Animal Protein Production, Consumption and Aquaculture

- Humans Origins as Traditional Hunter Gathering Societies

Animal Protein Production and Consumption

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- Transition to Simple Agrarian Farming Societies with Domesticated Animals

Animal Protein Production and Consumption

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- Change in Developed Countries to Centralized Farm Production and Agribusiness Factory Farms
Land Based Animal Protein Production

Environmental Economic and Social Costs
• Who accepts liability for animal wastes in direct production of commodity
  – Water Use
  – Water Pollution of Surface and Ground water
  – Air Pollution
  – Use of Chemicals and Drugs

Liability in Production of Feed Sources for Animal Protein Production

- Chemical Use
- Water Use and Pollution
- Land Productivity
- Energy Inputs

Numbers
• Choice of Animal Protein and Atkins Diet
• How Are We Calculating Impacts

37% of the world grain harvest (700 million tons) used to produce animal protein
Human Health and Humane Aspects of Animal Protein Production

Chemical Contaminants
Pathogen Contamination
Animal Welfare of Higher Vertebrates

Figure 9-1. World Meat Production by Type, 1950-2002

<table>
<thead>
<tr>
<th>Product</th>
<th>Fossil Fuel: Protein ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken</td>
<td>4:1</td>
</tr>
<tr>
<td>Beef cattle</td>
<td>54:1</td>
</tr>
<tr>
<td>Pork</td>
<td>17:1</td>
</tr>
</tbody>
</table>
Pimintel’s calculations

- 7 Billion livestock animals in US consume 5X as much grain consumed by population
- 41 million tons of plant protein fed to livestock to product 7 million tons of animal protein for consumption. Average conversion of 1:8
- 26 tons of livestock feed comes from grains, and 15 from forage crops

Water Use for Agriculture and Animal Protein

- US Agriculture accounts for 87% all fresh water consumed each year
- Livestock use 1.3 directly, and the rest used for forage and grain
- Kg beef produced takes 100,000 Liters of water

Agriculture and Water Use

- Grain fed beef 100,000
- Broiler Chickens 3,500
- Soybean 2,000
- Rice 1,912
- Wheat 900
- Potatoes 500
- Cultured fishes ?
Aquaculture Production myths and truths

- Wild is Safer?
- Aquaculture Causes Pollution
- Destroys Communities of Commercial Fishers
- Using Fish for Fish
- Drugs and Chemicals are Used in Production

Approved Drugs and Chemicals in the US

- (1) Chorionic gonadotropin (Chorulon) used for spawning,
- (2) oxytetracycline (Terramycin) antibiotic
- (3) Sulfadimethoxine, ormetoprim (Romet-30) antibiotic
- (4) tricaine methanesulfonate (Finquel and Tricaine-S) an anesthetic
- (5) formalin (Formalin-F, Paracide-F and PARASITE-S) used for fungus and parasite treatment
- (6) sulfamerazine antibiotic
- (7) Aquaflor for several claims, furunculosis, cwd

- IS USING FISHMEAL TO PRODUCE FISH WASTEFUL AND INEFFICIENT ENERGY TRANSFER?
If We Quit Using Fish Meal for Aquaculture What Would Happen?

- Used for other products and applications
- Market production would be used elsewhere

Fish Meal Production in N. America Was Used for Other Purposes Before Aquaculture

Fish Meal Uses

- Primitive fish meal is mentioned in the Travels of Marco Polo fourteenth century: ‘... they accustom their cattle, cows, sheep, camels and horses to feed upon dried fish, which being regularly served to them, they eat without any sign of dislike.’
- The utilization of herring as an industrial raw material actually started as early as about 800 AD Norway. A very primitive process of pressing the oil out of herring by means of wooden boards and stones was employed
Types of Fish and Meal

- Lean fish (cod, haddock etc) - oil in liver not flesh, and low in oil - white fish meal
- Industrial fish (Menhaden, anchovy, pilchard, sardines, mackerel) approx 90% of world fishmeal is this type.

Composition

- Most fish have 16% protein
- Oil component is dependent if it is removed or not.

Processing

- Cooking, pressing, drying and grinding
- When oil is not removed the pressing stage is omitted.
- Cooking coagulates proteins and is critical for sterilizing
- Press cake is protein, oils refined and antioxidants added
Type of Fish meal produced in US

- Majority in Atlantic ocean and Gulf Mexico
- 98% is menhaden
- Oil is by product in this process

World Fish Meal Use by Species by Diet Percent and 000 mt

<table>
<thead>
<tr>
<th>Species</th>
<th>2000 % in feed (mt)</th>
<th>2010 % in feed (mt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catfish</td>
<td>3 (15)</td>
<td>0</td>
</tr>
<tr>
<td>Salmon</td>
<td>40 (454)</td>
<td>30 (377)</td>
</tr>
<tr>
<td>Trout</td>
<td>30 (176)</td>
<td>25 (147)</td>
</tr>
<tr>
<td>Marine fish</td>
<td>45 (415)</td>
<td>40 (688)</td>
</tr>
<tr>
<td>Flatfish</td>
<td>55 (69)</td>
<td>45 (263)</td>
</tr>
<tr>
<td>Shrimp</td>
<td>25 (372)</td>
<td>20 (485)</td>
</tr>
<tr>
<td>Carp</td>
<td>5 (350)</td>
<td>2.5 (675)</td>
</tr>
</tbody>
</table>

Fishmeal Dilemma

- Global Fishmeal Use by Livestock
  - Average % Fishmeal in Feed
- Poultry 0 - 2.5
- Pigs 0 - 5
- Aquaculture
  - Salmon 30-40
  - Catfish 2-3
  - Shrimp 25
Global Fish Oil and Meal is Not Growing Versus Soybean Oil and Meal

Percent of Fishmeal Supply Consumed by US Livestock 1995

Recent Criticisms of Aquaculture

• Ignoring tradeoffs of alternatives for animal protein?
### Annual Growth in World Animal Protein Production 1990-2002
Data from FAO

<table>
<thead>
<tr>
<th>Source</th>
<th>1990 (million tons)</th>
<th>2002 (million tons)</th>
<th>Annual Growth (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquacultural output</td>
<td>13</td>
<td>38</td>
<td>10.2</td>
</tr>
<tr>
<td>Poultry</td>
<td>41</td>
<td>72</td>
<td>4.8</td>
</tr>
<tr>
<td>Eggs</td>
<td>38</td>
<td>58</td>
<td>3.6</td>
</tr>
<tr>
<td>Pork</td>
<td>70</td>
<td>94</td>
<td>2.5</td>
</tr>
<tr>
<td>Mutton</td>
<td>10</td>
<td>12</td>
<td>1.5</td>
</tr>
<tr>
<td>Oceanic fish catch</td>
<td>86</td>
<td>91</td>
<td>0.5</td>
</tr>
<tr>
<td>Beef</td>
<td>53</td>
<td>58</td>
<td>0.8</td>
</tr>
</tbody>
</table>

### Laws of Thermodynamics
- Poikilotherm vs Homeotherms
- Water Use versus Water Consumption
- Feed sources – herbivores and carnivores

### Conversion Efficiency
An Important Point for Meat Eating
Human Societies

- Animal                  | Pounds of feed/pound |
- Cattle                  | 8                    |
- Pigs                    | 3                    |
- Poultry                 | 2                    |
- Salmon                  | 1.0-1.2               |
- Catfish                 | 1.5-2.0               |
Impact Needs to Be Put into Perspective

- Other Sources from Wild Populations
- Substitutes for Market
- Relative Impact of Substitutes
- Humane Aspects of Production

Within Canada and US

- Highly visible issues
- Difficult politics
- Often Public Sees as an Either or Mentality
- Segmented Approach to Problems, often with Disregard for the Total Environmental Impact from Energy Subsidy, Water, Alternative Protein Production

US Commercial Aquaculture
Growing Pains and Frustrations

- Relatively new for Commercial Ventures- Infrastructure not Established
- Capture Fisheries have Dominated
- Subsidies Provided for Traditional Agriculture have not been Available
- Confusion in Regulatory, Promotional
Developing a Water-Based Industry in Contemporary Climates

Negative Issues

- Effluents
- Aquaculture Introductions
- Predation Issues (Depredation)

Conclusions/Discussion

What is Sustainability?

- Not In My Backyard
- Consumer Options/Animal Protein
- Risks/Benefits

Tuesday

- Pacific Fishery Management Council ???
- Otherwise, continue with this discussion and talk about conservation hatchery issues