

# Effects of Diet Choices

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## Abstract

In this report, we investigate how many animals would be spared by a human being adopting a plant-based diet. More specifically, we provide a rough estimate of the number of vertebrates spared per capita per plant-based year at a global level.

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## Animals spared per plant-based person per year

### Summary

When an individual adopts a plant-based diet, we expect they will spare a certain number of animals by this change in behavior. We assume that there are two methodologies for estimating the number of animals that would be spared: one based on production data, the other based on consumption data. Here we used a formula based on production data and identified the assumptions and limitations of our method. According to our estimations, the total number of vertebrates killed for human consumption in the world in 2018 was about 772 billion, most of which were fishes (about 88%). Based on this estimate, and assuming that 3% of the global population follows a plant-based diet, our calculations suggest that, globally, an individual would spare about **105 vertebrates per year** on average by adopting a plant-based diet. Even though we attempted to include as many vertebrates as possible, our estimate should be taken

as an underestimate. It excludes animals who have died due to indirect causes brought about by the animal agriculture industry and is based primarily on data from the Food and Agriculture Organization of the United Nations (FAO), which seems to err on the conservative side. Finally, we identified avenues for further research, including using a method based on consumption data, targeting different countries, and including invertebrates.

## Introduction

Many animal advocates seek to reduce animal suffering and counter speciesist prejudices by promoting the elimination or reduction of animal product consumption among individual members of the public. Here we investigate how many animals would be spared by a human being adopting a plant-based diet. More specifically, we provide a rough estimate of the number of vertebrates spared per capita per plant-based year at a global level.

Estimates of the number of animals—or the amount of suffering—spared per person adopting a vegetarian or plant-based diet rely on consumption data<sup>1</sup> or production data.<sup>2</sup> We believe that each of the two methodologies has its advantages and disadvantages. For example, estimates based on consumption data fail to account for the number of animal lives lost in the supply chain due to secondary causes, and estimates based on production data are not useful for calculating differences in the number of animals spared between people with specific consumption patterns (e.g., flexitarians, pescetarians, and vegetarians) adopting a primarily plant-based diet.

We believe that using these two methods could give a better picture of the quantitative effect of dietary change (i.e., number of animals spared) as well as shed light on the relative benefits and limitations of each type of method. We decided to start this project by using a method based on production data, with the hope that we can supplement it in the near future by using a method based on consumption data.

Previous estimates provided by Harish Sethu<sup>3</sup> and [Animal Charity Evaluators](#) (ACE) are also based on production data, but they differ in their target populations. Sethu's estimate focused on the U.S., while ACE's estimate focused on the U.K. Additionally, they both aimed to estimate the number of animals spared per *vegetarian* year, i.e., a year without the consumption of meat. Unlike these estimates, our estimate does not target residents of a specific country, and it focuses on the number of animals spared per *plant-based* year, i.e., a year without the consumption of meat (including fish), eggs, dairy, and other

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<sup>1</sup> For more information on animal product consumption data, see [Hurford \(2014\)](#).

<sup>2</sup> For more information on production data, i.e., animals raised or captured for food, see [Sethu \(2015\)](#).

<sup>3</sup> [Sethu \(2015\)](#)

animal products. Thus, our estimate is not only based on more recent 2018 data, it's also a global estimate based on a fully plant-based diet.

## Method

### Model

As mentioned above, we built on the same type of method used by Sethu and ACE in 2015. With this method, we assume that one way to estimate the number of animals spared per plant-based year is by estimating the global average of animals killed for food per non-plant-based human in a year. After a few adaptations, this is the formula we used:

$$\text{Number of vertebrates spared per plant-based year} = \frac{\text{Number of vertebrates killed for food}}{(\text{World population} - \text{Plant-based population})}$$

Because of the nature of this formula, our estimate shows an average of how many animals killed for food per year correspond to each human being who eats animals, irrespective of their particular diet (i.e., the number or kinds of animals they eat) or the country in which they are located. Therefore, it is a method focused on global animal production data.

### Data

It's important to note that our estimate does not include invertebrates. Thus, when we refer to *animals* spared per plant-based year, we are only referring to vertebrates. We attempted to include all vertebrates directly killed for food around the globe in recent years.

We included FAO's data on land animals slaughtered globally<sup>4</sup> as well as our estimates of animals who are not usually counted by global authorities, such as culled male chicks in the egg industry and other land animals who die before slaughter. We also included FAO's data on finfishes—both farmed and wild-caught—slaughtered globally as well as mortality rates for farmed fishes. Our estimate of male chicks culled in the egg industry was made relative to FAO's reporting of the number of laying hens. Our estimates of pre-slaughter mortality rates for farmed land animals were based on a wide range of publications providing empirical or theoretical data on mortality rates in different farmed animals. Our estimates of the number of fishes killed for food were based on FAO's 2017 production data of fishes in aquaculture,<sup>5</sup> along with varying publications providing information on the harvest weight of fishes. We also estimated the mortality rates of farmed fishes based on the available literature. As for the estimates of

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<sup>4</sup> [Food and Agriculture Organization of the United Nations \(n.d.-a\)](#)

<sup>5</sup> [Food and Agriculture Organization of the United Nations \(n.d.-b\)](#)

wild-caught fishes, we used FAO's 2017 data on the capture of fishes<sup>6</sup> in addition to different sources regarding the catch weight of fishes, particularly the FishBase calculator<sup>7</sup> for average fish weight by the average length of each species.

For more details on our data, sources, and estimations, see this [spreadsheet](#).

## Limitations

Our estimate involves various limitations and uncertainties. As previously mentioned, it excludes invertebrates spared per plant-based year, which means it fails to include estimates of shrimps, crabs, octopuses, crickets, and other aquatic and land invertebrates commonly killed for food. It also excludes animals killed for reasons other than direct human consumption, such as animals killed to feed other farmed animals (although some wild-caught fishes killed to feed other farmed animals may be included), aquatic animals who die as “bycatch,” wild animals killed because of their perceived threat to animal agriculture, wild animals killed during plant agriculture processes, and animals killed by deforestation or pollution caused by farmed animal systems.

Since most of our data on the numbers of animals slaughtered is based on FAO's data, it is important to acknowledge the accuracy and consistency issues associated with this source. As Šimčíkas (2019) suggests, the numbers of wild-caught fishes are likely to be underestimated, especially because they exclude bycatch animals, and other data such as numbers of farmed rodents may be incomplete. There might also be inconsistencies in land animal data between countries.<sup>8</sup> Furthermore, FAO statistics are not comprehensive. For example, they exclude quails, snakes, salamanders, crocodiles, and alligators.<sup>9</sup>

We have high uncertainties about most of our data due to the lack of reliable data about the numbers of animals slaughtered globally. This is especially the case with (i) our estimate of culled male chicks in the egg industry since it is an extrapolation of FAO's data on egg-laying hens, (ii) the number of farmed animals dead before slaughter since our calculations are based on diverse publications of empirical studies in different countries and different farmed animal systems, and (iii) our estimates of slaughtered fishes, amphibians, and reptiles since FAO's figures are given in tons rather than in numbers of individuals. We calculated the numbers of individual fishes, amphibians, and reptiles killed based on the average harvest/capture weight found in FAO's databases and other sources. Note that we are also uncertain about the accuracy of the global plant-based population data<sup>10</sup> we considered.

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<sup>6</sup> [Food and Agriculture Organization of the United Nations \(n.d.-c\)](#)

<sup>7</sup> [FishBase \(2020\)](#)

<sup>8</sup> [Šimčíkas \(2019\)](#)

<sup>9</sup> [Šimčíkas \(2020\)](#)

<sup>10</sup> [Ipsos \(2018\)](#)

One limitation of our estimate is associated with the fact that we prioritized the most recent data of animals slaughtered, resulting in data from different years. For example, data on land vertebrates is from 2018, while data on fishes is from 2017.

Finally, it is worth mentioning that because of the nature of using a methodology based on production data, our estimate does not account for differences between countries, people with different diets switching to plant-based diets, or supply and demand elasticity rates. We hope to address these limitations when we develop an estimate using a methodology based on consumption data.

Apart from the limitations acknowledged above, an additional reason to take our estimate as a very rough average of vertebrates spared per plant-based year is that we considered the non-plant-based population only. Vegetarians, other flexitarians, and non-plant-based people of all ages, including babies, were considered as part of the non-plant-based population.

## Results

### Number of animals killed per year

In total, based on FAO's data, we ended up considering individual animals belonging to at least 13 species of farmed land vertebrates, 262 species of farmed fishes, and 1,373 species of wild-caught fishes.

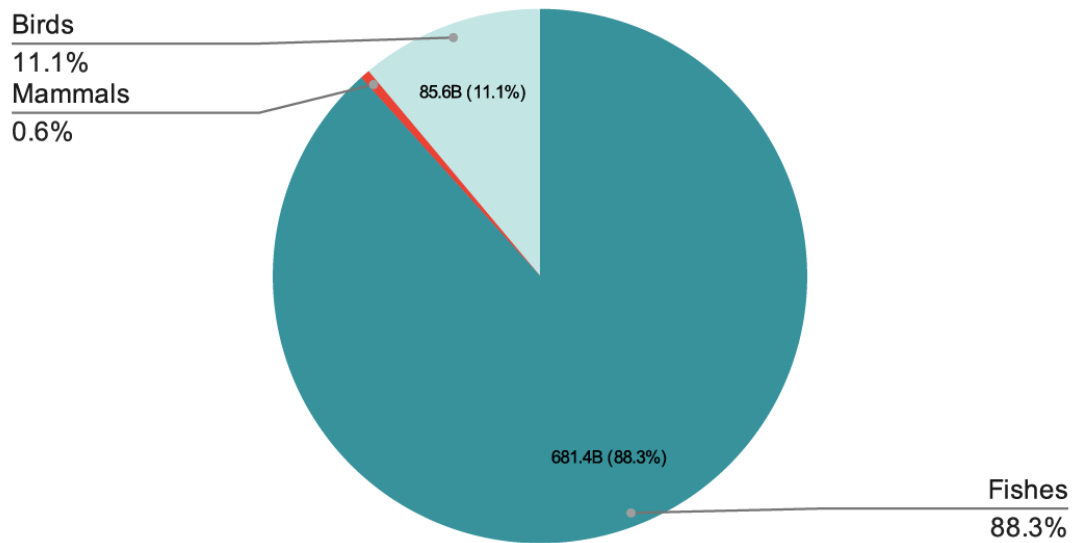
According to our calculations, the total number of vertebrates killed for human consumption in the world in 2018<sup>11</sup> was about **772 billion**.

Fishes are the type of vertebrates killed the most for human consumption per year (88.3%), both among farmed vertebrates (52.9%) and wild-caught vertebrates (99.9%).

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<sup>11</sup> Data pertaining to fishes is from 2017.

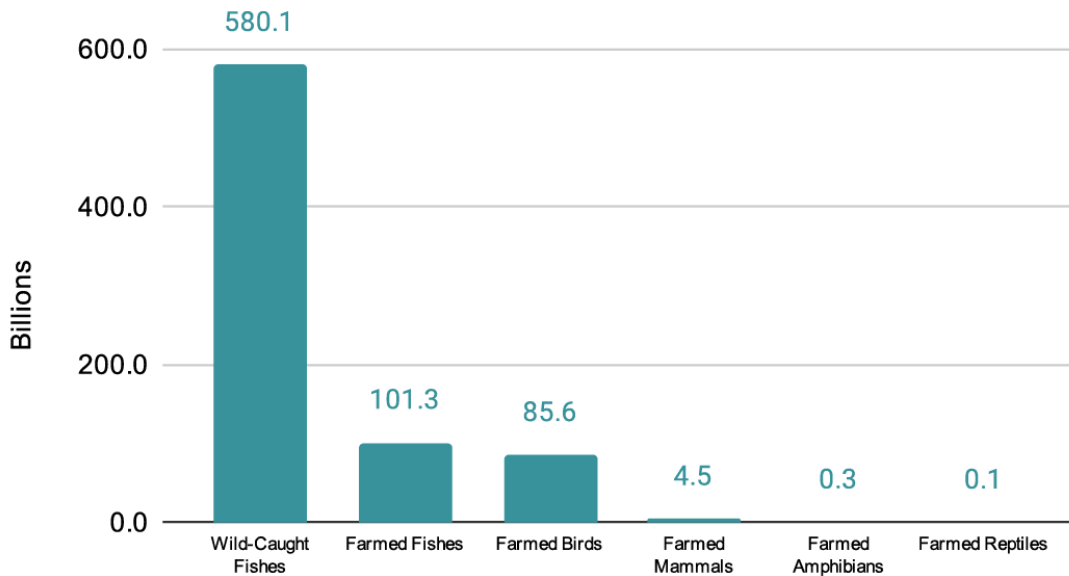
## Vertebrates Killed for Human Consumption per Year\*



\*We considered 2018 data for land vertebrates and 2017 data for fishes.

The group of vertebrates killed the most for human consumption after wild-caught fishes (580 billion) and farmed fishes (101.3 billion) is farmed birds (85.6 billion), followed by farmed mammals (4.5 billion).

## Vertebrates Killed for Human Consumption per Year\*



\*We considered 2018 data for land vertebrates, amphibians, and reptiles and 2017 data for fishes.

Among farmed land vertebrates, chickens are the species killed the most per year (81 billion), followed by ducks (3.1 billion), pigs (1.8 billion), and rabbits (1 billion).<sup>12</sup>

Farmed land vertebrates	Number of animals killed for human consumption in 2018*
Chickens	81B
Ducks	3.1B
Pigs	1.8B
Rabbits	1B
Geese and guinea fowls	720M
Turkeys	715M
Sheep	621M

<sup>12</sup> These estimates are based on FAO's data, which does not include data for quails. According to [Simcik \(2020\)](#), 1.5 billion to 1.9 billion quails are slaughtered annually.



Goats	568M
Cattle	315M
Rodents	80M
Other birds	57M
Buffaloes	35M
Horses	5M
Asses	3M
Camels	3M
Other camelids	1M
Mules	0.3M
Other animals	0.1M

\*These numbers include animals slaughtered according to FAOSTAT<sup>13</sup> and estimates of animals dead before slaughter. B refers to billion, and M to million.

### Number of animals spared per plant-based year

Following the formula from our model, and considering an estimate of the world population in 2018 of 7,592,886,800<sup>14</sup> and an estimate of the plant-based population of 3% in the same year,<sup>15</sup> our calculation suggests that about **105 vertebrates** are spared per plant-based person per year, of which approximately 79 are wild-caught fishes, 14 are farmed fishes, and 12 are farmed land vertebrates (11.5 farmed birds and 0.5 farmed mammals). The number of farmed amphibians and reptiles as well as the number of wild-caught land vertebrates<sup>16</sup> we considered were not large enough to appear in our estimate.

Animal type	Number of animals killed for human consumption in 2018*	Number of animals spared per plant-based person per year
Wild-caught fishes	580.13B	78.77

<sup>13</sup> [Food and Agriculture Organization of the United Nations \(n.d.-a\)](#)

<sup>14</sup> [The World Bank Group \(n.d.\)](#)

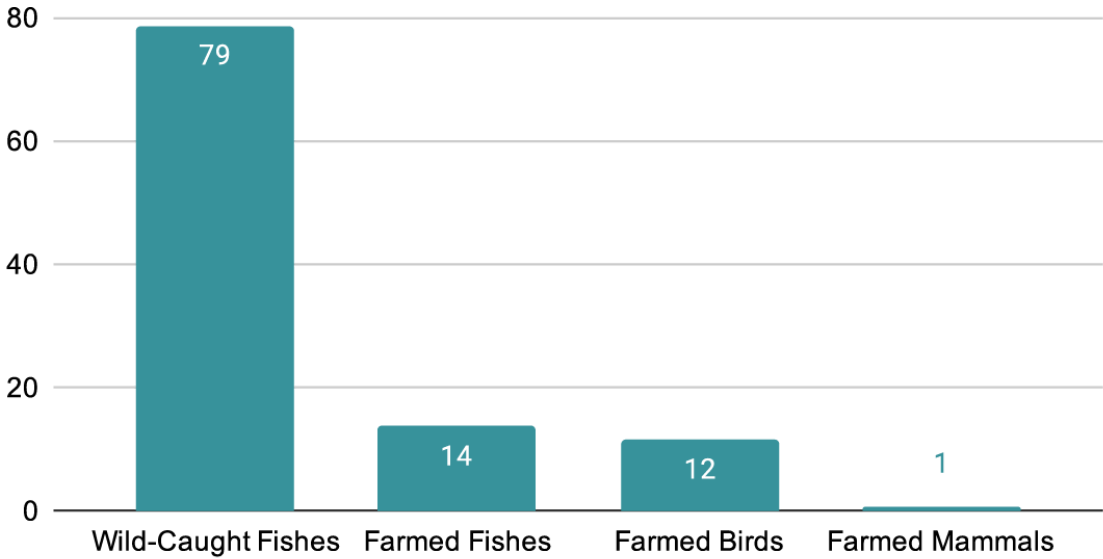
<sup>15</sup> [Ipsos \(2018\)](#)

<sup>16</sup> [Food and Agriculture Organization of the United Nations \(n.d.-a\)](#)

Animal type	Number of animals killed for human consumption in 2018*	Number of animals spared per plant-based person per year
Farmed fishes	101.33B	13.76
Farmed birds	85.61B	11.62
Farmed mammals	4.48B	0.61
Farmed reptiles	296.04M	0.04
Farmed amphibians	141.42M	0.02
Wild-caught land vertebrates	596k	0.00008
Other farmed land vertebrates	99.17k	0.00001
Total	771.99B	104.8

\*We considered 2017 data for fishes. B refers to billion, M to million, and k to thousand

### Vertebrates Spared per Plant-Based Person per Year\*



\*We considered 2018 data for land vertebrates and 2017 data for fishes.

For more details on our estimations, see this [spreadsheet](#).

## Avenues for further research

- Estimating the number of vertebrates spared per plant-based person per year in different countries rather than globally
  - Using two types of methods (one based on production data and the other based on consumption data) for each country to help compare not only differences in methodologies but also in animals spared per country
  - Estimating all vertebrates spared by adopting a plant-based lifestyle, especially fishes used for medicinal and entertainment purposes<sup>17</sup>
  - Estimating not only the number of vertebrates but also the number of invertebrates spared per plant-based person per year, including crustaceans, mollusks, insects, and other invertebrates killed for food
  - Although uncertainties would be high due to a lack of data, estimating the number of animals indirectly killed for food, e.g., animals killed during crop harvest and deforestation
  - Estimating the number of animals spared per vegetarian year as opposed to a plant-based year<sup>18</sup>
  - Estimating the number of years of animals' lives spared by taking into account the lifespans of animals spared per plant-based year
  - Incorporating elasticity rates of supply and demand for different animal food products
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## Resources

### References

FishBase. (2020, December). Retrieved from <https://www.fishbase.de/search.php>

Food and Agriculture Organization of the United Nations. (n.d.-a). *FAOSTAT*. Retrieved from <http://www.fao.org/faostat/en/#home>

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<sup>17</sup> Because our data is based on FAO's data, which does not seem to differentiate between fishes killed for food and fishes killed for other purposes, our estimate includes some fishes killed for non-food products.

<sup>18</sup> Such an estimate would be difficult to achieve as there are limitations to what animal products a vegetarian diet includes. Also, it may be difficult to obtain data on animals slaughtered for different animal products.

Food and Agriculture Organization of the United Nations. (n.d.-b). *Global Aquaculture Production 1950-2018*. Retrieved from <http://www.fao.org/fishery/statistics/global-aquaculture-production/query/en>

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Simcik, S. (2019, December 2). Accuracy issues in FAO animal numbers. *Effective Altruism Forum*. Retrieved from <https://forum.effectivealtruism.org/posts/amwCRLACACF6MnAvw/accuracy-issues-in-fao-animal-numbers>

Simcik, S. (2020, February 18). Estimates of global captive vertebrate numbers. *Effective Altruism Forum*. Retrieved from [https://forum.effectivealtruism.org/posts/pT7AYJdaRp6ZdYfny/estimates-of-global-captive-vertebrate-numbers#Summary\\_tables](https://forum.effectivealtruism.org/posts/pT7AYJdaRp6ZdYfny/estimates-of-global-captive-vertebrate-numbers#Summary_tables)

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The World Bank Group. (n.d.). *Data: Population, total*. Retrieved from [https://data.worldbank.org/indicator/SP.POP.TOTL?name\\_desc=true](https://data.worldbank.org/indicator/SP.POP.TOTL?name_desc=true)

## Archived reports

[2014 Effects of Diet Choices Report](#)