

APES Unit 5 Study Guide

Ultimate Review Packet (5.1 - 5.3)

5.1 - Tragedy of the Commons

- Explain** the tragedy of the commons, using an example other than overfishing the tendency of individuals to overuse a shared resource because they don't personally experience the negative externalities or because they assume others will if they don't. An example could be ranchers overgrazing on public rangelands because they don't suffer the long-term consequences of those lands being degraded by overgrazing (groundwater overuse, atmosphere/ocean pollution)
- Propose a solution** to the example you provided above Government or private landowners can charge a grazing fee per animal, incentivizing more responsible grazing and using the revenue to maintain the land (groundwater permits, pollution credits, carbon tax for other examples)

5.2 - Clearcutting

- Identify** TWO causes for clear cutting clearing land for residential/agricultural use, harvesting timber for sale, harvesting wood for fuel
- Explain** how clear cutting maximizes short-term economic benefits, but jeopardizes long-term economic benefits clearcutting is the fastest, easiest way to harvest timber, maximizing short-term revenue for timber companies. It can degrade soil quality and lead to erosion, however, which can decrease forest productivity in the long-term and result in decreased productivity and harvesting potential in the future
- Describe** how clearcutting impacts nearby water temperature clearcutting increases nearby surface water temperature by decreasing shade cover and increasing turbidity of the water, lowering albedo
- Describe** TWO ecosystem services that are devalued by clearcutting removal of PM, SO_x, NO_x from air by tree leaves, carbon sequestration and lessened climate change, pollinator species habitat, ground water filtration due to higher soil permeability and root structure

5.3 - Green Revolution

- Identify** THREE agricultural practices that are considered a part of the Green Revolution increased mechanization, increased monocropping, expanded irrigation systems, synthetic fertilizers and pesticides, high-yield varieties/GMOs
- Describe** the impact of the Green Revolution on agricultural yields the Green Revolution increased agricultural yields/acre as it lead to faster growing plants, larger plants, higher soil nutrients levels, greater irrigation, drought/disease resistant varieties, less pest damage
- Describe** a benefit and drawback of increased mechanization in agriculture (+): increased yields/acre, increase efficiency of land use, harvesting, lower consumer costs (-): increased reliance on fossil fuels and resulting air pollutants/GHGs released, increased soil erosion
- Describe** a benefit and drawback of GMOs (+): decreased pesticide use if resistance is engineered into crops, greater yield due to less crop loss to disease/drought (-) increased pesticide use if pesticide tolerance is engineered into crops, decreased crop biodiversity and increase susceptibility to catastrophic disease spread, increased growth rate leading to rapid nutrient depletion of soil/increased use of fertilizers to replenish soil nutrients
- Describe** a benefit and drawback of synthetic fertilizers (+): increased yields due to greater nutrient availability, lower consumer price, less land use to produce same yield (-): doesn't return organic matter to soil, easily leached through soil leading to groundwater contamination or washed off into surface waters leading to eutrophication, requires FF combustion releasing GHGs

APES Unit 5 Ultimate Review Packet (5.3 - 5.5)

5.3 - Green Revolution (cont.)

- a. **Describe** a benefit and drawback of synthetic pesticides (+): increased yields due to less crop loss to pests, decreased spread of insect-borne illnesses (-): increased non-target organism mutation or death, ground/surface drinking water pollution, human exposure through application, consumption of unwashed produce, water contamination leading to cancers
- b. **Describe** a benefit and drawback of irrigation (+): increased yields due to less crop loss to drought/lack of water, possibility of agriculture in regions previously too arid, (-): energy required to pump water from ground/surface waters, depletion of groundwater sources, soil salinization from naturally occurring salts in groundwater, cost of installing systems
- c. **Describe** a benefit and a drawback of monocropping (+): ease of fertilizer/pesticide/water application due to uniformity of crop needs, decreased consumer cost/decreased planting or equipment costs for farmers (-): soil erosion due to simultaneous mass harvest and loss of root structure, loss of crop biodiversity and disease resistance provided by biodiversity, loss of natural predator habitat for pests, increased pest population due to availability of preferred food source, decreased plant biodiversity in the area leading to loss of pollinator habitat/food

5.4 - Environmental Impacts of Agriculture

- a. **Describe** the process of tilling and **identify** a benefit and drawback to tilling the process of mechanically/physically mixing up the soil after harvest/before planting. (+): easier for farmers to plant seeds in friable soil, uniform development of root crops, increased oxygen/water infiltration in the short-term, easier for roots to spread through soil (-): increases erosion due to loosening of topsoil/destruction of root structure, increases CO₂ release from soil due to oxidation of organic matter
- b. **Explain** TWO reasons slash and burn agriculture may be used (1) quickly clears existing vegetation to create room for new agricultural fields or animal rangelands (2) returns nutrients in the vegetation to the soil (3) common in less developed nations where expanding agricultural land brings increased income for farmers
- c. **Describe** an environmental consequence of slash and burn agriculture releases air pollutants like CO, PM, NO_x into the air, releases CO₂ contributing to climate change, decreases future carbon sequestration due to loss of long-lived trees, habitat loss in especially biodiverse regions
- d. **Explain** a soil-related benefit of using organic fertilizers rather than synthetic fertilizers increases the depth of the O horizon which retains soil moisture, can include soil microbes leading to greater efficiency of nutrient cycling in soil, provides micronutrients often absent from synthetic fertilizers, slower release of nutrients due to slow breakdown of organic matter by decomposers/detritivores,

5.5 - Irrigation

- a. **Explain** how the the Ogallala Aquifer has become an example of the Tragedy of the Commons because no one entity owns the aquifer, farmers/communities in the Great Plains region use the water for irrigation/municipal water at a rate faster than it can recharge, leading to depletion

Furrow irrigation: furrows/trenches filled with H ₂ O Low cost/effort High evap./runoff loss Efficiency: 33% loss	Flood irrigation: flood fields with water Cheap and easy Can decrease roots' O ₂ access, evap. loss Efficiency: 20% loss	Spray irrigation: sprinkler system sprays water High cost/energy requirement Efficiency 25% or less	Drip irrigation: holes in hose allow water to drip out to roots High cost, but highly efficient Efficiency 5% loss
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APES Unit 5 Ultimate Review Packet (5.5 - 5.7)

5.5 - Irrigation (cont.)

- Explain** the process of soil salinization **the buildup of salt in soil due to use of groundwater for irrigation. Groundwater naturally contains a small amount which is deposited onto agricultural soil during irrigation and builds up over time as water evaporates, leaving salt in soil**
- Propose a solution to the issue of soil salinization **switching from groundwater to a freshwater source of water, flushing impacted soil with freshwater to wash salt deeper into soil, using drip irrigation to minimize evaporative water loss and salt buildup**

5.6 - Pest Control

- Identify** TWO sub-categories of pesticides and the organisms they target **herbicides - plants, fungicides- fungi, insecticides - insects, rodenticides - rodents**
- Explain** why extended use of a pesticide generally leads to a decrease in its effectiveness **due to genetic diversity, some pests in the target population will have mutations that enable them to resist the pesticide. They survive application and pass their resistant genes on to offspring, leading to higher and higher proportions of the population that are resistant to the pesticide**
- Describe** how GMOs can enable decreased pesticide application **crops can be genetically engineered to produce compounds that control pests, reducing the need to apply pesticides**
- Explain** how GMOs can actually make a crop more susceptible to catastrophic disease loss while GMOs often have disease-resistant genes for a specific pathogen, they're all genetically identical, eliminating the chance that any of the crops in a given field will have a gene that allows them to survive an unexpected future pathogen/infection

5.7 - Meat Production

- Describe** TWO advantages of meat producing using CAFOs **more meat production per unit of land, lower cost to consumer, more efficient delivery of food, water to animals, no risk of overgrazing leading to desertification of rangelands**
- Describe** TWO water-related disadvantages of producing meat using CAFOs **water depletion can occur due to the large volume of water needed for the animals themselves and the feed grain they consume, water contamination with manure (e. Coil, antibiotics, nutrients) in the event of manure lagoon overflow or seepage into groundwater**
- Explain** why producing plant protein for human consumption is a more efficient use of land than producing animal protein for human consumption **humans consuming animal protein are secondary consumers, meaning they are receiving roughly 1% of the energy from the producer level. When humans consume plant protein directly, they receive roughly 10% of the energy from the producer level, meaning the same amount of protein can be provided with roughly 1/10th of the land.**
- Describe** TWO non water-related environmental drawbacks of consuming animal protein rather than plant protein **animals raised for meat production release greenhouse gasses (CH₄, CO₂) from their digestive processes contributing to climate change, habitat loss related to growing grain for animal consumption, evolution of antibiotic-resistant bacterial strains in CAFOs, overgrazing and desertification of rangelands in freerearge meat production**
- Describe** a benefit and a drawback of producing meat using free range grazing rather than CAFOs (+) **none of the associated impacts/costs of producing grain for animal consumption, less fatty meat for consumer, higher price/pound for producer of meat, land too dry for producing edible plant protein can be used to produce animal protein, dispersed nature of animals negates need for antibiotics/buildup of manure in lagoons (-) more land is required per unit of meat produced, overgrazing can lead to desertification, slower animal growth means longer meat production timeline, higher cost to consumer**

APES Unit 5 Ultimate Review Packet (5.8 - 5.9)

5.8 - Overfishing

- Describe** how overfishing occurs when fishermen harvest/catch fish at a rate that is faster than they can repopulation, when there are no regulations in place a tragedy of the commons can ensue where individuals collectively harvest more fish than can be replenished in the same amount of time
- Define the term bycatch and **describe** an ecological consequence of bycatch bycatch refers to non-target species that are caught in commercial fishing nets/lines. This can disrupt aquatic food webs by reducing the top predators like dolphins or sharks that control populations of other organisms or are prey for larger predators like whales
- Describe** a negative ecological consequence of bottom-trawling nets used in bottom trawling can damage coral reef structure which reduces habitat for many organisms, nets can stir up ocean sediment which increases turbidity and reduces sunlight for producers like algae in the coral reef

5.9 - Mining

- Define the terms ore, overburden, and tailings ore - valuable mineral deposits which are the target of mining operations, overburden - soil, vegetation, and non-valuable rock matter overlying the ore being mined beneath, tailings - leftover waste material separated from the ore after it has been mined often stored in piles or pools near the mine site
- Describe** an environmental consequence of mining related to overburden removal overburden removal requires destruction of forest or other habitat overlying the ore, can involve mountaintop removal which features explosions that send overburden into surrounding valleys and filling in streams/destroying habitats/increasing PM in the air
- Describe** an environmental consequence of mining related to tailings tailing ponds can contain heavy metals (mercury, selenium, arsenic) that can contaminate nearby soil/ground/surface waters if runoff leaches metals from tailings, tailing pond overflow can lead to acidification of surrounding soils/surface waters
- Identify** an environmental consequence that mountaintop removal mining shares with strip mining and one economic consequence that is more associated with mountaintop removal both forms of mining result in habitat loss, soil erosion, heavy metal pollution in nearby soil/water, acidic runoff into nearby soil/water. Mountaintop removal is more associated with increased particulate matter leading to increased human respiratory damage and health care costs, flash flooding due to loss of soil permeability and the resulting property destruction
- Explain** why subsurface mining is more costly than surface mining it poses more threats to worker safety such as tunnel collapse/explosions/fires/lung diseases so worker wages/healthcare/insurance costs are higher