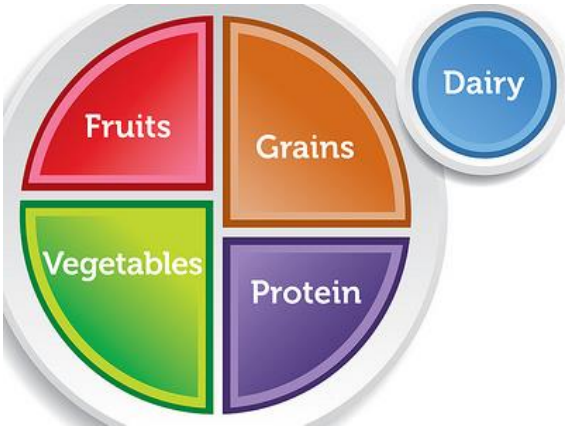
APES CHAPTER 11 NOTES (MRS. BAUCK): FEEDING THE WORLD

MODULE 31: Human Nutritional Needs

I. Nutritional issues (some info from Miller/Shlachtman)

A. **undernutrition**—insufficient calories are consumed to maintain health
   1) chronically undernourished—< 90% of minimum daily calorie intake
   2) seriously undernourished—< 80% of minimum daily calorie intake



B. **malnutrition**—carbohydrate, protein, vitamin, and mineral deficiencies regardless of amount of intake (example: iron deficiency = **anemia**)

C. **overnutrition**—ingestion of too many calories; can cause obesity, coronary heart disease, stroke, diabetes, etc.

D. https://www.choosemyplate.gov/ - see graphic above for guidelines

II. General information (some info from Miller/Shlachtman)

A. *wheat, rice, and corn* provide ~60% of the calories people consume globally

B. 2/3 of the world's people live primarily on grains

C. *U.S. largest agricultural crops: corn and soybeans*

D. *The principal cause of hunger and malnutrition is poverty.*
   1) we produce enough food to feed the current global population… but not everyone has the resources to access food easily
   2) political/governmental issues
   3) natural disasters, wars, etc.

E. from 1950-1990, the amount of food that is traded globally has quadrupled

F. main factors leading to decreased growth of per capita grain production
   1) population growth
   2) increasing affluence (more demand for meat products)
   3) degradation and loss of cropland

G. environmental effects of producing food
   1) soil erosion
   2) **desertification**—*the formation of deserts in a previously more lush area due to multiple factors, including soil degradation and climate change*

UNCCD: United Nations Coalition to Combat Desertification http://www.unccd.int/

      a) **desert**—*an arid area: < 10 in. of rainfall per year*
      b) **drylands**—*arid and semiarid regions with ~10-30 in. rainfall per year*
   3) **mineralization**—*loss of humus and breakdown of topsoil*
      a) results in decreased plant growth
      b) improved by adding substantial amounts of compost and organic matter
   4) salinization (see next module)
   5) waterlogging (see next module)
   6) water deficits/droughts
   7) loss of biodiversity

MODULE 32: Modern Large-Scale Farming Methods

I. Farming as a National and Global Practice

A. **Food Security Act of 1985**

http://www.thecre.com/fedlaw/legal14coast/food_security_act_of_1985_legal_matters.htm

1) FAIR (Federal Agricultural Improvement and Reform Act), 1996
2) WRP (Wetlands Reserve Program)

"SUMMARY: The 1985 Act contains provisions designed to discourage the conversion of wetlands into non-wetland areas. These provision collectively, are commonly referred to as the "Swampbuster" provisions (Food Security Act of 1985 (Title XII, Subtitle C)). *Swampbuster provisions denied Federal farm program benefits to producers who converted wetlands after December 23, 1985. The Food, Agriculture, Conservation, and Trade Act of 1990 strengthened Swampbuster by making violators ineligible for farm program benefits for that year and subsequent years. The Act also created a system for inadvertent violations allowing farmers to regain lost Federal benefits if they restore converted wetlands.*

The 1996 Farm Bill, (*Federal Agriculture Improvement and Reform Act of 1996*, PL 104-127) contains numerous provisions that proportedly modify the operation of certain agricultural programs. In particular, Subtitle C, Wetland Conservation, modifies Sections 1221 and 1222 (16 USC 3821, and 16 USC 3822) of the Food Security Act of 1985 regarding program ineligibility, wetland delineation, consultation and cooperation requirements, and clarifies the definition of agricultural lands in the Memorandum of Agreement signed with the Department of the Army, the Department of Interior, and the Environmental Protection Agency, January 6, 1994. It also authorizes the Secretary of Agriculture to *operate a pilot program for mitigation banking of wetlands to assist persons to increase the efficiency of agricultural operations while protecting wetland functions and values.*

The *Conservation Reserve Program* (Title XII) (16 USC 3831) *authorizes the Federal government to enter into contracts with agricultural producers to remove highly erodible cropland from production, in return for annual rental payments.* The *Wetlands Reserve Program* (16 USC 3837) authorizes enrollment of wetlands for protection and restoration through permanent and temporary (30 year) easements."

B. *Farm Bill* (FAIR successor)

Every five years, Congress passes a bundle of legislation, commonly called the *"Farm Bill"* that *sets national agriculture, nutrition, conservation, and forestry policy*.

1) dealt with FAIR issues whose deadlines were reached
2) increased funding for WHIP and EQUIP (Environmental Quality Incentives Program)

C. **U.N. FAO - Food and Agriculture Organization**

http://www.fao.org/about/who-we-are/en/

"An *intergovernmental organization*, FAO has 194 Member Nations, two associate members and one member organization, the European Union. Its employees come from various cultural backgrounds and are experts in the multiple fields of activity FAO engages in. FAO's staff capacity allows it to support improved governance to generate, develop and adapt existing tools and guidelines and provide targeted governance support as a resource to country and regional level FAO offices. Headquartered in Rome, Italy, FAO is present in over 130 countries. … FAO's new focus on governance is driven by the recognition that *mission-critical development-related processes affecting food security and nutrition, livelihoods, and the management and sustainable use of natural resources confront increasingly complex governance challenges*. Broader, more flexible and responsive, and more capable governance institutions and mechanisms are necessary to improve effective coordination among diverse stakeholders, enabling problem-solving while working towards the achievement of multiple, and sometimes conflicting, objectives."

D. **Farmer Field Schools**

http://www.fao.org/agriculture/ippm/programme/ffs-approach/en/

"In a typical FFS a group of 20-25 *farmers meet*s once a week in a local field setting and *under the guidance of a trained facilitator*. In groups of five they observe and compare two plots over the course of an entire cropping season. One plot follows local conventional methods while the other is used to experiment with what could be considered "best practices". *They experiment with and observe key elements of the agro-ecosystem by measuring plant development, taking samples of insects, weeds and diseased plants, and constructing simple cage experiments or comparing characteristics of different soils*. At the end of the weekly meeting they present their findings in a plenary session, followed by discussion and planning for the coming weeks… In this field-based setting, farmers are able to investigate a wide range of topics, such as *management of soil fertility and water resources; methods of local varietal selection and issues of seed quality; risks associated with toxic pesticides and implementation of low-toxicity alternatives; development of marketing skills; and diversification of farming systems with new crops for food, fodder and profit*."

II. Modern Farming Methods (some info from Miller/Shlachtman)

A. **The Green Revolution** (~1950-1970) – *fertilization, irrigation, improved crop strains*

1) **monocropping**—development and planting of *monocultures* of important crops
2) use *ample fertilizer, pesticides and water* on crops to increase yield
3) increase the intensity and frequency of cropping
4) second green revolution (~1967) began when fast-growing dwarf varieties of rice and wheat were introduced into developing countries

The Next Green Revolution https://www.nationalgeographic.com/foodfeatures/green-revolution/

B. **agribusiness** or **industrialized agriculture** (high-input agriculture)

1) uses fuel, energy, water, commercial fertilizers, pesticides
2) standardization and mechanization
3) replaces smaller family farms with large corporate farms
4) **energy subsidy** =
(human energy + fossil fuel energy) / calorie of food produced

C. mechanization

1) can be small-scale or large-scale
2) **economics of scale**—*production costs are inversely proportional to agricultural output*

"Mechanization covers all levels of farming and processing technologies, from simple and basic hand tools to more sophisticated and motorized equipment. It eases and reduces hard labour, relieves labour shortages, improves productivity and timeliness of agricultural operations, improves the efficient use of resources, enhances market access and contributes to mitigating climate related hazards. Sustainable mechanization considers technological, economic, social, environmental and cultural aspects when contributing to the sustainable development of the food and agricultural sector." http://www.fao.org/sustainable-agricultural-mechanization/en/

D. irrigation
   1) **irrigation**—*controlled introduction of water to an area*
   2) soil water-holding capacity and other soil attributes, topography, water use timing/restrictions are to be considered
   3) types of irrigation systems from the CDC: https://www.cdc.gov/healthywater/other/agricultural/types.html
      a) "*surface irrigation*—Water is distributed over and across land by gravity, no mechanical pump involved.
      b) *localized irrigation*—Water is distributed under low pressure, through a piped network, and applied to each plant.
      c) *drip irrigation*—A type of localized irrigation in which drops of water are delivered at or near the root of plants… minimized evaporation and runoff
      d) *sprinkler irrigation*—Water is distributed by overhead high-pressure sprinklers, 'guns' from a central location in the field, or sprinklers on moving platforms.
      e) *central pivot irrigation*—Water is distributed by a system of sprinklers that move on wheeled towers in a circular pattern. (common in flat areas of the U.S.)
      f) *lateral move irrigation*—Water is distributed through a series of pipes, each with a wheel and a set of sprinklers, which are rotated either by hand or with a purpose-built mechanism. The sprinklers move a certain distance across the field and then need to have the water hose reconnected for the next distance. (less expensive but requires more labor)
      g) *sub-irrigation*—Water is distributed across land by raising the water table, through a system of pumping stations, canals, gates, and ditches. (most effective in areas with high water tables)
      h) *manual irrigation*— Water is distributed across land through manual labor and watering cans. (very labor intensive)"
      i) *flood irrigation*—diverted canals (not efficient, 50% water is actually irrigating)
   4) effects of improper irrigation
      a) **waterlogging**—*soil degradation from soil being underwater or soaked with water for long periods of time (root rot, etc.)*
      b) **erosion**, usually by wind or water
      c) **salinization**—*salts accumulating in and on the soil from evaporation, hindering plant growth*

From the Environmental Literacy Council:
"Salt buildup is an existing or potential hazard on almost all of the irrigated farmland in the United States. Much of the world's unused land is in arid and semiarid regions where irrigation will be necessary. Water contains a small amount of salt and over time this salt accumulates in the soil. A small amount of salt in the soil will not affect the germination and growth of crops. However, as salt concentrations increase, negative impacts occur. Eventually salt concentrations will affect the germination of seeds. Excessive salinity is costing the U.S. billions of dollars in lost food crops."

E. Fertilizers
   1) **organic fertilizer**—*plant matter, animal waste (decomposed manure)*
   2) **synthetic** or **inorganic fertilizer**—*chemicals produced commercially*
      a) pros
         - ease of application
         - easily customizable to crops
      b) cons
         - use of fossil fuels in production
         - ease of runoff
         - contains no organic material (CEC and water-holding capacity)

III. Genetic Engineering

A. agricultural history
   1) traditionally, farmers choose seeds exhibiting desirable traits to grow subsequent generations (not gene splicing, but a type of artificial selection nonetheless)
   2) International Code of Nomenclature for Cultivated Plants
      a) International Society for Horticultural Science http://www.ishs.org/
      b) **cultivar**— *cultivated variety of plant*

From http://www.davidson.edu/

"Artificial plant breeding has been done for thousands of years. Since the beginning of farming, farmers have selectively chosen the plants they wish to continue to grow. *The farmers planted seeds harvested from the plants that were the biggest, healthiest, or tastiest.* This reproduces plants similar to the desired phenotype, although the farmers hundreds of years ago did not know their chances of success or understand the process of passing traits through generations. *Initial variation to a plant can be induced by changing conditions where the plant is grown. This will eventually force the plant to adapt to more extreme conditions.* For example, continuously growing seeds from a plant in colder conditions will slowly make that plant more likely to survive in a colder climate. Though it began with haphazard planting of seeds, plant breeding has become a specific science to manipulate the characteristics of plants. *Plant breeding is defined as the controlled pollination of plants*."

   2) The U.N. Food and Agriculture Organization (FAO) estimates food production will need to double in some parts of the world by 2050.
   3) USDA: GM seeds are used to plant > 90% of U.S. corn, soybeans, cotton

B. **GMO**—*genetically modified organism*; genetically modified DNA

C. pros of GMOs
   1) increased resistance to pests
   2) increased resistance to heat, cold, drought
   3) increased crop yield per unit area
   4) desired color of fruit of flowers
   5) tolerance to herbicides, even specific ones (Liberty Link, Roundup Ready)
   6) increased shelf life (can be stored longer and shipped to remote areas)
   7) decreased or eliminated seeds in fruit, etc.
   8) increased nutrient content (protein, calcium, etc.; beta-carotene "golden rice")
   9) decreased saturated fat content in animals

D. concerns about GMOs
   1) overall safety
      a) Codex Alimentarius: International Food Standards http://www.fao.org/fao-who-codexalimentarius/en/
      b) American Medical Association: in the past 20+ years, no clear GMO impacts on human health have been confirmed or reported in professional journals.
      c) there is no evidence that exposing foods to pesticides or radiation is any "safer" than producing GMOs
   2) allergies

Harvard University: There is no evidence that GM foods in general are more likely to trigger allergic reactions than non-GM foods. FAO and World Health Organization (WHO) protocols require GM foods to be tested for their ability to cause allergic reactions. Mayo Clinic: None of the GM foods that are currently on the market have been found to cause allergies.

   3) antibiotic resistance

Some people are concerned about the use of seeds modified with antibiotic-resistant genes. No studies have confirmed the claim of a link between those GM foods and rising rates of antibiotic resistant bacteria, but more research is needed.

   4) cancer: more research is needed
   5) effects on biodiversity—protecting wild varieties of species from crossing with GMOs

It would be beneficial to have additional careful, well-designed scientific studies conducted in unbiased academic settings, without the influence of special interest groups and politicians.

E. GMO animals

https://www.fda.gov/food/agricultural-biotechnology/how-gmos-are-regulated-food-and-plant-safety-united-states

   1) laboratory mice (not marketed as food, of course)
   2) Oxitec mosquito (eugenic mosquito population control) https://www.oxitec.com/
      https://www.fda.gov/animal-veterinary/animals-intentional-genomic-alterations/oxitec-mosquito
   3) AquAdvantage salmon https://www.fda.gov/animal-veterinary/animals-intentional-genomic-alterations/questions-and-answers-fdas-approval-aquadvantage-salmon

F. Regulation of GMOs

   1) U.S. - https://www.fda.gov/food/agricultural-biotechnology/how-gmos-are-regulated-food-and-plant-safety-united-states
      "Starting in January 2022, certain types of GMOs will require a disclosure that lets you know if the food you are eating (or ingredients in the food you are eating) is a bioengineered food."
   2) **organic** food is, by definition, non-GMO (more later)
   3) U.S. restrictions https://www.loc.gov/law/help/restrictions-on-gmos/usa.php

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IV. Ethnobotany

A. **ethnobotany**— *the study of how people of a particular culture and region make of use of indigenous plants*

1) ethnobotanists explore how plants are used for food, shelter, medicine, clothing, hunting, and religious ceremonies
2) examples

ALOE VERA	CLOVE	JASMINE	PARSLEY
ANISE	CORIANDER	JUNIPER	PATCHOULI
ARROWROOT	DANDELION	LAUREL	PEPPERMINT
BASIL	EUCALYPTUS	LAVENDER	ROSE
CAMPHOR	FENNEL	LEMON	SAGE
CELERY	GARLIC	MARJORAM	SANDALWOOD
CHAMOMILE	GINGER	MYRTLE	ST.JOHN'S WORT
CHICORY	GINKGO	NETTLE	TEA TREE
CINNAMON	GINSENG	OLIVE	TURMERIC

V. Farming Meat

A. *animal husbandry* (animal science)—the agricultural practice of breeding and raising livestock (cattle, hogs, sheep, horses, poultry, goats, yaks, alpacas, llamas…)

Roles of livestock: http://teca.fao.org/read/8378

- "Produce dung which is of great importance for soil fertility.
- Yield products such as milk or eggs for sale or own consumption continuously.
- Recycle by-products such as straw or kitchen waste, using them for feed.
- Serve as draught animals for tillage or transport.
- Produce meat, hides, feathers, horns etc.
- Serve as an investment or a bank.
- Help in pest control (e.g. digging) and weed management (e.g. grazing on barren fields).
- Have cultural or religious significance (prestige, ceremonies etc.).
- Produce young stock for breeding or sale."

B. AFO – animal feeding operations

https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/plantsanimals/livestock/afo/

"The U.S. Environmental Protection Agency (EPA) defines *AFOs as agricultural enterprises where animals are kept and raised in confined situations.* AFOs congregate animals, feed, manure and urine, dead animals, and production operations on a small land area. Feed is brought to the animals rather than the animals grazing or otherwise seeking feed in pastures, fields, or on rangeland. There are approximately 450,000 AFOs in the United States."

C. high-density animal farming = **CAFO (concentrated animal feeding operations)**

"A CAFO is another EPA term for a large concentrated AFO. A CAFO is an AFO with more than 1000 animal units (an animal unit is defined as an animal equivalent of 1000 pounds live weight and equates to 1000 head of beef cattle, 700 dairy cows, 2500 swine weighing more than 55 lbs, 125,000 broiler chickens, or 82,000 laying hens or pullets) confined on site for more than 45 days during the year. Any size AFO that discharges manure or wastewater into a natural or man-made ditch, stream or other waterway is defined as a CAFO, regardless of size. CAFOs are regulated by EPA under the Clean Water Act in both the 2003 and 2008 versions of the 'CAFO' rule."

From http://www.ncsl.org

D. advantages
   1) increased efficiency of operations
   2) closer monitoring and control
   3) do not have to bring the feed to them

E. disadvantages
   1) large amount of waste production in a concentrated area
   2) *increased air/water/land pollution for surrounding areas: nutrients, organic matter, solids, pathogens, antibiotics, odorous or volatile compounds, and trace elements such as arsenic and copper*
   3) potential for injury of animals in close quarters
   4) potential for faster spread of density-dependent illness

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VI. Aquaculture

A. General vocab
   1) **aquaculture** (**aquafarming**)— *cultivating freshwater and saltwater populations of fish, crustaceans, mollusks and aquatic plants under controlled conditions*
   2) **fishery**—*commercially harvestable fish population in an area*
   3) **fishery collapse**— *a 90+% decline in fish population*
   4) **bycatch**—*unintentional taking of nontargeted species as a result of fishing*

B. pros (some from PBS.org)
   1) efficient and high yields in small amounts of water
   2) "creates jobs in the community
   3) can increase city, state and national revenue
   4) can reduce seafood trade deficit
   5) can help feed a growing world population
   6) can encourage local investment
   7) can increase scientific knowledge and technology
   8) may reduce fishing pressure on certain wild stocks if that species can be produced through aquaculture rather than fished"

C. cons (PBS, Virginia Tech)
   1) "can conflict with other users of water bodies such as lobstermen, fishermen or migrating fish
   2) can put excess pressure on wild stocks that are used to create high protein feed pellets
   3) can amplify and transfer disease and parasites to wild fish populations
   4) can compromise native gene pools if farmed and native species interbreed
   5) can threaten livelihood of fishermen
   6) can be an unpredictable enterprise for small local communities due to its susceptibility to severe weather, predators, disease, and global competition
   7) can compromise the aesthetic beauty of coastline"
   8) "escaping of aquatic crops as an invasive species
   9) the relationship between effluents, eutrophication or pollution of water bodies, and changes in the fauna of receiving waters
   10) land use, specifically conversion of sensitive areas such as mangroves and wetlands
   11) water use and water loss from surface water systems
   12) overexploitation of stock over other resource uses, such as fish oil

13) predator control, such as the killing of birds near aquaculture facilities
14) genetic alteration of existing stocks from escaped hatchery products
15) antibiotic and hormone use, which may influence aquatics species near aquaculture facilities

D. EPA's aquaculture threat list topics:

Exotic Species, Human Bias, Habitat Loss and Degradation, Overexploitation, Aquaculture Pollution, Sedimentation, Climate Change, Alterations to Hydrology, Air Pollution, Dredging

E. United Nations Environment Program (UNEP) recommendations to minimize the adverse impacts of aquaculture on wild stocks:
   1) Closed culture: better containment to prevent escape of the organism
   2) Sterilization: easily induced way of avoiding direct genetic effects
   3) Localization: locating farms away from wild populations, and choosing locations for sea ranching that minimize straying so as to reduce gene flow to wild populations
   4) Coastal parks: providing totally protected areas for valuable wild populations
   5) Reduced or selective fishing: protecting native populations by reducing fishing pressure or by directing that pressure toward cultured fish
   6) Restrictions on transport: reducing the spread of exotic genes and diseases by restricting transport of live fish and eggs.
   7) Gene banks: counteracting extinction of local populations by the establishment of gene banks
   8) Minimal genetic differences from native populations: reducing effects of gene flow by minimizing the genetic differences between escaping or released fish and recipient wild populations
   9) Training of workers: basic training of aqua-culture workers (including non-specialists) to minimize the risk of accidental releases of organisms into aquatic ecosystems"

MODULE 33: Alternatives to Industrial Farming Methods

I. Combating low productivity and poor soil
   A. **shifting agriculture**
      1) letting the land lie *fallow* (unused) after a few seasons
      2) may involve slash-and-burn after harvest to replenish the soil
      3) can reuse the same plot after a while
      4) water erosion of nutrients can be an issue
   B. **nomadic grazing**—*moving grazing animals away from areas long enough for vegetation to recover*
   C. **sustainable agriculture** (**SA**, **"sus. ag."**) https://www.sare.org/
      1) characteristics
         a) *topsoil integrity*
         b) *food quality*
         c) *chemical pesticide reduction*
         d) *farming's financial feasibility*
      2) main goals
         a) *economic profitability*: sustain the economic viability of farm operations
         b) *human nutrition*: satisfy human food and fiber needs

c) *environmental health*: enhance environmental quality and the natural resource base upon which the agricultural economy depends
d) *resource management*: make the most efficient use of nonrenewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls
e) *social and economic equity*: enhance the quality of life for farmers and society as a whole

3) sus.ag. practices
a) use of animal/plant waste as fertilizers
b) **no-till agriculture**—*weed control, planting, and covering up all at once; soil is not tilled between seasons*
c) **low-till agriculture**—*decrease the amount of tilling*
d) **contour plowing**/**contour-strip cropping**—*cultivation along sloping ground, following the land's topography*
e) **intercropping**—*planting two or more crops at the same time in the same area*
f) **agroforestry**—*intercropping trees with vegetable crops*
g) **shelter belts**—*rows of trees planted around farmland to reduce wind erosion*

D. potential issues from nonsustainable farming practices
1) **overcultivation** *from frequent plowing can be an issue*
2) **overgrazing**—*animals stripping vegetation at a rate too fast for natural growth patterns to counteract it*
3) **deforestation**—*depletion of forest land*
a) *causes increased leaching and erosion*
b) *worst-case scenario—layers above the subsoil are gone*
c) the other end of the erosion problem: Where do the particles go? ... *displaced sediments can wash into rivers and streams*
4) problems with fertilizers
a) *inorganic chemical fertilizer does not replenish organic material*
b) *mineral content remains high but soil degrades anyway*

E. addressing soil degradation
1) *SARE—Sustainable Agriculture Research and Education*
2) LISA program—Low Input Sustainable Agriculture
3) CRP (Conservation Reserve Program) and CREP (Conservation Reserve Enhancement Program)
https://www.fsa.usda.gov/programs-and-services/conservation-programs/index

II. **IPM – Integrated Pest Management**
A. background info from the EPA
from https://www.epa.gov/ipm/introduction-integrated-pest-management

"**Integrated Pest Management (IPM**) is an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. IPM programs use current, comprehensive information on *the life cycles of pests and their interaction with the environment*. This information, in combination with *available pest control methods*, is used *to manage pest damage by the most economical means, and with the least possible hazard to people, property, and the environment.* The IPM approach can be applied to both agricultural and

non-agricultural settings, such as the home, garden, and workplace. IPM takes advantage of all appropriate pest management options including, but not limited to, the judicious use of pesticides…"

B. steps of IPM

1) *Set Action Thresholds*

"Before taking any pest control action, IPM first sets an action threshold, *a point at which pest populations or environmental conditions indicate that pest control action must be taken*…"

2) *Monitor and Identify Pests* – action done by **field scouts**

"…This monitoring and identification removes the possibility that pesticides will be used when they are not really needed or that the wrong kind of pesticide will be used."

3) *Prevention*

"As a first line of pest control, IPM programs work to manage the crop, lawn, or indoor space to *prevent pests from becoming a threat*. In an agricultural crop, this may mean using cultural methods, such as rotating between different crops, selecting pest-resistant varieties, and planting pest-free rootstock. These control methods can be very effective and cost-efficient and present little to no risk to people or the environment."

- **pest-loss insurance**—eliminates the need for **insurance spraying**

4) *Control*

"Once monitoring, identification, and action thresholds indicate that pest control is required, and preventive methods are no longer effective or available, IPM programs then evaluate the proper control method both for effectiveness and risk. *Effective, less risky pest controls are chosen first, including highly targeted chemicals, such as pheromones to disrupt pest mating, or mechanical control, such as trapping or weeding.* If further monitoring, identifications and action thresholds indicate that less risky controls are not working, then additional pest control methods would be employed, such as targeted spraying of pesticides. Broadcast spraying of non-specific pesticides is a last resort."

C. IPM uses a *combination of chemical and ecological approaches*

crop rotation	*phenological asynchrony*	*eliminating crop residue*
polyculture	*sanitation of planting area*	*intercropping / mixed cropping*
managed application of water or fertilizer		*plowing and/or burning of plant residue*

trap crops—planting strips of a crop to lure pests, which are attracted and then destroyed

D. comments from Community IPM

"The training approach which has been used to help rural people learn about IPM is called the *Farmers Field School (FFS)*. This entails weekly meetings by a group of farmers… these farmers observe, record and discuss what is happening in their own fields from the time of planting to the time of harvest... Since 1990 more than two million farmers have graduated from FFS… In recent years, IPM farmers have started organizing themselves in order to carry out field experiments, train other farmers, and interact more effectively with government agencies. These developments have given rise to a new term, *Community IPM."*

III. Organically grown food

A) general guidelines

1) no antibiotics or hormones used on animals
2) no synthetic chemical pesticides or fertilizers used on plants

B) comments from the EPA:

"In contrast [to IPM], organic food production applies many of the same concepts as IPM but *limits the use of pesticides to those that are produced from natural sources, as opposed to synthetic chemicals*."

C) comments from MOFGA: Maine Organic Farmers and Growers Association (the oldest and largest state organic organization in the U.S.)

"Many people are aware that food that is grown according to organic principles is free from exposure to harmful herbicides and pesticides, but that is only one small aspect of organic agriculture…

A larger part of organic agriculture involves the health of the soil and the ecosystem in which crops and livestock are raised. *Organic practices recognize that a healthy, vibrant, and live soils and ecosystems significantly benefit crops. Natural, undisturbed soil is alive with microbiotic organisms which exist in harmony together with the native plant life and the inorganic minerals that provide the soil's substrate.*"

D) *NOSB: National Organic Standards Board* http://www.ams.usda.gov/nosb/

"*The Organic Foods Production Act of 1990*, part of the 1990 Farm Bill, authorized the Secretary of Agriculture to appoint a 15-member National Organic Standards Board (NOSB). The board's main mission is to assist the Secretary in developing standards for substances to be used in organic production. The NOSB also advises the Secretary on other aspects of implementing the national organic program…"

IV. Sustainable Fishing

A. fishing strategies

1) *TAC = total allowable catch* (a fishing free-for-all, which determined when the season would end)
2) *ITQ, IQ = individual transferable quotas, individual quota system* (you are awarded a calculated allotment of the TAC, and you can fish during a predetermined length of time)

B. **Magnuson-Stevens Fishery Conservation and Management Act (MSA)**

From https://www.fisheries.noaa.gov/topic/laws-policies

"The Magnuson-Stevens Fishery Conservation and Management Act (MSA) is the primary law governing marine fisheries management in United States federal waters. The Act was first enacted in 1976… Most notably, the Magnuson-Stevens Act aided in the development of the domestic fishing industry by phasing out foreign fishing. *To manage the fisheries and promote conservation, the Act created eight regional fishery management councils.* The 1996 amendments* focused *rebuilding overfished fisheries, protecting essential fish habitat, and reducing bycatch* [living creatures that are caught unintentionally by fishing gear]."

C. ***Sustainable Fisheries Act (SFA)**: SFA amended the MSA in 1996 with numerous provisions requiring science, management, and conservation actions

D. *NOAA's National Marine Fisheries Service (NMFS)*
(NOAA = National Oceanic & Atmospheric Administration)

From http://www.nmfs.noaa.gov

"NOAA's National Marine Fisheries Service is the federal agency, a division of the Department of Commerce, responsible for the stewardship of the nation's living marine resources and their habitat. NOAA's National Marine Fisheries Service is responsible for the management, conservation and protection of living marine resources within the United States' *Exclusive Economic Zone (water 3-200 miles offshore)*.

Using the tools provided by the **Magnuson-Stevens Act**, *NOAA's National Marine Fisheries Service assesses and predicts the status of fish stocks, ensures compliance with fisheries regulations and works to reduce wasteful fishing practices.*

Under the **Marine Mammal Protection Act** and the **Endangered Species Act**, NOAA's National Marine Fisheries Service *recovers protected marine species* (i.e. whales, turtles) without unnecessarily impeding economic and recreational opportunities. *With the help of the six regional offices and eight councils, NOAA's National Marine Fisheries Service is able to work with communities on fishery management issues.*

NOAA's National Marine Fisheries Service works to promote sustainable fisheries and to prevent lost economic potential associated with overfishing, declining species and degraded habitats. NOAA's National Marine Fisheries Service strives to balance competing public needs."

E. **Marine Mammal Protection Act (MMPA) of 1972**
http://www.nmfs.noaa.gov/pr/laws/mmpa/

1) protects all marine mammals
2) prohibits, with certain exceptions, the "take" of marine mammals in U.S. waters and by U.S. citizens on the high seas
3) prohibits, with certain exceptions, the importation of marine mammals and marine mammal products into the U.S.
4) NMFS (National Marine Fisheries Service) maintains marine mammals at or above optimum sustainable population levels
5) regular assessment of marine mammal stocks
6) amended since, major amendments in 1994

"Development will bring food security only if it is people centered, if it is environmentally sound, if it is participatory and if it builds local and national capacity of self-reliance."

-- James Gustave Speth