

Feeding the Future

What Role Can Aquaponics and Aquaculture Play?

2019 Aquaponic Association Conference

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KSU's Program of Distinction

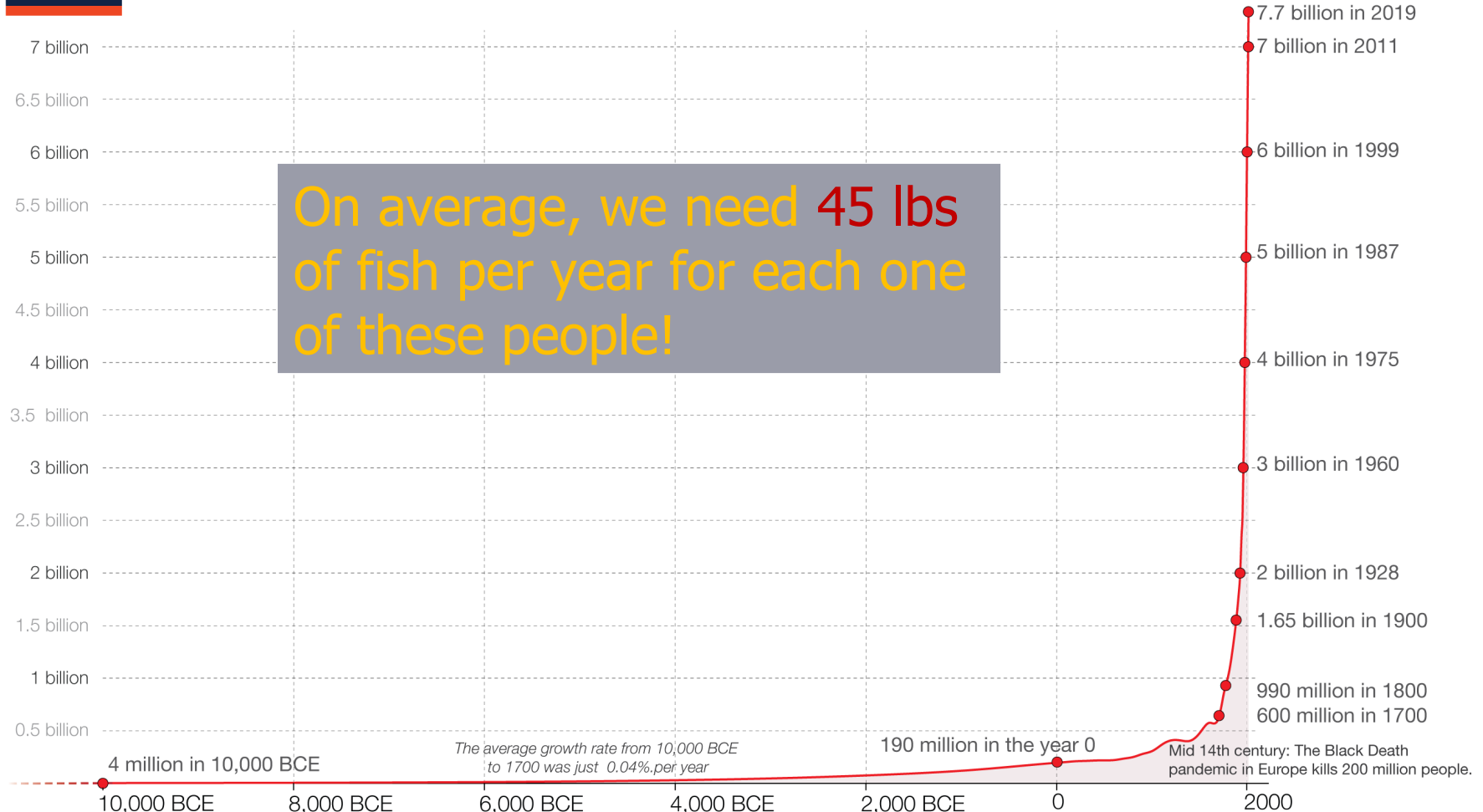


Human Population Growth

Est Of **10 billion**
by 2050!

Our World
in Data

The size of the world population over the last 12,000 years

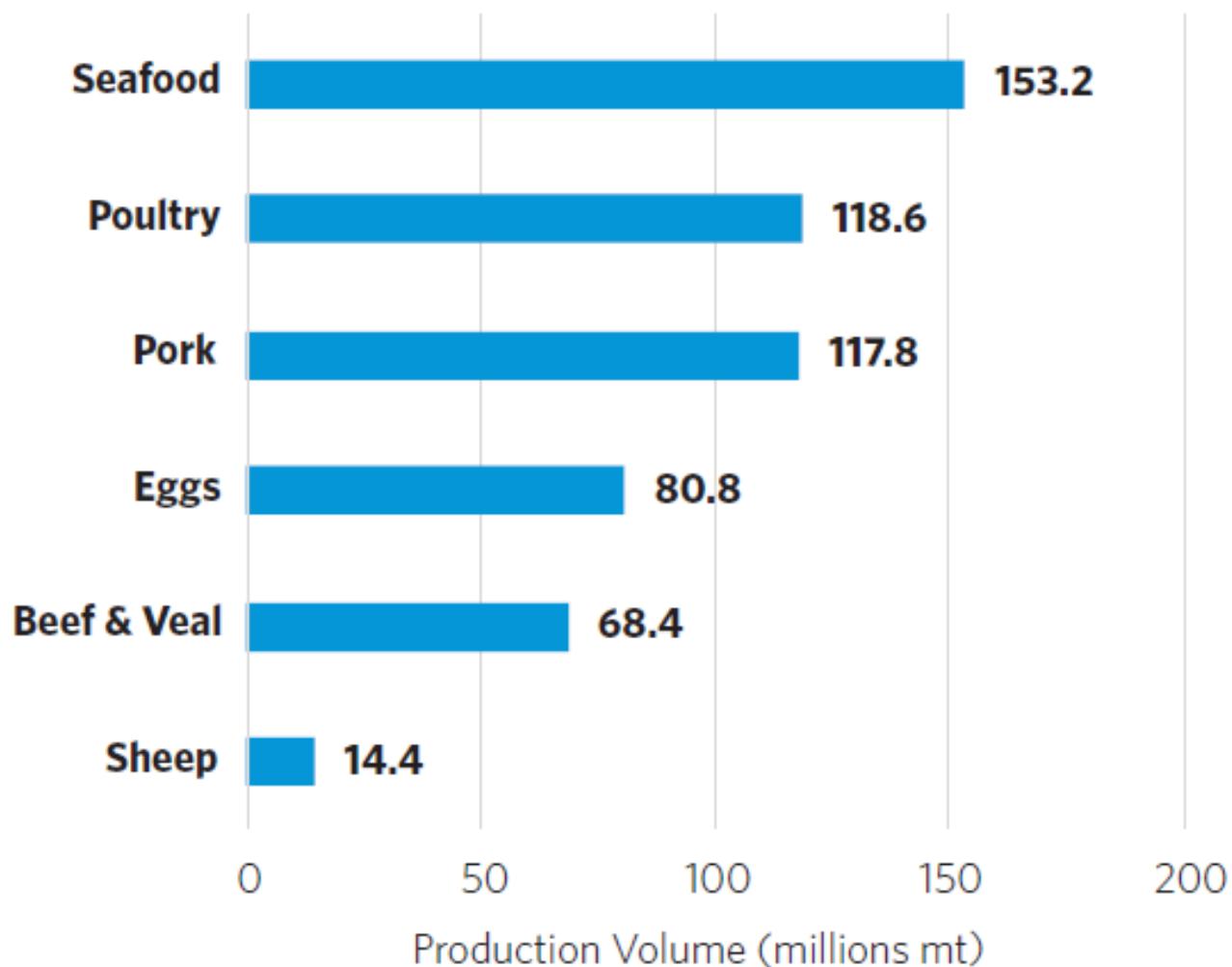


Based on estimates by the *History Database of the Global Environment* (HYDE) and the United Nations. On OurWorldinData.org you can download the annual data.

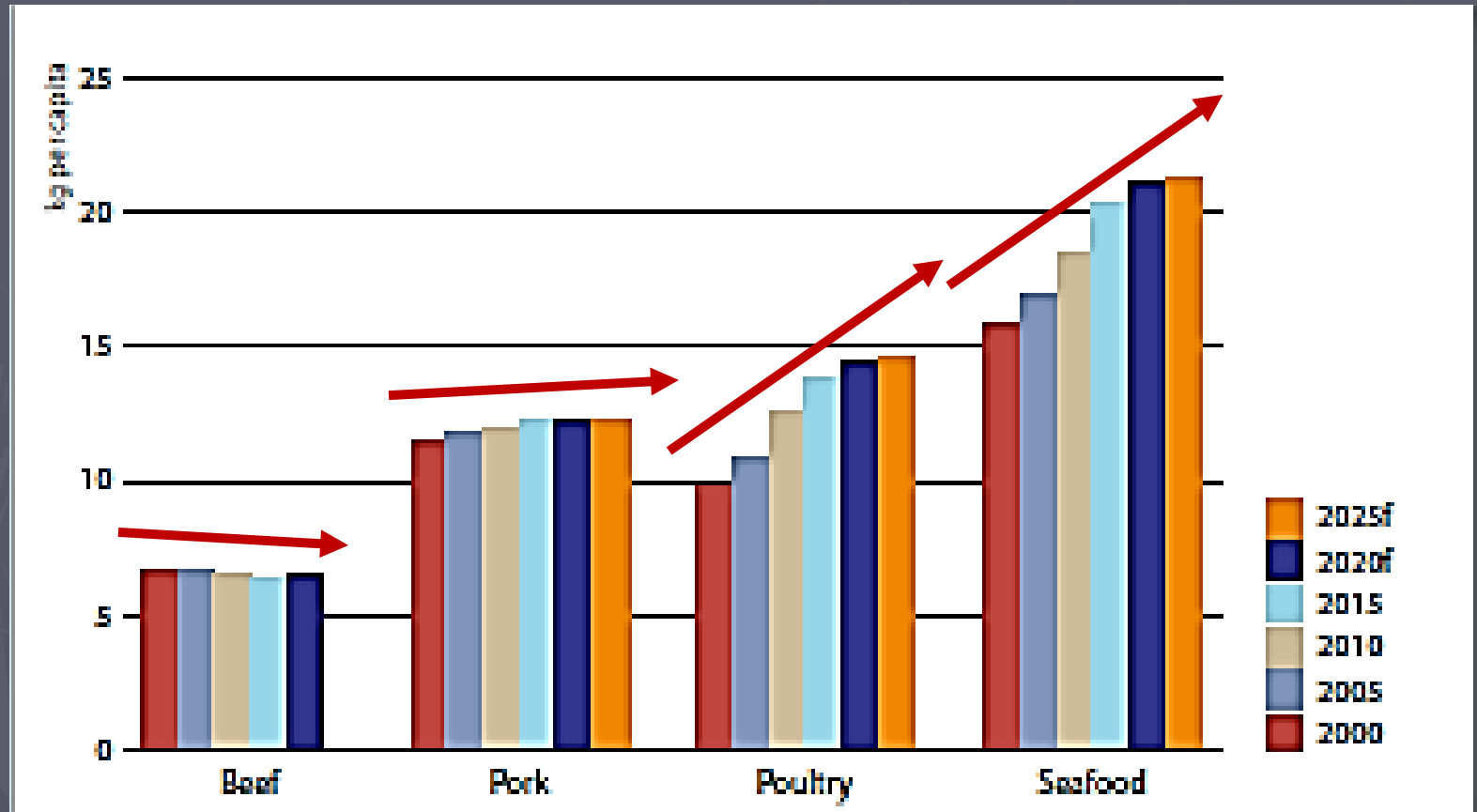
This is a visualization from OurWorldinData.org, where you find data and research on how the world is changing.

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Animal Protein Production, 2016



Global per Capita Consumption of Animal Proteins 2000-2025



Fish provides ~20% of the world's protein

Only Two Sources- Capture or Culture

- ▶ Historically – Most captured from the oceans
- ▶ Always **thought the ocean was limitless. Wrong!**
- ▶ Most wild fisheries are at maximum sustainable yields or declining.



The ocean's bounty is **not** limitless.



71% of ocean fisheries fully exploited (FAO, 2014).

33% of stocks are fished at biologically unsustainable levels (FAO 2018)

Buy Wild???

Environmental Costs of Capture Fisheries

By-Catch

Longline fisheries for swordfish also catch sharks – slow reproduction rates.



Trawling technologies for flounder-also catch skates and rays.

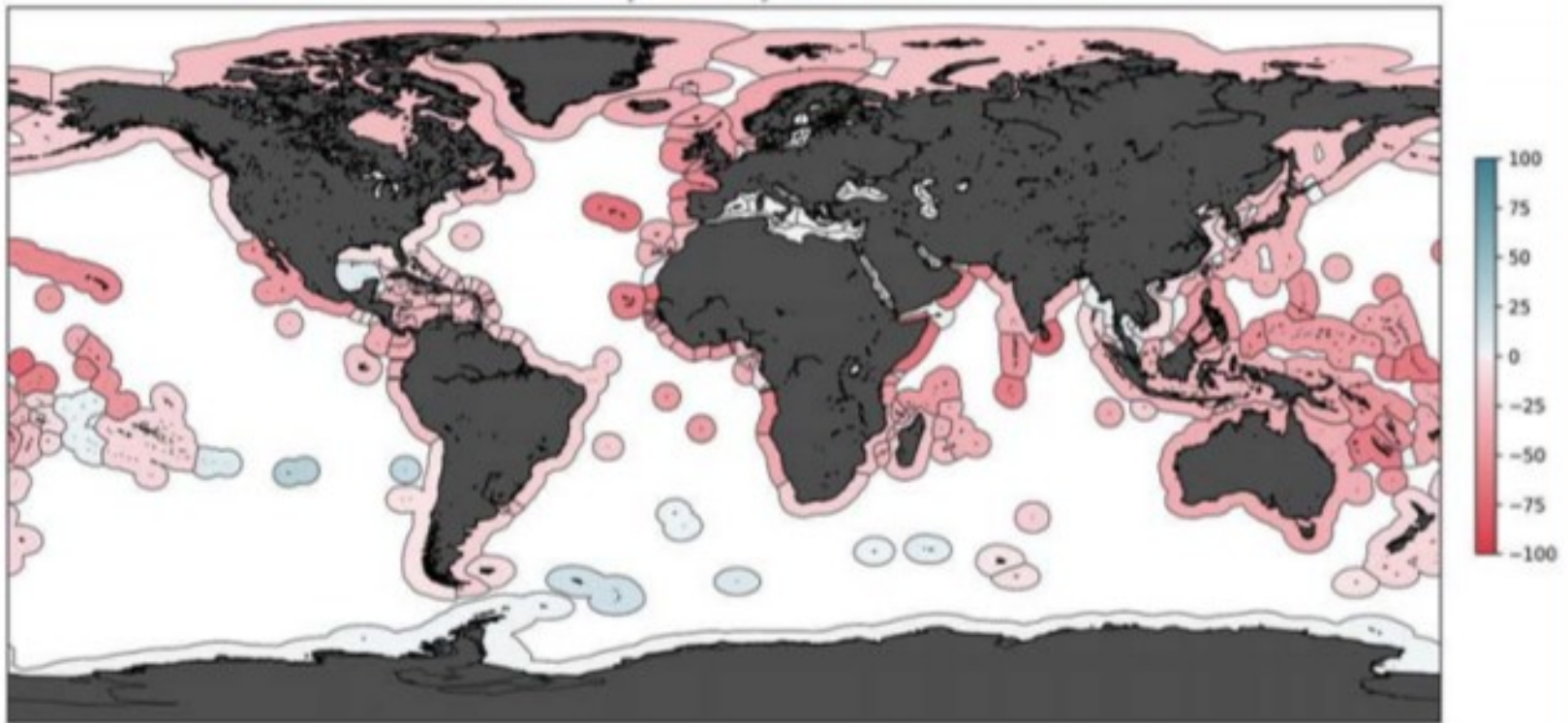


Shrimp trawls can kill 10 lbs of juvenile finfish for each lb of shrimp.

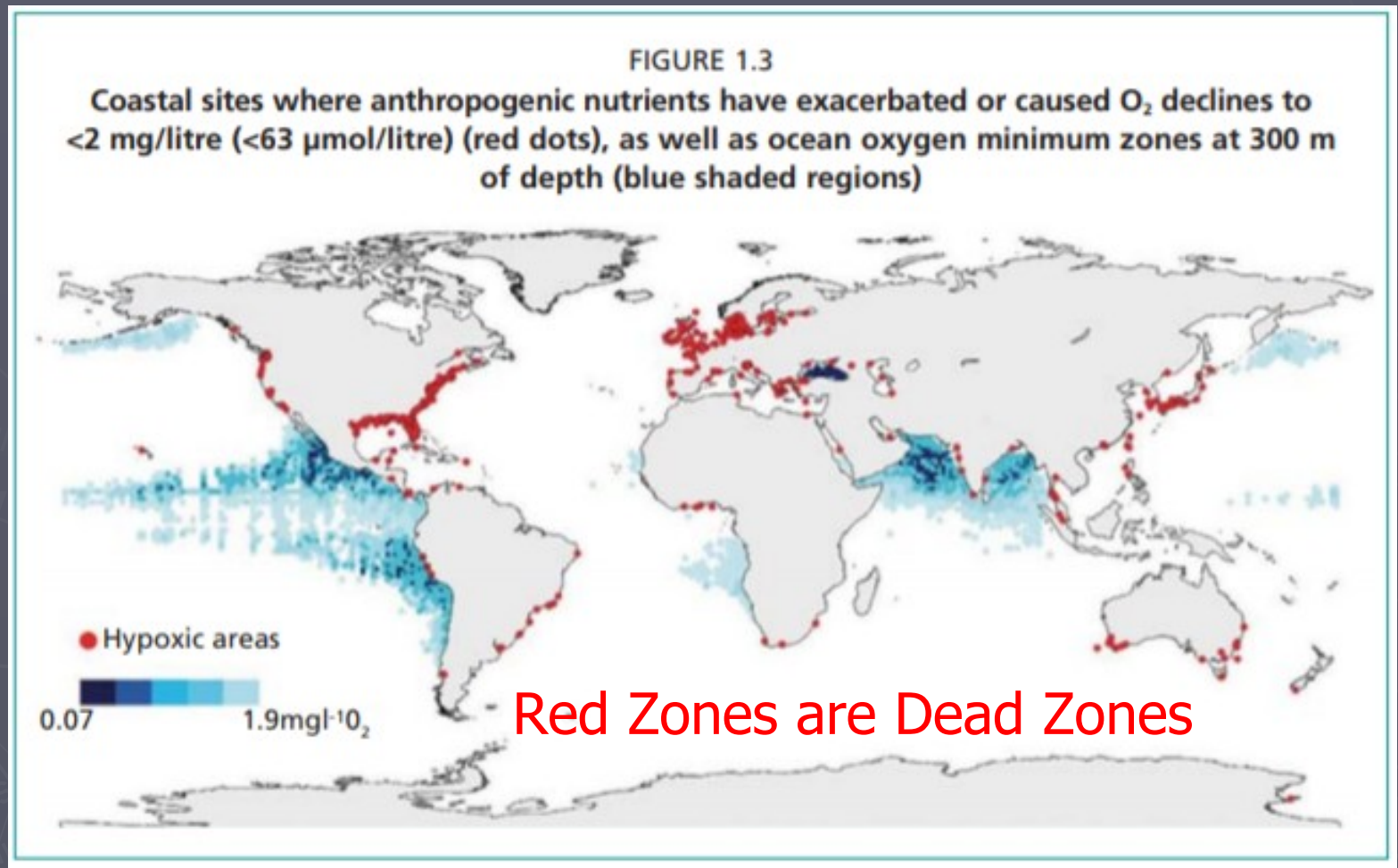
FAO Predicted Impacts Of Climate Change on Wild Fisheries Harvest

Blue is Increases, while Red is Decreases

B Catch potential end of century RCP8.5 – Dynamic size-based food web model

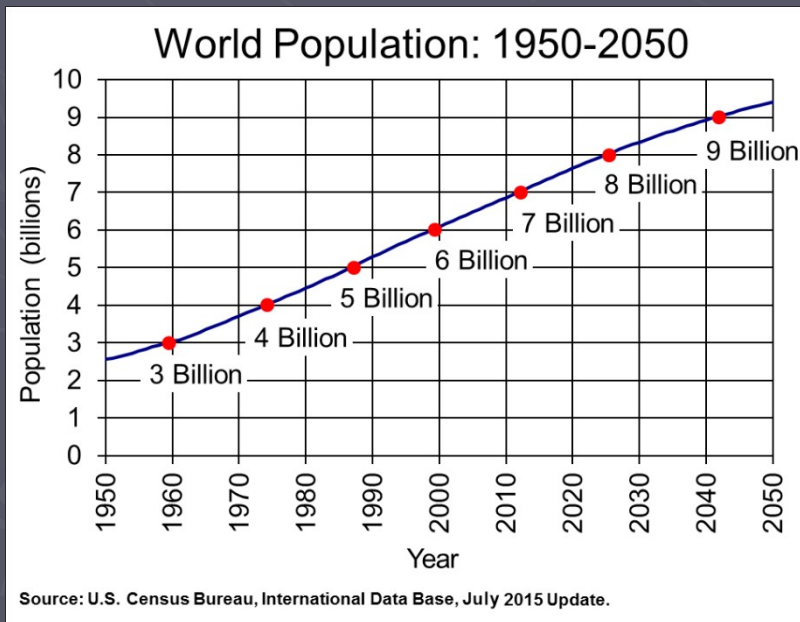


Effect of Increasing Water Temperature on **Oxygen Levels** in the Water



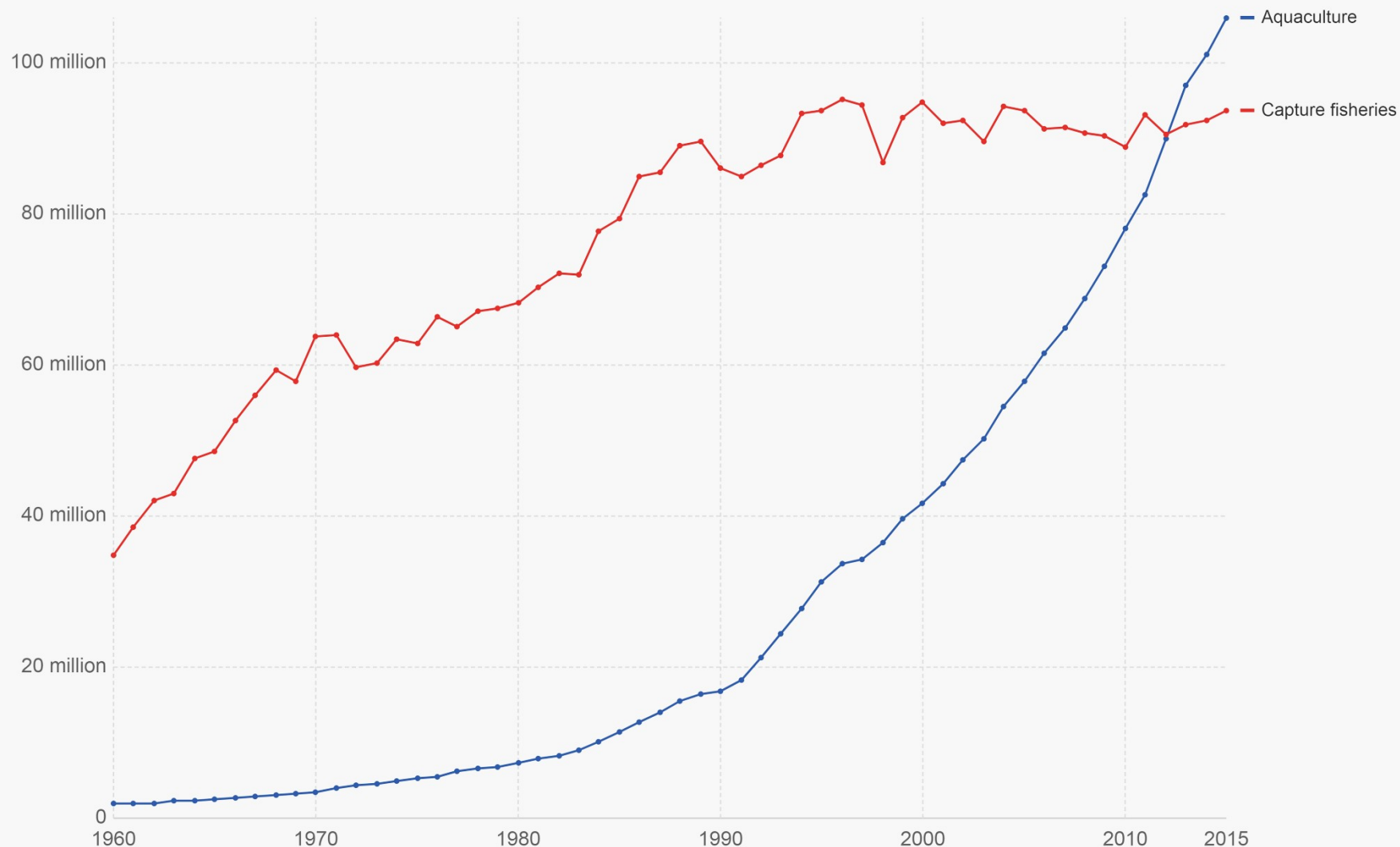
Only in fish do we remain at the Hunter & Gatherer stage getting large amounts of food from the wild

Without terrestrial agriculture, we could never support the current human population.

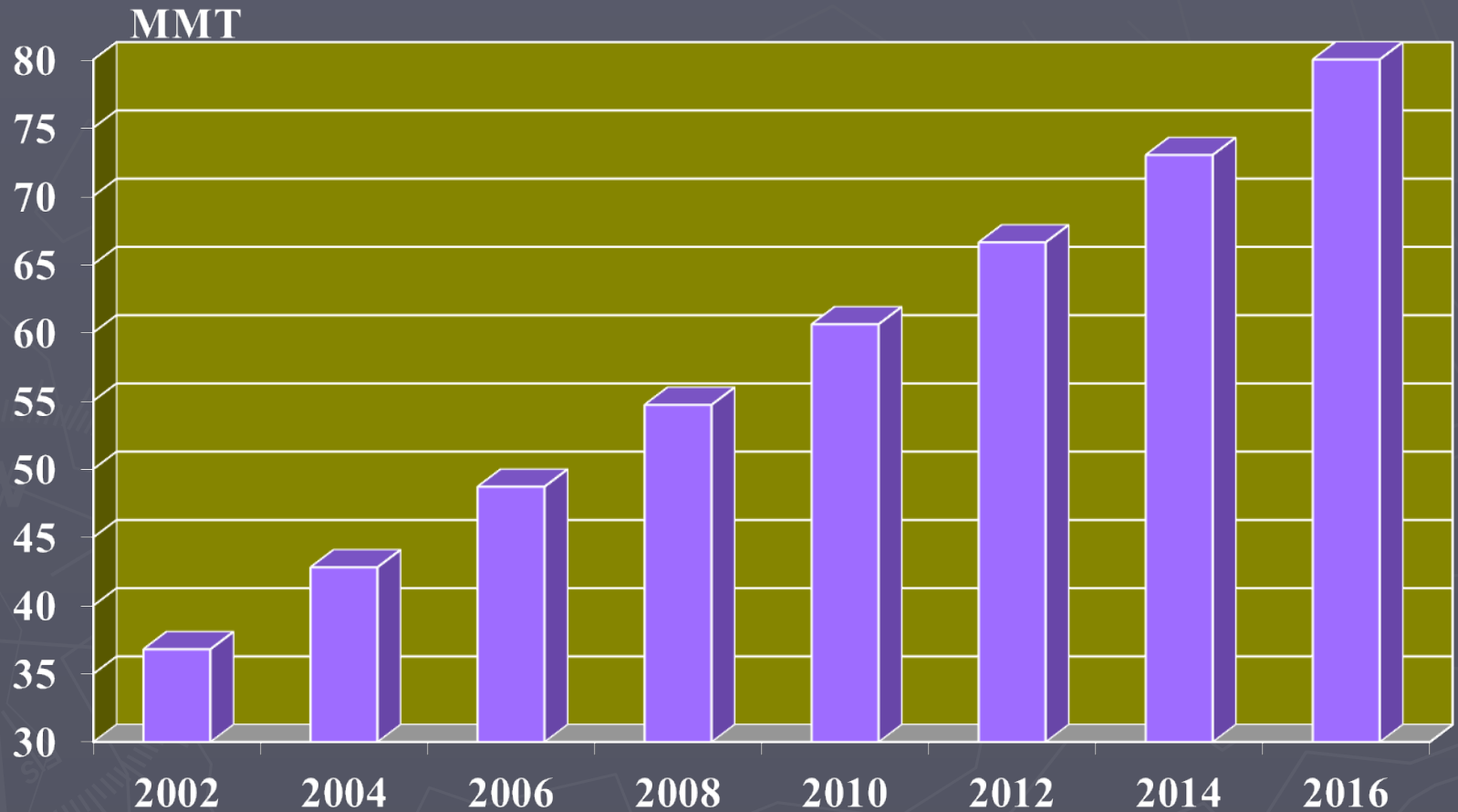


Capture fisheries vs. aquaculture (farmed fish) production, World

Annual production of seafood from wild-catch fisheries and aquaculture (farmed seafood) practices, measured in metric tonnes per year. Data is inclusive of all aquatic species, including aquatic animals and plants.



Aquaculture is world's fastest growing animal food production activity



Data: FAO, 2018

↗
\$232 Billion

Aquaculture is More Efficient

- ▶ Less waste – In capture fisheries **40%-50%** of the total catch may be wasted or discarded.
- ▶ In aquaculture there is a shorter chain from production to harvest to processing and distribution.





Two big areas where aquaponics can help or serve as a model.

1) Increase food production without expanding agricultural land.

a) Increase the efficiency of natural resource use

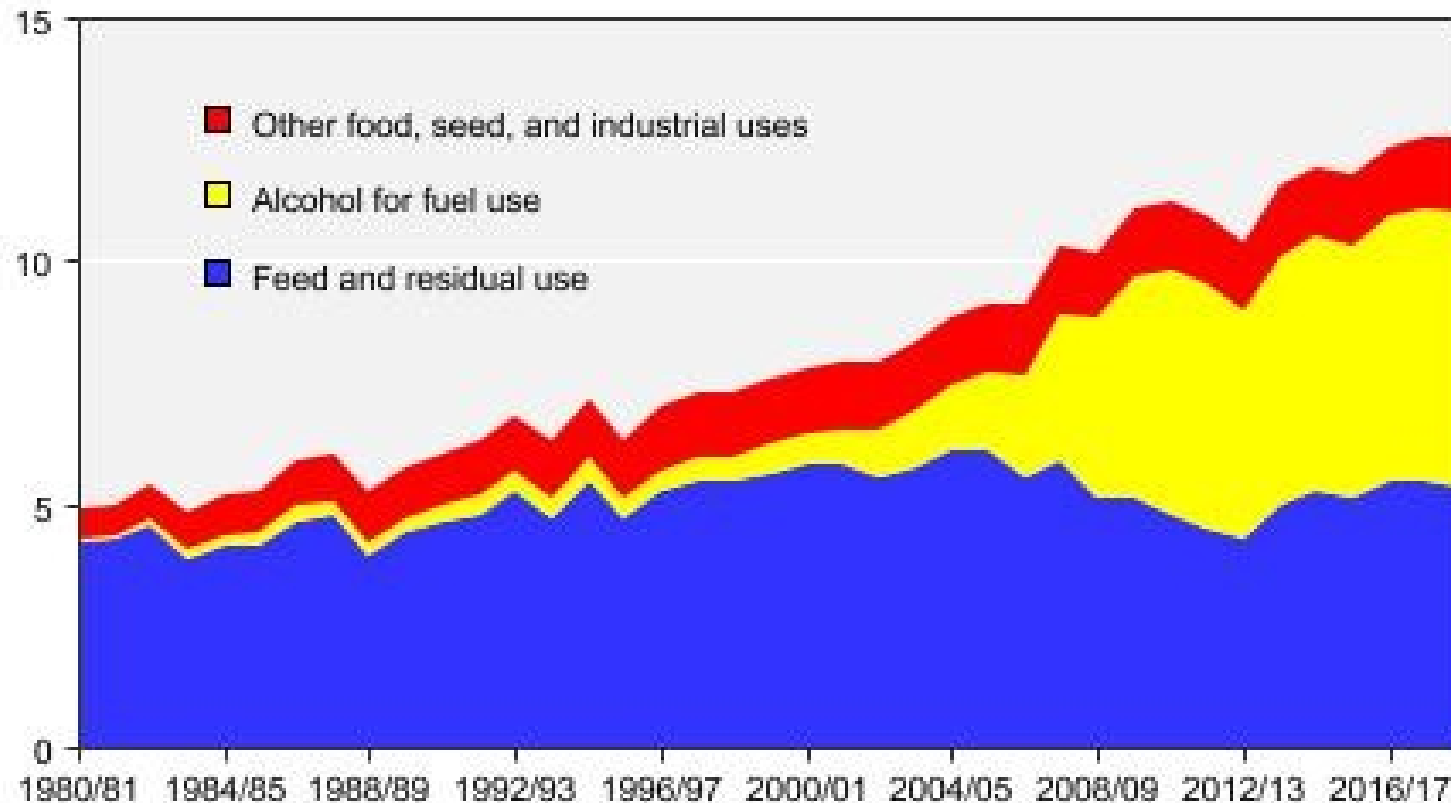
b) Increase production intensity.

2) Increase the fish supply, but also make it more land efficient

Worldwide, 40% of grain produced is used to feed livestock. In the US it is 70%.

U.S. domestic corn use

Billion bushels



Fish are Biologically Efficient Farm Animals

lbs of feed needed to produce 1-lb of gain



Cattle **10 lbs**



Pigs **3.5 lbs**



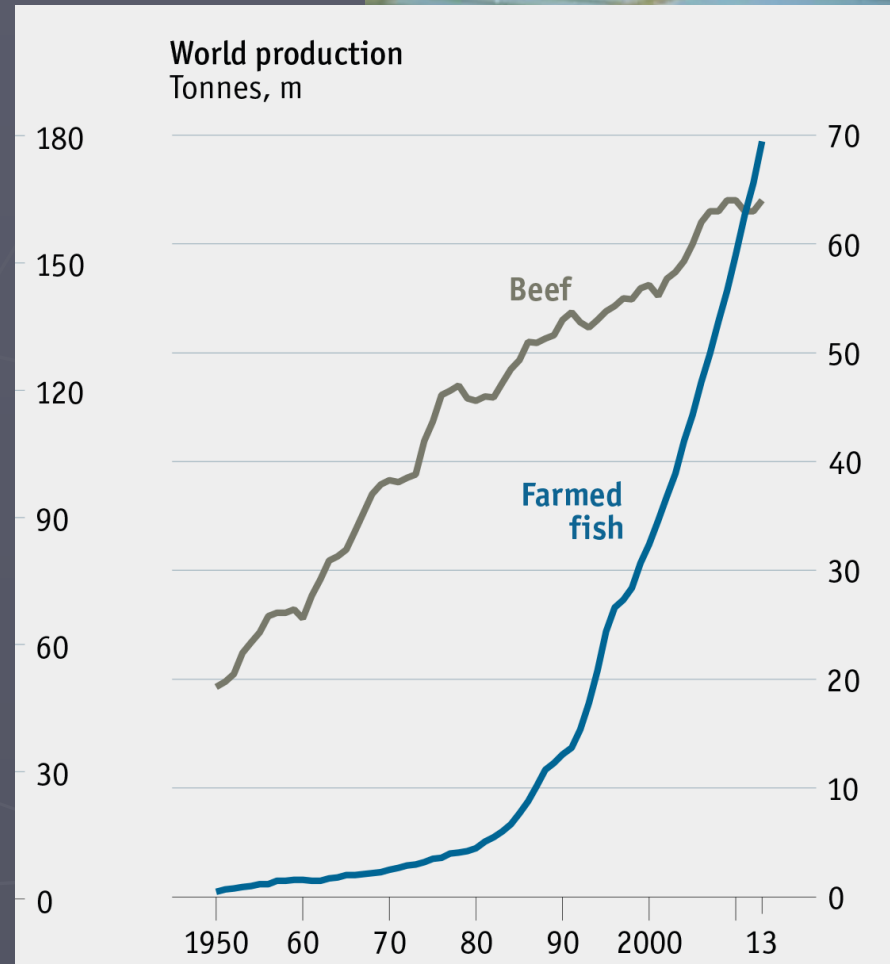
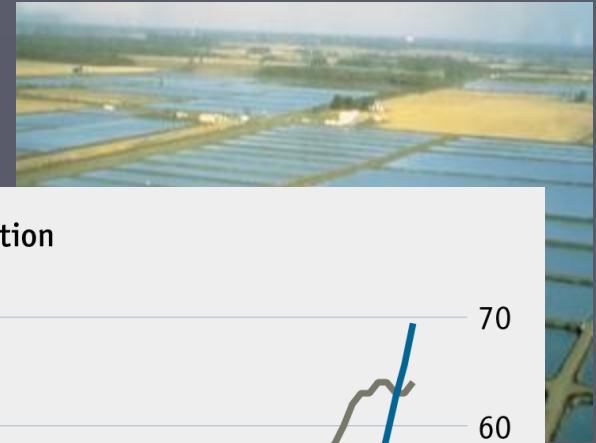
Chickens **2.0 lbs**



Fish **1.5 lbs**

Growth of Aquaculture

Aquaculture-How big a deal can that be??



- With a growth rate of 11% per year — Aquaculture **passed beef in 2012.**

Fish are Biologically Efficient Farm Animals

lbs of feed needed to produce 1-lb of gain



Cattle **10 lbs**



Pigs **3.5 lbs**



Chickens **2.0 lbs**



Fish **1.5 lbs + lettuce**



Efficient Utilization of Protein

% feed protein retained



Cattle 4%



Pigs 9%



Chickens 20%



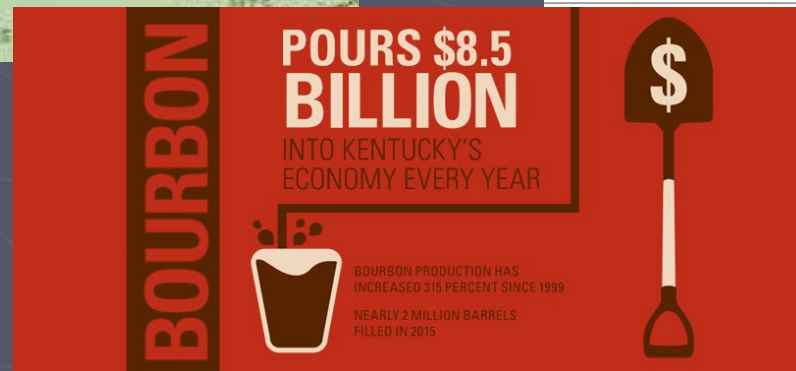
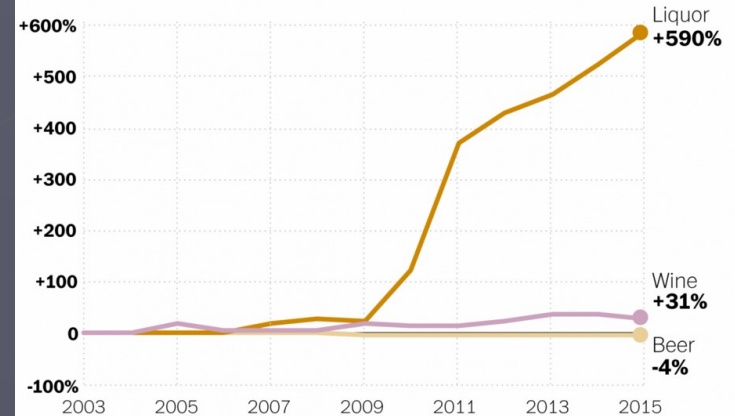
Fish 32%

Distillers Grains in Fish Feeds



Liquor production has spiked dramatically

% change in domestic production of beer, wine and liquor since 2003



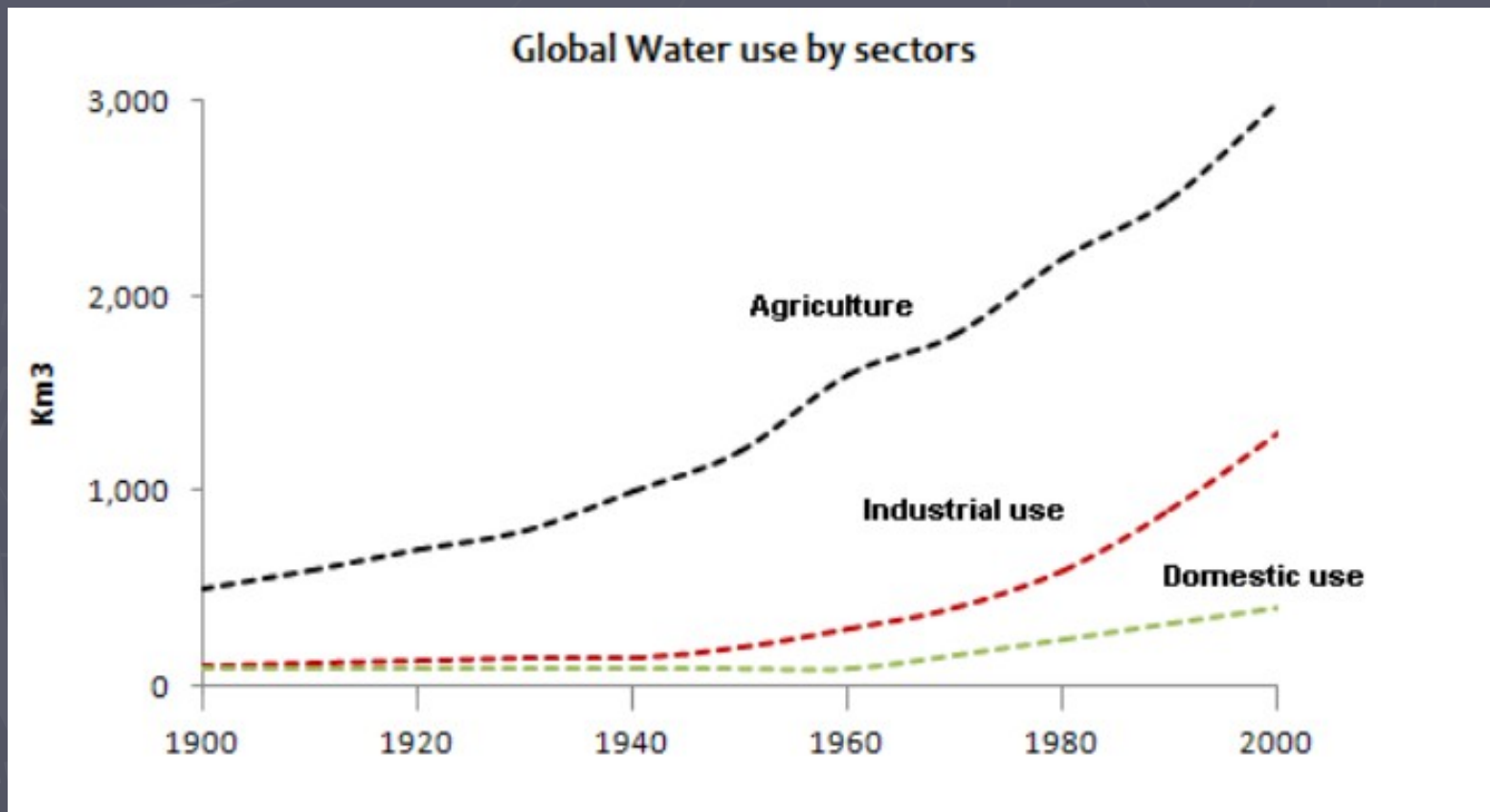
and Trade Bureau.
based on year-to-date figures through October or November of 2015

KSU has conducted feed studies since the 80s.
DDGS is an excellent feed ingredient for fish.

Up to 30% increase growth and survival.

Efficient Use of Water

Agriculture uses **90%** of the water used by humanity



Efficient Use of Water

Gallons of water per lb of gain



Cattle **1,800 gallons!**



Pigs **720 gallons**



Chickens **515 gallons**



Fish **350 gallons**

Efficient Use of Water

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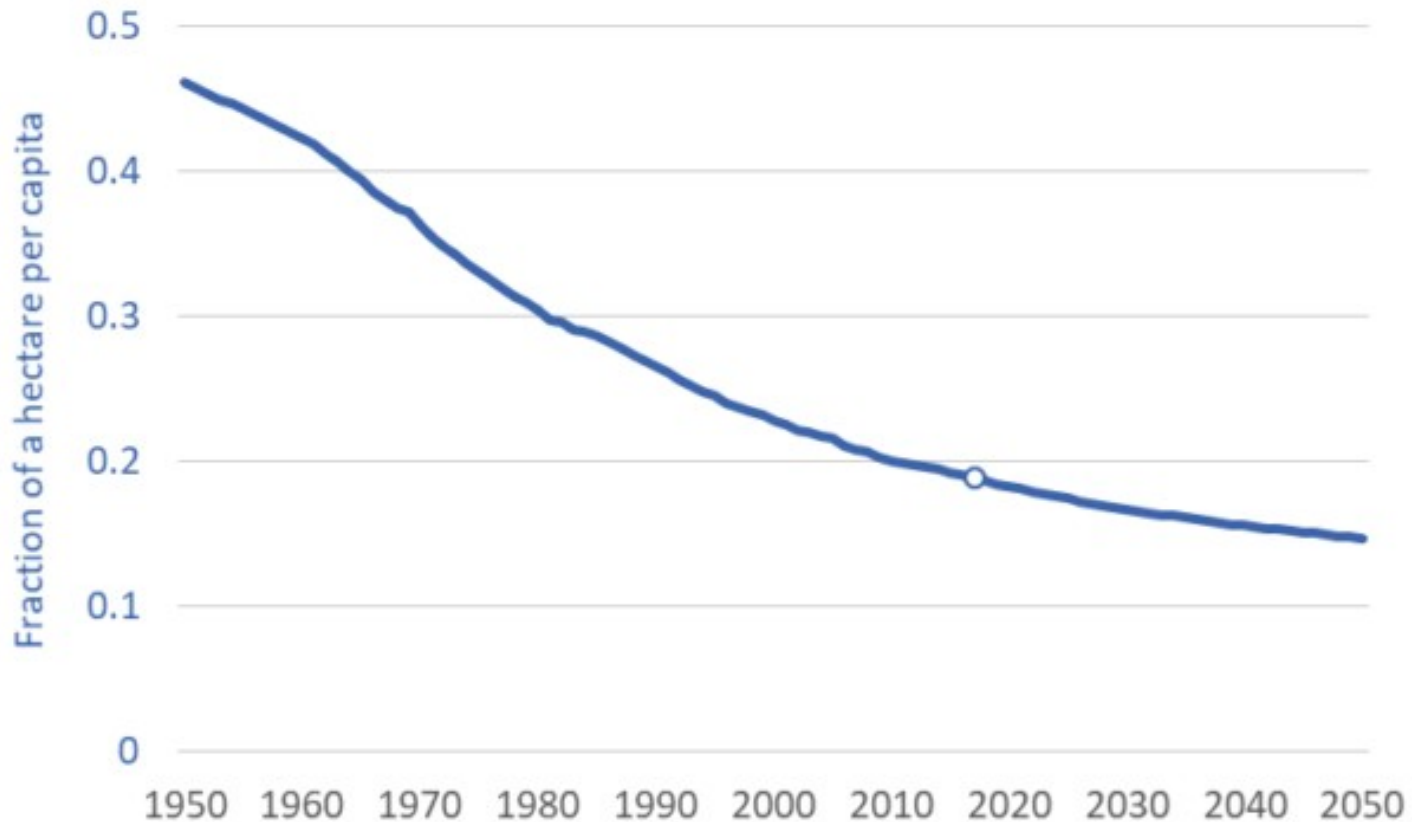


Fish **350 gallons**

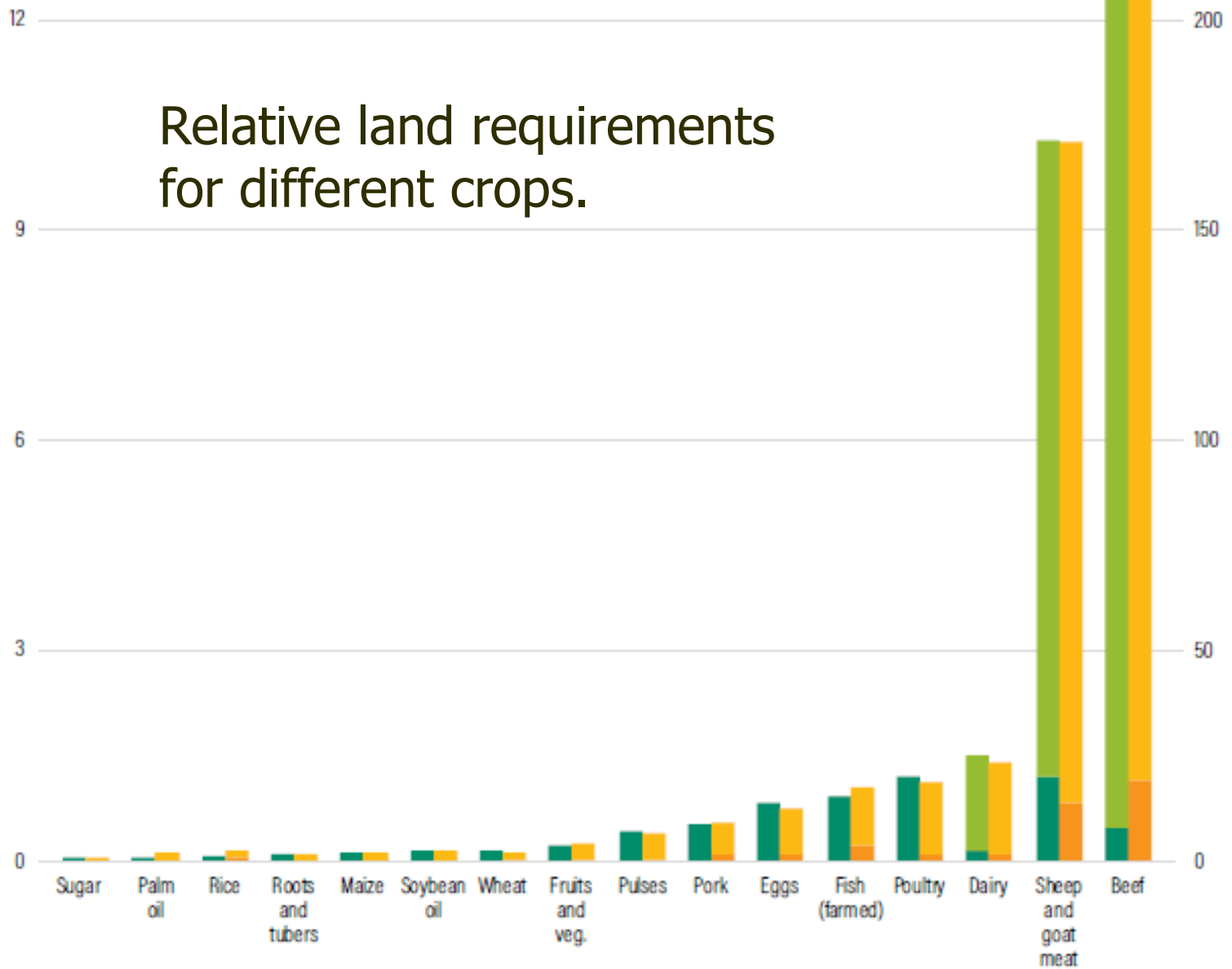
Aquaponics uses 1% of the water/lb as pond production

Efficient Use of Land

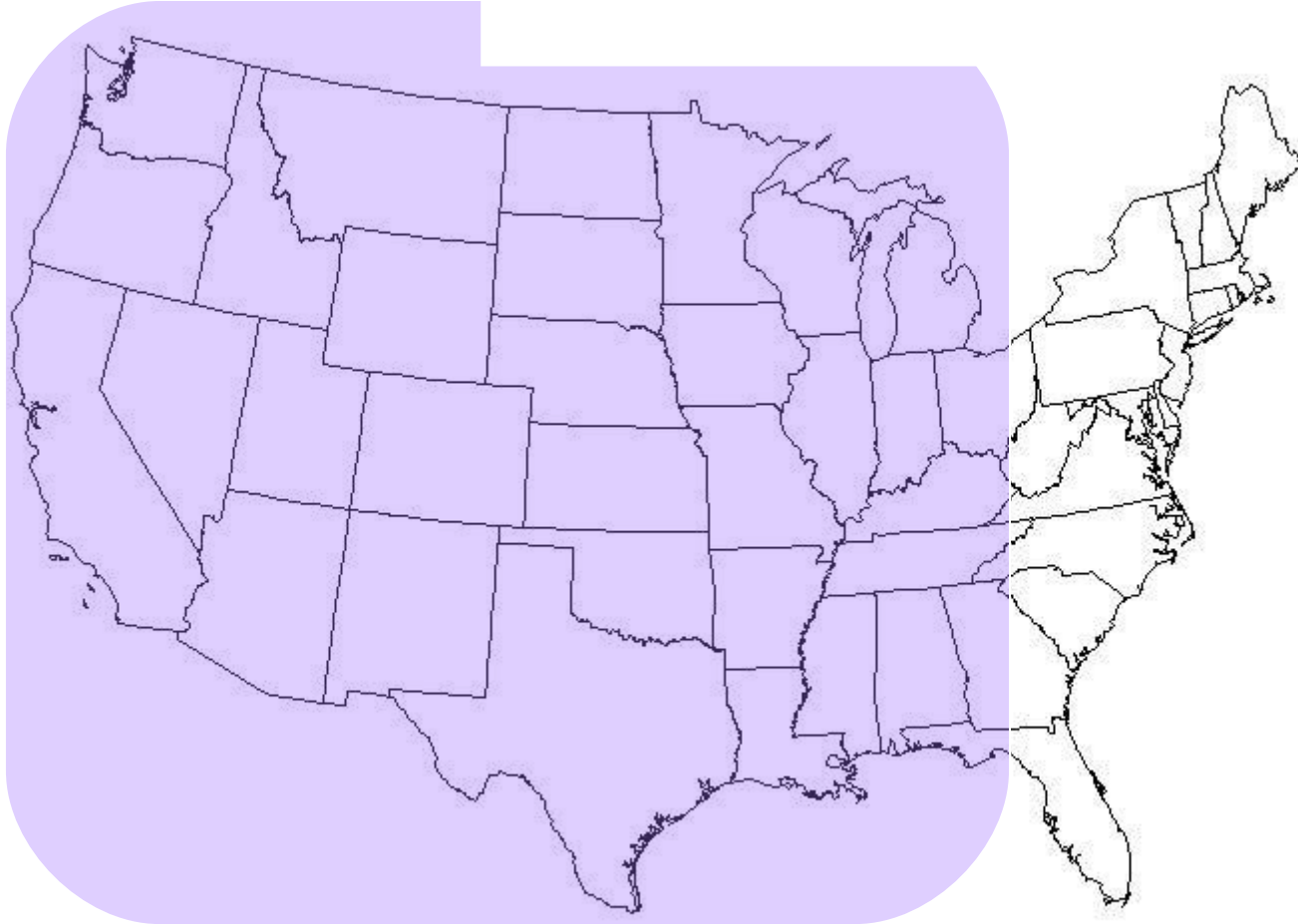
Cropland available per person
World average, 1950 to 2050.



Relative land requirements for different crops.



New crop land that needs to be added to meet crop demand by 2050 if using traditional methods



Fish are so much more efficient at converting feed.

How much crop land could be saved if just the increased production the next 30 years was fish instead of cows, pigs and chickens??

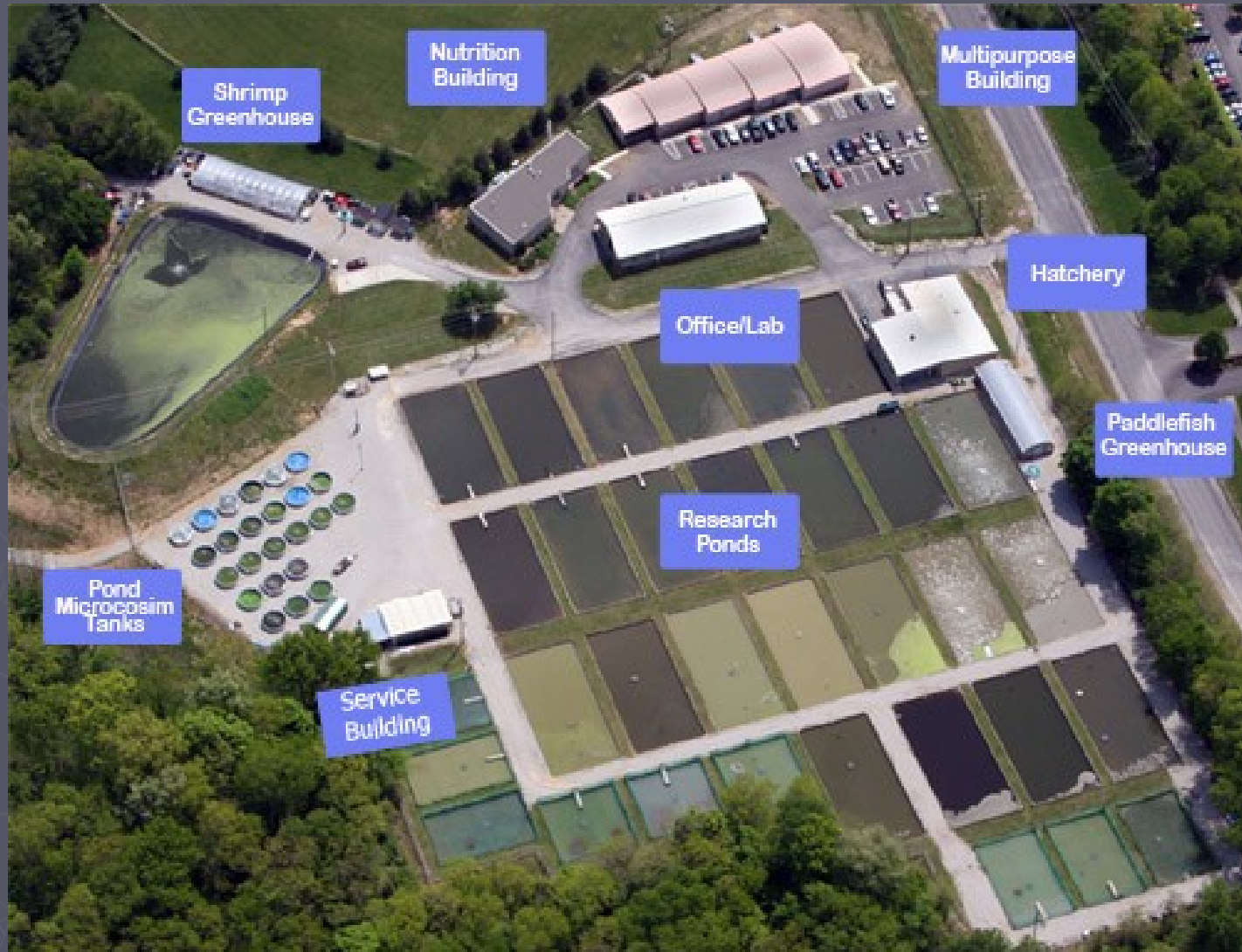
Could spare over 1.8 Billion acres globally; area twice the size of India.



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KSU Aquaculture Research Center



Today the facility consists of: 33 research ponds, modern hatchery, nutrition laboratory, histology laboratory, and greenhouse w/ temp. control.

U.S. is **World's Largest Importer** of Seafood

>91% of US seafood is imported!!

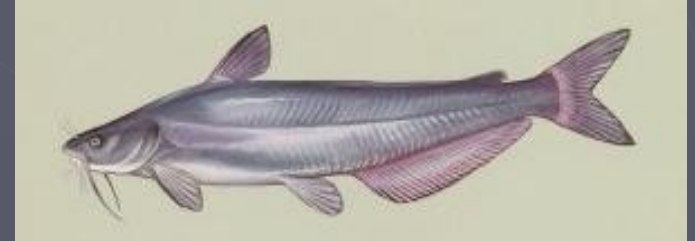
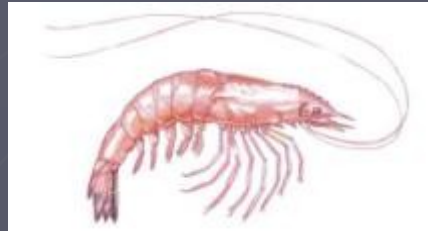
U.S. Trade Deficit in Seafood **\$16 Billion** in 2017!

Food Safety a Big Concern!

Less than 2% even gets a
look by FDA!



Experience with a variety of species. National or world leader in several.



Environmental concerns with food from the other side of the planet!



Food Miles



In US, food has traveled avg **1,500 miles** before you eat it.

Imported seafood has traveled **>6,000 miles!!**



Hyper-Local Seafood

Shrimp is America's Favorite Seafood

KSU BioFloc Saltwater Shrimp System



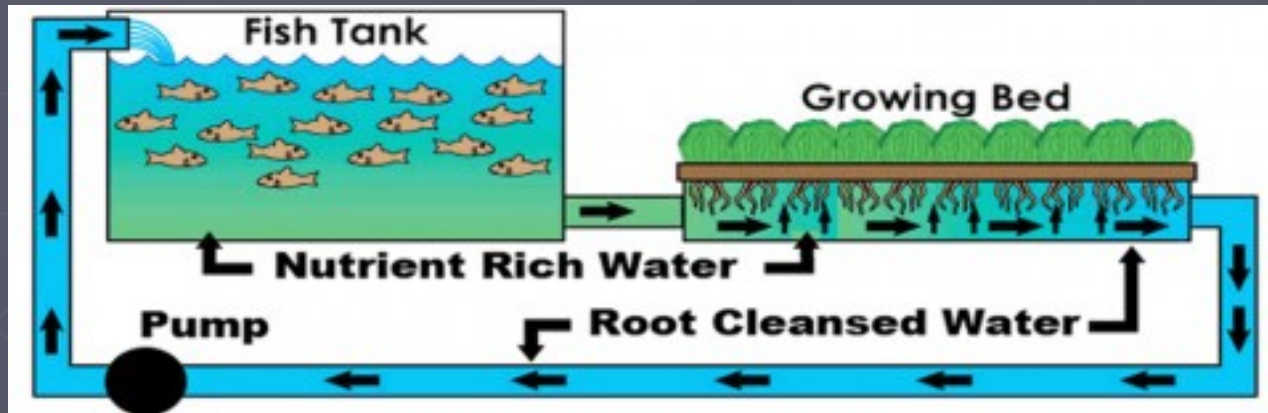
What if our shrimp traveled
6 miles not 6,000??

Less waste than wild caught which
kills 10 lbs of by-catch / lb of
shrimp



Aquaponics

One of the most nutrient & water efficient systems yet devised



FoodChain Aquaponics in Lexington

Now that's local food!



\$



What is Ahead?

Improved versions of aquatic crops

Only 1-3% of aquaculture uses domesticated or selected stocks.

In poultry, genetics increased growth rate 300% & feed conversion 100%.

Genetic improvement MORE promising in aquatic animals.



KSU Internet Courses

- ▶ Use Video Format.
- ▶ Largest offering of internet based aquaculture courses of any university maybe the world.
- ▶ Includes Principles, Methods, Fish Disease, Reproduction, Genetics, and now - Aquaponics
- ▶ Over 1,200 students from 40 states and 30 countries.



Kentucky State University



Information on all things
Aquaculture on our website at:
www.ksuaquaculture.org