THE US SUPPLEMENT INDUSTRY KILLS 24 BILLION ANIMALS EVERY YEAR

JUNE 2022

ANIMAL AND ENVIRONMENTAL

IMPACTS

OF THE US SUPPLEMENT INDUSTRY.

THE US SUPPLEMENT CREATES 1.8 BILLION PLASTIC PILL BOTTLES EVERY YEAR

TERRASEED

TABLE OF CONTENTS

1. INTRODUCTION

When **Terraseed** was presented with the challenge of building the most sustainable supplements on earth, we aimed to learn more about the supplement industry in an effort to identify major information gaps regarding its impact on our environment and animals. For perspective, **Terraseed** has conducted this desk report to mainly answer 2 key questions:

- How prevalent are animal-derived ingredients and *how many animals are killed each year* to produce supplements?
- *How many plastic bottles are being used* for supplements, and how many end up in landfills or the ocean?

The supplement industry's estimated **annual worth of $55 billion,** makes its observation anything but simple. Yes, some issues, like safety and quality have gotten more attention in recent years. But we hear virtually nothing about the supplement industry's devastating effects on animals and the planet.

Terraseed pushed to fill this information gap to fully **understand the scope of the problem** and create productive conversations to find possible solutions.

ABOUT TERRASEED

Terraseed creates vegan dietary supplements made with sustainably-sourced ingredients and packaged in a fully biodegradable pill bottle.

For more info visit www.terraseed.com

Sign a petition to the FDA to demand transparency about the use of animal-derived ingredients in supplement products.

TERRASEED

To create this report, we conducted extensive research and partnered with **industry experts, animal rights groups and the NIH Office of Dietary Supplements,** which shed light on the truth.

We estimate that **over 24 billion fish and 18 million cows, sheep and pigs are consumed each year to make supplement ingredients** for the US market alone. If that's not shocking enough, these supplements are packaged in roughly **1.8 billion plastic pill bottles**. Only about 30% of these bottles are recycled and 3% end up in the ocean.

And this is only the beginning...

The following chapters detail our findings -- our goal is to raise awareness and spark conversations that will *propel us towards further research*.

The impact of the supplement industry in

24 billion

animals are killed every year. as **44%** of all supplements contain animal byproducts.

1.8 billion

plastic pill bottles are wasted every year. only **9%** of recycled plastic is actually recycled.

TERRASEED

2. ANIMAL IMPACTS

2.1. PREVALENCE OF ANIMAL-DERIVED INGREDIENTS

50% of all supplement products contain at least one animal-derived ingredient.

Ingredient sourcing in the supplement industry is notoriously opaque. It can be very difficult for the average consumer to decipher if the nutrients in their supplements come from and how they're made.

There are a wide variety of ingredients that may be used in supplements, but at a high level, they can be sorted into three categories: **vitamins** (derived from plants and animals), **minerals** (inorganic elements), and **botanicals** (plants valued for medicinal properties).

Vitamins, minerals and botanicals used in supplements can either be derived solely from natural sources or synthesized using a variety of methods that may lead to varying levels of bioavailability.

While synthesized vitamins are widely used due to their lower cost, there are still a high number of common supplement ingredients that are often derived from animal byproducts.

Exactly how prevalent are animal-derived ingredients in the supplement industry? **We analyzed data from over 79,000 supplement products** included in the US National Institutes of Health Dietary Supplement Label Database (DSLD) to find out .

The table below shows the **five most common supplement ingredients that are typically derived from animals.** Magnesium stearate and gelatin are made from processing animal byproducts, primarily from cows, pigs and sheep. Vitamin D is commonly derived from sheep's wool. Omega-3s typically come from fish oil. Bee pollen and propolis are harvested from honeybees.

INGREDIENT	# OF PRODUCTS	% OF ALL PRODUCTS
MAGNESIUM STEARATE	20,846	29.4%
GELATIN	16,374	23.1%
VITAMIN D	8,761	12.3%
OMEGA-3S / FISH OIL	4,906	6.9%
BEE POLLEN / PROPOLIS	4,147	5.8%

Accounting for overlap in products that include both ingredients, we found that approximately **44% of all on-market supplement products contain at least one** of the two most common animal ingredients (magnesium stearate and gelatin).

Due to DSLD limitations, it's not feasible to broadly account for product overlaps in the table above. However, we would estimate that **at least 50% of all supplement products contain at least one animal-derived ingredient.**

NOTE; SEE APPENDIX A FOR OUR METHODOLOGY ON THE PREVALENCE OF ANIMAL-DERIVED INGREDIENTS.

TERRASEED

2.2. ANIMALS KILLED FOR MAGNESIUM STEARATE, GELATIN, AND VITAMIN D

Magnesium stearate, gelatin, and Vitamin D are three very common ingredients that contribute to the regular killing of millions of cows, sheep and pigs every year.

Magnesium stearate is a common "filler ingredient" that can be used as a binder to keep ingredients from sticking to the machines that manufacture pills. Gelatin, another common filler is often used in softgels or to create capsules. Both of these ingredients are made from processing byproducts, such as fat, bones and tendons from cows, pigs and sheep.

Vitamin D can be synthetically derived, but natural Vitamin D is sourced from sheep's wool. While shearing its wool does not directly kill a sheep, this contributes to an industry that unnecessarily exploits, harms and slaughters them.

Through further analysis of the DSLD, investigating supplement manufacturing cost structures, the animal rendering and byproducts industry and the animal slaughtering industry, we were able to estimate that approximately **14.4 million pigs, 3.6 million cows and 244.1 thousand sheep are consumed to produce supplement ingredients each year for the US market.**

NOTE; SEE APPENDIX B FOR OUR METHODOLOGY ON THE NUMBER OF COWS, SHEEP AND PIGS KILLED TO SUPPORT THE US SUPPLEMENT INDUSTRY.

TERRASEED

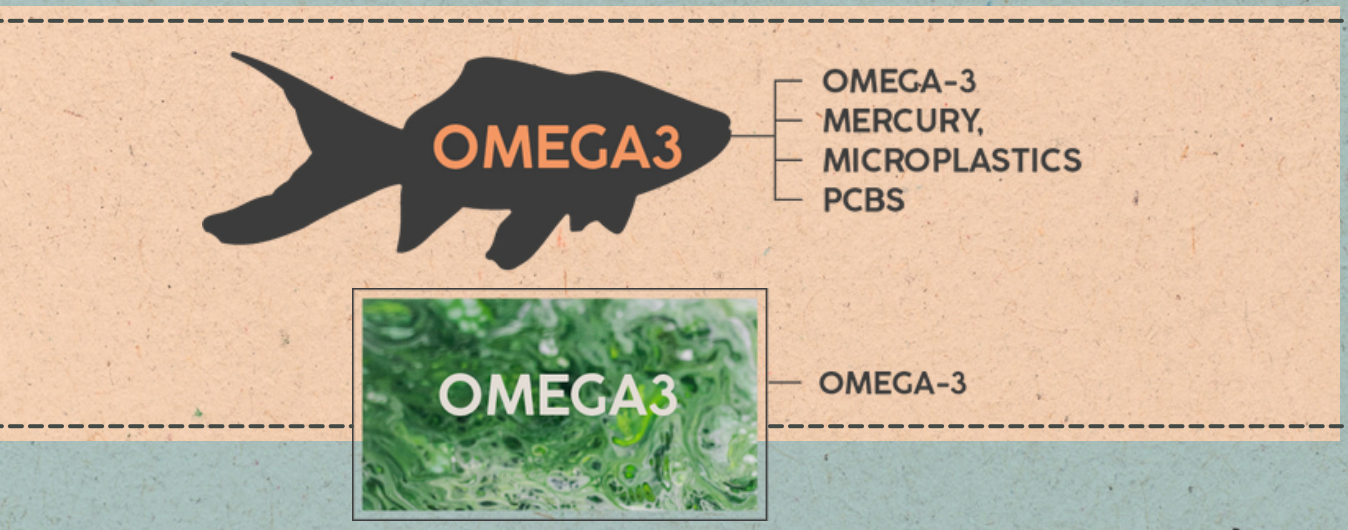
2.3. FISH KILLED FOR OMEGA-3S

Fish make up the vast majority of animals killed to produce supplements.

They're often used to produce **Omega-3, specifically EPA/DHA,** supplements. This practice is so common that Omega-3 supplements are often referred to as "fish oil" supplements. EPA/DHA from fish is generally harvested from small species of fish such as anchovies, capelin and sand eel. However, larger species and other small species are also used in many cases.

Algal Omega-3s vs. Fish Oil

The Omega-3s found in algae are biochemically identical to those found in fish and are just as potent and bioavailable. While the Omega-3s found in algae have identical properties, the methods through which they are produced and obtained are not.



Algal Omega-3s are typically grown under controlled conditions and purified (a cleaner source), with no risk of exposure to toxins or environmental contaminants. Straight from the source, algal Omega-3s are inherently more sustainable and ethical.

TERRASEED

Each year, approximately **16 million metric tons of fish are caught to produce fish oil and fish meal (**the same fish will be processed to produce both products) globally. Given the average weights of the small fish most commonly used, this equates to **540.5 billion fish**.

Approximately 75-80% of globally-produced fish oil and fish meal is used as feed for aquaculture (farming of larger fish, like salmon) and other animal feed. An estimated 13% of fish oil is actually used for human consumption, primarily fish oil supplements.

Using this information, we were able to calculate a conservative estimate of 70.3 billion fish globally and **24.3 billion fish in the US alone are consumed in the production of fish oil for Omega-3 supplements.**

IT TAKES APPROXIMATELY 100 ANCHOVIES JUST TO MAKE ONE BOTTLE OF OMEGA-3.

While these fish may be small, they are living creatures whose lives matter and should not simply be measured in metric tons.

We believe that quantifying the enormous number of fish killed for supplements is an important step in moving toward a more ethical industry.

NOTE; SEE APPENDIX C FOR OUR METHODOLOGY ON THE NUMBER OF FISH KILLED TO PRODUCE SUPPLEMENTS.

TERRASEED

3.ENVIRONMENTAL IMPACTS

3.1. PLASTIC BOTTLE PACKAGING FOR SUPPLEMENTS

1.8 billion plastic supplement bottles are sold each year in the US alone.

The supplement industry has a massive impact on the environment, with **over 100,000 individual supplement products on the market in the US alone**. Based on an analysis of the size of the US supplement market and the average cost of a supplement bottle, we estimate that approximately 2.3 billion supplement bottles are sold annually.

The large **majority of supplement products sold are packaged in plastic bottles,** many also packaged in "secondary packaging" such as boxes, sachets and plastic wrap.

Overall, **76% of supplement packaging is made of plastic,** which is a low-cost and lightweight solution. We can therefore estimate that **1.8 billion plastic supplement bottles are sold each year**, most of which are Polyethylene Terephthalate (PET) or HDPE.

76%
OF SUPPLEMENT PACKAGING IS PLASTIC.

NOTE; SEE APPENDIX D FOR OUR METHODOLOGY ON THE NUMBER OF PLASTIC SUPPLEMENT BOTTLES .

TERRASEED

Glass Bottles

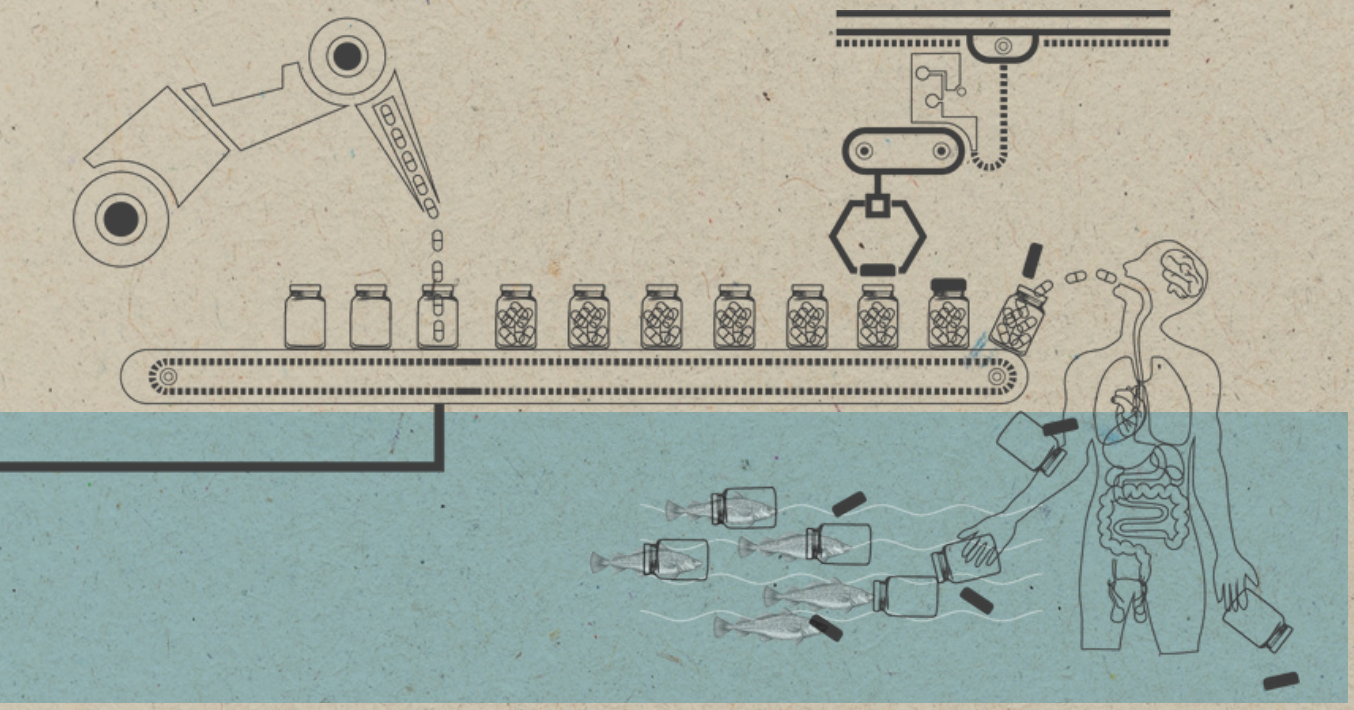
In an effort to be more environmentally-conscious, some companies have moved to glass bottles. Reused glass is a great option for reducing waste. However, glass creates other serious problems in the lifecycle of the product that must be considered and managed. Glass is heavy, **generating more greenhouse gas emissions** when shipped vs. plastic or paper packaging. Additionally, glass takes over **1 million years to decompose** in the environment.

TERRASEED

3.2. PLASTIC POLLUTION AND OCEAN PLASTIC

The vast majority of plastic waste (almost 70%) ends up in landfills, roughly 17% of which is combusted and 3% ending up in the ocean every year.

According to the EPA, **less than 9% of all (US) plastic waste is recycled**. The recycling rate for PET and HDPE bottles is a bit higher, although still highly problematic at around 29%.



Over 50% of the recycled plastic waste is shipped overseas, with the vast majority going to lower-income countries with ineffective waste management systems. This is where a significant proportion of plastic is discarded or burned at the expense of the environment.

All too often, this mismanaged trash flows by river from land into the ocean. **Around 3% of plastic waste ends up in the ocean every year**. While plastic in the land environment takes an incredible 450 years to decompose, plastic that flows into the ocean NEVER actually decomposes. Instead, it breaks down into tiny pieces called “microplastics” that are infiltrating every corner of the earth.

Plastics in the environment have lasting negative effects to both land and marine ecosystems, killing millions of animals annually. Both marine and land animals mistakenly consume microplastics that can block digestive tracts, pierce organs or cause starvation from lack of nutrients. Marine animals can also be strangled by fishing nets or other plastic debris.

The **impact of plastic waste, both from packaging as well as fishing nets, is a serious problem** that the supplement industry can help make real progress on.

4. CONCLUSIONS AND FUTURE RESEARCH

After researching the US supplement industry, we've learned that an astounding **50% of supplement-oriented products contain at least one animal-derived ingredient.** As a result, **24.3 Billion fish, 14.4 Million pigs, 3.6 Million cows and 244 Thousand sheep are slaughtered every year in the US alone**.

Additionally, a whopping 76% of supplement packaging is made of plastic. In fact, roughly **1.8 Billion plastic supplement bottles are sold annually, 70% of which end up in a landfill or in the ocean.**

Even after everything we've uncovered, *this research is just the tip of the iceberg*.

Through our process of finding the best, most sustainable methods for producing vegan supplements, we've learned that people truly care about these issues in more ways than one. While the environmental impact of humans has been overlooked over the years, more people are realizing that looking the other way won't change a thing. People are showing immense interest in bettering their health, treatment towards animals, and of course, ensuring the wellbeing of our environment.

We'll continue to shed light on these issues and other less-than-stellar practices in the supplement industry. This independent study is just the beginning.

TERRASEED

SUMMARY OF MAIN FINDINGS

IMPACT ON ANIMALS

- There are still a **high number of common supplement ingredients that are often derived from animal byproducts**.
- **50% of all supplement products contain at least one animal-derived ingredient**, with 44% of all on-market supplement products containing at least one of the two most common animal ingredients: magnesium stearate and gelatin.
- **Magnesium stearate and gelatin are made from processing byproducts**, such as fat, bones, and, tendons from cows, pigs, and sheep.
- Most **Vitamin D is sourced from sheep's wool,** contributing to an industry that unnecessarily exploits, harms, and slaughters animals.
- Each year, **14.4 million pigs, 3.6 million cows, and 244.1 thousand sheep are consumed to produce supplement ingredients** for the US market.
- **24 billion fish make up the vast majority of animals killed to produce supplements.** They're often used to produce Omega-3, specifically EPA/DHA, supplements. This is such a common practice that Omega-3 supplements are often referred to as "fish oil" supplements.
- **70.3 billion fish globally and 24.3 billion fish in the US alone are consumed in the production of fish oil** for Omega-3 supplements.
- It takes approximately **100 anchovies just to make one bottle of Omega-3**.

SUMMARY OF MAIN FINDINGS

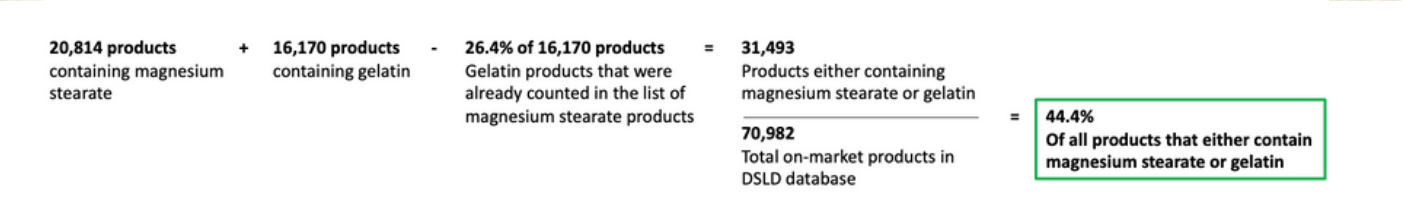
IMPACT ON THE PLANET

- **1.8 billion plastic supplement bottles are sold each year** in the US alone.
- There are ov**er 100,000 individual supplement products on the market in the US alone** and 2.3 billion supplement bottles are sold annually.
- Overall, **76% of supplement packaging is made of plastic,** which is a low-cost and lightweight solution. Most plastic supplement bottles are Polyethylene Terephthalate (PET) or HDPE.
- Only **less than 9% of all plastic pill bottles in the US are recycled**. The vast majority of plastic bottles (almost 70%) ends up in landfills, while around 17% is combusted.
- Around **3% of plastic waste ends up in the ocean every year**.
- While plastic in the land environment takes an incredible 450 years to decompose, **plastic that flows into the ocean NEVER actually decomposes**. Instead, it breaks down into tiny pieces called “microplastics” that are infiltrating every corner of the earth.

APPENDIX: METHODOLOGY

APPENDIX A: METHODOLOGY ON THE PREVALENCE OF ANIMAL-DERIVED INGREDIENTS

To estimate the share of US supplement products that contain either gelatin or magnesium stearate, the two most common ingredients that are typically animal-derived, we turned to the NIH Dietary Supplement Label Database and found that 31,493 of 70,982 products (44.4%) contained one or the other or both ingredients. See Exhibit below.



The NIH Dietary Supplement Labels Database (DSLD) includes 70,982 on-market product labels. There are 20,814 on-market products listed in the database that include magnesium stearate and 16,170 that include gelatin.

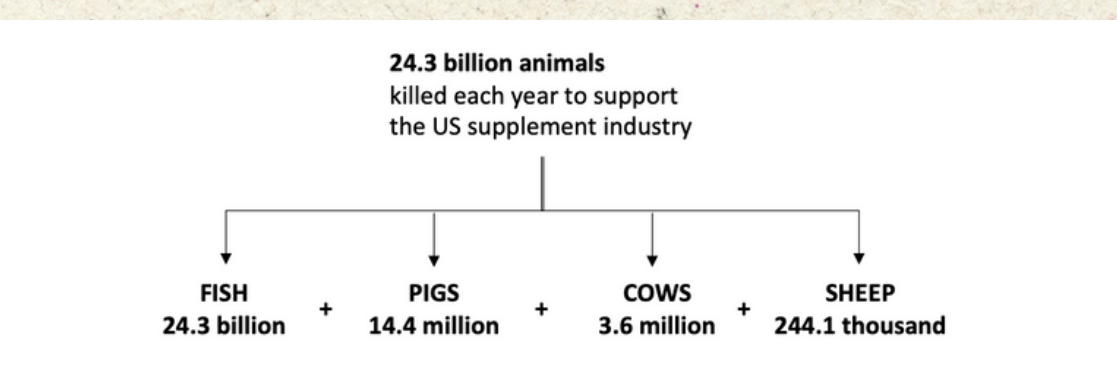
To avoid "double counting" products that contain both magnesium stearate and gelatin, we compared a large sample of data (the database can only return the first 5000 results) and found a 26.4% overlap, meaning that 26.4% of products contained both ingredients.

Removing the duplicates, the sum of products containing either magnesium stearate or gelatin is 31,493 (20,814 magnesium stearate products + 16,170 gelatin products - 26.4% of magnesium products that also contain gelatin), which is 44.4% of all on-market products in the database.

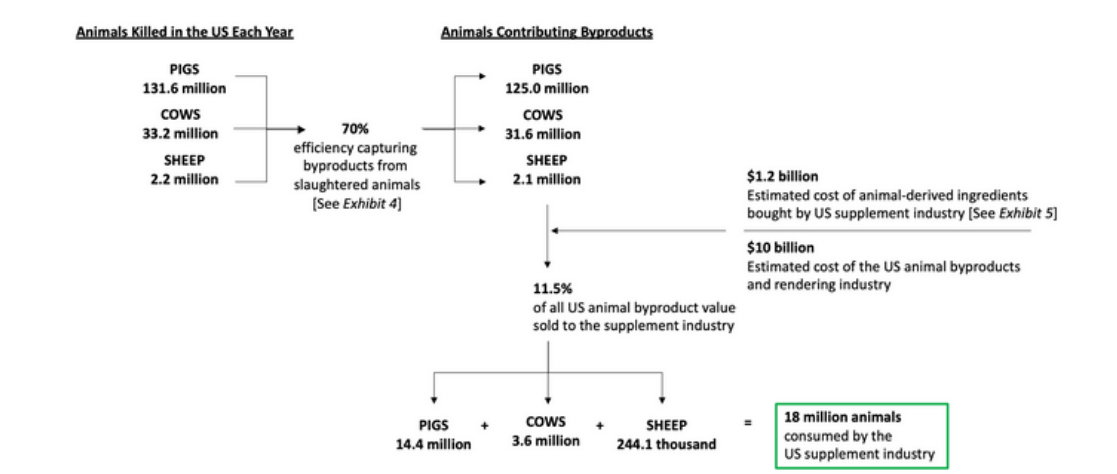
For the raw data and calculations see the tab “Combined Calculation” here.

APPENDIX B: METHODOLOGY ON THE NUMBER OF COWS, SHEEP AND PIGS KILLED

In total we estimate that 24.3 billion animals are killed each year to support the US supplement industry. The vast majority of these are fish, and around 18 million are pigs, cows, and sheep. The calculation for this is complex and relies on some assumptions, making it subject to error. However, we believe this number is useful in helping to understand the order of magnitude on which this problem exists.



We estimate that roughly 30 million pigs, cows, and sheep are consumed by the US supplement industry, annually. This is based on an underlying estimate of the share of all animals slaughtered whose byproducts are captured for rendering, as well as the approximate share of the value of the byproducts/ rendering industry that is sold to supplement companies. See Exhibit below.



Each year there are approximately 131.6 million pigs, 33.2 million cows, 2.2 million sheep, and 9.4 billion chickens slaughtered in the United States. However, chickens are not commonly used to produce gelatin or magnesium stearate and thus, have been removed from our estimates.

The United States has a concentrated and relatively efficient system for slaughtering animals and capturing byproducts (e.g., using hides for leather, rendering fat and bones for gelatin). Experts from the North American Renderers Association estimate that roughly 95% of all inedible animal weight produced by the slaughter industry is actually captured by the rendering and byproducts processing industry.

We can then use this 95% figure as an estimate for the share of all slaughtered animals that contribute byproducts to the industry, resulting in an estimated 125.0 million pigs, 31.6 million cows, and 2.1 million sheep that contribute byproducts.

The next question that arises is what percentage of these animals are consumed by the supplement industry? We have estimated that approximately 11.5% of all animal byproducts and rendered material in the US is sold to the supplement industry in the form of gelatin, magnesium stearate, lanolin, etc. This estimate is based on comparing the value of animal-derived supplement ingredient costs to the size of the byproducts and rendering industry. See Exhibit below.

According to the Nutrition Business Journal, supplements make up a $54 billion per year industry in the US. IBIS World estimates that input costs for vitamin and supplement manufacturers in the US account for 30.4% of revenue, or $16.4 billion across the entire market. We made the assumption that wholesale raw ingredients account for approximately 60% of input costs on average across the US market, or $8.2 billion. Due to a lack of market level data, this assumption was made based on looking at Terraseed's own cost breakdown.

In order to determine the cost of raw ingredients that are specifically animal-derived, we turned to the National Institutes of Health Office of Dietary Supplements Dietary Supplement Label Database, which catalogs the information printed on labels of 70,982 on-market dietary supplement products sold in the United States, as well as additional off-market products. Based on the analysis of said database, animal-derived ingredients (excluding fish-derived ingredients which are separately accounted for in the analysis above), account for approximately 11.7% of all instances of supplement ingredients, which equates to a total cost for all animal-derived ingredients of $1.15 billion ($54 billion *.304 *.6* .117)

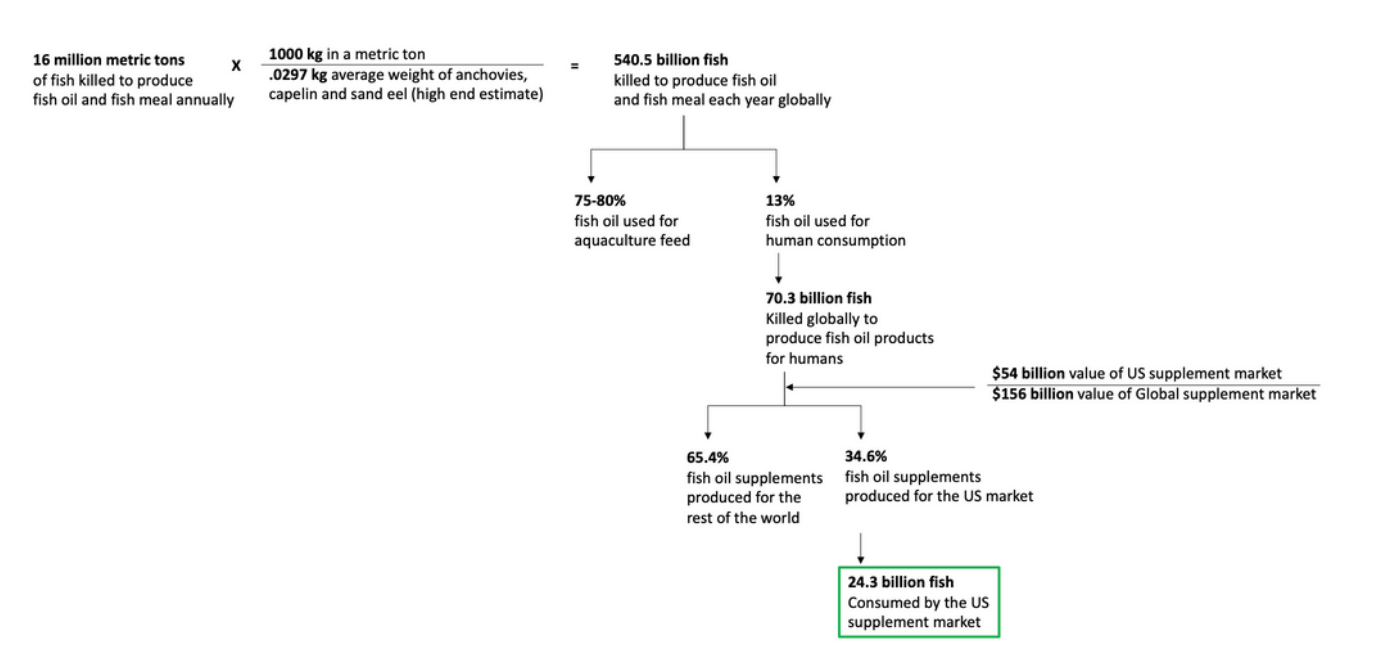
The analysis quantifying animal-derived ingredients was conducted by downloading the data for all active ingredients in the database, including how many on-market products contain an instance of each ingredient. We also downloaded data of "other ingredients" that we knew to be significant (gelatin, magnesium stearate, and bee propolis). We then coded which ingredients are typically animal-derived, and counted the total number of animal-derived ingredient product instances and divided that by the total number of on-market product ingredient instances. We excluded any fish-derived ingredients from the numerator or denominator. To view the coded data and calculations, see the tab "Animal Derived Excluding Fish" here.

Given that the value of the US animal rendering and byproducts industry is worth roughly $10 billion and the cost of animal-derived supplement ingredients (which come from byproducts/ rendering) was $1.15 billion, we can estimate that the supplement industry accounts for approximately 11.5% of the animal byproducts/ rendering industry value ($1.15 billion/ $10 billion).

Therefore, as stated above, if 125.0 million pigs, 31.6 million cows, and 2.1 million sheep contribute byproducts to the industry, we can assume that approximately 11.5% of those are consumed by the US supplement industry, or approximately 18 million animals each year.

APPENDIX C: METHODOLOGY ON THE NUMBER OF FISH KILLED

Looking at total fish caught each year to produce fish oil and fish meal, as well as data on the use of fish oil and considering the scale of the US vs global supplement industry, we calculated that over 24 billion fish are consumed by the US supplement industry. See Exhibit below.



Each year, around 16 million metric tons of small fish, such as anchovies, capelin, and sand eel are caught to produce fish oil and fish meal around the world. Both fish oil and fish meal are byproducts of the same fish, so we can assume all 16 million tons of fish are used to produce fish oil.

The average of the high end (conservative) estimates for typical weight estimates for these small fish commonly used in fish oil is .0297 kg (anchovies - 29g, capelin - 50g, sand eel - 10g). Therefore, one metric ton (1000 kg) of these small fish is equivalent to approximately 33,784 fish (1000kg/.0297kg).

Multiplying this by 16 million metric tons, you arrive at 540.5 billion fish killed annually to produce fish oil each year.

These 540 billion fish produce around 1 million metric ton of fish oil, 75-80% of which is used as feed for aquaculture and 13% of which is used for human consumption, which we assume to be primarily used in fish oil supplements.

Therefore, we can estimate that conservatively, 70.3 billion fish are killed each year globally to produce fish oil supplements for humans (13% of 540.5 billion fish). Note that while this sounds like a very high number, it is estimated that between .79 and 2.3 billion fish are caught from the wild every year and an additional 51 billion to 167 billion farmed fishes were slaughtered globally in 2017.

The US supplement market is worth $54 billion dollars, which is 34.6% of the $156 billion global supplement market. Therefore, we can extrapolate that 34.6% of the fish killed to produce fish oil supplements globally can be attributed to the US supplement industry specifically, which equates to 24.3 billion fish (70.3 billion fish * .346).

A European Anchovy, which are very commonly used for producing fish oil, contains 1.4% of its total weight in DHA and EPA (combined). Using the conservative (high) estimate for an anchovy's weight of 29 g, we can estimate that one anchovy produces .41g of DHA/EPA.

According to researchers' analysis of the NIH Dietary Supplement Label Database, the average serving (assumed to be one pill) of DHA/EPA is 697mg.

Therefore, we can then calculate that it would take roughly 1.7 average sized anchovies to produce a single pill of DHA/EPA (.697/.41). Assuming the average bottle contains 60 pills, we can estimate that it takes 102 fish to produce one bottle of Omega -3 pills (DHA/EPA).

APPENDIX D: METHODOLOGY ON THE NUMBER OF PLASTIC BOTTLES

The US supplement industry is estimated to be worth $54 billion annually, with the average price of a supplement bottle being around $23.59 (author's calculation based on the number of pages of Amazon product listings in each price range. See the data and calculations here.) Therefore, there are 2.3 billion supplement bottles sold each year in the US ($54 billion/ $23.59 per bottle).

According to a report by Grandview Research, plastic packaging accounts for 76% of the supplement packaging market. We can make the assumption that this percentage applies to bottles, meaning that the supplement industry produces around 1.75 billion plastic bottles each year.

ABSTRACT

To create the world's most sustainable supplements, we set out to learn more about the supplement industry. After partnering with industry experts, animal rights groups and the NIH Office of Dietary Supplements, we found that 24 billion fish, 18 million cows, sheep and pigs are consumed every year to make supplement ingredients... and that's just in the US market. More specifically, at least 50% of supplements contain at least one animal-derived ingredient.

As a result, 1.8 billion plastic supplement bottles are sold in the US market annually, 76% of which is made of plastic. Less than 9% of this plastic is recycled, almost 70% of which ends up in landfill or the ocean.

We conducted this study to raise awareness of the supplement industry's damaging norms and to eventually shed light on more sustainable alternatives.

MORE INFORMATION

For more information, please contact:

Maria Cebrian
Terraseed Founder and CEO
maria.cebrian@terraseed.com
www.terraseed.com