APEC FSCF PTIN
Developing Food Safety Plans for the Supply Chain Module

This talk is: Aquaculture, Food Safety, and Preventative Measures

“Prevention not Detention”

November 5-7, 2010

Beijing, China

My E-Card to Everyone

Brett Koonse

United States Food and Drug Administration

+01.301.436.1415

Brett.Koonse@fda.hhs.gov

Outline for Today's Talk:

1. Background
2. Aquaculture Need and Trade
3. Why have a Good Aquaculture Practice (GAqP) or other preventative program
4. Some Basic GAqPs
5. What a GAqP program should look like

Summary of Today's Talk:

1. Wide variety of Aquaculture and is needed as a food source
2. It is a very important to world trade.
3. There are serious food safety issues unique to aquaculture products that impact this important trade
4. These issues are preventable. And Good Aquaculture Practices (GAqPs)..or whatever you call them.. is a food safety preventative program for producers that should be tailored to each farm, country, etc.
5. GAqPs can save money, produce a safer and better quality product, reduce liability, ensure products reach market… reduce risk and document what you do.
6. GAqPs contribute to sustainability, general public health, employee safety, and environmental efforts
7. What are GAqP and what should a GAqP program look like

Aquaculture, Food Safety, and Preventative Measures

Outline:

1.Background

Modern Aquaculture Diverse and Complicated

- Broodstock
- Hatchery
- Growout
- Feed Production
- Medicines/Vaccines
- Sustainability Issues
- Environmental Issues
- Harvest

Aquaculture – The science and art of fish farming

Wide Variety Species and Production

Shrimp

Millions of “mom and pop” farms

1 2 3

Salmon Farms

Catfish and Tra/Basa Farms

Shellfish Farms

Tilapia Farms

Eel Farms

Grouper Farms

Tuna Farms

Deep ocean fish ranching

“Kona Blue” Sashimi & Sushi Grade

Yellowtail similar to an amberjack

Shark Farm

Systems

Raceways - Trout

Recirculating systems; striped bass, tilapia

Nets or Pens;
Salmon, tilapia
tuna, amberjack

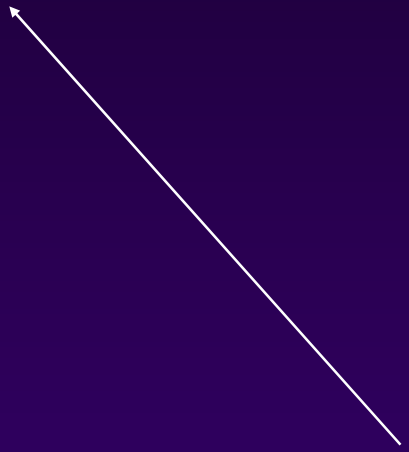
Ponds – Shrimp, Tilapia, Catfish

Aquaculture, Food Safety, and Preventative Measures

2. Aquaculture Trade and Need

What is the Number One Traded Food?

- **Seafood**
- **Bananas**
- **Coffee**
- **Tea**
- **Cocoa**
- **Rice**

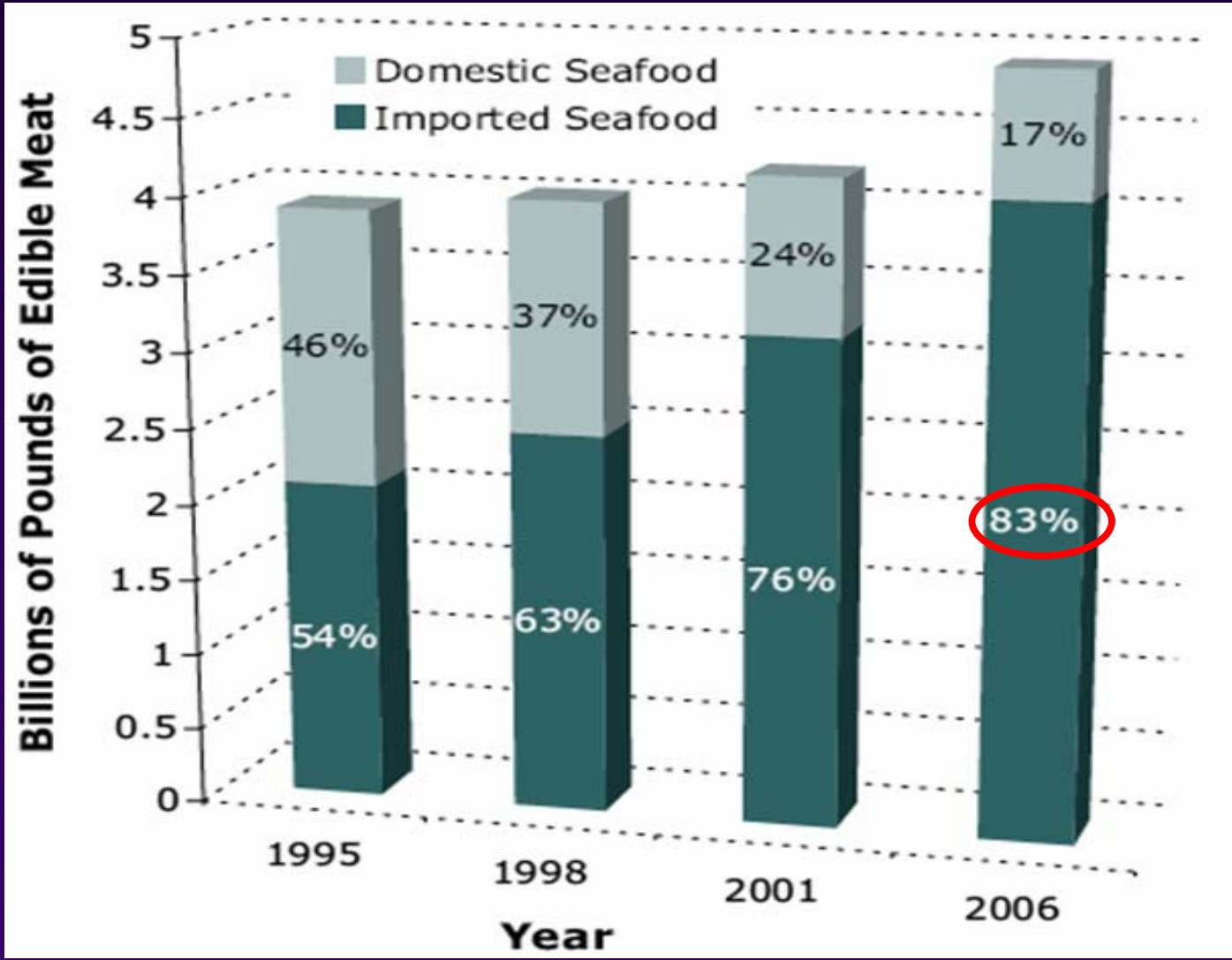


Seafood Trade; exceeds all grains combined and more than tea, coffee, bananas, cocoa and other meats combined

Seafood Trade

- One of world's largest and fastest growing commodity industries.
- In U.S. seafood trade deficit is second largest, after petroleum, for any natural product.
- Worldwide, worth more than US$ 101.6 BILLION (2008) year
- From almost 200 countries
- More than 800 commercially important species, including 30 species of shrimp alone

Like Most Developed Countries, U.S. Imports The Vast Majority of their Seafood



Source: Food and Water Watch, 2007

Need For Aquaculture;
Global Fishery Decline

- **75% of the world's fish stocks are fully exploited, over-exploited, depleted, or in fragile state of recovery**

- **One in five of world population depend on fish as their protein source. Especially developing countries**

Need for Aquaculture; Food Security

- **Human Growth expected to increase from 6.8 billion to over 9.2 billion by 2050**

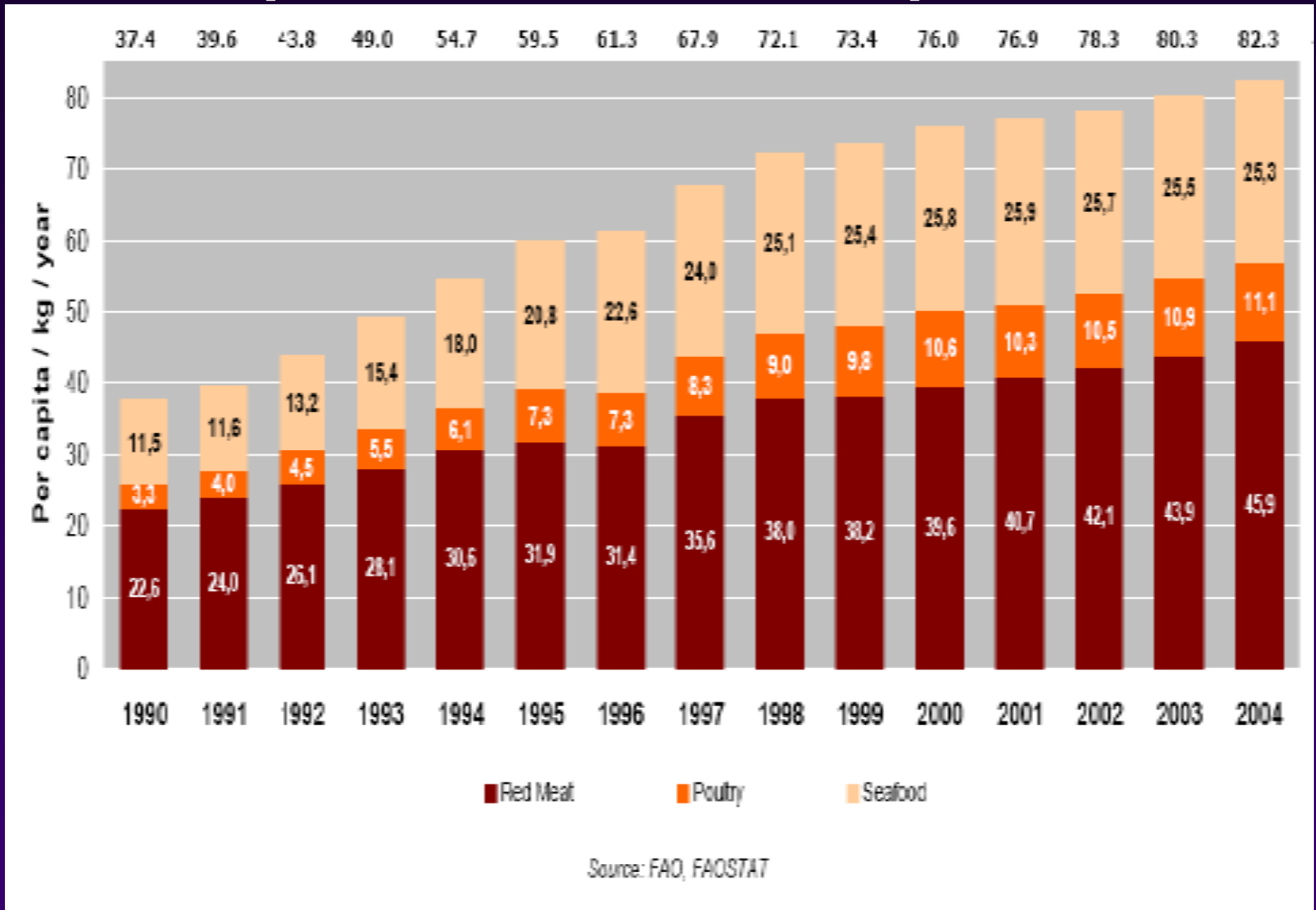
- **To keep up, global food output must increase 110 percent**

Need for Aquaculture; Food Security

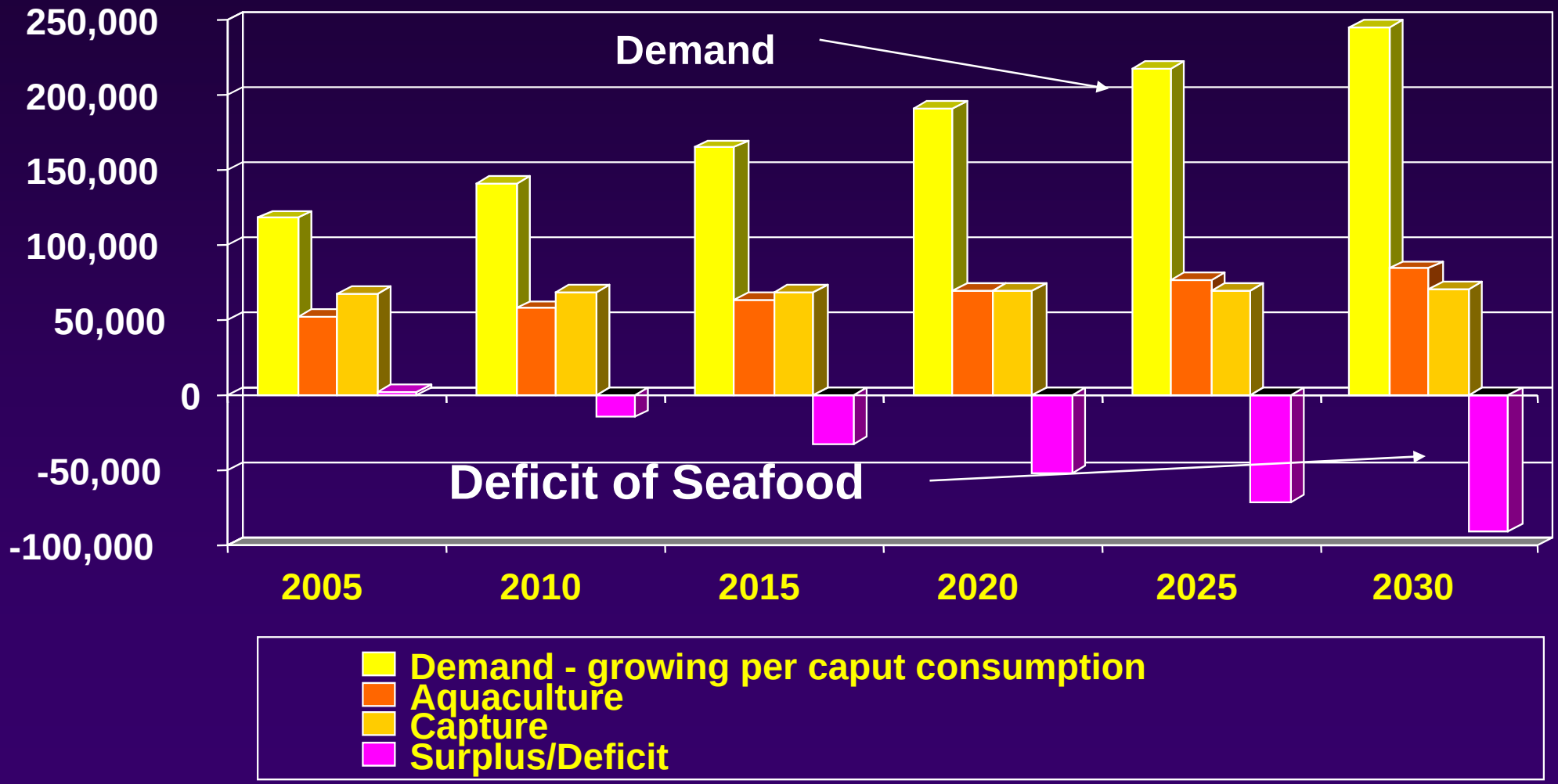
- But, With global economic development, people can afford more protein
- Which means the 9.2 billion people in 2050 will eat as much as 13 billion people… more meat, fish!
- Where will it come from?
- Could have serious Environmental consequences

Fish, Only Hunt and Gathered Commercial Food Left

For Example, Protein Consumption in China



Need for Aquaculutre; Future Demand and Trade



Future is now. For Example, Top Ten Seafood Consumed in USA

1988 – 6.90 kg Edible Wt	2009 – 7.17 kg	Percent Change
Canned Tuna – 1.59 kg	Shrimp – 1.86 kg	+ 71%
Shrimp – 1.09	Canned Tuna – 1.13	- 29%
Cod – 0.78	Salmon –0 .93	+ 365%
Alaska Pollock – 0.54	Alaska Pollock –0 .66	+ 22%
Flatfish – 0.28	Tilapia – 0.55	+ 3000%
Clams – 0.28	Catfish – 0.39	+ 44%
Catfish – 0.27	Crabs – 0.27	+ 80%
Salmon – 0.20	Cod – 0.19	- 76%
Crab – 0.15	Clams – 0.19	- 32%
Scallops – 0.14	Pangasius – 0.16	Off Chart

It's clear, the public health benefits of eating Seafood. But, If we consume seafood like recommended; Even More Demand

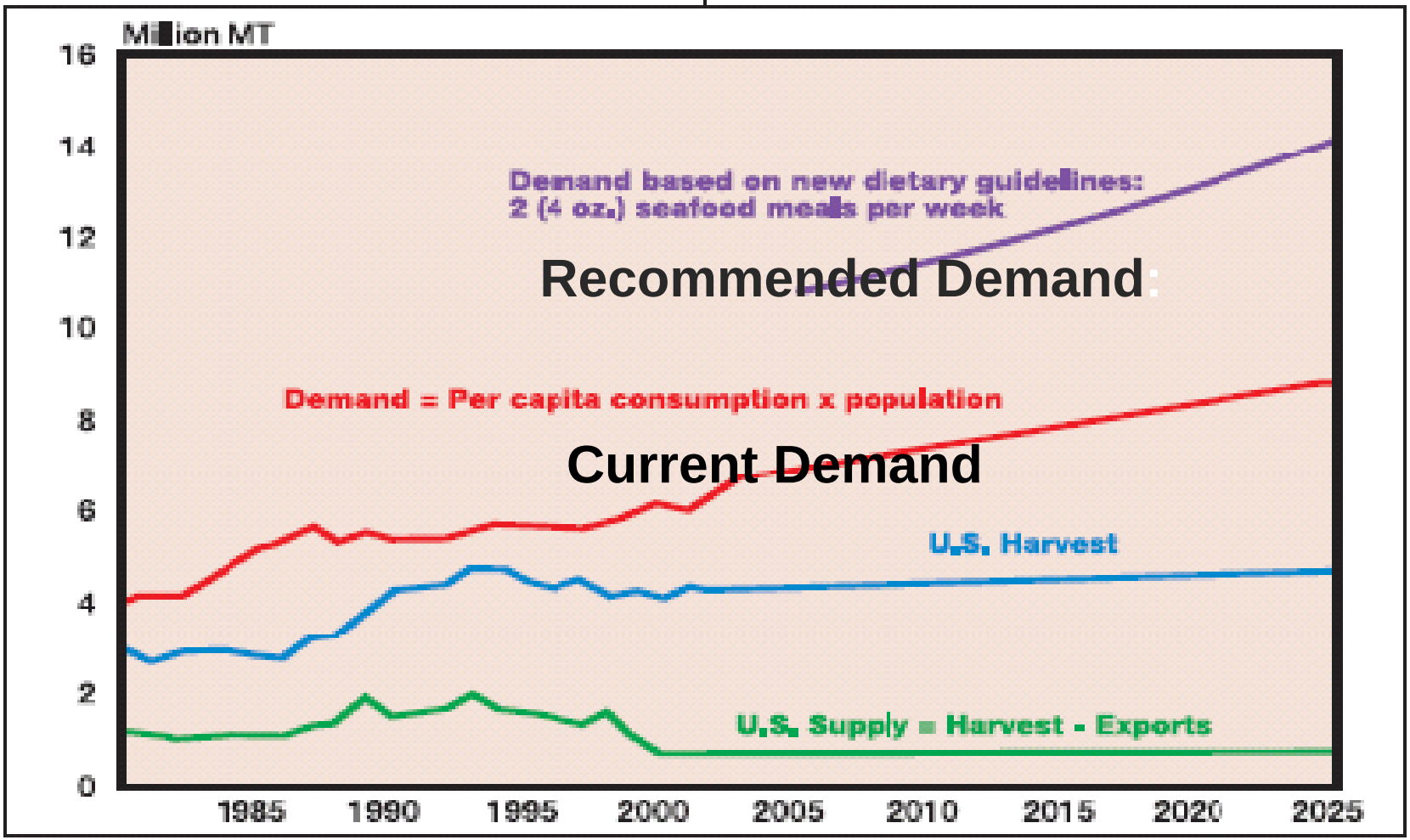
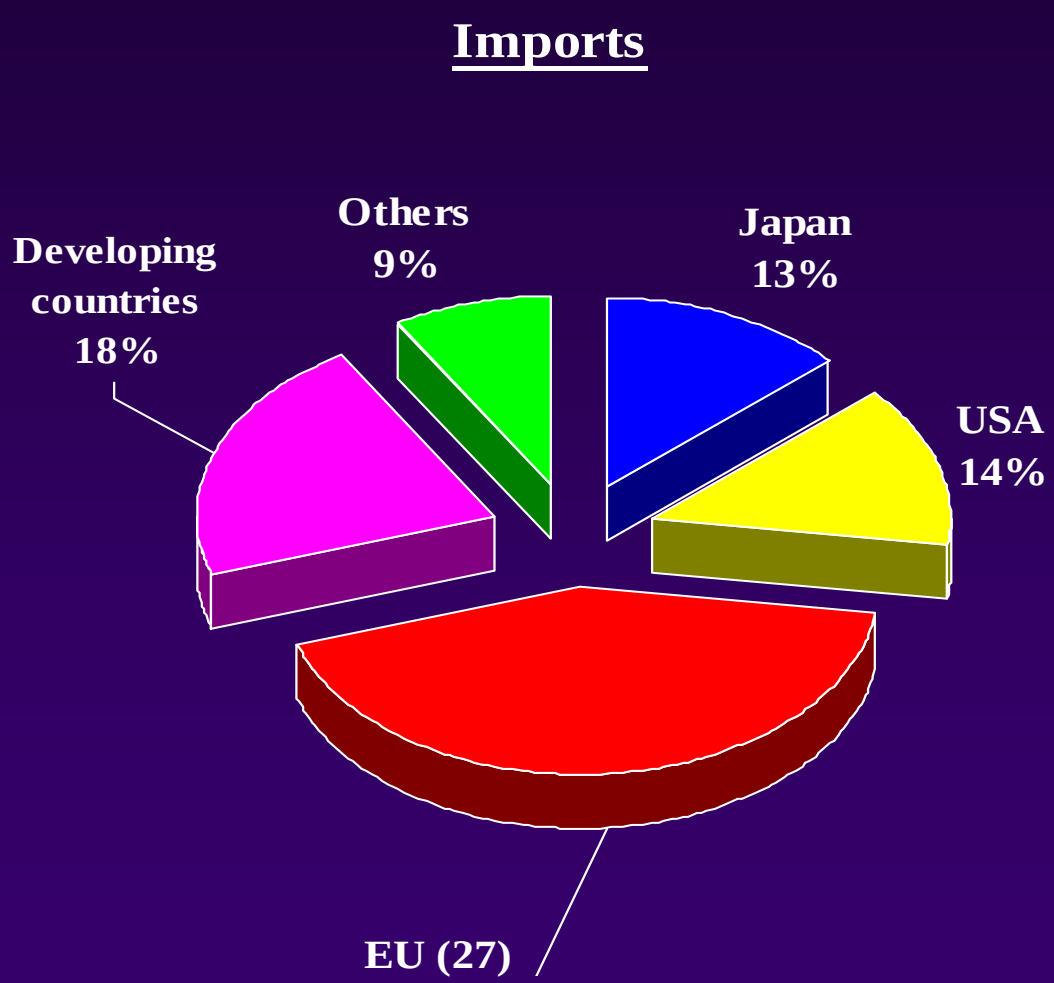
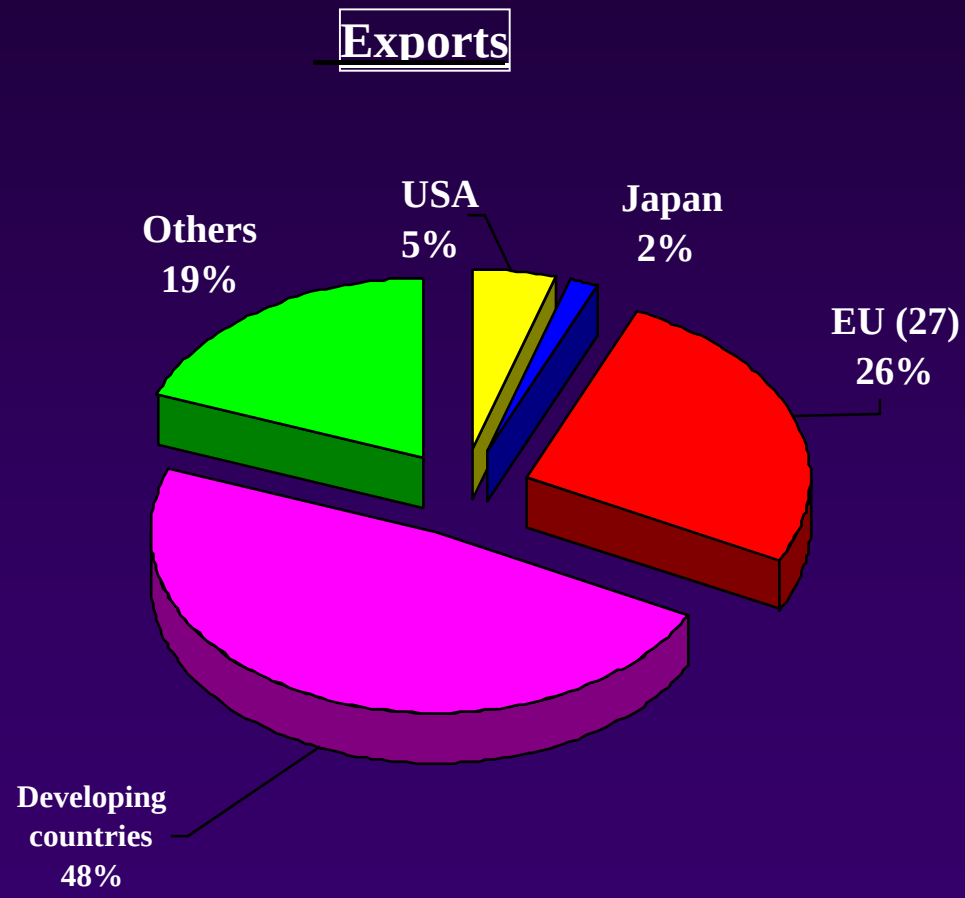


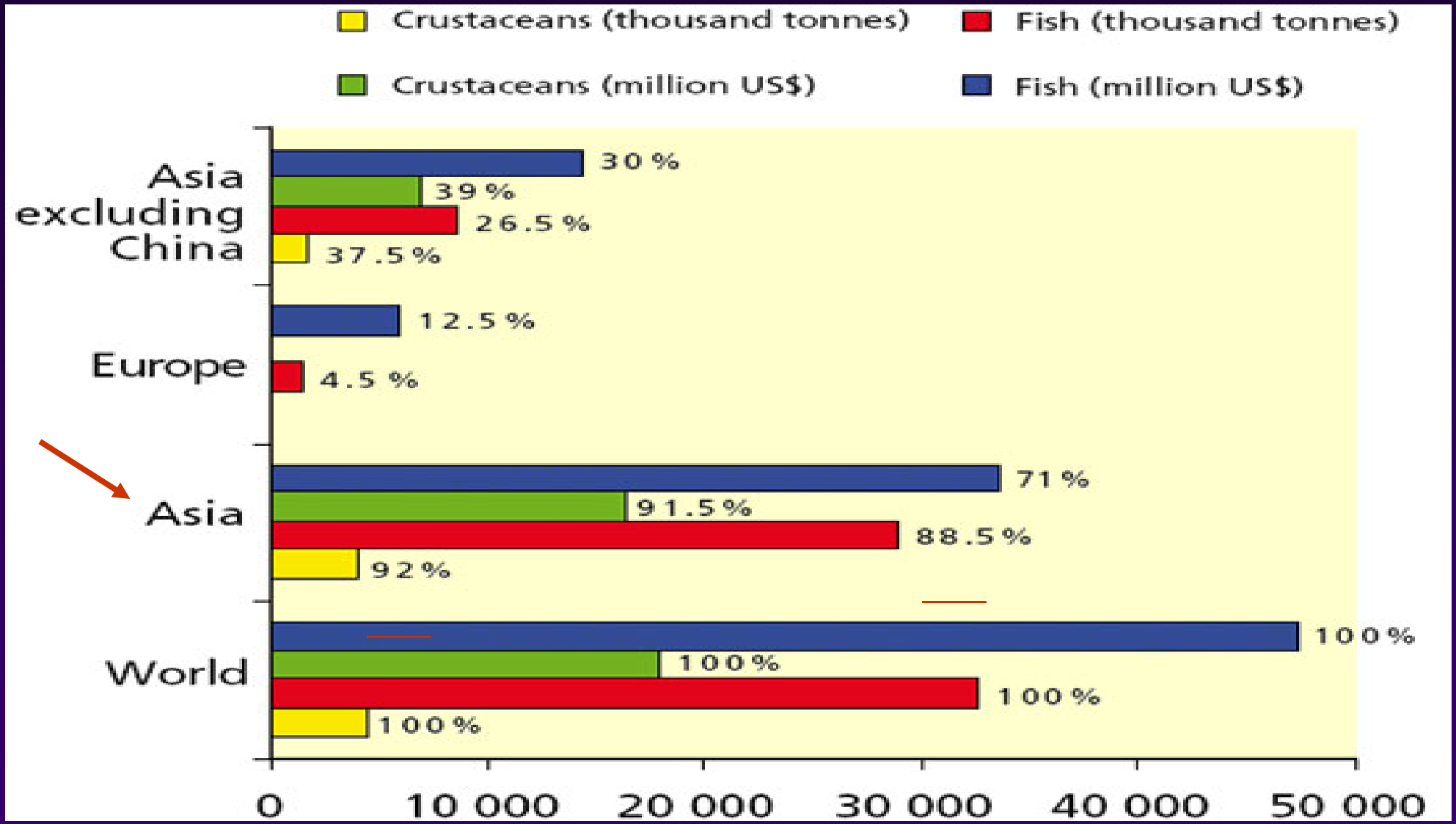
Figure 1. U.S. seafood supply and demand, past and projected.

World Fish Trade 2007 (by value)





Where does Aquaculture come from: Contribution of Asia by type of Culture



Need for aquaculture; it's generally done in rural areas in developing countries

- Provides highly nutritional food that is affordable
- Provides jobs and income in these most needed areas
- Majority of farms are small

Aquaculture, Food Safety, and Preventative Measures

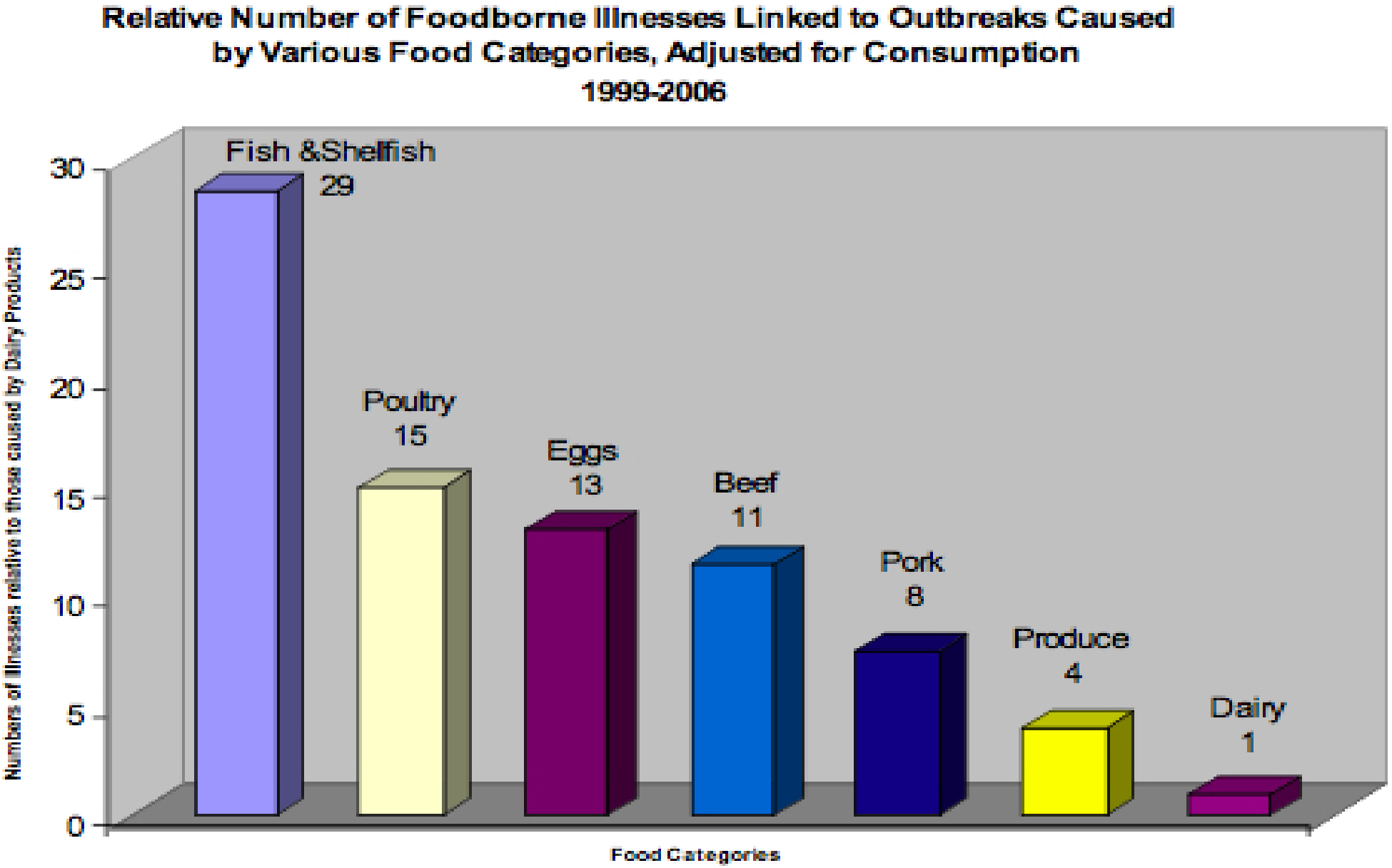
Outline:

2. Need for Preventative Measures or GAqPs.

What are the Food Safety Concerns with aquaculture products?

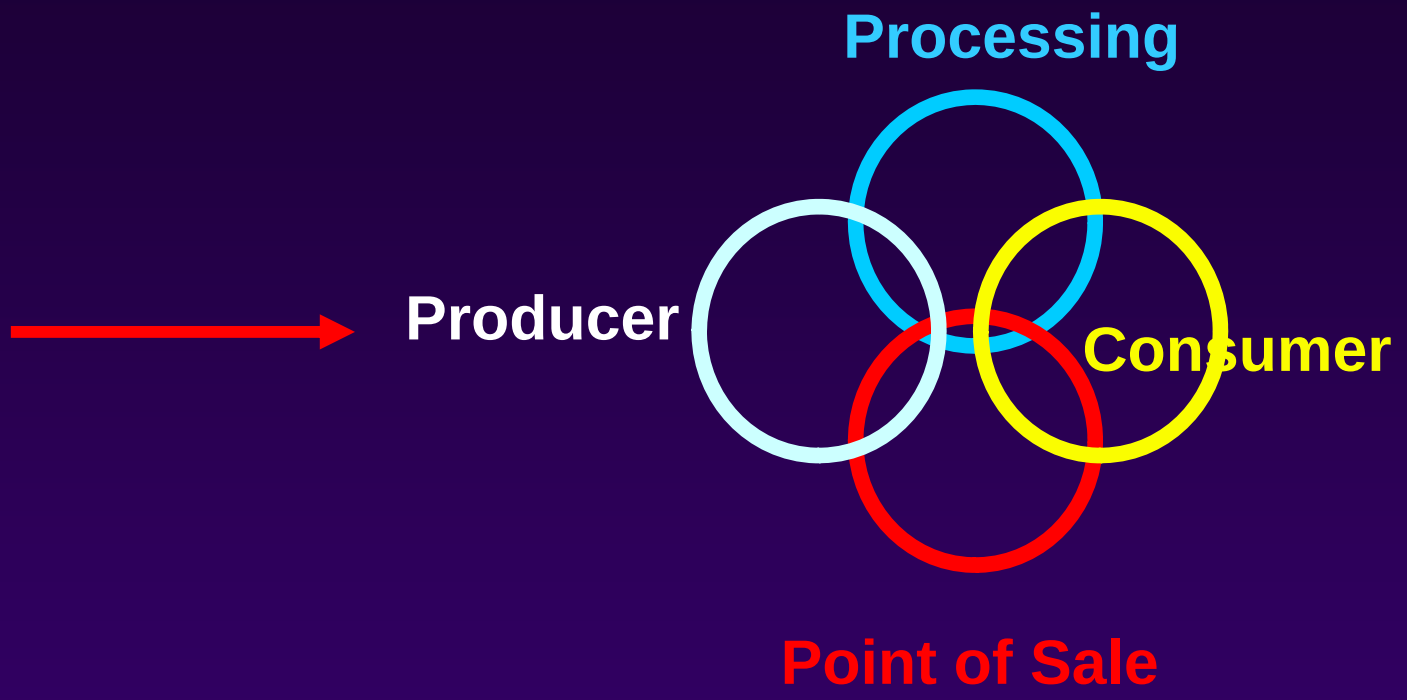
Foodborne Illnesses - For Example in USA

- Estimated, 76 million foodborne illnesses
- 325,000 hospitalizations
- 5,200 deaths
- Known pathogens account for an estimated 14 million illnesses, 60,000 hospitalizations, and 1,800 deaths annually



From: The Center for Science in the Public Interest (CSPI)

Food Safety Today



Aquaculture Food Safety Concerns: Down on the Farm

1. Antibiotic Residues
2. Chemical and Heavy Metal Contamination
3. Pathogens (bacterial, viruses)
4. Parasites
5. Marine Toxins

Aquaculture Food Safety Concerns: Down on the Farm

1. Unapproved Residues

- A 2003 study found on average, 13 chemical and biological products are used in each shrimp pond

- The risk of exposing consumers to suspected carcinogens (e.g., malachite green).

- The risk of antibiotics that are harmful at very low levels to (e.g., chloramphenicol and aplastic anemia)

- Increasing antimicrobial resistance in foodborne pathogens which may be transferred to humans.

Example of U.S. FDA Aquaculture Residue Samples for 1 year

Country (name deleted)	1 Crab sample for Chloramphenicol
2.	1 Salmon sample for Oxolinic Acid
3.	1 Tilapia sample for Fluoroquinolones
4.	1 Catfish sample for Malachite Green 1 Dace sample for Malachite Green
5. 11% Positive →	3 Crab samples for Chloramphenicol 2 Shrimp samples for Nitrofurans
6.	1 Basa sample for Malachite Green
7.	1 Shrimp sample for Chloramphenicol
8. **22% Positive** →	1 Basa sample for Fluoroquinolones 6 Catfish samples for Malachite Green 4 Channel Catfish samples for Malachite Green 26 Eel samples for Malachite Green 2 Grouper samples for Malachite Green 4 Shrimp samples for Nitrofurans 3 Tilapia samples for Malachite Green
9. **21% Positive** →	3 Eel samples for Malachite Green 1 Clarius sample for Malachite Green
10 17% Positive →	3 Basa samples (2 for Malachite Green, 1 for Fluoroquinolones) 3 Crab samples for Chloramphenicol 1 Grouper sample (both Malachite Green and Fluoroquinolones) 1 Shrimp sample for Chloramphenicol

Bacteria Sex - Antibiotic Resistance, a Real Problem

- Bacteria do exchange genes forming new combinations
- This can be done between unrelated species of bacteria
- Studies of shrimp in Thailand, Vietnam, the Philippines and Mexico found relatively high levels of bacteria resistant to antibiotics, especially *Vibrio* bacteria

Antibiotic Resistance – An Emerging Public Health Crisis." Keep Antibiotics Working: The Campaign to End Antibiotic Overuse, Washington DC, www.keepantibioticsworking.com

2. Chemical\Pesticide Residue

Seafood Safety Problems: Real and Perceived

Chemicals in Feed

The New York Times

Filler in Animal Feed

Melamine

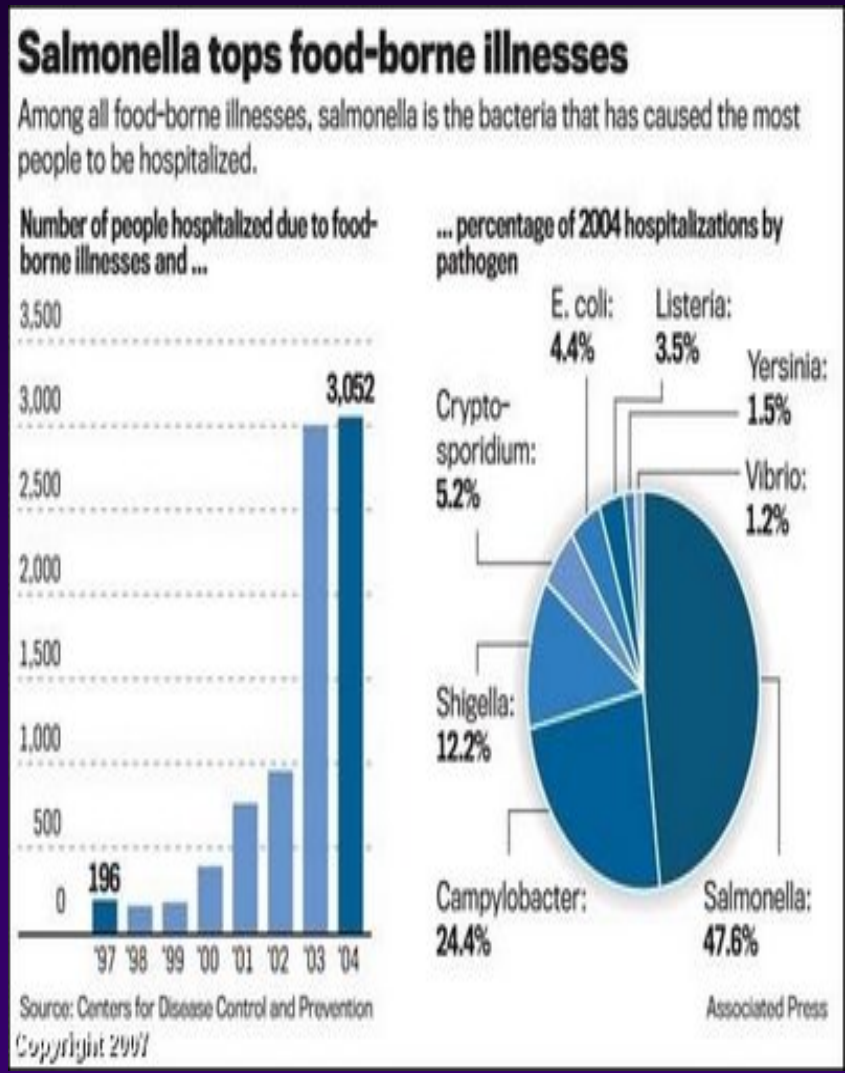
Chemical Residue

Be aware of the widespread use of Leather Meal

- **Potentially high in metals**
- **Country Limits**
- **Cheap protein**

3. Pathogen Concern

- Effort to minimize pathogens
- Is “preventable”
- Should not have to expect our food to be contaminated
- Liability issue
- Salmonella; Indicator of fecal contamination
- Fecal Waste is waste…cooked or not



Surf Clam

Oysters

Manila & Littleneck Clams

Geoduck

Scallops

Mussel

Quahog Clams

Viruses

Norwalk-like: frequently associated with seafood

Hepatitis A: frequently associated with seafood

Hepatitis E: Not documented

Astrovirus: Suspected in one outbreak (oysters)

Rotavirus: Not documented

Adenovirus: Not documented

Salmonella Shrimp Illness Outbreak, 2000

- **Traced back to aquaculture shrimp**
- **FDA inspected the foreign processor of the shrimp 3-4 months prior. Almost perfect (I was part of the inspection team)**
- **Found same serotypes in remaining shrimp samples and in shrimp on farm**

Raw, undercooked seafood, not uncommon and cross contamination does happen!

Over cooked seafood tough as a boot

Salmonella Study Showed Contamination Can Begin at Farm

Journal of Food Protection, Vol. 68, No. 12, 2005, Pages 2527–2532

Salmonella and the Sanitary Quality of Aquacultured Shrimp

BRETT KOONSE,[1]* WILLIAM BURKHARDT III,[3] STUART CHIRTEL,[2] AND GEORGE P. HOSKIN[1]

[1]*Office of Seafood and* [2]*Division of Mathematics, U.S. Food and Drug Administration, Center for Food Safety and Applied Nutrition, College Park, Maryland 20740; and* [3]*Office of Seafood, U.S. Food and Drug Administration, Center for Food Safety and Applied Nutrition, Gulf Coast Seafood Laboratory, Dauphin Island, Alabama 36528, USA*

MS 05-168: Received 18 April 2005/Accepted 7 August 2005

ABSTRACT

In this study, we examined the prevalence of *Salmonella* and coliform bacteria on shrimp aquaculture farms to develop guidelines or preventative measures for reducing *Salmonella* and fecal contamination on products harvested from these farms. The U.S. Food and Drug Administration, in conjunction with foreign government regulatory agencies, the aquaculture industry, and academia affiliates, analyzed 1,234 samples from 103 shrimp aquaculture farms representing six countries between July

Parasites

- **Nematodes or round worms**
  - *Anisakis* spp. (Worldwide)
  - *Gnathostoma* spp. (Worldwide)
  - *Capillaria philippensis (Philippines)*
  - *Angiostrongylus* spp. (Worldwide)
- **Cestodes or tape worms**
  - *Diphyllobothrium* spp. (worldwide)
- **Trematodes or flukes**
  - *Clonorchis* spp. (South East Asia)
  - *Opisthorchis* spp. (South East Asia, Eastern Europe)
  - *Heterophyes* spp. (Worldwide)
  - *Paragonimus* spp. (worldwide)
  - *Metagonimus yokagawai (Asia, Egypt)*
- **Effect of cooking** (55C, 1 min), **freezing** (- 20C, 24 h), **Salting** (4-5% WPS for 10-12 weeks; 8-9 %, 5-6 weeks)

Anisakis simplex (left) and *Pseudoterranova dicipiens* (right) both in cod

Biotoxins; Shellfish but also others

- **PSP-Paralytic shellfish poisoning:** Worldwide
- **DSP-Diarrheic shellfish poisoning**: Worldwide
- **NSP-Neurotoxic shellfish poisoning**: USA, New Zealand, Caribbean
- **ASP-Amnesic shellfish poisoning**: North America
- **Ciguatera fish poisoning**: Tropical, sub-tropical
- **Puffer fish (tetrodotoxin) poisoning:** Japan, South Pacific

These Food Safety Concerns Cost Time and Money

1. **All the internal inspections, surveys, samples**
2. **Market driven certifications**
3. **EU conducts Competent Authority audits**
4. **Many countries conduct processor inspections in countries.**
5. **Border Checks and detentions**
6. **Requirements for getting health Certificates**
7. **Testing, testing, testing being done**
8. **One processor I visited spends 250,000 a year testing for residues!**

These Food Safety Concerns – Cause Serious Trade Disruptions

- **Countries not on Canada's "A" list**
- **Countries and processors on USA's automatic detention list (no green light)**
- **Countries not on the EUs "List of Approved Countries"**
- **Countries that are testing a high percentage of incoming product**
- **Detentions, rejections, testing, storage, etc**

FE The Financial Express

New EU testing rule hits shrimp exporters hard

Friday, 9 July 2010

Tags: bangladesh arsenic, bangladesh film, bangladesh net, bangladesh post

Monira Munni

Bangladeshi shrimp consignments worth Tk 2.0 billion have remained stranded at different ports after European Union pressed for a new testing requirement on health ground.

European Union, the 27-nation grouping, has recently set a criteria saying it will not allow entry of shrimps and fishes containing crystal violet (one kind of dye) more than 0.5 parts per billion (PPB).

The new rule is expected to deal a big blow to Bangladesh's shrimp exports to the EU as the country's shrimp consignments are carrying certificate of crystal violet limit at 2.0 PPB, exporters said.

They said the new requirement on shrimps' health certificate has blocked entry of shipment to the EU, which account for more than 50 per cent of Bangladesh's shrimp export.

Officials said due to imposition of new criteria hundreds of Bangladeshi shrimp consignments worth millions of taka have remained stranded at different ports of the world.

FDA bans import of drugged fish!

"All the News That's Fit to Print"

The New York Times

Late Edition

NEW YORK, SATURDAY, DECEMBER 15, 2007

REPORT TO URGE SWEEPING CHANGE FOR SUNY SYSTEM

OVERHAUL OF FINANCING

Higher Tuition Possible at Elite Colleges — Resistance Likely

Seafood Industry: Dirty Water, Dangerous Fish

DELAY IS SOUGHT BY JUSTICE DEPT. ON C.I.A. INQUIRY

A REQUEST TO CONGRESS

Mukasey Is Not Giving House Panel Data on Tape Destruction

A Baseball Lover From Queens, Key to Tarnishing a Yankee Era

Taxi TV, Brisk As the Traffic You're Stuck In

Aquaculture, Food Safety, and Preventative Measures

Outline:

3. **What are Some Basic GAqPs and what can they do?**

Food Safety Preventive Measures

Reactive (boarder checks, testing)

Proactive (training, buy in, inspecting)

Prevention…..Not Detention

What GAqPs Do

- Reduces Risk (pathogens, unapproved residues, chemicals)
- Reduces need for interventions (i.e., drugs, rejections)
- Reduces Trade issues
- Improves Environment Footprint
- Reduces Liability

GAqPs Can Increase General Public Health

1. Providing sanitation to communities to reduce risk of pathogen contamination
2. Minimizing site discharges
3. Assuring health and safety of workers
4. Minimizing risk of dangerous drugs and chemicals

GAqP Training
Presently and Planned

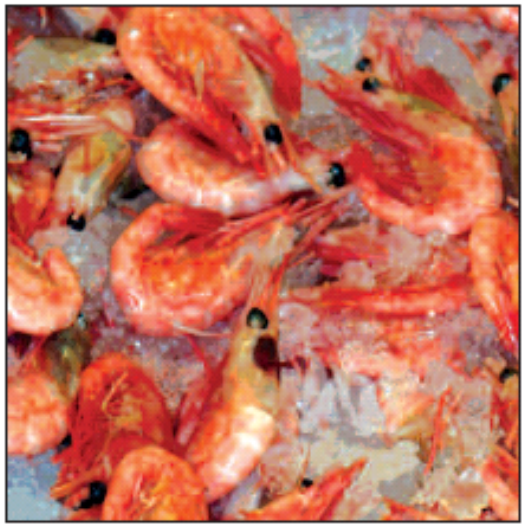
Country

- **Vietnam 2006**
- **Thailand 2007**
- **Indonesia 2008**
- **Bangladesh 2009/2010**
- **Malaysia in March 2010**
- **In Discussion with India**
- **China 2011**

By Brett Koonse
Series Editor: Carrie Ainsworth

Seafood Safety: Down on the Farm

Worldwide, the "daily catch" means much more than just the type of fish that is being offered at seafood restaurants. More than 200 million people rely on their daily catch as a primary source of income. Seafood is an essential part of



U.S. Seafood Consumption and Importation

In the United States, seafood consumption has risen steadily to a record 16.6 pounds per person per year.[1] About 80 percent of this seafood is imported from at least 62 countries (mostly developing countries). Forty percent of that seafood comes from aquaculture operations. China, with its large and expanding aquaculture industry, may soon bypass Canada and Thailand to become the largest exporter of seafood into the U.S.

Three of the most popular seafood items are also three of the top aquaculture imports: shrimp, salmon and tilapia. Together, they represented more than 2 billion pounds of seafood imported into the U.S. in 2004. It is estimated that 90 percent of shrimp, the number one seafood consumed in the U.S., is imported, and 75 percent of salmon, the third most consumed seafood, is imported.

GAqPs for Various Operations

Hatchery

Growout

Nursery

Feed

A GAqP Program for Farms Includes :

1. **Aquaculture Farm Site Selection and Monitoring** – locating farms away from pollution sources such as sewage treatment outfalls, or industrial contaminated sites, and subsequent monitoring to assure the site products do not become contamination.

2. **Sewage and Pollution Control –** This includes the proper disposal of sewage, wash water (i.e., gray water) on a farm or at a farm site, presence of restroom facilities for workers, etc.

3. **Personnel/Worker Practices.** The aquaculture farming facility needs to have an employee hygiene and sanitation program which includes training employees, monitoring, and verifying that employees wash their hands, have clean outer garments, do not work while sick, etc.

An Effective GAqP Program Includes:

4. **Harvesting and Transport–** equipment and techniques to minimize contamination during the harvest and transportation of products. This includes boats or trucks for live or dead transport, nets or materials used for harvesting, totes or containers used to transport product

5. **Post harvesting –** the sizing, sorting, grading, packing, etc that may occur at the farm site prior to transport to a processing facility.

6. **Ice and Water** – using a safe water source for ice and the water used on product for transport, chilling, holding, etc.

7. **Equipment Construction, Maintenance, and Control –** the construction, maintenance, and control of the equipment or materials used during husbandry at broodstock facilities, hatcheries, growout sites, transportation of frys, post larva, eggs, smolts, This also includes such things as pond liners, cages, tanks, nets, aerators, antifouling agents, etc.

An Effective GAqP Program Includes:

8. Site Control – This is controlling access to hatchery facilities and growout ponds or cages to animals or unauthorized personnel that could contaminate a aquaculture farm.

9. Feed Control – This includes appropriate protection of the feed during storage and use and sourcing feed carefully. Choose feed that has been tested to assure it's free of contaminates. Feed should not be used that is contaminated with mold, heavy metals, PCBs, or other chemical contaminates such as melamine.

10. Drug and Chemical Use – The appropriate use of approved drugs and chemicals on aquaculture farms with correct withdrawal times.

11. Record Keeping – Record one up, one back. And all input materials such as drugs, chemicals, feed, probiotics, vitamins, etc. should be recorded. This includes the name of the material used, when they are used, why they are used, withdrawal times, how they are applied, etc.

What are GAqPs in General?

Improper site - Houses with no plumbing, animals, human activity

Improper site – animal waste running into pond

Improper site – source water highly contaminated

Farm Location and Density

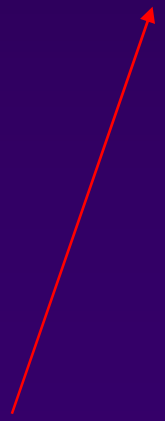
Farm Location

Source water and pond, pen water protection

Pond protection – possible PCB contamination during runoff

Source and pond water not protected from water fowl contamination

Source water contaminated via animal and human waste



Holding Ponds

Simple pond protection

Sewage and Pollution Control

Toilets over water

Human sewage going onto ground around pond

Human waste draining onto ground around pond

Would not want this in your source water

Personnel/Worker Practices

Disinfecting Before Entry and Sanitizing Equipment

Shrimp in Mud, Sand, Dirt

Ice, Product and Equipment Control

Shrimp being contaminated via dirty ice, dirty water, and ice made from non-potable water

Site Control

Security at the aquaculture site is critical

Example of poor site control – animals and children in pond

Animals on Farm

Feed Control

An example of improperly stored feed. The black pellets are rodent waste

Feed Control

Salmon Farm Precautions

Random underwater inspection.

A feed monitor, used to reduce wastage

Record Keeping

Records

1. One up, one back principal used
2. Drug or Chemical Use Records:

- Name of chemical or drug
- Date started
- Date Stopped
- How much used
- Calculated withdrawal times

Discharge Water Treatment

An Effective GAqP Program

- Individualize by farm or a cluster of farms.
- Know the intended market of you product.
  - -Each country has their own requirements such as drugs that are approved or prohibited, etc.
- Should work with processor, exporter and government.
  - -To comply with HACCP requirements
  - - For food safety, environmental, hatchery, feed control
- Carefully source ice, feed, chemicals, drugs, etc
- Control transport of product…and feed, hatchery
- Document, document, document

An Effective GAqP Program: Trains Farmers and Workers

An Effective GAqP Program May Include:

- **Hatchery Controls:**
  - drug and chemical use
  - biosecurity
  - waste discharge

Feed Mill

- **Feed Controls:**
  - import control
  - includes component and final product verification
  - on farm protection from contamination
  - inspection

An Effective GAqP Program - Inspects Farms; Third party, government, own QA

Includes Verification Testing

- The world is spending millions on testing
- Testing three, four times.
- With a good GAqP or preventative program, millions can be saved by only testing for verification
- But, got to have a proven prevention program

Summary:

- Aquaculture is needed
- There are practices and conditions during production that increase the risk of contamination and trade issues
- Farms must be brought into the food safety continuum to minimize these risk
- GAqP training is needed for farmers, processors, retailers, and importers about… and Inspections made

Thank You!

Brett Koonse

United States Food and Drug Administration

+01.301.436.1415

Brett.Koonse@fda.hhs.gov