Suffering by the Pound:
Meat and Animal Product Harm Comparisons

That, Sir, is the good of counting. It brings every thing to a certainty, which before floated in the mind indefinitely…. You should not allow yourself to be delighted with errour.

~Samuel Johnson

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Consumer guide and resources

A reducetarian consumer guide

Given the suffering involved in all factory farming, as well as for significant environmental reasons, the best diet is one free from all factory farmed meat and animal products. But for anyone not ready or willing to completely abstain, there are significant differences in food options.

The priority of intake reduction, based on 6 basic levels of harm, with the most harmful at the top, is shown below. The goal should be to completely eliminate levels 1 through 4 (in red) from your diet, starting at the top. It would be best to also eliminate levels 5 and 6 (in yellow), but some intake of these is not too bad. Below the 6 levels of harm are good options in green.

These priorities are highly counterintuitive. We have the least sympathy and concern for the animals at the top of the list. But studies show that these animals feel pain just like the ones we tend to care more about. This issue is further discussed below.

All the analysis that led to these conclusions and suggestions is laid out below. Quotes are taken from Nick Cooney's *Veganomics*. For an overview of the worst abuses in the animal industry see "Farm to Fridge" on YouTube.

1: Minimal Farmed Crustaceans
There's 3 to 6 months of intense suffering per farmed shrimp. With 10 to 70 kills per pound, that's 5 to 17.5 years of suffering per pound. With a possible average of 26 kills per pound, that's 10 years of suffering per pound. 55% of US consumed shrimp is farmed. Most US consumed crayfish is farmed. Farmed crustaceans are "penned in densely packed, waste filled pools." Many "die slowly from disease or parasites." Female shrimp have their eyes cut out ("eyestalk ablation"). They should be completely avoided.

2: Minimal Farmed Finfish
Farmed finfish endure 5 to 31 months of intense suffering per pound, 14 months on average. "Farm-raised fish are penned in densely packed, waste filled pools. Up to a third of them die slowly from disease or parasites. Some have their face or flesh chewed off by sea lice. Because the close confinement increases aggression, some fishes' fins, tails, or eyes are bitten off and out by other fish." Salmon, tilapia, pangasius and catfish are usually farmed. All of these should be completely avoided.

3: Minimal Factory Farmed Eggs and Poultry
Factory farmed laying hens, broilers and turkeys all endure intense suffering. Laying hens suffer 1.9 days per egg. That's 17.6 days per pound of eggs. Broilers suffer 14 days per pound. Turkeys suffer 10.5 days per pound. These three birds suffer an average of two weeks per pound. "Egg-laying hens are kept for their entire lives in dirty wire cages so small they can barely turn around." Many "lose their feathers from constantly rubbing against the bars of their cages. Their feet become crippled from standing on wire-mesh flooring their whole life." Their beaks are often seared off. Male chicks are thrown alive into grinders, or sometimes suffocated. Broilers and turkeys are "crammed into indoor pens or sheds with little room to move around." They often "experience crippling leg disorders, heart attacks, and other painful ailments as a result of being bred to grow so large, so quickly." Many die before making it to the slaughterhouse. They should all be completely avoided.

4: Minimal Factory Farmed Pork
Factory farmed pigs endure 32 hours of intense suffering per pound. They are "crammed into indoor pens or sheds with little room to move around." They're often tattooed with metal spiked mallets and have their tales cut off. "Sows are enclosed for most of their lives in cages so small they cannot turn around." They often chew the bars of the cage until they bleed. They should be completely avoided.

5: Limited Factory Farmed Dairy and Beef
Dairy cows face serious abuses, described below, but on the whole live lives that are perhaps not too bad. They are also astonishingly productive (7.5 gallons/day), making dairy products among the least harmful of all meat or animal product options.

Though they do face abuses, described below, on the whole beef cows live fairly decent lives. They also produce far more meat than any other animal (4 x pig; 42 x turkey; 180 x chicken; 318 x finfish; 14,040 x shrimp), making beef by far the least harmful of all meat.

There are health risks associated with red meat (beef, pork and lamb) and any processed meat. The American Institute for Cancer Research recommends no more than 18 ounces of red meat per week and no processed meat of any kind.

6: Limited Humanely Raised and Wild Caught
Pasture fed animals live good lives but go to the same slaughter houses as factory farmed animals, where improper stunning can lead to a tortuous death. Labels for supposedly humanely raised animals can be highly misleading. The ASPCA has a "Meat, Eggs and Dairy Label Guide" that shows which labels ensure good treatment. You can also buy products directly from local farmers.

Wild caught fish live good lives but die by suffocation or are crushed to death. Lobster and crab are often boiled alive. Squid and octopus might also be sentient and thus die badly. Tuna, polluck and cod are usually wild caught. Many serious problems with commercial fishing are discussed here. Seafood Watch has consumer guides for sustainably caught seafood.

Unlimited Bivalves
Clams, oysters, mussels and scallops are almost certainly not sentient. And Seafood Watch's National and Southeast Consumer Guides show bivalves as being sustainably harvested.

Unlimited Hunting and Fishing
Hunting and fishing provide food from animals that lived good lives and they can be killed humanely. When you catch a fish, be sure to spike the brain or cut off the head, otherwise it suffocates to death. See ikijime.com.

Unlimited from Waste
All food options have negative effects. A completely vegan diet even kills some animals. Though a vegan diet requires the least land, results in the least pollution, has the smallest carbon footprint, and kills the least animals, it's not harmless. Eating food that would otherwise go to waste, including meat and animal products, is harmless. So any meat or animal products acquired from waste is actually better than even a completely vegan option.

Vegan shopping, cooking and nutritional information

https://veganoutreach.org/vegan/
https://www.peta.org/living/food/
http://chooseveg.com/

Animal welfare support and advocacy information

https://animalcharityevaluators.org/

Books

The Ethics of What We Eat, Peter Singer and Jim Mason, 2006
Practical Ethics, Peter Singer, 1979, third edition 2011

Doing Good Better, William MacAskill, 2015
Compassion, by the Pound, F. Bailey Norwood and Jayson L. Lusk, 2011
Veganomics, Nick Cooney, 2014

Counting the animals

Pounds of meat per kill

Cow: 540 pounds of meat (1200 lb steer x 0.45, Norwood and Lusk, p.255)
Pig: 134 pounds of meat (250 lbs x 0.535, Norwood and Lusk, p.255)
Turkey: 12.85 pounds of meat (30.7 lbs x 0.79 x 0.53)
https://www.theatlantic.com/technology/archive/2013/11/the-supersized-american-turkey/281843/
http://www.thepoultrysite.com/articles/1207/calculating-carcass-yield-of-turkeys/
http://www.ellenskitchen.com/turkey/yields.html
Chicken: 3 pounds of meat (6.18 lbs x 0.7 x 0.7)
http://www.nationalchickencouncil.org/about-the-industry/statistics/u-s-broiler-performance/
https://ask.extension.org/questions/190648
http://posc.tamu.edu/wp-content/uploads/sites/20/2012/08/l-2290.pdf
Farmed Finfish: 1.7 pounds of meat average (calculations and sources below)
((Salmon, 4.3 + Pangasius, 1.1 + Catfish, 0.85 + Tilapia, 0.4) / 4 = 1.7)
Farmed Shrimp: 26 per pound average
http://www.countinganimals.com/how-many-animals-does-a-vegetarian-save/

1 cow = 4 pigs = 42 turkeys = 180 chickens = 318 finfish = 14,040 shrimp

Laying Hen: 312.5 lifetime eggs x 1.7 oz per egg = 531 oz / 16 = 33 lbs of food (sources below)

Dairy Cow: 15,629,555 lifetime milk calories / 1,329 calories per pound of beef = 11,760 beef pound equivalents (sources below)

Number of kills per pound

Shrimp: 10 to 70 shrimp per pound, with a possible average of 26
Finfish: 1lb / 1.7 lbs of meat per average fish = 0.59 kills per pound
Chicken: 1 lb / 3 lbs of meat per chicken = 0.33 kills per pound
Turkey: 1 lb / 12.85 lbs of meat per turkey = 0.08 kills per pound
Eggs: 1 lb / 33 lbs (312.5 eggs) of eggs per hen = 0.03 kills per pound (9.4 eggs)
Pork: 1 lb / 134 lbs of meat per pig = 0.007 kills per pound
Beef: 1 lb / 540 lbs of meat per cow = 0.002 kills per pound
Dairy: 1 lb / 11,760 beef pound equivalents (1,329 calories) per cow = 0.000085 kills per pound

Pounds of meat per person, US

90.4 pounds of chicken per year
56.6 pounds of beef per year
51 pounds of pork per year
17 pounds of turkey per year
http://www.nationalchickencouncil.org/about-the-industry/statistics/per-capita-consumption-of-poultry-and-livestock-1965-to-es timated-2012-in-pounds/

4.76 pounds of farmed finfish per year (14.9 pounds of fish)
(2.18 salmon + 1.18 tilapia + 0.89 pangasius + 0.51 catfish = 4.76)
https://animalcharityevaluators.org/research/dietary-impacts/fish-consumption/

4.1 pounds of shrimp per year (4.1 x 0.55 = 2.3 pounds of farmed shrimp)

https://www.aboutseafood.com/press_release/top-10-list-highlights-seafood-consumption-progress/
55% farmed (This is globally. I saw somewhere that it's also 55% for US, but can't find the source):
https://www.worldwildlife.org/industries/farmed-shrimp

Number of kills per person, US

90.4 lbs consumed / 3 lbs per chicken = 30 chickens killed per person per year
17 lbs consumed / 12.85 lbs per turkey = 1.3 turkeys killed per person per year
51 lbs consumed / 134 lbs per pig = 0.38, or about 2/5ths of a pig killed per person per year
56.6 lbs consumed / 540 lbs per cow = 0.1, or 1/10th of a cow killed per person per year

Kills from eggs and dairy (Norwood and Lusk):
2 chickens (1 laying hen plus one male chick killed right after birth)
1/30 dairy cow

3.93 to 7.8 farmed finfish killed per person per year
https://animalcharityevaluators.org/research/dietary-impacts/fish-consumption/

tilapia: 1.18 lbs consumed / 0.4 pounds per fish = 2.95 killed
pangasius: 0.89 lbs consumed / 1.1 lbs per fish = 0.8 killed
catfish: 0.51 lbs consumed / 0.85 lbs per fish = 0.6 killed
salmon: 2.18 lbs consumed / 4.3 lbs per fish = 0.5 killed

total finfish kills: 2.95 + 0.8 + 0.6 + 0.5 = 4.85

Mortality rates (% that die before slaughter) should also be factored in:
pigs: 16.22%
turkeys: 11.17%
cows: 4.95%
chickens: 4.52%
http://www.countinganimals.com/how-many-animals-does-a-vegetarian-save/

30 x 1.0452 = 31.4 chickens killed per person per year
1.3 x 1.1117 = 1.45 turkeys killed per person per year
0.38 x 1.1622 = 0.44, or nearly 1/2 of a pig killed per person per year
0.1 x 1.0495 = 0.1, or 1/10th of a cow killed per person per year

(3.93 to 7.8) + (0.9 to 4.2) = 4.83 to 12 farmed finfish killed per person per year (middle estimate 8.4)
https://animalcharityevaluators.org/research/dietary-impacts/fish-consumption/

4.1 pounds x 26 per pound = 107 shrimp killed per person per year
2.3 pounds farmed x 26 per pound = 60 farmed shrimp killed per person per year

60 farmed shrimp (58%) + 31.4 broilers (30%) + 8.4 finfish (8%) + 1.45 turkeys (1.4%) + 1 hen (1%) + 1 male chick (1%) + 0.44 pigs (0.4%) + 0.1 beef cows (0.1%) + 0.033 (0.03%) dairy cows = **104 animals killed per person per year**

Fish (shrimp + finfish) and broilers makeup 96% of the kills.

That's not including other shellfish, wild caught shrimp and finfish, feeder fish and bycatch, which Harish Sethu puts at **over 400 killed**:
http://www.countinganimals.com/how-many-animals-does-a-vegetarian-save/

Vegan death toll (crop kills)

Even a completely vegan diet results in some animals being killed. Steven Davis estimated that 15 animals are killed per hectare of crop (6 per acre) and 7.5 are killed per hectare of pasture (3 per acre). He concluded from this that a diet that includes pasture fed animals would actually kill less animals than a vegan diet.
https://www.morehouse.edu/facstaff/nnobis/papers/Davis-LeastHarm.htm

Gaverick Matheny then pointed out that Davis failed to account for the fact that pasture land produces far less food than crop land. "Crop production uses less than half as many hectares as grass-fed dairy and one-tenth as many hectares as grass-fed beef to deliver the same amount of protein. In one year, 1,000 kilograms of protein can be produced on as few as 1.0 hectares planted with soy and corn, 2.6 hectares used as pasture for grass-fed dairy cows, or 10 hectares used as pasture for grass-fed beef cattle. As such, to obtain the 20 kilograms of protein [44 lbs] per year recommended for adults, a vegan-vegetarian would kill 0.3 wild animals annually, a lacto-vegetarian would kill 0.39 wild animals, while a Davis-style omnivore would kill 1.5 wild animals."
http://www.morehouse.edu/facstaff/nnobis/papers/least-harm.pdf

Mark Middleton, using Davis's estimates for wild kills per hectare, came up with estimates for total number of kills per one million calories for eight different food categories. (One million is the number of calories consumed in a year at 2,740 calories per day.)

Chicken: 251.1 kills (237.6 chickens slaughtered + 13.5 wild kills)
Eggs: 92.3 kills (83.3 hens slaughtered + 9 wild kills)
Beef: 29 kills (1.7 cows slaughtered + 27.4 wild kills)
Pork: 18.1 kills (7.1 hogs slaughtered + 11 wild kills)
Milk: 4.78 kills (0.04 cows slaughtered + 4.74 wild kills)
Vegetables: 2.55 wild kills
Fruits: 1.73 wild kills
Grains: 1.65 wild kills
http://www.animalvisuals.org/projects/data/1mc?/data/1mc

Note: There seems to be some confusion in these papers as to whether the kill estimates are per harvest or per year. There's more than one harvest per year so these would be different estimates. My calculations below use Davis's kill estimate's and assumes they are per harvest. If the estimates should be per year then the number of kills would be less.

Wheat
3.2 tonnes per hectare (2017) = 1.427 tons per acre
https://data.oecd.org/agroutput/crop-production.htm
1,520 calories per pound
https://modernsurvivalblog.com/survival-kitchen/calories-per-pound-of-rice-beans-wheat/
2,854 pounds x 1,520 calories = 4,338,080 calories per acre
4,338,080 cal per acre / 6 kills per acre = 723,013 calories per kill
1,000,000 cal / 723,013 cal per kill = 1.38 kills per million calories

Soybeans
49.1 bushels per acre (2017)
https://www.nass.usda.gov/Newsroom/Executive_Briefings/2018/01-12-2018.pdf
1 bushel of soybeans = 60 pounds
https://www.unc.edu/~rowlett/units/scales/bushels.html
49.1 bushels per acre x 60 pounds per bushel = 2,946 pounds per acre
1 cup of soybeans is 774 calories (calorie book) and 1 lb is 2.5 cups (online somewhere)
2.5 cups x 774 calories = 1,935 calories per pound
2,946 pounds per acre x 1,935 calories per pound = 5,700,510 calories per acre
5,700,510 calories per acre / 6 kills per acre = 950,085 calories per kill

1,000,000 calories / 950,085 calories = 1.05 kills per million calories

Rice
5.8 tonnes per hectare (2017) = 2.587 tons per acre
https://data.oecd.org/agroutput/crop-production.htm
1,648 calories per pound
https://modernsurvivalblog.com/survival-kitchen/calories-per-pound-of-rice-beans-wheat/
5,174 pounds x 1,648 calories = 8,526,752 calories per acre
8,526,752 cal per acre / 6 kills per acre = 1,421,125 calories per kill
1,000,000 cal / 1,421,125 cal per kill = 0.70 kills per million calories

Corn
176.6 bushels per acre (2017)
https://www.nass.usda.gov/Newsroom/Executive_Briefings/2018/01-12-2018.pdf
1 bushel of corn = 56 pounds
https://www.unc.edu/~rowlett/units/scales/bushels.html
176.6 bushels per acre x 56 pounds per bushel = 9,889.6 pounds per acre
1 pound of corn = 1,655.61 calories
http://convert-to.com/507/yellow-dry-corn-grain-kernels-amounts-conversion.html
9,889.6 pounds per acre x 1, 655.61 calories per pound = 16,373,321 calories per acre
16,373,321 calories per acre / 6 kills per acre = 2,728,887 calories per kill
1,000,000 calories / 2,728,887 = 0.37 kills per million calories

Using World Resource Institute's hectares per million calories.
https://resourcewatch.org/data/explore/Foo_046-Food-Footprint-in-Calories
Pulses: 0.44 ha x 15 wild kills per ha = 6.6 wild kills per million calories
Nuts: 0.36 x 15 = 5.4 kills
Fruits and Vegetables: 0.24 x 15 = 3.6 kills
Wheat: 0.14 x 15 = 2.1 kills
Roots and Tubers: 0.12 x 15 = 1.8 kills
Maize: 0.11 x 15 = 1.65 kills
Rice: 0.09 x 15 = 1.35 kills
Sugar: 0.03 x 15 = 0.45 kills

Duration of suffering

Duration of suffering caused per person, US

Broilers live 0.115 years (6 weeks)
Turkeys live 0.37 years (4.5 months)
Pigs live 0.5 years (6 months)
Beef cows live 1.5 years
Laying hens live 1.6 years
Dairy cows live 4 years
http://www.aussieabattoirs.com/facts/age-slaughtered

Beef cows live 16 months (Norwood and Lusk, p. 152)
Dairy cows live 4 years
https://en.wikipedia.org/wiki/Dairy_cattle#Management

Farmed Finfish (calculations and sources below)
Catfish live 2.25 years
Salmon live 1.75 years
Pangasius live 0.58 years
Tilapia live 0.5 years

Shrimp live 3 to 6 months
https://en.wikipedia.org/wiki/Marine_shrimp_farming#Life_cycle

31.4 chickens x 0.115 years = 3.6 years of chicken suffering
1.45 turkeys x 0.37 years = 0.54 years, or 6 months of turkey suffering
0.44 pigs x 0.5 years = 0.22 years, or 80 days of pig suffering
0.1 beef cows x 1.33 years = 0.133 years, or 49 days of beef cow suffering
0.033 dairy cows x 4 years = 0.132 years, or 48 days of dairy cow suffering

Average American consumes 267 eggs per year:
http://www.aeb.org/farmers-and-marketers/industry-overview
267 eggs per year / 312.5 total eggs per hen = 0.8544 hens per year
0.8544 hens x 1.6 years = 1.37 years of hen suffering (egg calculations below)

Farmed Finfish (calculations and sources below)
Tilapia: 1.18 lbs x 1.25 years per lb = 1.48 years of suffering
Catfish: 0.51 lbs x 2.6 years per lb = 1.33 years of suffering
Salmon: 2.18 lbs x 0.4 years per pound = 0.87 years of suffering
Pangasius: 0.89 lbs x 0.52 lbs per year = 0.47 years of suffering

Finfish Total: 4.15 years of suffering

Farmed Shrimp (calculations and sources below)
2.3 pounds x 9.75 years per pound = 22.4 years of suffering

All Animals:
22.4 shrimp-years (68.9%) + 4.15 finfish-years (12.8%) + 3.6 broiler-years (11%) + 1.37 hen-years (4.2%) + 0.54 turkey-years (1.7%) + 0.22 pig-years (0.7%) + 0.133 beef-years (0.4%) + 0.132 dairy-years (0.4%) = **32.5 years of animal suffering per person per year**

Fish (shrimp + finfish) makeup 81.7% of the years of suffering.
Chicken (broilers + hens) makeup 15.2% of the years of suffering.
Fish and chicken combined makeup 96.9% of the years of suffering.

Duration of suffering per pound and per serving

Shrimp (calculations below)
3 to 6 months of suffering per shrimp = 9.75 years of suffering per pound on average (26 shrimp) = 2.4 years per 4 oz (6.5 shrimp)

Finfish (calculations below)
1.2 years of average finfish suffering per pound = 3.6 months per 4 oz serving

Eggs (calculations below)
1.9 days of hen suffering per egg = 17.6 days per pound (9.4 eggs) = 4.5 days per 4 oz (2.4 eggs)

Chicken
42 days / 3 lbs = 14 days of suffering per pound = 3.5 days per 4 oz serving

Turkey
135 days / 12.85 lbs = 10.5 days of suffering per pound = 2.6 days per 4 oz serving

Pig
180 days / 134 lbs = 1.34 days (32 hours) of suffering per pound = 8 hours per 4 oz serving

Beef Cow
485 days / 540 = 0.9 days (21.6 hours) of life per pound = 5.4 hours per 4 oz serving

A beef cow has a questionable quality of life for its last four months, on a feedlot, out of its 16 month life. So for a duration of possible suffering per pound we can multiply the duration of life per pound by 0.25.
21.6 hours of life x 0.25 = 5.4 hours of questionable quality of life per pound = 1.35 hours per 4 oz serving

Dairy Cow (calculations below)
3 hours of questionable quality of life per beef pound equivalent (1,329 calories). That's about a half-gallon of milk or 7 ounces of cheese. A pint of milk is the caloric equivalent of 4 ounces of beef and entails 45 minutes of suffering. That's 22.5 minutes of suffering per cup.

Shrimp suffer 8.1 times longer per pound than average finfish (9.75 years / 1.2 years)
Average finfish suffers 31.2 times longer per pound than average bird (62.4 weeks / 2 weeks)
Average bird suffers 10.4 times longer per pound than a pig (14 days / 1.34 days)
Pigs suffer 6 times longer per pound than beef cows (32 hours / 5.4 hours)
Beef cows suffer 1.8 times longer per pound than dairy cows (5.4 hours / 3 hours)

Note: I included mortality rates to calculate the number of animals killed but did not include them for the duration of suffering calculations. To do that I would need the average age of death for animals that die before they are slaughtered.

Duration of suffering for 1 day's calories

The average American consumes 2,765 calories per day:
http://www.livestrong.com/article/347737-the-average-american-daily-caloric-intake/

Shrimp:
1 lb shrimp = 480 calories (calorie book)
2,765 daily cal / 480 cal per pound = 5.8 lbs of shrimp
9.75 years (established below) x 5.8 lbs = **57 years of shrimp suffering for 1 day's calories**.

Average Farmed Finfish:
1 lb pangasius = 340 calories (fatsecret.com)
1 lb tilapia = 435 calories (fatsecret.com)
1 lb catfish = 613 calories (calorie book)
1 lb salmon = 830 calories (fatsecret.com)
(340+ 435 + 613 + 830) / 4 = 555 average calories
2,765 daily cal / 555 cal per pound = 5 lbs of fish
14.4 months (established below) x 5 lbs = 72 months or
6 years of finfish suffering for 1 day's calories.

Eggs:
1 egg = 75 calories (calorie book, "whole, raw, large")
1 lb egg = 705 calories (16oz / 1.7oz egg = 9.4 eggs per pound x 75 cal)
33lbs (established below) x 705 cal = 23,265 total calories per hen
2,765 daily cal / 23,265 cal = 0.119 hens
0.119 hens x 1.6 life-years = 0.19 years, or
69.5 days of hen suffering for 1 day's calories.

Turkey:
1 lb turkey = 680 calories (170 in 4oz):
http://www.butterball.com/products/whole-turkeys/frozen-whole-turkey
12.85lbs x 680 cal = 8,738 total calories per turkey
2,765 daily cal / 8,738 cal = 0.32 turkeys
0.32 turkeys x 0.37 life-years = 0.118 years, or

43.22 days of turkey suffering for 1 day's calories.

Chicken:
1 lb chicken = 989 calories (215 in 3.5 oz):
http://www.nationalchickencouncil.org/chicken-the-preferred-protein-for-your-health-and-budget/the-nutritional-value-of-chicken/
3 lbs x 989 cal = 2,967 total calories per chicken
2,765 daily cal / 2,967 cal = 0.93 chickens
0.93 chickens x 0.115 life-years = 0.1 years, or
36.5 days of chicken suffering for 1 day's calories.

Pork:
1 lb pig = 1030 calories (from calorie book, "Fresh: Untrimmed: raw")
134 lbs x 1030 cal = 138,020 total calories per pig
2,765 daily cal / 138,020 cal = 0.02 pigs
0.02 pigs x 0.5 life-years = 0.01 years, or
3.65 days of pig suffering for 1 day's calories.

Beef:
1 lb cow = 1,329 calories ("Assuming 25 percent fat, the burger is 1329 cal/pound."):
https://answers.yahoo.com/question/index;_ylt=A0LEViqGndFYEPIAplonnIlQ;_ylu=X3oDMTByOHZyb21tBGNvbG8DYmYxBHBvcwMxBHZ0aWQDBHNlYwNzcg--?qid=20081220234733AAfe5zj&p=calories%20per%20cow
540 lbs x 1,329 cal = 717,660 total calories per cow
2,765 daily cal / 717,660 cal = 0.0039 cows
0.0039 cows x 1.33 life-years = 0.005 years or 1.9 days of cow life
1.9 days of cow life x 0.25 time of questionable quality of life = 0.475 days or
11.4 hours of questionable quality of life for 1 day's calories.

Dairy:
15,629,555 total calories per dairy cow (established below)
2,765 daily cal / 15,629,555 = 0.00018 dairy cows
0.00018 cows x 4 life-years = 0.00072 years, or 0.2628 days or
6.3 hours of questionable quality of life for 1 day's calories.

Shrimp suffer 9.5 times longer than average finfish by calorie (57 years / 6 years)
Finfish suffer 44.1 times longer than average bird by calorie (6 years / 0.136 years)
Birds suffer 13.6 times longer than pigs by calorie (49.74 days / 3.65 days)
Pigs suffer 7.7 times longer than beef cows by calorie (3.65 days / 0.475 days)
Beef cows suffer 1.8 times longer than dairy cows by calorie (11.4 hours / 6.3 hours)

Relative duration of suffering by pound and by calorie

The gap between each of these levels is tremendous. Shrimp suffer 8.1 times longer per pound than the average finfish (9.75 years / 1.2 years) (9.5 times longer per calorie). The average finfish suffers 31.2 times longer per pound than the average bird (62.4 weeks / 2 weeks) (44.1 times longer per calorie). The average bird suffers 10.4 times longer per pound than a pig (14 days / 1.34 days) (13.6 times longer per calorie). Shrimp suffer 2,656 times longer per pound than a pig (3,559 days / 1.34 days) (5,700 times longer per calorie). The average fish suffers 327 times longer per pound than a pig (438 days / 1.34 days) (600 times longer per calorie).

Relative Duration of Suffering by pound and calorie					
Intense Suffering				Questionable Quality of Life	
	Level 2 Finfish	Level 3 Birds	Level 4 Pigs	Level 5 Beef Cows	Level 5 Dairy Cows
Level 1 Shrimp	8.1 x per lb 9.5 x per cal	254 x per lb 418 x per cal	2,656 x per lb 5,700 x per cal	15,818 per lb 43,800 x per cal	28,472 per lb 79,167 x per cal
Level 2 Finfish		31 x per lb 54 x per cal	327 x per lb 600 x per cal	1,947 x per lb 4,611 x per cal	3,504x per lb 8,333 x per cal
Level 3 Birds			10.4 x per lb 13.6 per cal	62 x per lb 105 x per cal	112 x per lb 189 x per cal
Level 4 Pigs				5.9 x per lb 7.7 x per cal	10.7 x per lb 13.9 x per cal

Meat from all four levels of suffering entail a great deal of suffering and should be avoided. But if choosing among these, opting for something lower on the list makes an enormous difference. Level 5 is much better in duration as well as intensity of suffering.

Intensity of suffering

Welfare ratings

In addition to the length of suffering, there are also different levels of suffering to consider. Bailey Norwood, in *Compassion by the Pound*, ranked factory farmed animal welfare on a 20 point scale, from positive 10, the best possible welfare, to negative 10, the worst possible welfare. Animal welfare expert Dr. Sara Shields, using the same scale, gives some different numbers. (Her scoring is cited in Nick Cooney's *Veganomics*. It's available online here: http://www.mattball.org/2014/07/part-1-analyzing-numbers-to-optimize.html)

Norwood and Shields both give beef cows a positive rating. Norwood says +6 and Shields says +2. If they're correct that the life of a beef cow is net positive, then the estimates for duration of beef cow suffering above can be disregarded.

Norwood gives dairy cows a +4 and Shields gives a 0. If they're correct that dairy cow life is not net negative, then the estimates for the duration of dairy cow suffering can also be disregarded.

Chapter five of *Compassion, by the Pound* describes the conditions of most of the animals I've been comparing. Using that chapter as my guide, I've adjusted Norwood's and Shields' scores. Here's the time of suffering per pound along with a welfare rating:

Shrimp: 9.75 years of suffering per pound (26 shrimp) at 75% of maximal suffering.
Finfish: 1.2 years of suffering per pound at 75% of maximal suffering.
Laying Hen: 17.6 days of suffering per pound of eggs (9.4 eggs) at 90% of maximal suffering.
Broiler Chicken: 14 days of suffering per pound at 80% of maximal suffering.
Turkey: 10.5 days of suffering per pound at 80% of maximal suffering.
Pig: 1.34 days of suffering per pound at 75% of maximal suffering.

Alternative welfare ratings

Here's a table that shows some different animal welfare scores. Below the table are brief descriptions of the treatment of each animal. This will hopefully help you form your own ideas about just how bad each of these animals are treated and consequently whether or not consuming them can be justified.

Norwood's and Shields' welfare ratings are mentioned above. Also included here are Avi Norowitz's ratings, from private correspondence. He sees an asymmetry between good and bad welfare conditions and thus takes the negative rating all the way to 25 for caged hens. His scores represent "the average (mean) day of the farm animal's life." Brian Tomasik has another way of rating animal welfare. He uses beef cows as a reference point and rates other animals as multiples of how much worse they're treated than beef cows. I've included his ratings as well. His scoring system also factors in the impact of slaughter on overall welfare. Check out his system here:
http://reducing-suffering.org/how-much-direct-suffering-is-caused-by-various-animal-foods/

Farmed Animals	Warren	Norwood	Shields	Norowitz	Tomasik
Beef	+6	+6	+2	+6	reference
Dairy	0	+4	0	-4	x 2
Fish	-5		-7	-7	x 1.5
Pork	-5	-2	-5	-10	x 2.5
Turkeys	-6	+3*	-8	-11	x 3
Broilers	-6	+3	-8	-13	x 3
Cage-Free Hens	-7	+2		-7	
Veal	-7	-8			
Caged-Hens	-8	-8	-7	-25	x 4

*Asterisk indicates Norwood's presumed turkey score. He didn't provide one but did write "we assume that broilers and turkeys possess similar levels of welfare." And Shields gave turkeys and broilers the same score.

Here's an overview of the conditions for each animal, based on chapter five of *Compassion, by the Pound* (CBTP). CBTP does not discuss transport conditions and slaughter, both of which can be brutal. Animals can also receive horrific treatment from workers. "Farm to Fridge" on YouTube provides an overview of factory farm conditions as well as the worst sorts of abuses the animals can face. Depending on how bad you take transport and slaughter to be, as well as how prevalent individual abuse is, you might want to subtract a point or two from each score. If the slaughterhouse horrors shown in Farm to Fridge are not prevalent, but rare, then verifiably humanely raised products perhaps belong in the green section of the reducetarian consumer guide and not the yellow.

Beef (+6: 12 months at +8 and 4 months at 0)
Beef cows spends their first 7 to 8 months, February or March through October, with their mothers on a pasture with plenty of space. At this point they are weaned and sent to a wheat pasture to graze for the winter. In late spring, at around a year old, they are sent to a feedlot for "finishing" for about four months. "Generally, 50 to 250 cattle are held in one pen, the cattle have ample room to move, and aggression is not typically a problem. The space afforded each steer/heifer in a feedlot is around 250 square feet when at their largest size, which is about ten times the amount of space provided to a finishing hog on a per-pound basis." Large amounts of manure accumulate on these lots. The cows are standing and sleeping in this. "The large number of flies in a feedlot, presumably attracted to the manure, does serve as a constant nuisance to the animals." On the feedlot, and typically on the pasture, the cows have no shade or shelter. Cows are branded and dehorned, and the males are castrated. This is typically done without anesthesia.

I rate pre-feedlot cow life at an 8. Shade and shelter would bring that to 9. Anesthesia for surgery would make it 10. I rate feedlot life at 0. Since they spend ¼ of their life on the feedlot, I take the pre-feedlot score ¼ of the way towards the feedlot score to get the overall score. This gives a score of 6, which is also Norwood's score, but a fair bit higher than Shields' score of 2.

Note: The USDA "grass-fed" label doesn't mean the cow spent its whole life on a pasture. It just means it wasn't fed any grain. It likely went to a feedlot just like other cows. So from a cow welfare perspective, the label doesn't mean anything.

Dairy (0)
To produce milk a cow must have a calf. Very shortly after giving birth her calf is taken from her. This experience is very traumatic for her and the calf. This is done to her three times over the course of her life. Dairy calves need their mothers, but they're raised separately. Dairy cows are typically "provided with a dry lot with shelter, they have access to indoor stalls with dry sand for bedding, and they are fed on a concrete pad under shelter. The cows generally have ample room and convenient access to both indoor shelter and the outdoors…. About 78 percent of cows are milked in a parlor-type system where they are taken into a milking barn." About 22% are "tethered to an individual stall for significant periods of time."

Many cows have bone problems as a result of breeding for maximal milk output, as well as from the concrete floors. "Estimates suggest that between 14 percent and 25 percent of all dairy cows suffer from some sort of lameness." An estimated 16.5% have inflamed udders, a condition that "is painful and potentially deadly." About 33% have their tales cut off. "Docking causes pain at the time of docking and can lead to chronic pain; the absence of a full tail also means that the cow is unable to free itself of flies." It's done "almost always without anesthetics." The pretext for this practice is that it "is said to contribute to the cleanliness of udders and to prevent the spread of disease." There is no evidence to support this claim and is likely done just to make milking more convenient. Like beef cows, dairy cows are also dehorned and branded, usually without anesthesia.

Norwood gives dairy cows a rating of +4 and Shields gives a 0. I went with 0 and think it would not at all be unreasonable to conclude that their lives are overall negative. If so, then dairy belongs in the red section of the reducetarian consumer guide and not the yellow.

Fish (-5)
CBTP doesn't cover fish, so here's a quote from *Veganomics*. "Farm-raised fish are penned in densely packed, waste filled pools. Up to a third of them die slowly from disease or parasites. Some have their face or flesh chewed off by sea lice. Because the close confinement increases aggression, some fishes' fins, tails, or eyes are bitten off and out by other fish." That all sounds pretty horrific, but I'm not sure how prevalent those worst experiences are. Shields rates farmed fish life at -7. I went more conservative with -5. Maybe I should just use her number.

Pork (-5)
Piglets have their teeth clipped, tails cut, ears notched, and males are castrated, all without anesthesia. "From birth to death the pigs live exclusively indoors and in tight quarters." A full-size hog occupies 5 square feet of space and has 8 square feet of space in the finishing barn. They are on concrete floors, so they can't root, and they have no bedding.

Breeding sows are kept in "gestation crates where each sow remains exclusively in an individual crate that is barely larger than the sow herself (14 square feet). The animal cannot turn around and can have trouble lying down. When they do lie down, their feet often extend into the neighboring crate, which makes it difficult for all sows to lie down simultaneously in a comfortable manner." Some states have banned gestation crates and breeding sows are put two to six in a small pen, with 16 to 30 square feet of room per sow. This gives them a little bit of room to move around, but it's still extremely cramped and as a consequence they fight a lot. They have no bedding or dirt for rooting. It's questionable if they're any better off. Norwood gives gestation crate sows a welfare rating of -7 and ones kept in pens a -5. Sows are 2.3 % of the pork population.

Turkey (-6)
CBTP doesn't cover turkey treatment. But they do write that "turkey production very closely resembles broiler production. The same production methods and welfare issues discussed in regards to broilers generally apply to turkeys…. we assume that broilers and turkeys possess similar levels of welfare." So I added a turkey score for Norwood to match his broiler score. Shields also gives turkeys and broilers the same score. So I rate turkeys at -6 to match my broiler score.

Norowitz gave turkeys a better score than broilers due to a smaller fraction of their lives being spent in transport and slaughterhouses.

Broilers (-6)
Broilers live in extremely tight quarters. “Just prior to harvest each chicken has about 100 square inches (0.7 square feet).” Their manure accumulates, and they live in it. “Barn air is filled with ammonia, which can cause lung problems.” Extended periods of light induce more eating. So farmers typically cut the lights in the barn off for only four hours.

As a result of being bred for maximum size, they “grow so fast and heavy that they develop leg problems.” CBTP cites a study that measured the prevalence of leg problems. Birds were assigned a “gait score” ranging from 0 (normal gait) to 5 (unable to walk). “About 28 percent of birds were assigned a gait score of 3 or higher, and despite the fact that the farmers routinely culled birds with severe leg problems, 3.3 percent... were almost unable to walk.” An overwhelming majority of birds had problems. 71.1% had a score of 2 or higher. 97.7% had a score of 1 or higher. The study singles out level 3 because other studies using analgesics indicate that chickens are in pain at that level.
http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0001545

Along with the leg problems, some have “a heart problem that kills up to 3 percent of broilers and affects the welfare of another 2 percent.”

As a result of being bred to grow so fast, if the breeders were to grow to full size they would not be able to walk. So they’re starved, “receiving 25-35 percent of the feed they would like to consume.” Breeders also have their beaks cut off and their combs cut. Breeders are 0.69% of the population.

Given these conditions, which Norwood himself documents, his positive rating for broilers is puzzling. But I also think Shields goes too far with -8. Hens have it even worse than broilers and she gives hens a -7. I settled on -6, worse than pork and better than hens.

Note: Broilers are tightly confined, but they’re not caged. A “cage-free” label on chicken is just a trick to give the impression that it was humanely raised.

Cage-Free Hens (-7)
Cage-free hens have a little more room than caged hens but still live extremely cramped, with 144 to 200 square inches per hen. Hen breeds are aggressive, and such cramped quarters lead to a lot of fighting, injury and death. The flocks often contain 30,000 or more hens, which means they can’t establish a pecking order. This also leads to fighting, injury and death. “Producers report much higher rates of injury, cannibalism, and death on cage-free farms.” Mortality rates in cage-free systems are 7% compared to 3% for cage systems. Like broilers, they live in their own manure, with very high levels of ammonia in the air.

“Many farmers and animal scientists in the US believe the cage system to provide higher welfare. While a barn system allows hens to walk around and behave naturally, the higher prevalence of injury and higher mortality rates counteract those benefits.”

Given these conditions, which Norwood himself documents, his positive rating for cage-free hens is puzzling. I think they might be a little better off than caged hens, but the conditions are still terrible. They’re worse off than broilers. So I settled on -7. Shields gave no score for cage-free.

Veal (-7)
Very little veal is sold in the US (0.4 lbs per person, 2008), so I didn’t include it in all the comparisons. But since CBTP covers it and Norwood gave it a score I’m including it here. Most male calves of dairy cows are raised for beef. About 30% are raised for veal. Separation shortly after birth is highly traumatic for both the mother and her calf. Some calves are kept in individual stalls so small they can’t turn around. Others are kept in group pens where they have a little room to move around. CBTP, published in 2011, states, “Approximately 35 percent of veal calves are currently raised in group housing, and by 2017 most all veal operations will be doing the same.”

Calves, obviously, need their mothers. And not having them makes for a surely miserable 16 weeks of life.

Caged Hens (-8)
Male chicks are thrown live into grinders, if not put in bags to suffocate. At 17 weeks of age, laying hens are placed in a cage with four or five other hens where she will spend the rest of her life. “Typical cage systems provide 67 square inches per bird.” That’s not even enough room for them to extend their wings. Many lose their feathers from rubbing against the wires and their feet become crippled from standing on the wire-mesh floor. Close confinement leads to a lot of fighting, injury and death. Their beaks are cut off to minimize fighting injuries. “The beak contains high populations of nerve fibers and studies have shown that beak trimming may lead to chronic pain.” They “have a natural desire to dust-bathe and lay eggs in private nests, both of which are unavailable in a cage system.”

“Hens naturally go through a molting stage where they lose and then grow new feathers.” Following this, their egg-laying rate increases. When an adult hen becomes less productive starvation can induce molting. Most US eggs are United Egg Producers Certified, which does not allow starvation-induced molting.

The FOWEL rating system rates the cage system as the worst possible system. “On a scale of 0 (worst) to 10 (best), the FOWEL model gave the cage system a score of 0.0, the enriched-cage system a score of 2.3, the aviary system a score of 5.8, barn system a score of 5.9, and a barn system with free-range received a score of 6.3” About “95 percent of all US eggs are produced under the cage system.”

Welfare labels

Welfare labels can be highly misleading. “Grass-fed” and “cage-free” are two deceptive labels already mentioned above. The ASPCA has a “Meat, Eggs and Dairy Label Guide” that recommends only these three labels:

Animal Welfare Approved
Certified Humane
Global Animal Partnership, step 2 and above

The Humane Society also has information on labels. They claim that Animal Welfare Approved has the highest standards.

Norwood and Lusk agree that Animal Welfare Approved has the highest standards. (p. 159)

Store and farm locations for each of the labels can be found on their websites.

“Organic” is a popular label which allows all sorts of abuse. Not only that, but organic is any some ways even worse than standard factory farming. For farmers to sell their animals and animal products as organic they can’t use antibiotics. That means that when their animals are sick they can’t treat them. They have to just let them stay sick. There are also synthetic amino acids that help meet animals’ nutritional needs, but organic farmers can’t use them. So the animals suffer. Hen mortality rates for organic eggs are more than four times higher than for standard eggs (13% compared to 3%). (Norwood and Lusk p. 122, 158)

More calculations

Finfish calculations

Fish live long and produce relatively little meat. Many provide less meat than chickens. This means the time of suffering per pound, for farm-raised fish, is far more than for all the other animals. The farmed-fish

living conditions are also among the worst. Shields rates it at -7. That's just as bad as for laying hens and just about as bad as for broilers and turkeys at -8. For wild caught fish, this is not an issue. The central ethical issue for wild caught fish is their gruesome death. They either suffocate to death or are crushed to death in nets.

Here are the numbers for the top four US consumed farmed finfish.

Catfish:
1.7 lbs live x 0.5 = 0.85 lbs of meat
2.25 years of life / 0.85 lbs = **2.6 years of suffering per pound at 75% of maximal suffering.**
http://reducing-suffering.org/how-much-direct-suffering-is-caused-by-various-animal-foods/

Tilapia:
1.16 lbs live x 0.34 = 0.4 lbs of meat
183 days of life / 0.4 lbs of meat = 458 days or
1.25 years of suffering per pound at 75% of maximal suffering.
http://www.thefishsite.com/articles/58/tilapia-life-history-and-biology/

Pangasius:
2.2 lbs live x 0.5 = 1.1 lbs of meat
210 days of life / 1.1 lbs of meat = 191 days or
6.4 months of suffering per pound at 75% of maximal suffering.
2.2 lbs:
http://www.countinganimals.com/how-many-animals-does-a-vegetarian-save/
live 6-8 months:
https://www.seafoodwatch.org/-/m/sfw/pdf/reports/c/mba_seafoodwatch_catfish_vietnam_report.pdf

Salmon:
8.6 lbs live x 0.5 = 4.3 lbs of meat
1.75 years of life / 4.3 lbs of meat = 0.4 years or
4.9 months of suffering per pound at 75% of maximal suffering.
http://reducing-suffering.org/how-much-direct-suffering-is-caused-by-various-animal-foods/

That's a range from 4.9 months to 2.6 years of suffering per pound.
4.9 months + 6.4 + 15 + 31.2 / 4 = 14.375 months = **1.2 years average**

Average by US consumption:
(4.9 x 0.458) + (6.4 x 0.187) + (15 x 0.248) + (31.2 x 0.107) = 10.5 months
https://animalcharityevaluators.org/research/dietary-impacts/fish-consumption/

The 4 fish above are drawn from the top 10 US consumed fish by the pound. The top 10 make up 90% of consumption (13.46 lbs per capita out of 14.9 lbs total). Shellfish—shrimp (1), crab (8) and clams (10)—are excluded due to more questionable sentience. Shrimp is dealt with below. Tuna (3), polluck (5) and cod (7) are usually wild caught. That leaves salmon (2), tilapia (4), pangasius (6) and catfish (9) making up the vast majority of farmed finfish.
https://animalcharityevaluators.org/research/dietary-impacts/fish-consumption/

Shrimp calculations

Looking at brain structure, crustacean consciousness is more questionable than finfish consciousness. But the evidence for crustacean consciousness from behavioral studies is just as strong as for finfish.
https://en.wikipedia.org/wiki/Pain_in_crustaceans

Farmed shrimp live 3 to 6 months.
https://en.wikipedia.org/wiki/Marine_shrimp_farming#Life_cycle

There are 10 to 70 shrimp per pound.
https://www.thespruceeats.com/shrimp-counts-per-pound-and-serving-sizes-3054059

26 per pound is perhaps the average. (I suspect this is low.)
http://www.countinganimals.com/how-many-animals-does-a-vegetarian-save/

Assuming the smallest shrimp reach maturity the fastest the range is:
3 months x 70 per pound = 210 months or 17.5 years
6 months x 10 per pound = 60 months or 5 years

That's **5 to 17.5 years of suffering per pound at 75% of maximal suffering.**

Possible average:
4.5 months x 26 per pound = 117 months or
9.75 years of suffering per pound at 75% of maximal suffering.

Using middle count as average:
4.5 months x 40 per pound = 180 months or
15 years of suffering per pound at 75% of maximal suffering.

Egg Calculations

Hen lays 250 eggs per year:
https://www.farmsanctuary.org/learn/factory-farming/chickens/
Starts laying at 20 weeks and is killed at 85 weeks:
http://extension.psu.edu/animals/poultry/topics/general-educational-material/the-chicken/modern-egg-industry
1 hen life = 85 weeks = 595 days = 1.6 years
1.6 years = 1.25 productive years (85 weeks - 20 weeks)
1.25 x 250 = 312.5 eggs produced by 1 hen
595 / 312.5 = 1.9 days of suffering per egg
1 hen = 312.5 eggs x 1.7 oz = 531 oz / 16 = 33 pounds of food per hen

A hen provides 11 times as much food as a broiler (33 lbs of eggs / 3 lbs meat), but it suffers 14 times longer (85 weeks / 6 weeks).

A broiler lives 6 weeks and provides 3 lbs of food. 6 weeks of a hen's life amounts to 2.4lbs of food.

Egg industry male chicks are killed. Assuming male and female chicks are 50:50, then for every hen killed (after production declines) there was also 1 male chick killed. So 312.5 eggs from 1 hen = 2 chickens killed, or 1 kill per 156 eggs. (This does not include the mortality rate.)

"Most of the nutrients consumed by a hen are put to work in egg production. Consequently, there is very little meat to harvest at the end of the hen's life. As a result, spent hens are used mainly in the production of pet food." (Norwood and Lusk, p. 117)

Dairy Calculations

22,774 lbs milk per cow per year, 2016:
(This excludes calf milk; includes dry cows; and "excludes heifers not yet fresh," which I assume means not yet lactating.)
http://usda.mannlib.cornell.edu/usda/current/MilkProd/MilkProd-03-20-2017.pdf
680 calories per quart x 4 = 2,720 per gallon
http://www.myfitnesspal.com/food/calories/generic-raw-jersey-cow-milk-411153310
1 gallon = 8.6 pounds

http://familycow.proboards.com/thread/12870
22,774lbs / 8.6 = 2,648 gallons x 2,720 = 7,202,560 calories per year
Bred at 13 months + 9 months gestation = milk at 22 months:
https://en.wikipedia.org/wiki/Dairy_cattle#Management
48 month life - 22 months before lactating = 26 month productive period
7,202,560 calories per year x 2.17 years = 15,629,555 lifetime calories
15,629,555 / 4 = 3,907,389 average calories per year over lifetime

540 lbs x 1,329 calories = 717,660 calories per beef cow
15,629,555 lifetime milk calories / 717,660 beef calories = 22 times more calories from milk cow

540 lbs / 1.5 years = 360 lbs per year x 1,329 calories = 478,440 beef calories per year
3,907,389 milk calories per year / 478,440 beef calories per year = 8.2 times more calories from milk cow per year of life

The estimate for beef was 24 hours of suffering per pound (1,329 calories).
15,629,555 lifetime milk calories / 1,329 = 11,760 beef pound equivalents from a dairy cow.
1,460 life-days / 11,760 = 0.124 days or 3 hours of suffering per beef pound equivalent.

7.5 gallons of milk per day (Norwood and Lusk, p. 257)

1 lb cheese = 10 lbs milk (Norwood and Lusk, p.257)

In addition to the 15.6 million calories of milk she produces, she is then slaughtered for her meat. 7.7% of the cows killed for meat are dairy cows (2008). (Norwood and Lusk, p.232)

“In 2014, approximately 9.5% of the cattle slaughtered in the U.S. were culled dairy cows.”
https://en.wikipedia.org/wiki/Dairy_cattle#Management

Ground beef is 18% dairy cow (1994).
https://www.aphis.usda.gov/animal_health/nahms/dairy/downloads/dairy96/Dairy96_is_BiosecurityPrac.pdf

"20 percent of the U.S. beef production is derived from dairy-breed cows and steers."
"Market dairy cows are responsible for 18 percent of total ground beef production…"
https://www.beefboard.org/producer/CBBFinalDairyBrochure.pdf
(2008 or later)

"Dairy cows make up about 30% of all market-cow slaughter" (2011)
https://fyi.uwex.edu/wbic/files/2011/04/Beef-from-Market-Cows.pdf

Consciousness

Intuition and uncertainty

The harm rankings in the reducetarian consumer guide are highly counter intuitive. Our strongest sympathies are for the animals lowest on the list and we have virtually no sympathy for the ones highest on the list. Many animal lovers don't eat beef, pork, turkey or chicken but do eat fish. I think this is a big mistake. One meal of shrimp causes more suffering than eating beef every day for many years. Vegetarians eat eggs. Eating eggs causes more suffering than eating chicken or turkey and it causes 13 times more suffering than eating pork. It’s even worse than that in relation beef.

Even if we factor in lower probabilities of consciousness for the animals higher on the list the enormous gaps in time of suffering between levels mean that these different probabilities won't change the rankings. In order to think that eating shrimp is less harmful than eating finfish you would have to think

that shrimp are not just less likely than finfish to be conscious but more than 8 times less likely. There's no reason to think this. The same behavioral studies that suggest fish feel pain also suggest that crustaceans feel pain.

To be more concerned for birds than fish you would have to think that fish are more than 31 times less likely to be conscious. Again, there's no reason to think this. They both have a telencephalon which is similar to the mammalian cortex and behavioral studies suggest they both feel pain.

To be more concerned for pigs than birds you would have to think that birds are more than 10 times less likely to be conscious. Again, there's no reason to think this.

Expected value is the possible outcome (x days of suffering) multiplied by the probability of the outcome (y probability of consciousness). For example, 2 days of suffering x 0.8 probability of consciousness = 1.6 expected days of suffering.

Let's say finfish has a probability of consciousness of 1, which is certainly too high. And let's say shrimp has a probability of consciousness of 0.5, which is definitely too low relative to a finfish probability of 1.

9.75 years of suffering x 0.5 probability of consciousness = 4.88 expected years of suffering
1.2 years of suffering x 1 probability of consciousness = 1.2 expected years of suffering

Even with what is clearly too large of a spread between probabilities the expected time of suffering for shrimp is still 4 times longer than for finfish. Plug in 0.5 and 1 to compare each level and a large gap between levels remains. The only way to change these rankings is to plug in clearly unmerited extreme gaps in probability.

Here's another illustration, using probabilities of 0.1, 0.2, 0.3 and 0.4 for each level:

117 months of shrimp suffering x 0.1 probability of consciousness = 11.7 months of suffering per pound
14.4 months of finfish suffering x 0.2 probability of consciousness = 2.9 months of suffering per pound
14.5 days of bird suffering x 0.3 probability of consciousness = 4.35 days of suffering per pound
32 hours of pig suffering x 0.4 probability of consciousness = 12.8 hours of suffering per pound

Here's if we peg mammals at 1 and have an equal spread down to 0.1 for crustaceans:

117 months of shrimp suffering x 0.1 probability of consciousness = 11.7 months of suffering per pound
14.4 months of finfish suffering x 0.4 probability of consciousness = 5.8 months of suffering per pound
14.5 days of bird suffering x 0.7 probability of consciousness = 10 days of suffering per pound
32 hours of pig suffering x 1 probability of consciousness = 32 hours of suffering per pound

I think the above illustrations for probabilities of consciousness also cover the possibility of differing capacities for suffering among different classes of animals.

The consciousness problem

All the above analysis and recommendations might be completely wrong.

I know that I am conscious, can feel pain and can suffer. When I feel pain, I behave in a way that signals to others that I am in pain. When I see others behaving in a similar way, I infer that they are in pain. But they might not be. I don't know for sure that anyone other than myself is conscious. But the inference is a good one. As members of the same species, other humans have brains that are like mine. Whatever it is my brain that is responsible for consciousness, other humans likely have it too. So when I see behavior in others that I associate with consciousness in myself, I can reasonably assume that that behavior is associated with consciousness in them. (People can also tell me what they're feeling.)

Our belief that animals are conscious is based on this same inference. When we see animals behave in ways that we associate with various emotions and feelings in ourselves, we assume that they are feeling something similar. This is not necessarily so. Whatever it is in our brains that is responsible for consciousness might not be in their brains. We know that all sorts of extremely sophisticated behavior that we associate with consciousness can occur without consciousness. It could be that the specific neural correlates of consciousness are unique to humans. It could also be that they are present in some animals that we assume are conscious, but not in others.

Most neuroscientists agree that the cortex is necessary for consciousness. Only mammals have a cortex. The neural correlates of consciousness might be present in humans only, or perhaps humans and apes only, or perhaps humans and all mammals. So maybe all mammals are conscious and no non-mammals. Then again, perhaps some non-mammals have developed their own neural correlates of consciousness in brain structures that we don't have. The telencephalon in birds, for example, is a cortex like structure. So birds may have developed consciousness independently of mammals. The same might be the case for fish and their telencephalon.

Until neural networks necessarily correlated with consciousness, or behavior necessarily correlated with consciousness, are pinned down, we simply don't know what other animals, if any, are conscious. However, all mammals, birds, finfish and crustaceans have nervous systems that are plausibly capable of consciousness and they all display behavior associated with consciousness. As a basic moral principle, we should therefore presume they are all conscious until proven otherwise.

A wide range of probabilities of consciousness were added to the conclusions above and none of them changed the conclusions. The rankings of harm hold up to a very wide range of possibilities.

Comparisons within animal classes, having no difference in probabilities of consciousness, can be made with the highest degree of confidence. This is most relevant for pigs and cows, since there is a large difference in their treatment and output. Since pigs are treated considerably worse than cows and produce much less meat, we can say with near certainty that eating factory farmed pork is much worse than eating factory farmed beef or dairy.

Some reading on consciousness

Neuroscientist Joseph LeDoux, in his 2015 book *Anxious*, reviews all the evidence and concludes that there is no scientific evidence for animal consciousness:

> All members of a species are genetically endowed with brains that have the same general capacities, so it is safe to assume that if one person has the capacity for consciousness, other humans are very likely to as well. And because the brain circuits that play a key role in human consciousness (especially the prefrontal cortex) are different (at least to some degree) even in nonhuman primates, we should tread carefully when attributing consciousness to other species. (p. 200)

Neuroscientist V.S. Ramachandran believes that consciousness can't occur apart from self-consciousness and is unique to humans. In this paper he proposes three laws of consciousness and a behavioral test for consciousness.
https://www.sciencedharma.com/uploads/7/6/8/0/76803975/qualia.pdf

Christof Koch, who believes mammals, birds and fish are conscious, is a leading neuroscientist working on finding the neural correlates of consciousness. Here's a 2016 paper of his on that. (The most recent I've seen.)
https://www.researchgate.net/publication/301567963_Neural_correlates_of_consciousness_Progress_and_problems

Here's the evidence for bird and cephalopod consciousness.

http://users.sussex.ac.uk/~anils/Papers/EdelmanBaarsSeth.pdf

Here's the evidence for fish consciousness.
http://www.fishpain.com/
http://www.humanesociety.org/assets/pdfs/farm/hsus-fish-and-pain-perception.pdf

Here's the evidence for consciousness in all vertebrates.
http://wexler.free.fr/library/files/merker%20(2006)%20consciousness%20without%20a%20cerebral%20cortex.%20a%20challenge%20for%20neuroscience%20and%20medicine.pdf

Here's the evidence for crustacean consciousness.
https://en.wikipedia.org/wiki/Pain_in_crustaceans

Here's the evidence for consciousness in all vertebrates and insects.
www.pnas.org/content/113/18/4900.full

Environmental_impact

CO2eq

This is a meta-analysis published in Science, 6/1/18. It provides estimates for kilograms of CO2 equivalent per 100 grams of protein (p. 6):
http://users.ox.ac.uk/~quee3380/Science%20360%206392%20987%20-%20Accepted%20Manuscript.pdf
I converted kilograms to pounds and divided that by 5 to get pounds of CO2 equivalent per serving of 20 grams of protein. This is then multiplied by 365 to get pounds of CO2e per year at 1 serving of 20g of protein per day.

Beef (from beef herd): 22 lbs CO2e per 20g prot x 365 days = 8,030 lbs in year at 1 serving per day
Beef (ground, 18% from dairy herd): (22 x 0.82) + (7.5 x 0.18) = 19.39 lbs x 365 = 7,077
Lamb and Mutton: 8.8 lbs x 365 = 3,212
Crustaceans (farmed): 8 lbs x 365 = 2,920
Beef (from dairy herd): 7.5 lbs x 365 = 2,738
Cheese: 4.86 lbs x 365 = 1,774
Milk: 7 lbs CO2e per liter = 4.14 lbs per 20g prot x 365 = 1,511
Pork: 3.36 lbs x 365 = 1,226
Fish (farmed): 2.64 lbs x 365 = 964
Poultry: 2.52 lbs x 365 = 920
Eggs: 1.86 lbs x 365 = 679

Grains: 1.19 lbs x 365 = 434
Tofu: 0.88 lbs x 365 = 321
Groundnuts: 0.53 lbs x 365 = 193
Other Pulses: 0.352 lbs x 365 = 128
Peas: 0.176 lbs x 365 = 64
Nuts: 0.132 lbs x 365 = 48

The least carbon intensive animal product (eggs) is 1.56 times more carbon intensive than the most carbon intensive animal alternative (grains). It's 5.28 times more carbon intensive than the most common animal alternative (pulses).

For comparison, one gallon of gasoline produces 19.6 pounds of CO2:
https://www.eia.gov/tools/faqs/faq.php?id=307&t=11

Since beef is by far the most carbon intensive meat some might be inclined to eat other meats instead of beef for the sake of saving carbon. So let's take a look at what that trade-off entails. One serving of chicken with 20 grams of protein entails 19.48 pounds less CO2e than one serving of beef with 20 grams

of protein. That one serving of chicken also entails 2.2 days of intense suffering. Is that a fair trade? Is it fair to inflict 2.2 days of intense suffering on an animal to save 19.48 pounds of greenhouse gases? I don't think so. If you're going to eat meat, it's much better to produce a few pounds of greenhouse gases than a few days of intense suffering.

To minimize suffering and greenhouse gases we need to eat plant alternatives. 20 grams of protein from beans produces 21.6 pounds less CO2e than beef and 2.2 lbs less than chicken, without any suffering.

In 2013, Giving What We Can reviewed over 100 organizations that work to reduce greenhouse gas emissions. They concluded that donating to Cool Earth was the most cost-effective way to save carbon:
https://www.givingwhatwecan.org/post/2013/11/less-burn-for-your-buck-part-ii/
In *Doing Good Better* (2015), William MacAskill discusses their findings and cites $1.34 per metric ton as a conservative estimate and $5 per metric ton taking this conservative estimate and allowing a 300% margin of error.

No meat or animal products is best, but even a high level of beef can be very cheaply offset. 20 grams of protein from beef every day for a year produces 8,030 pounds of CO2e. That's 3.64 metric tons. At $5 per tonne that can be offset for $18.20.
https://www.coolearth.org/

Whether or not that's the best thing to do with $18.20 is another question. For more on that, read Will's book.

This more recent paper (7/18?) identifies two organizations that are even more cost-effective:
https://www.founderspledge.de/en-US/research/Cause%20Report%20-%20Climate%20Change.pdf
"…a donation to CfRN will avert a tonne of CO2e for $0.12, with a plausible range of $0.02 - $0.72."
http://rainforestcoalition.org/
"…CATF produced large benefits for human health, and averted a tonne of CO2e for $1.26 with a confidence interval of $0.35- $4.40."
http://www.catf.us/

Here are the above numbers converted to 200 calorie servings.

Crustaceans (shrimp): 20g prot serving = 102 total cal; 8 lbs CO2e x 1.96 = 15.68 lbs CO2e per 200 cal
Beef: 20g prot serving = 328 total cal; 22 lbs x 0.6 = 13.2 lbs
Beef (ground): 20g prot serving = 328 cal; 19.39 lbs x 0.6 = 11.6 lbs
Fish: 20g prot serving = 177 total cal; 2.64 lbs x 1.13 = 3 lbs
Turkey: 20g prot serving = 170 total cal; 2.52 lbs x 1.18 = 3 lbs
Chicken: 20g prot serving = 166 total cal; 2.52 lbs x 1.2 =3 lbs
Cheese: 20g prot = 353 cal; 4.86 lbs x 0.57 = 2.77 lbs
Pork: 20g prot serving = 312 total cal; 3.36 lbs x 0.64 = 2.15 lbs
Milk: 7 lbs CO2e per liter = 634 cal = 1.89 lbs per 200 cal
Eggs: 20g prot serving = 250 total cal; 1.86 lbs x 0.8 = 1.5 lbs

The changes in rankings here are due to large differences in fat content. If you're eating lean meat, then the protein comparisons are better. If you're eating meat with full fat, then the calorie comparisons are better. To compare the meat and animal products to plants we need to look at calories, since the plants have a lot of carbohydrates in addition to protein and fat. If we just compare protein, then most of the calories aren't being counted. Here are the plants from above converted to 200 calories along with other plants from the study that were already given in calories.

Tofu: 20g prot serving = 188 total cal; 0.88 lbs CO2e x 1.06 = 0.93 lbs CO2e per 200 cal
Cassava: 3.09 lbs per 1,000 cal / 5 = 0.618 lbs
Rice (flooded): 2.65 lbs per 1,000 cal / 5 = 0.53 lbs
Soymilk: 2.2 lbs CO2e per liter = 902 cal = 0.49 lbs per 200 cal
Oatmeal: 1.98 lbs per 1,000 cal / 5 = 0.396 lbs

Other Pulses (soy) = 20g prot serving = 242 total cal; 0.352 lbs x 0.83 = 0.29 lbs
Potatoes: 1.32 lbs per 1,000 cal / 5 = 0.264 lbs
Wheat and Rye (bread): 1.32 lbs per 1,000 cal / 5 = 0.264 lbs
Groundnuts (peanuts) = 20g prot serving = 460 total cal; 0.53 lbs x 0.43 = 0.23 lbs
Maize (meal): 0.88 lbs per 1,000 cal / 5 = 0.176 lbs
Peas: 20g prot serving = 320 total cal; 0.176 lbs x 0.625 = 0.11 lbs
Nuts: 20g prot serving = 720 total cal; 0.132 lbs x 0.28 = 0.04 lbs

The World Resource Institute also has estimates for CO2 equivalents for many foods. There's a bar graph on page four of this 2016 report that compares by calorie and a bar graph on page six that compares by protein. Both graphs also show estimates for land and water use.
http://www.wri.org/sites/default/files/Shifting_Diets_for_a_Sustainable_Food_Future_1.pdf
The data for the calorie graph can be seen here:
https://resourcewatch.org/data/explore/Foo_046-Food-Footprint-in-Calories
The data for the protein graph can be seen here:
https://resourcewatch.org/data/explore/Foo_046a-Food-Footprint-in-Protein
The CO2e estimates are far higher than in the Science paper above. This is due to a different way of calculating "land-use change," such as deforestation to make way for crops and pasture. The estimates just for production are actually lower than in the Science paper. The Science paper does incorporate land-use change estimates which can be seen on page 17 of that report.

Land use

Square meters of land per year per 20 grams of protein, from same Science paper as above (p. 6).
http://users.ox.ac.uk/~quee3380/Science%20360%206392%20987%20-%20Accepted%20Manuscript.pdf

Lamb and Mutton: 37
Beef (from beef herd): 32.8
Cheese: 8.2
Beef (from dairy herd): 4.4
Pork: 2.2
Nuts: 1.58
Other Pulses: 1.46
Poultry: 1.42
Eggs: 1.14
Grains: 0.92
Fish: 0.74
Groundnuts: 0.7
Peas: 0.68
Tofu: 0.44
Crustaceans: 0.4

Some of the above orderings don't make much sense. Here are some other estimates:
https://ourworldindata.org/agricultural-land-by-global-diets

Beef/Mutton: 20.5 square meters per year per 20 grams of protein
Pork: 2.6
Fresh Produce: 2
Poultry: 1.5
Eggs: 1
Dairy: 0.88
Wheat: 0.7
Rice: 0.46
Maize: 0.29
Pulses: 0.2

The World Resources Institute has estimates that distinguish between pasture and cropland. The graphs are on pages four and six here:
http://www.wri.org/sites/default/files/Shifting_Diets_for_a_Sustainable_Food_Future_1.pdf
The data for the calorie graph can be seen here:
https://resourcewatch.org/data/explore/Foo_046-Food-Footprint-in-Calories
The data for the protein graph can be seen here:
https://resourcewatch.org/data/explore/Foo_046a-Food-Footprint-in-Protein

Per million calories (1 year's calories) // 2,740 calories (1 day's calories) // 200 calorie serving

Beef: 1.26 acres cropland + 30 acres pasture = 31.26 total acres per million calories
/ 365 = 414.5 square yards per day's calories / 13.7 = 30.3 square yards per 200 calories
Sheep and Goat: 3.48 acres cropland + 25.7 acres pasture = 29.18 total acres per year's cal
/ 365 = 387 square yards per day's cal / 13.7 = 28.9 square yards per 200 cal
Dairy: 0.5 acres cropland + 4.5 acres pasture = 5 total acres
/ 365 = 66.3 square yards per day's cal / 13.7 = 4.8 square yards per 200 cal
Poultry: 4.4 acres per year = 58.35 sq yards per day = 4.26 sq yards per 200 cal
Fish: 3.24 acres per year = 42.96 sq yards per day = 3.14 sq yards per 200 cal
Eggs: 3.06 acres per year = 40.58 sq yards per day = 2.96 sq yards per 200 cal
Pork: 1.8 acres per year = 23.87 sq yards per day = 1.74 sq yards per 200 cal
Pulses: 1.09 acres per year = 14.45 sq yards per day = 1.06 sq yards per 200 cal
Nuts: 0.89 acres per year = 11.80 sq yards per day = 0.86 sq yards per 200 cal (7.74 sq ft)
Fruits & Vegetables: 0.59 acres per year = 7.82 sq yards per day = 0.57 sq yards per 200 cal (5.13 sq ft)
Wheat: 0.35 acres per year = 4.64 sq yards per day = 0.34 sq yards per 200 cal (3 sq ft)
Roots & Tubers: 0.30 acres per year = 3.98 sq yards per day = 0.29 square yards per 200 cal (2.61 sq ft)
Maize: 0.27 acres per year = 3.58 sq yards per day = 0.26 sq yards per 200 cal (2.35 sq ft)
Rice: 0.22 acres per year = 2.92 sq yards per day = 0.21 sq yards per 200 cal (1.92 sq ft)
Sugar: 0.074 acres per year = 0.98 sq yards per day = 0.07 sq yards per 200 cal (0.64 sq ft)

Land use is an important issue because demand for cropland and pasture drives deforestation, which is a major contributor to global warming, as well as a contributor to the displacement of people that live in or depend on the forests being cut down. Plant alternatives to meat and animal products use much less land.

More on land use here:
https://ourworldindata.org/yields-and-land-use-in-agriculture
https://ourworldindata.org/agricultural-land-by-global-diets

Maps showing how much land is used for pasture, livestock feed and human crops in contiguous U.S.:
https://www.bloomberg.com/graphics/2018-us-land-use/

Calorie conversion inefficiency

Conversion inefficiency, by calorie and protein
http://iopscience.iop.org/article/10.1088/1748-9326/11/10/105002

Beef: 97% loss of calories, 34.2 in to 1 out
Pork: 91% loss of calories, 11.2 in to 1 out
Poultry: 87.6% loss of calories, 8 in to 1 out
Dairy 83.4% loss of calories, 6 in to 1 out
Eggs: 81.8% loss of calories, 5.5 in to 1 out

Conversion inefficiency, by calorie and protein (p. 43)
Beef, Sheep, Shrimp, Milk, Pork, Poultry, Finfish, Egg (99 to 87% loss)
http://www.wri.org/sites/default/files/Shifting_Diets_for_a_Sustainable_Food_Future_1.pdf

These rankings appear to contradict Kleiber's law, which states, I think, that larger animals convert calories more efficiently. The big jump in inefficiency for beef might be explained by the fact that they eat a large amount of roughage, and that roughage is converted less efficiently than grain. But that wouldn't explain why pork is less efficient than poultry. So I don't know what is going on here. Whatever the case may be, converting crop to flesh for human consumption, whatever the animal, is extremely inefficient.

Waste

This 2/14 USDA report provides food waste estimates for numerous food groups at the retail and consumer level by pounds and percentage (p. 17), per capita pounds and percentage (p. 20), dollars and percentage (p. 21), per capita dollars and percentage (p. 23), calories and percentage (p. 25), and per capita calories and percentage (p. 27). The data is from 2010.
https://www.ers.usda.gov/publications/pub-details/?pubid=43836

Grain products: 31% wasted, 19% at consumer level
Fruit: 29% wasted, 19% at consumer level
    Fresh: 37% wasted, 25% at consumer level
    Processed: 17% wasted, 4.5 % at consumer level
Vegetables: 30% wasted, 22% at consumer level
    Fresh: 34% wasted, 24% at consumer level
    Processed: 24% wasted, 18% at consumer level
Dairy products: 31% wasted, 20% at consumer level
    Milk: 32% wasted, 20% at consumer level
    Other: 29% wasted, 19% at consumer level
Meat, poultry, and fish: 26% wasted, 22% at consumer level
    Meat: 27% wasted, 23% at consumer level
    Poultry: 22% wasted, 18% at consumer level
    Fish: 39% wasted, 31% at consumer level
Eggs: 28% wasted, 21% at consumer level
Tree nuts and peanuts: 15% wasted, 9% at consumer level
Added sugar and sweeteners: 41% wasted, 30% at consumer level
Added fats and oils: 38% wasted, 17% at consumer level

Total: 31% wasted, 21% at consumer level

All the environmental impact estimates in this section are for production. Much of what is produced is wasted. To get estimates for what is consumed we can divide the production estimates by the percentage consumed estimates. Here are estimates for CO2e:

Beef: 22 lbs CO2e per 20g prot produced / 0.73 consumed = 30.1 lbs CO2e per 20g prot consumed
Beef (ground, 18% from dairy herd) 19.39 lbs / 0.73 = 26.6 lbs
Crustaceans: 8 lbs / 0.61 = 13.1 lbs
Lamb and Mutton: 8.8 lbs / 0.73 = 12.1 lbs
Beef (from dairy herd): 7.5 lbs / 0.73 = 10.3 lbs
Cheese: 4.86 lbs / 0.71 = 6.8 lbs
Milk: 4.14 lbs / 0.68 = 6.1 lbs
Pork: 3.36 lbs / 0.73 = 4.6 lbs
Fish (farmed): 2.64 lbs / 0.61 = 4.3 lbs
Poultry: 2.52 lbs / 0.78 = 3.2 lbs
Eggs: 1.86 lbs / 0.72 = 2.6 lbs

Grains: 1.19 lbs / 0.69 = 1.7 lbs
Tofu: 0.88 lbs / 0.69 = 1.3 lbs
Groundnuts: 0.53 lbs / 0.85 = 0.62 lbs
Other Pulses: 0.352 lbs / 0.69 = 0.51 lbs
Peas: 0.176 lbs / 0.69 = 0.26 lbs

Nuts: 0.132 lbs / 0.85 = 0.16 lbs

Suffering per pound, factoring in waste:

Shrimp: 9.75 years of suffering per pound produced / 0.61 consumed = 16 years per pound consumed
Finfish: 1.2 years of suffering per pound produced / 0.61 = 2 years per pound consumed
Eggs: 17.6 days of hen suffering per pound produced (9.4 eggs) / 0.72 = 24.4 days per pound consumed
Chicken: 14 days of suffering per pound produced / 0.78 = 17.9 days per pound consumed
Turkey: 10.5 days of suffering per pound produced / 0.78 = 13.5 days per pound consumed
Pig: 1.34 days of suffering per pound produced / 0.73 = 1.8 days per pound consumed
Beef Cow: 5.4 hours of questionable quality of life per pound produced / 0.73 = 7.4 hrs per lb consumed
Dairy Cow: 3 hrs questionable life quality per beef lb eq produced / 0.73 = 4.1 hrs per lb consumed

This 8/12 NRDC report provides food waste percentage estimates for five food categories at five stages in the supply chain (p. 5, 6):
https://www.nrdc.org/sites/default/files/wasted-food-IP.pdf
Milk: 20% wasted, 17% by the consumer
Meat: 22% wasted, 12% by the consumer
Grain Products: 38% wasted, 27% by the consumer
Seafood: 50% wasted, 33% by the consumer
Fruits and Vegetables: 52% wasted, 28% by the consumer

NRDC report, second edition, 8/17:
https://www.nrdc.org/resources/wasted-how-america-losing-40-percent-its-food-farm-fork-landfill

More food waste estimates, ranging from 30 to 50%:
30-40%
https://www.usda.gov/oce/foodwaste/faqs.htm
33% globally
http://static.newclimateeconomy.report/wp-content/uploads/2015/02/WRAP-NCE_Economic-environmental-gains-food-waste.pdf?utm_content=buffer01c20&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer
33%
https://news.nationalgeographic.com/news/2014/10/141013-food-waste-national-security-environment-science-ngfood/
40-50%
https://www.foodnavigator-usa.com/Article/2004/11/26/US-wastes-half-its-food?id=56376-us-wastes-half

Global impact

From the Science paper used throughout this section:

"…Meat, aquaculture, eggs, and dairy use ~83% of the world's farmland and contribute 56-58% of food's different emissions, despite providing only 37% of our protein and 18% of our calories…. We find that the impacts of the lowest-impact animal products exceed average impacts of substitute vegetable proteins across GHG emissions, eutrophication, acidification (excluding nuts), and frequently land use."

"…Moving from current diets to a diet that excludes animal products has transformative potential, reducing food's land use by 3.1 billion hectares (a 76% reduction), including a 19% reduction in arable land; food's GHG emissions by 6.6 billion metric tons of CO2eq (a 49% reduction); acidification by 50% (45-54%); eutrophication by 49% (37-56%); and scarcity-weighted freshwater withdrawals by 19% (-5 to 32%) for a 2010 reference year…. For the United States, where per capita meat consumption is three times the global average, dietary change has the potential for a far greater effect on food's different emissions, reducing them by 61-73%."

Report on the paper:
https://amp.theguardian.com/environment/2018/may/31/avoiding-meat-and-dairy-is-single-biggest-way-to-reduce-your-impact-on-earth?__twitter_impression=true
"Avoiding meat and dairy products is the single biggest way to reduce your environmental impact on the planet… Without meat and dairy consumption, global farmland use could be reduced by more than 75% – an area equivalent to the US, China, European Union and Australia combined – and still feed the world. Loss of wild areas to agriculture is the leading cause of the current mass extinction of wildlife…. The scientists also found that even the very lowest impact meat and dairy products still cause much more environmental harm than the least sustainable vegetable and cereal growing."

Contribution of farmed animal products
18% of calories
37% of protein
83% of farmland
58% of greenhouse gas emissions
57% of water pollution
56% of air pollution
33% of freshwater withdrawals

Prices and supply and demand impact

Prices

Cents per gram of protein (2013-2015)
http://www.wri.org/resources/data-visualizations/protein-scorecard
Converted to cents per 20 grams of protein. I added a price for pork.

Nuts: $1.87

Beef (ground): 88 cents
Fish: 83 cents
Pork: 67 cents (using 2016 ham price, USDA)
Poultry: 62 cents
Milk: 58 cents
Eggs: 54 cents

White Rice: 46 cents
Soy: 45.6 cents
Corn: 24.6 cents
Black Beans: 24 cents
Wheat: 22 cents
Lentils:18 cents

The cheapest animal product is more expensive than the most expensive animal alternative, not including nuts. The average meat and animal product price is more than double the average animal alternative price. (I didn't include lamb and goat, which is even more expensive. And ground beef is the cheapest beef.)

Meat average: 75 cents
Milk and egg average: 56 cents
Meat and animal product combined average: 69 cents
Meat and animal product alternative average: 30 cents

Calories per dollar (2014)
https://efficiencyiseverything.com/calorie-per-dollar-list/

Cheapest meat alternatives
- Flour: 4,464
- White Bread: 3,333
- Rice: 2,320
- Plain Oats: 2,148
- Ramen: 1,949
- Angel Hair and White Pasta: 1,600
- Peanut Butter: 1,487
- Whole Wheat Pasta: 1,470
- Instant Rice: 1,148
- Pinto Beans: 1,026
- Whole Wheat Bread: 946
- Lentils: 929

Cheapest meat, dairy and eggs
- Whole Milk: 902
- Eggs (Costco): 802
- Butter: 747
- 0.5% Milk: 699
- Sweet Baby Rays BBQ: 624
- Frozen Breakfast Sausages: 588
- Eggs (Walmart): 566
- 72/27 Ground Beef: 439
- Great Value Italian sausage: 407
- 88/12 Ground Beef: 264
- Chicken: 239
- Pork Sirloin Tip Roast: 203
- Bacon: 179
- Tilapia: 167
- Pollock: 140
- Canned Chicken: 115
- Albacore Canned Tuna: 113
- Beef Jerky: 96
- Salmon: 85
- Sliced Turkey Breast (Jeanie O): 78

Dollars per 100 calories (2017)
https://www.thesimpledollar.com/buying-foods-based-on-cost-per-calorie/

- Pinto beans: 0.05
- Great northern beans: 0.05
- Peanut butter: 0.05
- Lentils: 0.07
- Navy beans: 0.07
- Black beans: 0.07
- Peanuts: 0.08
- Kidney beans: 0.09
- Oatmeal: 0.09
- Steel cut oats: 0.12
- Brown rice: 0.14
- Quinoa: 0.16
- Wheat bread: 0.18

Whole milk: 0.11
2% milk: 0.13
Various cheeses: 0.15 – 0.61
Eggs: 0.19
Italian sausage: 0.35
Pepperoni: 0.36
Beef brisket: 0.37
Yogurt: 0.37
Ground beef 90/10: 0.39
Salami: 0.43
Bacon: 0.51 (corrected price using cheapest bacon at Walmart)
Pork loin: 0.54
Chicken breast: 0.54
Tuna: 0.58
Trout: 0.59
Farmed Salmon: 0.65
Lamb chops: 0.75
Turkey breast: 0.86
Sirloin steak: 1.00
Tilapia: 1.04

Price per pound (cooked pound for dry grains)
https://www.nomeatathlete.com/cheap-healthy-food/

Comparing beef cuts

Different cuts of meat have different prices, which means they don't all contribute equally to the demand and supply of cows. I concluded above that there are 5.4 hours of questionable quality of life for each pound of beef. That's an average for all the meat on a cow. We can use the different beef prices to adjust this time up and down for different cuts of meat. I'll use the USDA's prices in "Summary of retail prices and price spreads" found here:
https://www.ers.usda.gov/data-products/meat-price-spreads.aspx
The prices are for May 2018. Assuming the "all-fresh" price of $5.68 is the average price for all beef we can divide the other prices by that price to get a multiple of the average price and then multiply that number by 5.4 to get the number of hours of questionable quality of life for each cut of meat.

Ground beef: $3.69 / $5.68 = 0.65
5.4 hours per pound average x 0.65 = 3.5 hours of questionable quality of life per pound

Round roast: $5.18 / $5.68 = 0.91
5.4 hours per pound average x 0.91 = 4.9 hours of questionable quality of life per pound

Choice: $5.97 / $5.68 = 1.05
5.4 hours per pound average x 1.05 = 5.7 hours of questionable quality of life per pound

Choice sirloin steak: $8.25 / $5.68 = 1.45
5.4 hours per pound average x 1.45 = 7.8 hours of questionable quality of life per pound

"Retail prices for beef, pork, and poultry cuts, eggs, and dairy products" on the same USDA page show the prices for a wider range of cuts for making more comparisons.

Here's another price list:
https://www.bls.gov/regions/mid-atlantic/data/averageretailfoodandenergyprices_usandmidwest_table.htm

Elasticity

When we don't buy meat, we're not saving the animal that we could have bought. That animal is already dead. But by removing ourselves from the animal market, we reduce demand for those animals, and so less animals are produced in the future. We prevent future suffering. That's the basic story. But how does this work out in detail? When I don't buy one pound of meat does that result in one less pound of future supply? Not quite. Future supply does drop, but it's not a 1-to-1 ratio.

When meat is left sitting on the shelf, the grocer will reduce the price to get rid of it. The price drop creates new demand. Some will buy more than they otherwise would have due to the lower price. But that doesn't mean the grocer will resupply with as much as before. The reduced price means she made less, if any, profit. So she'll resupply with less.

Norwood and Lusk did the math for six products and here's what they came up with (p. 223). The numbers for fish, dairy and turkey are provided by Peter Hurford. He got them from Animal Charity Evaluators research.
http://everydayutilitarian.com/essays/how-much-suffering-is-in-the-standard-american-diet/

1 egg not purchased results in 0.91 eggs less of future supply.
1 pound of chicken not purchased results in 0.76 pounds less of future supply.
1 pound of fish not purchased results in 0.75 pounds less of future supply.
1 pound of pork not purchased results in 0.74 pounds less of future supply.
1 pound of veal not purchased results in 0.69 pounds less of future supply.
1 pound of beef not purchased results in 0.68 pounds less of future supply.
1 pound of dairy not purchased results in 0.65 pounds less of future supply.
1 pound of milk not purchased results in 0.56 pounds less of future supply.
1 pound of turkey not purchased results in 0.26 pounds less of future supply.

If these numbers are correct, then we can simply multiply all the conclusions above, such as time of suffering per pound, by these numbers to determine the impact of our choices. For example, one egg involves 1.9 days of suffering. 1.9 x 0.91 = 1.7 days of suffering saved by not purchasing one egg. But I'm skeptical of the numbers, for a few reasons.

1) I think the long-term impact on supply has to come much closer to 1-to-1 than any such calculations suggest.

2) There are a very wide range of estimates that can be found. Here, for example, is a range for chicken from 0.06 to 0.7.
https://animalcharityevaluators.org/research/dietary-impacts/effects-of-diet-choices/
That enormous range doesn't even cover Norwood's and Lusk's estimate. What use are such a wide range of estimates?

3) The numbers, however useful they might be for determining the future supply of a specific product, fail to show the impact for animals overall. When you bought my turkey after they lowered the price you *didn't* buy your chicken. When people buy things they wouldn't have otherwise because of lowered prices this is not all new demand, it's largely a shift in demand. The overall impact on animal welfare has to come much closer to 1-to-1 than these numbers would lead us to believe. (Analysis of such shifts is called "cross-elasticity.")

All that said, the numbers *might* be useful for approximating *short-term-relative* impact.

More detailed arguments against using elasticity estimates here:

https://www.lesswrong.com/posts/qjie7bsCT2gaHHQqp/misapplied-economics-and-overwrought-estimates
https://www.lesswrong.com/posts/BvLpXNBevSZe32bXd/how-much-does-consumption-affect-production

Pets

A lot of people that change their own diets don't seem to have put any thought into their pets' diets. Dog and cat food has a significant portion of meat in it. Cheap dog and cat food is made mostly, if not all, with animal byproduct. This is stuff that would otherwise go to waste. Using byproduct does not contribute to demand, or contributes very little, and so does not have much, if any, impact on animal suffering. So cheap dog and cat food, to the extent it's made of byproduct, is not a problem. Premium food, however, uses meat that is not byproduct and so does contribute to demand, and thus animal suffering. To be sure you're not contributing to animal suffering, they do make vegan cat and dog food. Though it's quite expensive. So there's a trade-off question of whether to buy the vegan food and ensure no harm, or buy the cheap stuff, which may cause some harm, but also saves money that can be used for good. Either way, don't buy premium meat-based pet food. That's worst of both worlds: more money and more harm.

This paper analyzes the environmental impact of pet food, though the unknown amount of byproduct in it makes the whole thing of questionable value:
http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0181301

This paper looks at how many animals are killed by free-ranging cats (a helluva lot):
http://abcbirds.org/wp-content/uploads/2015/07/Loss-et-al.-2013-Impact-of-free-ranging-domestic-cats-on-wildlife-in-U.S..pdf

Deer hunting

Sources for pounds of meat estimate:
http://www.butcher-packer.com/index.php?main_page=document_general_info&products_id=331
http://www.pgc.pa.gov/Wildlife/WildlifeSpecies/White-tailedDeer/Pages/DeerWeightChart.aspx
http://peachorcharddeerprocessing.com/processing-facts/
http://www.askthemeatman.com/estimate_deer_weight.htm

One deer yields around 60 pounds of meat. A clean kill causes no suffering. One deer, instead of the following farmed sources of meat, saves the following amounts of suffering:
Shrimp: 9.75 years per pound x 60 = 585 years of suffering
Finfish: 1.2 years per pound x 60 = 72 years of suffering
Chicken: 14 days per pound x 60 = 840 days or 2.3 years of suffering
Turkey: 10.5 days per pound x 60 = 630 days or 1.7 years of suffering
Pork: 1.34 days per pound x 60 = 80 days of suffering
Beef: 5.4 questionable hours per pound x 60 = 324 hours or 13.5 days of questionable quality of life

A few more points on eating deer:
-Without hunting, deer would overpopulate. They need to be culled.
-Eating deer is carbon and land use negative.
-Culling the deer population reduces the number of vehicle accidents they cause.
-Culling deer reduces the spread of lyme disease.