OPTIMIZING SOIL & PLANT HEALTH IN AGRI-FOOD PRODUCTION

Module 8

Regenerative Agriculture - its benefits and innovations

Réseau Agroalimentaire de l'Est ontarien
Eastern Ontario Agri-Food Network

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My NORDIC Garden
Natural & Sustainable Kitchen Gardens

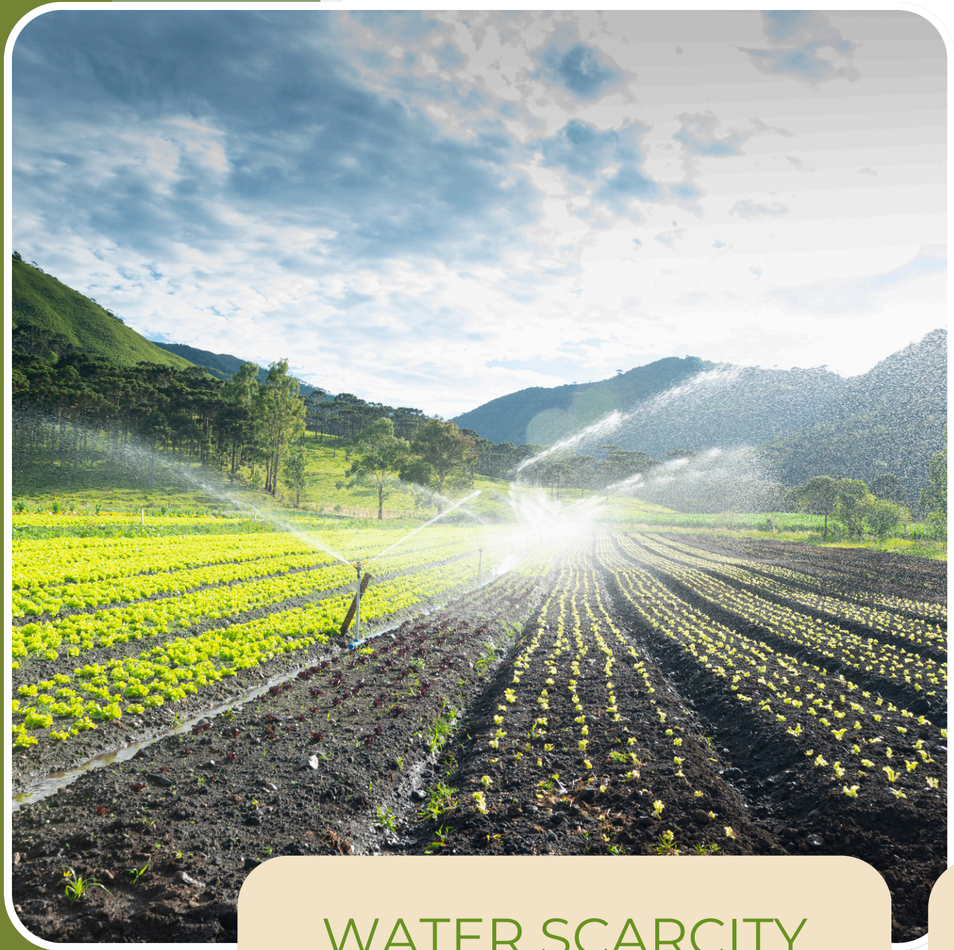
MODULES

1. INTRODUCTION TO SOIL HEALTH
2. SOIL TESTING & ANALYSIS
3. BUILDING HEALTHY SOIL WITH COMPOSTING
4. PREVENTING MOLD & FUNGAL DESEASES
5. NUTRIENT MANAGEMENT & FERTILIZATION
6. ORGANIC SOIL AMENDMENTS & ALTERNATIVES
7. CROP ROTATION & PLANT PAIRING
8. WATER MANAGEMENT & IRRIGATION PRACTICES
9. INTEGRATED PEST MANAGEMENT (IPM)
10. SOIL CONSERVATION & SUSTAINABLE PRACTICES

MODULE 8:

WATER MANAGEMENT & IRRIGATION PRACTICES

- Water Sources
- Mismanagement Examples
- Sustainable Watering Methods
- Water Conservation Practices
- Ancient Water Systems
- Modern Technology
- Water Management in Food Processing
- Livestock Water Management
- Integrated Farming Challenges



1) INTRODUCTION

WATER essential in agri-food production:

- raising life stock
- growing crops
- processing food
- soil organisms for soil health
- 70% of global freshwater use

> efficient water usage without wastage

CHALLENGES:

WATER SCARCITY

geographical situations + environmental conditions + over-extensive water usage

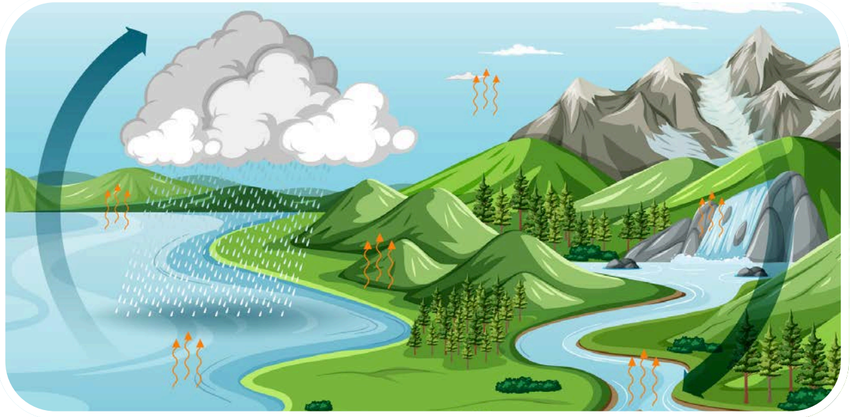
CLIMATE CHANGE

hotter & drier in some regions, other regions facing flood issues

POLLUTION

intensive use of pesticides/herbicides + industrial waste water + over fertilization + salination

2) WATER SOURCES



Surface Water: Lakes, Stream, Rivers, Reservoirs
> water often diverted through canals for irrigation

Groundwater: extracted from underground aquafers using wells
> crucial in areas with limited surface water, especially during droughts, over reliance > aquafer depletion, reduced quality, land subsidence

Rain Water/Snow Melt: storage in tanks or ponds during wet season for agricultural use
> depends strongly on precipitation

Recycled Water: treated waste water from urban & industrial sources
> provides sustainable option, BUT requires careful management to avoid contamination

Desalination: alternative in arid regions, desalination of brackish or sea water
> energy intensive, can supplement other resources

3) WATER MISMANAGEMENT

Example: **ARAL SEA BASIN (Uzbekistan, Kazakhstan - Central Asia)**

- unsustainable irrigation practices (diverting Amu Darya & Syr Darya) for cotton & rice farming > drastically reduced water levels within 50yrs
- vast deserts + brake up in smaller lakes
- devastating agriculture & fisheries
- increased salinity
- ENVIRONMENTAL, SOCIAL & ECONOMICAL DISASTER

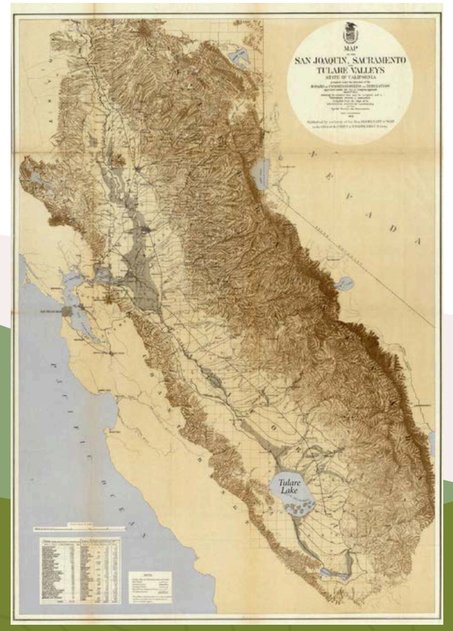
NASA/UN

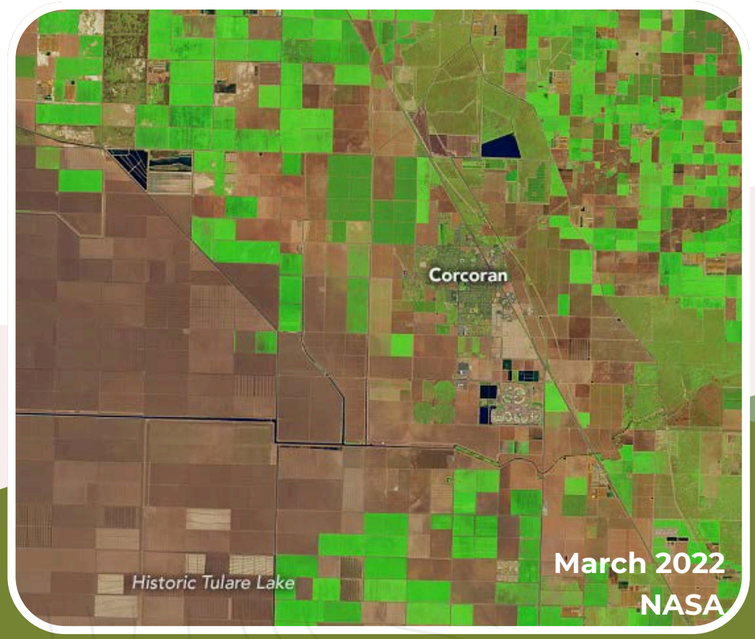
3) WATER MISMANAGEMENT

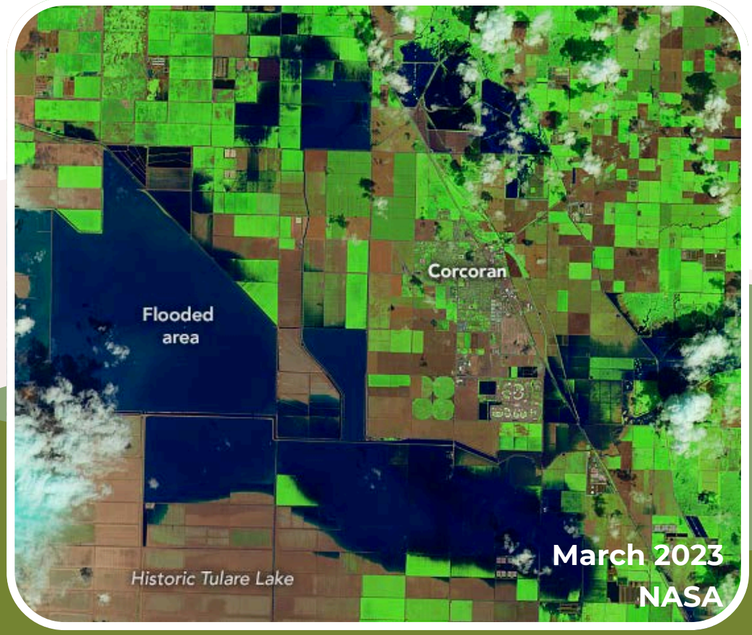
Example: **TULARE LAKE (California) - Once the biggest fresh water lake west of Mississippi**

- in late 19th century, dammed & diverted rivers for irrigation > by mid 20th century nearly all the lake was drained & replaces with agriculture > now water comes back
- flooding issues in years with heavy snow & rain falls in Sierra Nevada mountains > towns & fields receive flooding > finding ways to divert the water out of this area

1874 Map of San Joaquin, Sacramento, and Tulare Valleys







4) SUSTAINABLE WATERING METHODS

- **Drip Irrigation**: water delivery directly to root zone of plants, reduced water loss due to evaporation & runoff
- **Efficient Sprinkler System**: mimics rain fall, distributes water evenly, low energy precision application, optimized for large scale farming
- **Soil Moisture Sensors & Smart Irrigation Systems**: technology monitors moisture & adjusts irrigation, prevents overwatering
- **Rain Water Harvesting**: capturing & storing rain water, reduces dependence of external water source, replenishes groundwater
- **Micro Irrigation**: small scale sprinklers or misters, target water delivery, ideal for high value crops

5) WATER CONSERVATION PRATICES

- **High Organic Matter Content in Soil:** increased water retention
- **Mulch:** various materials incl. straw, wood chips, leaves, plastic; covers bare soil > prevents evaporation & keeps soil cool
- **Cover Crops**: living plants, cover/shade bare soil > prevents evaporation & keep soil cool
- **Drought Resistant Crops**: less water usage, adapted roots & drought tolerant tissues, can help refilling natural aquafers, e.g. sorghum, millet, buckwheat, amaranth, cow peas, black eyed peas, lentils, quinoa, olive trees, chickpeas

6) ANCIENT WATER SYSTEMS

first man made irrigation techniques:

Canals

canals to divert river water/flood water towards fields by canals & dams; Egypt, 5000yrs ago

Levees, Deichs & Canals

canals to divert river water/flood water towards fields by canals & dams; Mesopotamia, 5500yrs ago

Gated Ditches

6) ANCIENT WATER SYSTEMS

Cantalloc Aqueducts

bringing water from mountain streams of wells to the fields & for drinking; Incas, about 600yrs and older

Quanats (Underground Water Canals)

transport groundwater or well water underground for irrigation, middle-East, 3000yrs old

Terracing

rice terraces, e.g. China & Philippines, 3000-2500yrs old

7) MODERN TECHNOLOGY

Hydroponics

nutrient rich water cycles through tubes to feed plant roots

Aeroponics

plant roots hang freely in the air, sprayed or dripped on by nutrient rich water

Dew or Fog Water Collection

collecting water through condensation on cold surface over night, age-old technique, off-grid solution

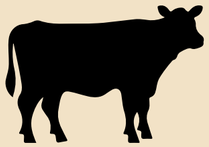
8) WATERMANAGEMENT IN FOOD PROCESSING

Water necessary for product safety & quality, sustainable practices preferable

a) **Preserving fresh water** > prevents overdrawing of water recourses
b) **Recycle & treating wastewater** > reduces use of fresh water usage
c) **Minimized pollution through filter systems** > protects ecosystem
d) **Protects public health** > filter systems; prevents contaminated food products from reaching distribution
e) **Economic losses** > less loss of fresh water = lower energy bills; fines apply for non-compliance with waste water regulations

9) LIVESTOCK WATERMANAGEMENT

CATTLE



- natural sources: ponds, streams, wells
- troughs for indoor feeding

Practices:

- protect ponds, wells, streams with fencing from contamination
- install gravity fed or solar powered water pumps
- provide shade near water sources (algae prevention)

PIG

- nipple or bowl drinkers to minimize waste

Practices:

- monitor water quality to prevent contamination > disease
- recycle waste water when safe for non-drinking purposes, e.g. cleaning hands

CHICKEN

- automated nipple drinkers or bell drinkers

Practices:

- regular cleaning & maintenance for hygiene
- water meters to detect consumption or leaks
- optimal temperature

10) INTEGRATED FARMING CHALLENGES

www.cbc.ca/news/health/carrots-recall-fda-cdc-1.7386665

<u>Problem:</u> close proximity of livestock & food producing fields can lead to contaminations with pathogens, e.g. E.coli (studies proven)

WATER RUNOFF & E. COLI CONTAMINATION

surface water runoff from livestock fields > high level in pathogens > irrigation water for food crops > foodborne diseases

PROXIMITY TO LIVESTOCK FARMS

food crops grown on fields near livestock farms at higher risks of contamination > windborne, particles, direct runoff, contaminated manure

VEGETATIVE BARRIERS AT MITIGATION

proven effective: vegetation barrier between fields > reducing transmission of pathogens; barriers slow & filter runoff (soil microbes, root systems, contamination rates reduced by **up to 82%**

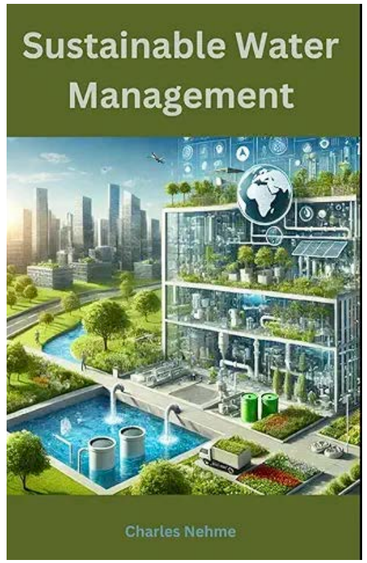
CONCLUSION

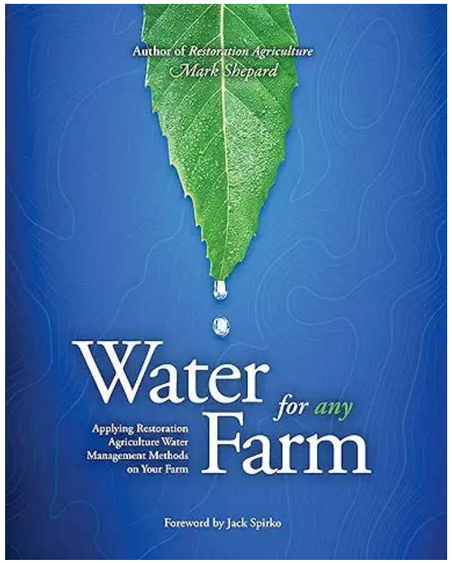
- WATER CONSERVATION
- REDUCED WATER WASTE
- REDUCED IRRIGATION

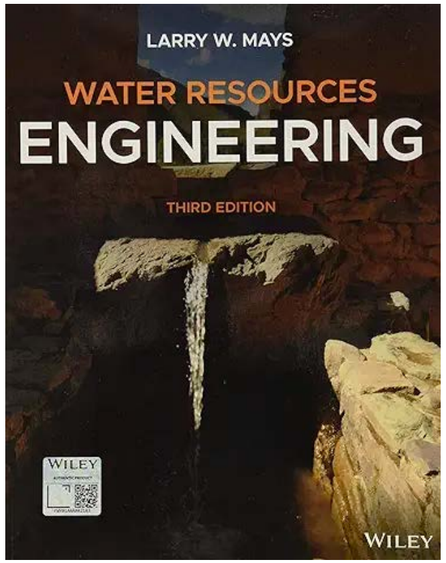
+ ENHANCED RESILIENCE OF FOOD SYSTEMS
+ ECONOMIC STABILITY
+ VIABILITY OF AGRICULTURAL PRACTICES

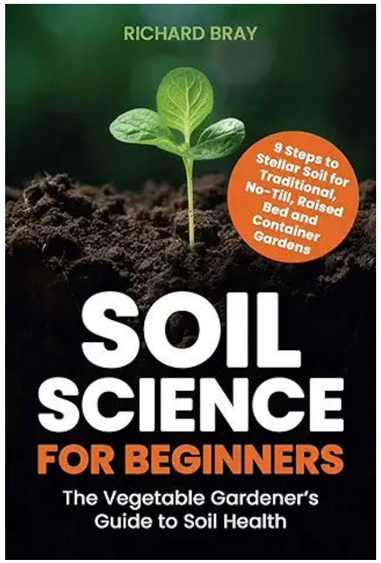
Water management is a central aspect of agri-food production.
Mismanagement can cause severe ecological, economical and social damage

RESOURCES









Aral Sea

https://na.unep.net/geas/getUNEPPageWithArticleIDScript.php?article_id=108

Krapivin, Vladimir F., Ferdenant A. Mkrtchyan, and Gilbert L. Rochon. 2019. "Hydrological Model for Sustainable Development in the Aral Sea Region" Hydrology 6, no. 4: 91. https://doi.org/10.3390/hydrology6040091

Tulare Lake

https://earthobservatory.nasa.gov/images/151174/return-of-tulare-lake

https://hanfordsentinel.com/news/local/600-000-years-of-history-and-tulare-lake-isnt-done-yet/article_680ec871-732d-5e85-84a7-5945d

https://storymaps.arcgis.com/stories/27911a186f6041e19e12364c3e908b2e

Dokras Dr. U. 2022. Circular Cities of the ancient world. Indo Nordic Author's Collective.
www.academia.edu/88402508/Circular_Cities_of_the_ancient_world

Dew/Fog Water Harvesting Systems

Hasila Jarimi, Richard Powell, Saffa Riffat, Review of sustainable methods for atmospheric water harvesting, International Journal of Low-Carbon Technologies, Volume 15, Issue 2, May 2020, Pages 253–276, https://doi.org/10.1093/ijlct/ctz072

Quanats

www.worldhistory.org/qanat/

archaeology-world.com/ancient-3000-year-old-underground-irrigation-canals-invented-by-people-of-persia/

Ancient Water Systems

Reyes-Knoche, A., 2012. Sustainable water supply in pre-Columbian civilizations in Ancient Peru and South America. Evolution of water supply through the millennia, pp.271-299.

Center for Produce Safety

www.centerforproducesafety.org/research-database/how-does-weather-influence-transmission-of-e-coli-o157h7-from-animal-operations-to-produce-fields

E. Coli Risks

BENJAMIN LA, JAY-RUSSELL MT, ATWILL ER, et al. Risk factors for Escherichia coli O157 on beef cattle ranches located near a major produce production region. Epidemiology and Infection. 2015;143(1):81-93. doi:10.1017/S0950268814000521

THANK YOU