参考网站：
https://ourworldindata.org/fish-and-overfishing

问题：

1. What does sustainable fishing mean?
2. How much of the world's fish is managed sustainably?
3. What impact does trawling have on wildlife?

文章：

Is the global fishing industry sustainable? Which types of fish are we harvesting sustainably, and where are we overfishing?

These are critical questions, but to answer them, we need to first agree on what ‘sustainability’ actually means when it comes to fishing. One of the biggest conflicts I see is not actually about technical discussions of how much fish we catch or whether populations are increasing or decreasing, but a larger ethical conflict in how we view fish. When we view fish through different lenses, these debates don’t get very far.

One school of thought views fish as animals with their own inherent value. In this realm, our end goal is often to restore wild animal populations to as close to their pre-human levels as possible. Ultimately, this means we should be catching very little (if any at all).

The other school of thought views fish as a resource. Most of us eat fish; hundreds of millions rely on it for nutrition and income across the world. This is incompatible with restoring populations to their historical levels because we can’t do that and catch lots of fish at the same time. Sustainability, in this view, means catching as many fish as possible without depleting fish populations any further. This ties in with the classic Brundtland definition of sustainability: “meeting the needs of the current generation, without sacrificing the needs of future generations”. We catch as many fish as possible to meet the needs of people alive today but don’t take too much such that populations decline, and this sacrifices catch for future generations.

We can see these two schools of thought emerge in the typical diagram of sustainable fishing. On the x-axis, we have fishing pressure; as we move towards the right, we catch a larger proportion of the fish stock each year. Fishing pressure tells us about the fraction of the fish population that is caught in a given year. Note that this measure is a flow – it is an input variable that changes over time.

On the y-axis, we have fish biomass, which is given as two variables. First, we have the fish catch – shown as the red line. This, again, is a flow variable. Second, we have fish stocks. The fish stock is the total amount of fish left in the population. It, as we'd expect, is a stock variable.

Let’s first look at the ‘stock’ line. This is the amount of fish we have in the oceans. It slopes downwards towards the right: if we fish very little, then lots of fish are left in the ocean, and as we increase fishing pressure, we deplete the amount of fish in our oceans. This makes sense.

Our first school of thought – that fish are not a resource but a wild animal population in their own right – suggests we should be aiming for the top-left corner. Fish populations are as close to pre-human levels as possible. To do this, we need to catch very little (if any) fish.

Our second school of thought – that fish are a resource – would consider the optimal level to be the red dot. This is what is called the ‘maximum sustainable yield’. This is a key concept in fishery research and industry. It's the largest long-term average catch that can be taken from a fish stock under prevailing environmental and fishery conditions. If you get greedy and catch more than this, then you deplete populations for future generations. If you catch too little, then you're sacrificing food and income for the current generation. Most fisheries are aiming for this sweet spot: catching not too much, not too little, just right.

The tension between these two schools becomes obvious. The optimal outcome is completely different. When the biomass of a fish stock is at the point where the 'maximum sustainable yield' can be achieved, it's around half of its original virgin biomass.This level can vary between fish populations but is typically in the range of 37% to 50% of its pre-fishing levels. This may seem counterintuitive, but wild animal population growth rates are often greatest when the population size is moderate and before the population starts to reach its natural limit, or carrying capacity.

In other words, if you view fish as a resource, you probably want fish populations to be less than 50% the size of pre-fishing size in order to achieve the maximum sustainable yield.

Most of the research, industry, and policymaking is geared towards the second school: viewing fish as a resource. Therefore, much of our work on fish on Our World in Data will explore these concepts and explain what the research and data tell us about fish stocks, catch, and the sustainability of fishing across the world. However, we will also offer the perspective of the first school by looking at how fish populations have changed from their pre-human levels.

Sustainable fishing, by its fisheries definition, is catching just the right amount. If you harvest too much, then fish stocks decline. If you catch too little, then you're giving up valuable food resources and income. In the previous section, we take a closer look at different concepts of sustainable fishing and how this 'sweet spot' – the maximum sustainable yield – is defined.

How much of the world's fish is caught sustainably?

This is often measured in terms of fish stocks. A fish stock is a subpopulation of a particular species of fish with common parameters such as location, growth, and mortality. Often, it's a species of fish in a given location. Indian Ocean tuna, for example. Importantly, this metric treats each fish stock as being equal, regardless of how big each stock is. A stock where we catch 1000 tonnes is counted the same as a stock where we catch 10 tonnes.

When defining the sustainability of fisheries, we need to know three terms:

Overfished: this is sometimes termed 'overexploited'. A fish stock with abundance below the biomass that would produce the maximum sustainable yield (MSY) is potentially considered "overfished". Fish stocks become overexploited when fish are caught at a rate higher than the fish population can support.

Maximally sustainably fished: this has sometimes been termed 'fully fished' or 'fully exploited' in the past. Some might interpret these terms negatively, but this is actually the 'sweet spot' that fisheries are aiming for. This is the maximum sustainable yield, where we're catching as much fish as possible without reducing fish populations below the most productive level.

Underfished: this is when the fish stock is greater than the biomass that would produce the maximum sustainable yield. We could catch more fish without the decline of fish populations. From a resource point of view, this is suboptimal because we're missing out on a key food source and income source from fishing communities.

The breakdown of these three categories is shown in the chart. Combined, underfished and

maximally fished would be considered to be sustainable because fish stocks are not declining.
One-third (34%) of assessed global fish stocks were overfished in 2017. However, 60% were maximally fished, and 6% were underfished.
But this does not tell us how much fish was sourced sustainably. This is because fish stocks can be very different sizes. Let's say we have two fish stocks. Stock A is sustainable, and we're catching 80 tonnes of fish per year. Stock B is unsustainable, and we're catching 20 tonnes from it. If we aggregate them, we'd conclude that only half of our fish stocks are sustainable, but 80% of our catch is.
When we adjust for the different amounts of catch from each stock, we find that almost four-fifths (79%) of fish catch is sourced sustainably. 21% of the catch comes from overfished populations.
Overall, two-thirds of assessed fisheries are sustainable, providing four-fifths of our seafood.

Passing a trawl over the seabed can have quite a severe impact on the organisms that live there. How much of the biota is affected depends on a couple of factors, including the type of gear used, the type of sediment, and what lifeforms live there. We might imagine that a coral that sticks out from the seabed will be destroyed while organisms deeper in the sediment might survive.
Researchers have carried out studies to see what impact trawling has on wildlife – either through experimental methods or observing real-world impacts. In an analysis published in PNAS, Jan Geert Hiddink and colleagues brought these experiments together to build a complete picture.
The impact of trawling really depends on the type of method and gear that's used. We see that in the chart below, which shows the impact of four types: otter trawling, beam trawling, towed dregs, and hydraulic dredging. On the y-axis, we have the share of organisms that are removed or killed by a single pass of a trawl over the seabed. On the x-axis, we have the depth of the ocean sediment that the trawl reaches.
What we see clearly is that the deeper the trawl digs into the sediment, the more biota we kill. Otter trawls have the lowest impact: they dig just 2.4 centimeters into the sediment, and around 6% of organisms are lost. Beam trawls lose 14%. Towed dredges dig twice as deep, and one-fifth of organisms are killed off. The most damaging method is hydraulic dredging: it digs deep into the sediment at 16 centimeters, and 41% of organisms are destroyed as a result.
Once this area has been affected by trawling, how long does it take for its biodiversity to recover?
For the ecosystem to get back to its pre-trawling state takes a few years if it's left alone. In their analysis, Hiddink and colleagues found average recovery times (where 'recovery' means getting back to 95% of pre-trawling biomass levels) in the range of 1.9 to 6.4 years. The differences here were dependent on the method used – the shallower otter trawls caused less damage and recovered more quickly than the deep hydraulic trawling – and the environmental context, such as the type of seabed. This finding was consistent with previous studies, finding recovery to be in the range of years [this study, for example, reports a 4-5 year recovery time across multiple commercial trawling sites].
Several years might seem like a long time, but it's actually pretty fast for an ecosystem to recover. This is why I don't find the comparison between dredging and rainforest clearing to be a particularly helpful one. If we cut down the Amazon rainforest, it will be decades, if not centuries, before it gets back to its previous state. Thankfully, these seabed communities recover orders of

magnitude more quickly. But, of course, they only recover if we leave them alone.