

Land and Water Use

AP Environmental Science ■ Unit 5

AP Environmental Science



What we will cover

- 1 The tragedy of the commons
- 2 Agriculture and food
- 3 Irrigation and water
- 4 Pest control and IPM
- 5 Harvesting resources
- 6 Urbanization and sustainability



The tragedy of the commons

A shared **common resource** 公共资源 open to all tends to be over-used:

- the gain goes to **one** user
- the cost is shared by **all**

Fix it with **regulation** 管制 (catch limits) or **private ownership** 私有制 (owner protects it).



open pit mine

Agriculture and food

The **Green Revolution** 绿色革命 raised yields with high-yield crops, fertilizer, irrigation, mechanization, and monoculture.

Costs: eutrophication, desertification, lost biodiversity.



Intensive farmland: high yield, high impact

Agriculture and food

N
nitrogen
leaf and stem
growth

P
phosphorus
strong roots

K
potassium
flowers and fruit

NPK fertilisers contain all three - ammonium salts and nitrates supply the nitrogen



*Wind power supports sustainable energy
mix*

Irrigation and water

Irrigation methods 灌溉方法 differ in waste:

- **flood** 漫灌 wastes most; **drip** 滴灌 wastes least

Over-watering causes **salinization** 盐碱化 and **aquifer depletion** 含水层枯竭.

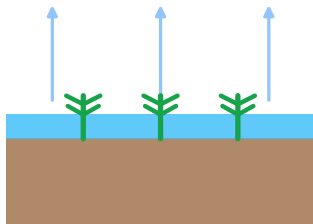


rice terraces

Irrigation and water

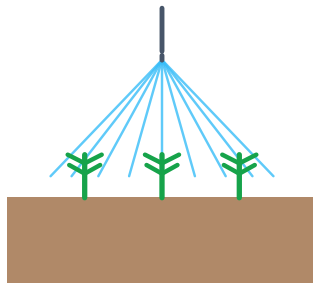
Flood / furrow

much evaporates
& runs off



water efficiency
~50%

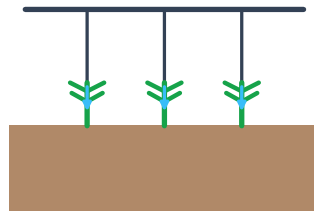
Spray / sprinkler



water efficiency
~70%

Drip

water to the roots



water efficiency
~90%

Pest control and IPM

Two approaches to pests:

- **chemical** 化学的: fast, but breeds **pesticide resistance** 抗药性
- **biological** 生物的: natural predators, no poison

IPM 病虫害综合治理: monitor first, spray last.



Chemical control: fast, but resistance rises

Harvesting resources

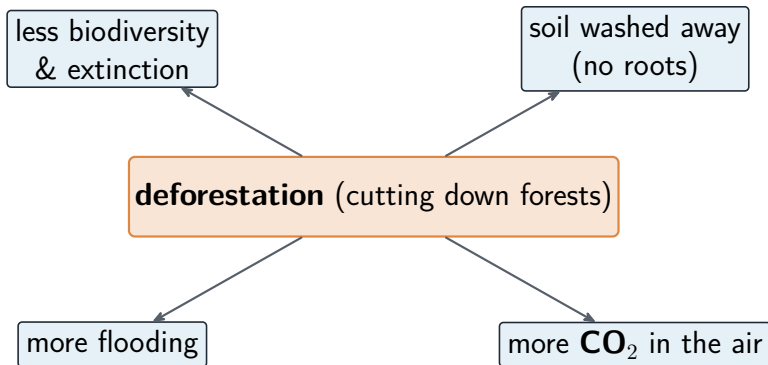
Take renewables no faster than they regrow – the **sustainable yield** 可持续产量.

- **clearcutting** 皆伐 erodes; selective cutting sustains
- mining: acid drainage + tailings; reclaim afterward



Clearcutting: short yield, long erosion

Harvesting resources



Urbanization and sustainability

Urbanization 城市化 adds **impervious surfaces** 不透水面:

- more runoff, less recharge; heat island; sprawl
- fix with permeable pavement, green roofs

An ecological footprint above biocapacity cannot last.



Sprawl: impervious surfaces and heat islands

Worked example – the tragedy of the commons

A shared pasture supports 100 cattle. Each of 10 herders adds one more animal. Explain the outcome.

- The **benefit** of an extra animal goes entirely to **one** herder.
- The **cost** – overgrazing – is shared by **all ten**.
- So it is rational for each to add one, though all lose: 110 cattle **exceed the carrying capacity**.
- The grass fails $\Rightarrow$ **the resource collapses and everyone is worse off**.

The tragedy needs an **open-access** resource with **private gain and shared cost**. Fixes: regulate, privatise, or agree limits – as with fisheries and the atmosphere.

Unit 5 – key takeaways

1

Commons

gain to one, cost to all; regulation or ownership

2

Food & water

Green Revolution trade-offs; drip beats flood

3

Pests & harvest

IPM over spraying; sustainable yield

4

Cities

impervious runoff, heat island; footprint vs biocapacity

Check yourself

- 1 In the commons, who gets the gain and who pays the cost?
- 2 Which irrigation method wastes the least water?
- 3 What does IPM do before spraying pesticide?
- 4 Name the three pillars of sustainability.



Answers 1. gain to one user, cost shared by all 2. drip 3. monitor pest numbers
4. economic, social, environmental