,400

Next, the rate at which each species converts the calories and protein in grain into meat, milk or eggs was taken from Cassidy *et al*. and Fry *et al*. In each case the more

efficient conversion rate provided by Cassidy or Fry was used to avoid overstating the loss of calories and protein in feeding grain to animals. The counterpart of the conversion ratio is the waste ratio which shows the proportion of grain fed to animals that is wasted in the sense that it does not produce any protein or energy for human consumption. Finally, the waste ratio was used to calculate the amount of global grain wasted annually as result of it being fed to animals.

Table 5 shows the conversion and waste ratios for each species and the amount of grain wasted in 2022-23 due to poor protein and calorie conversion rates.

Table 5: Protein and calorie conversion rates for each species and the amount of global grain wasted in 2022-23 by being fed to animals

Species	**Protein conversion (C) & waste (W) ratios**	**Calorie conversion (C) & waste (W) ratios**	**Amount of grain lost looked at through poor protein conversion lens (metric tonnes)**	**Amount of grain lost looked at through poor calorie conversion lens (metric tonnes)**
Beef cattle	C:10% (Fry) W: 90%	C: 5% (Fry) W: 95%	98,457,228	103,927,074
Dairy cows	C: 43% (Cassidy) W: 57%	C: 40% (Cassidy) W: 60%	70,701,318	74,422,440
Pigs	C: 15% (Fry) W: 85%	C:11% (Fry) W: 89%	251,567,164	263,405,619
Broiler chickens	C: 40% (Cassidy) W: 60%	C: 25% (Fry) W: 75%	202,404,636	253,005,795
Laying hens	C: (Cassidy) 35% W: 65%	C:(Cassidy) 22% W: 78%	97,476,112	116,971,335
Total			720,606,458	811,732,263

Finally, the total amount of grain lost looked at through both poor protein and calorie conversion lenses were combined and then divided by two to produce one overall figure which is that 766,169,360 metric tonnes of grain were lost globally in 2022-23 due to the poor conversion of the protein and energy in grain into meat, milk and eggs.

August 2025

Section 6. Number of extra people who could be fed in EU, US, UK & France if the use of grain as feed was ended

U.S.

Our calculations show that in the U.S. 160,036,451 tons of grain are lost annually due to the poor conversion of the protein and energy in grain into meat, milk and eggs. This amount of U.S. tons is equivalent to 145,182,626 tonnes.

FAO figures show that on average wheat, maize (also known as corn) and barley contain 3,406,000 calories per tonne.

The U.S. grain wasted by being used as feed would produce 494,492,024,156,000 calories per year.

Average dietary energy requirement (ADER) per person is 2,353 kcal/p/d [38] which amounts to 858,845 calories per year. Accordingly, the 494,492,024,156,000 calories wasted annually in the U.S. by being fed to animals could feed 575,763,990 people annually.

However, when human-edible crops are no longer used to feed animals, around 50% of these crops (or other crops) are still needed to replace the reduction in production of animal-source food due to no longer feeding grain to animals, while around 50% are 'saved' and can be used to feed additional people. This indicates that the above figure of people who could be fed by ending the use of grain as feed should be halved. In conclusion, an additional 287,881,995 people could be fed if the use of cereals as animal feed was ended.

EU

Our calculations show that in the EU 124,623,910 metric tonnes of grain are lost annually due to the poor conversion of the protein and energy in grain into meat, milk and eggs.

FAO figures show that on average wheat, maize and barley contain 3,406,000 calories per tonne.

The EU gain wasted by being used as feed would produce 424,469,037,460,000 calories per year.

Average dietary energy requirement (ADER) per person is 2,353 kcal/p/d [39] which amounts to 858,845 calories per year. Accordingly, the 424,469,037,460,000 calories wasted annually in the EU by being fed to animals could feed 494,232,413 people annually.

However, when human-edible crops are no longer used to feed animals, around 50% of these crops (or other crops) are still needed to replace the reduction in production of animal-source food due to no longer feeding grain to animals, while around 50% are 'saved' and can be used to feed additional people. This indicates that the above figure

of people who could be fed by ending the use of grain as feed should be halved. In conclusion, an additional 247,116,206 people could be fed if the use of grain as animal feed was ended.

UK

Our calculations show that in the UK 8,331,519 metric tonnes of grain are lost annually due to the poor conversion of the protein and energy in grain into meat, milk and eggs.

FAO figures show that on average wheat, maize and barley contain 3,406,000 calories per tonne.

The UK grain wasted by being used as feed would produce 28,377,153,714,000 calories per year.

Average dietary energy requirement (ADER) per person is 2,353 kcal/p/d [40] which amounts to 858,845 calories per year. Accordingly, the 28,377,153,714,000 calories wasted annually in the UK by being fed to animals could feed 33,041,065 people annually.

However, when human-edible crops are no longer used to feed animals, around 50% of these crops (or other crops) are still needed to replace the reduction in production of animal-source food due to no longer feeding grain to animals, while around 50% are 'saved' and can be used to feed additional people. This indicates that the above figure of people who could be fed by ending the use of grain as feed should be halved. In conclusion, an additional 16,520,532 people could be fed if the use of grain as animal feed was ended.

France

Our calculations show that in France 15,422,444 metric tonnes of grain are lost annually due to the poor conversion of the protein and energy in grain into meat, milk and eggs.

FAO figures show that on average wheat, maize and barley contain 3,406,000 calories per tonne.

The French grain wasted by being used as feed would produce 52,528,844,264,000 calories per year.

Average dietary energy requirement (ADER) per person is 2,353 kcal/p/d [41] which amounts to 858,845 calories per year. Accordingly, the 52,528,844,264,000 calories wasted annually in France by being fed to animals could feed 61,162,193 people annually.

However, when human-edible crops are no longer used to feed animals, around 50% of these crops (or other crops) are still needed to replace the reduction in production of animal-source food due to no longer feeding grain to animals, while around 50% are 'saved' and can be used to feed additional people. This indicates that the above figure of

people who could be fed by ending the use of grain as feed should be halved. In conclusion, an additional 30,581,096 people could be fed if the use of grain as animal feed was ended.

July 2025

Section 7. Amount of arable land that could be released if the use of grain as feed was stopped

U.S.

A report produced for the Institute for Feed Education and Research (IFEEDER) shows that corn comprises 97.X% of the grain used in animal feed.[42] USDA say that U.S. farmers plant about 90 million acres of corn each year and animal feed typically accounts for about 40 percent of total domestic corn use.[43] On this basis we calculate that 36 million acres of arable land would be released if the use of corn as feed was brought to an end in the U.S.

However, when human-edible crops are no longer used to feed animals, around 50% of these crops (or other crops) are still needed to replace the reduction in production of animal-source food due to no longer feeding grain to animals, while around 50% are 'saved' and can be used to feed additional people. This indicates that the above figure of 36 million acres of arable land that would be released if the use of corn as feed was brought to an end in the U.S. should be reduced by 50%. In conclusion, 18 million acres of arable land would be released if the use of grain as animal feed was ended.

The above proposal that the arable land released should be reduced by 50% is based on the following two studies. Schader *et al.* (2015) calculate that if human-edible crops were no longer fed to animals the amount of animal-source food available in 2050 would be reduced by 53%, while the cropland used to feed the human population would fall by 26%.[44] Similarly, Westhoek *et al.* (2014) calculate that a 50% reduction in the consumption of animal-source food in the EU would lead to a 23% reduction in cropland use.[45]

EU

The EU's Cereals Balance Sheet shows that in 2023-2024 an estimated 50,608,000 hectares were used to produce cereals. The Balance Sheet shows that 58.5% of EU cereals are used as animal feed. Accordingly, 29,605,000 hectares are used to provide animal feed and would be released if the use of cereals as animal feed was ended.

However, as explained in the above section on the U.S. this figure needs to be reduced by 50% to take account of the fact that when human-edible crops are no longer used to feed animals, around 50% of these crops (or other crops) are still needed to replace the reduction in production of animal-source food due to no longer feeding grain to

animals, while around 50% are 'saved' and can be used to feed additional people. This indicates that the above figure of 29,605,000 hectares of arable land should be reduced by 50%. In conclusion, 14.8 million hectares of arable land would be released in the EU if the use of grain as animal feed was ended.

UK

The government publication *Agriculture in the UK 2024* shows that in the period 2022-2024 an annual average of 3,012,000 hectares were used to produce wheat, barley and oats in the UK.[46]

Calculations based on *Agriculture in the UK 2024* show that 52.8% of UK grain – wheat, barley and oats - are used as animal feed. Accordingly, 1,590,336 hectares are used to provide animal feed and would be released if the use of grain as animal feed was ended.

However, as explained in the above section on the U.S. this figure needs to be reduced by 50% to take account of the fact that when human-edible crops are no longer used to feed animals, around 50% of these crops (or other crops) are still needed to replace the reduction in production of animal-source food due to no longer feeding grain to animals, while around 50% are 'saved' and can be used to feed additional people. This indicates that the above figure of 1,590,336 hectares of arable land should be reduced by 50%. In conclusion, 795,168 hectares of arable land would be released in the UK if the use of grain as animal feed was ended.

France

The French Ministry of Agriculture states that French cereal production in 2023 was 64,900,000 tonnes.[47] The French organisation Réseau Action Climat states that 31,4% of French production, which equates to 20.378.600 tonnes, is used as animal feed.[48]

The French Ministry of Agriculture states that 8.819.000 hectares were used to grow grain in 2023. Accordingly, 2.769.166 hectares are used to provide animal feed and would be released if the use of grain as animal feed was ended.

However, as explained in the above section on the U.S. this figure needs to be reduced by 50% to take account of the fact that when human-edible crops are no longer used to feed animals, around 50% of these crops (or other crops) are still needed to replace the reduction in production of animal-source food due to no longer feeding grain to animals, while around 50% are 'saved' and can be used to feed additional people. This indicates that the above figure of 2.769.166 hectares of arable land should be reduced by 50%. In conclusion, 1.384.583 hectares of arable land would be released in France if the use of grain as animal feed was ended.

Czechia, Italy, Netherlands, Poland, Spain, Brazil, China, and South Africa

For these countries the percentage of domestic grain production (column A in the below Table) used as feed (column B) was calculated and set out in column C. The figures in columns A and B are FAO data.

Column D sets out the hectares in each country used for grain production; these figures come from the World Bank Group (WBG) except the Dutch figure which is provided by *Trading Economics*. The WBG figure for China was reduced to take account of the fact that a significant portion of Chinese grain production consists of rice which is generally not used as animal feed. Column E shows the hectares used for the production of grain as animal feed; this is the percentage shown in column C of the hectares used for overall grain production shown in column D.

However, as explained in the above section on the U.S. the figure in column E needs to be reduced by 50% to take account of the fact that when human-edible crops are no longer used to feed animals, around 50% of these crops (or other crops) are still needed to replace the reduction in production of animal-source food due to no longer feeding grain to animals, while around 50% are 'saved' and can be used to feed additional people. This indicates that number of hectares of arable land in column E should be reduced by 50% to show the arable land that would be released if the use of grain as animal feed was ended; the figure reduced by 50% is shown in column F.

Table: Hectares of arable land that would be released if the feeding of grain to farmed animals was ended: 2022 figures except column D which is 2021

	A: Domestic grain production: tonnes	B: Domestic grain production used as feed: tonnes	C: Domestic grain production used as feed: Percentage of overall grain production	D: Hectares used for grain production	E: Hectares used for production of grain as feed	F: Hectares released if use of grain as feed was ended
Brazil	88,353,000	54,132,000	61.2%	25,023,100	15,314,137	7,657,068
China	486,922,000	268,408,000	55.1%	71,138,000	39,197,038	19,598,519
Czechia	4,586,000	2,119,000	46.2%	1,345,800	621,759	310,879
Italy	26,376,000	14,535,000	55.1%	2,978,400	1,641,098	820,549
Netherlands	18,455,000	13,202,000	71.5%	183,200	130,988	65,494
Poland	27,428,000	14,827,000	54.0%	7,451,300	4,023,702	2,011,851
South Africa	17,719,000	7,804,000	44.0%	3,856,500	1,696,860	848,430
Spain	39,022,000	29,978,000	76.8%	6,034,600	4,634,572	2,317,286

August 2025

[1] European Commission. Food Waste. https://food.ec.europa.eu/food-safety/food-waste_en Accessed 29 August 2025
[2] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Food_waste_and_food_waste_prevention_-_estimates Accessed 29 August 2025
[3] https://food.ec.europa.eu/food-safety/food-waste_en Accessed 29 August 2025
[4] https://agriculture.ec.europa.eu/farming/crop-productions-and-plant-based-products/cereals_en#:~:text=The%20EU's%20cereals%20are%20mostly,3%25%20is%20used%20for%20biofuels Accessed 15 May 2025
[5] Cassidy E M *et al.*, 2013. Redefining agricultural yields: from tonnes to people nourished per hectare. University of Minnesota. Environ. Res. Lett. 8 (2013) 034015
[6] Cassidy *et al*. (*Op. Cit.*)
[7] Fry *et al.*, 2018. Feed conversion efficiency in aquaculture: do we measure it correctly? Environ. Res. Lett. 13 024017 Corrigendum: Feed conversion efficiency in aquaculture: do we measure it correctly? (2018 *Environ. Res. Lett.* 13024017) https://iopscience.iop.org/article/10.1088/1748-9326/aad007
[8] EU cereals balance sheet. https://agriculture.ec.europa.eu/data-and-analysis/markets/overviews/balance-sheets-sector_en Accessed 29 August 2025
[9] FEFAC, 2023. From farm to table: 2022 feed statistics in charts https://fefac.eu/wp-content/uploads/2023/08/statistics_year_2022.pdf
[10] https://www.usda.gov/about-food/food-safety/food-loss-and-waste/why-should-we-care-about-food-waste Accessed 2 April 2025
[11] https://ourworldindata.org/grapher/share-cereals-animal-feed?tab=table Accessed 2 April 2025
[12] Cassidy E.M *et al.*, 2013. Redefining agricultural yields: from tonnes to people nourished per hectare. University of Minnesota. Environ. Res. Lett. 8 (2013) 034015
[13] Cassidy *et al*. (*Op. Cit.*)
[14] Fry *et al.*, 2018. Feed conversion efficiency in aquaculture: do we measure it correctly? Environ. Res. Lett. 13 024017 Corrigendum: Feed conversion efficiency in aquaculture: do we measure it correctly? (2018 *Environ. Res. Lett.* 13024017) https://iopscience.iop.org/article/10.1088/1748-9326/aad007
[15] Animal Feed Consumption, 2025. https://www.afia.org/pub/?id=0e89a761-ca2e-f503-29dd-dc7ae4f2d3dc
[16] *Ibid*
[17] House of Commons Library, 2024. https://researchbriefings.files.parliament.uk/documents/CBP-7552/CBP-7552.pdf Accessed 30 August 2025
[18] Defra, 2025. Agriculture in the UK 2024. https://assets.publishing.service.gov.uk/media/6881de3ff47abf78ca1d35b0/agriculture-in-the-uk-2024.pdf
[19] Cassidy E.M *et al.*, 2013. Redefining agricultural yields: from tonnes to people nourished per hectare. University of Minnesota. Environ. Res. Lett. 8 (2013) 034015
[20] Cassidy *et al*. (*Op. Cit.*)
[21] Fry *et al.*, 2018. Feed conversion efficiency in aquaculture: do we measure it correctly? Environ. Res. Lett. 13 024017 Corrigendum: Feed conversion efficiency in aquaculture: do we measure it correctly? (2018 *Environ. Res. Lett.* 13024017) https://iopscience.iop.org/article/10.1088/1748-9326/aad007
[22] European Commission, 2025. EU food loss and waste prevention hub. European Food Loss and Waste Prevention Hub - Explore the Member States Initiatives Accessed 27 May 2025
[23] FranceAgriMer. Données céréales https://www.franceagrimer.fr/fam/content/download/76538/document/FAB_par_camp_ABDFAB-022025.pdf?version=1 Accessed 17 June 2025
[24] Agreste France, Statistical Book, 2024. Statistical book, 2024 edition|Agreste, agricultural statistics Accessed 27 May 2025

[25] Réseau Action Climat, 2025. Elevage intensif & souveraineté : les limites du produire plus. https://reseauactionclimat.org/elevage-intensif-et-souverainete-les-limites-du-produire-plus/
[26] Cassidy E.M *et al.*, 2013. Redefining agricultural yields: from tonnes to people nourished per hectare. University of Minnesota. Environ. Res. Lett. 8 (2013) 034015
[27] Cassidy *et al*. (*Op. Cit.*)
[28] Fry *et al.*, 2018. Feed conversion efficiency in aquaculture: do we measure it correctly? Environ. Res. Lett. 13 024017 Corrigendum: Feed conversion efficiency in aquaculture: do we measure it correctly? (2018 *Environ. Res. Lett.* 13024017) https://iopscience.iop.org/article/10.1088/1748-9326/aad007
[29] https://www.lacooperationagricole.coop/ressources/chiffres-cles-2024
[30] Agreste, Statistical Book 2024 Statistical book, 2024 edition|Agreste, agricultural statistics Accessed 27 May 2025
[31] International Grains Council, 2025. https://www.igc.int/en/markets/marketinfo-sd.aspx Accessed 13 August 2025
[32] https://www.alltech.com/sites/default/files/2023-01/2023%20Alltech%20Agri-Food%20Outlook%20v2_1.pdf
[33] Cassidy E M *et al.*, 2013. Redefining agricultural yields: from tonnes to people nourished per hectare. University of Minnesota. Environ. Res. Lett. 8 (2013) 034015
[34] Cassidy *et al*. (*Op. Cit.*)
[35] Fry *et al.*, 2018. Feed conversion efficiency in aquaculture: do we measure it correctly? Environ. Res. Lett. 13 024017 Corrigendum: Feed conversion efficiency in aquaculture: do we measure it correctly? (2018 *Environ. Res. Lett.* 13024017) https://iopscience.iop.org/article/10.1088/1748-9326/aad007
[36] International Grains Council, 2025. https://www.igc.int/en/markets/marketinfo-sd.aspx Accessed 13 August 2025
[37] https://www.alltech.com/sites/default/files/2023-01/2023%20Alltech%20Agri-Food%20Outlook%20v2_1.pdf
[38] World Health Organization & Food and Agriculture Organization of the United Nations, United Nations University. 2001. Human Energy Requirements, Report of a Joint FAO/WHO/UNU Expert Consultation.
[39] Ibid
[40] Ibid
[41] Ibid
[42] Animal feed consumption, 2025. https://www.afia.org/pub/?id=0e89a761-ca2e-f503-29dd-dc7ae4f2d3dc
[43] USDA, 2025. Corn and Other Feed Grains. https://www.ers.usda.gov/topics/crops/corn-and-other-feed-grains/feed-grains-sector-at-a-glance
[44] Schader C *et al.*, 2015. Impacts of feeding less food-competing feedstuffs to livestock on global food system sustainability. J. R. Soc. Interface 12: 20150891. http://dx.doi.org/10.1098/rsif.2015.0891
[45] Westhoek H *et al.*, 2014. Food choices, health and environment: Effects of cutting Europe's meat and dairy intake. Global Environmental Change: 26, 196-205
[46] https://assets.publishing.service.gov.uk/media/6881de3ff47abf78ca1d35b0/agriculture-in-the-uk-2024.pdf
[47] Agreste France, Statistical Book, 2024. Statistical book, 2024 edition|Agreste, agricultural statistics Accessed 27 May 2025
[48] Réseau Action Climat, 2025. Elevage intensif & souveraineté : les limites du produire plus. https://reseauactionclimat.org/elevage-intensif-et-souverainete-les-limites-du-produire-plus/