ROOTS:

CLIMATE CHANGE AND KOREAN AGRICULTURE IN THE US

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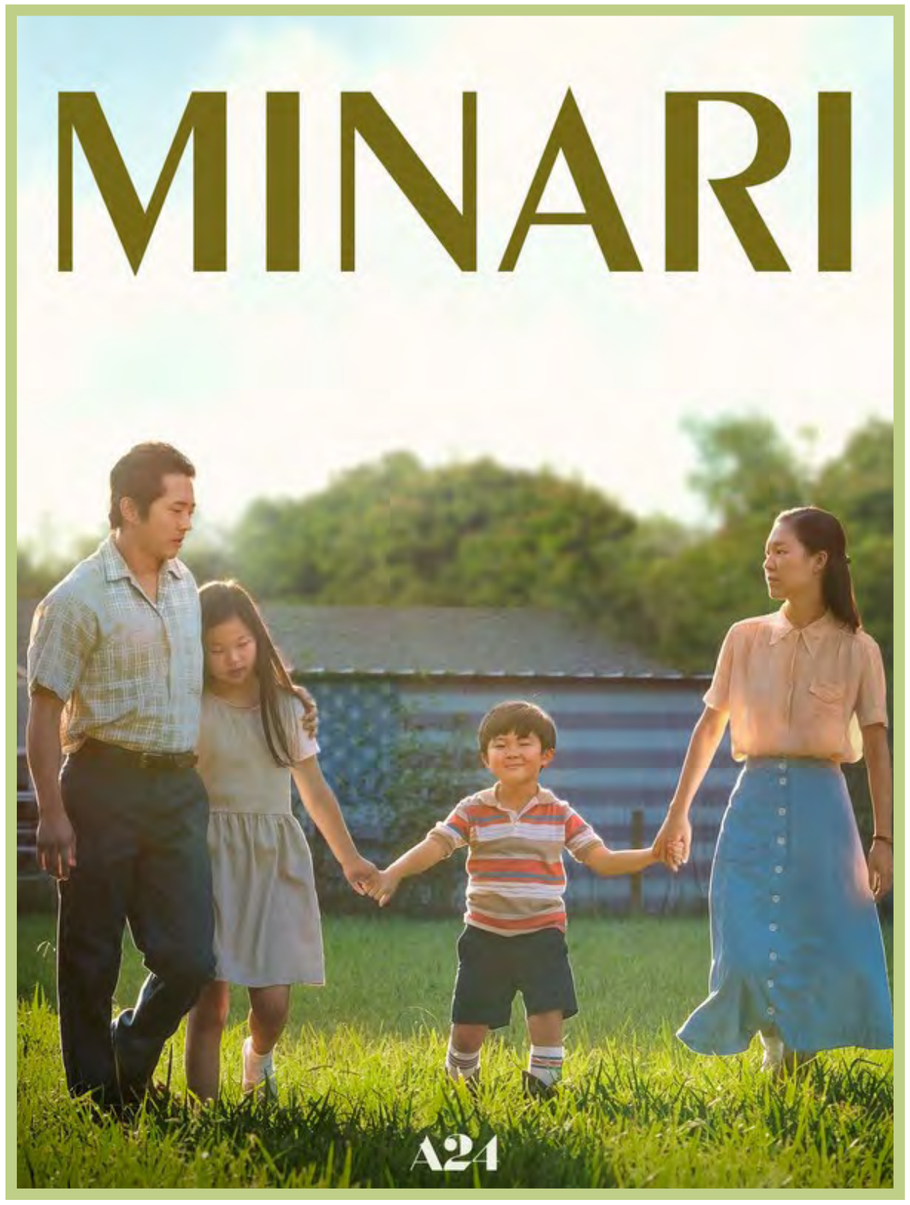
Committee Chair: Arianna Lindberg
Committee Members: Richard Alomar, Holly Nelson

SETTING THE STAGE



INDUSTRY STANDARD

85% of the Agricultural Market Value

REVOLUTIONARY CONSEQUENCES

Benefits

Mechanical Tillage

used against

Soil Compaction

Detriments

Mechanical Tillage

leads to

Organic Decomposition

Microbial Loss

Pollution

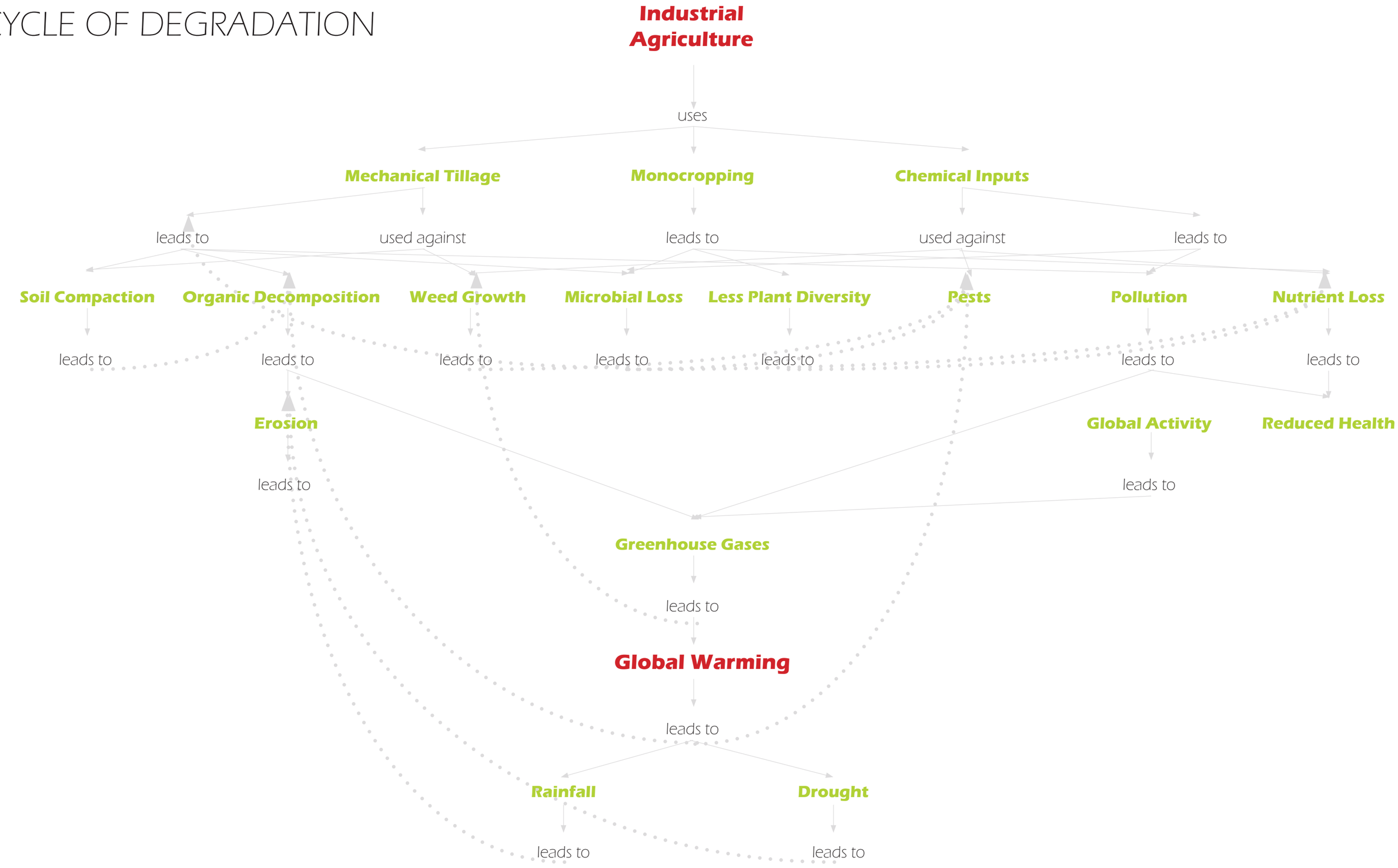
leads to

Greenhouse Gases

Erosion

Soil Compaction

CYCLE OF DEGRADATION



GLOBAL CLIMATE CRISIS

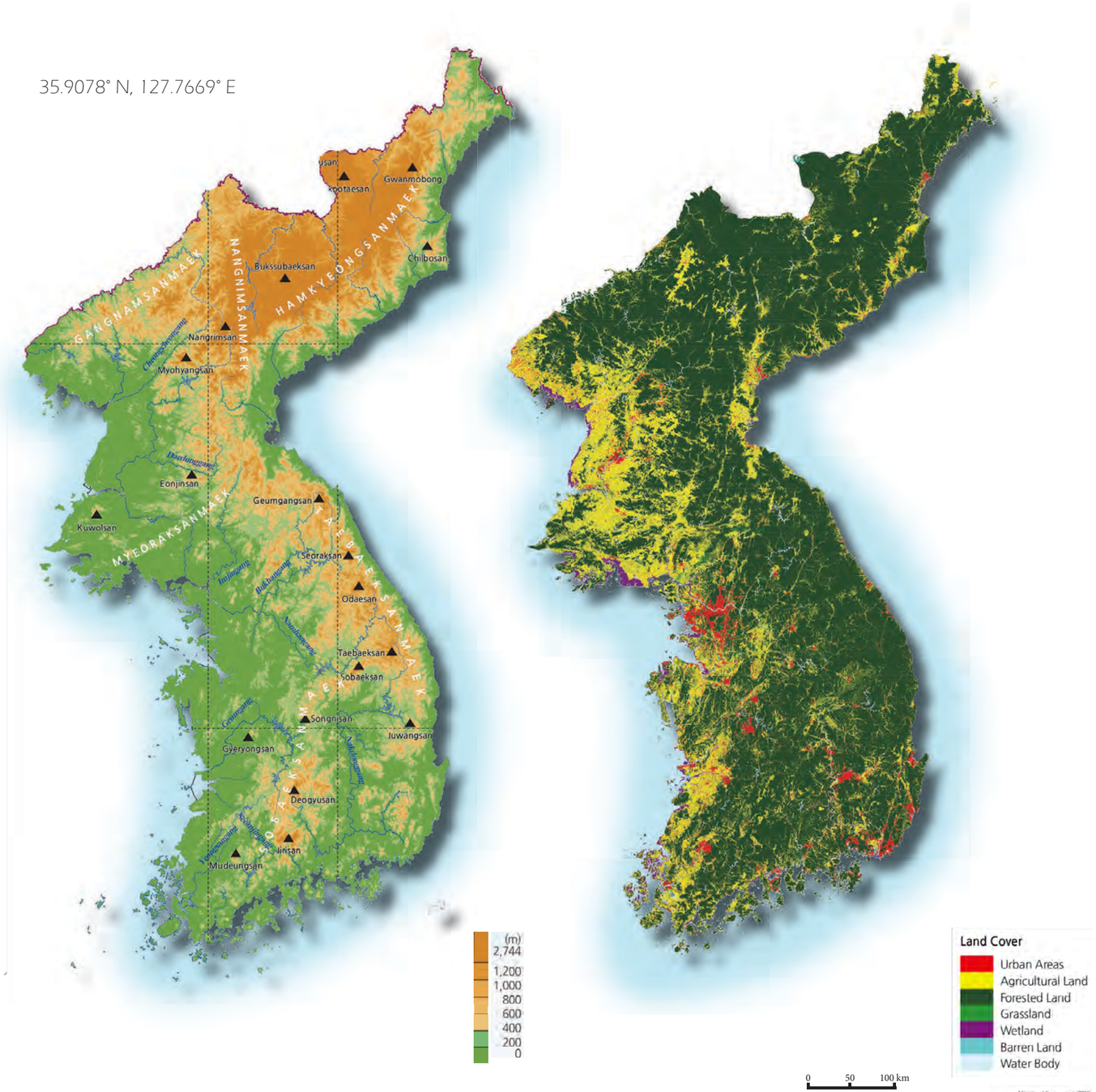
The USDA has identified 3 key topics in the face of climate change:

Water
Management

Soil
Health

Pest and Disease
Pressure

RESILIENCE BY NECESSITY



- ~30,000,000 acres

- Mountain ranges cover 70% of the peninsula

- Coastline bordering 3 oceans

- Numerous inhabited islands off the mainland

RESILIENCE BY NECESSITY

- Lowland area increasingly urbanized.

- Monsoon season brings floods and typhoons.

- Severe droughts at 4-6 year intervals.

INTERVENTION ANALYSIS

Water Management

Island Terraces

Soil Health

Ginseng Farming

Pest and Disease Pressure

Paddy Management

THESIS QUESTIONS

What techniques have Korean farmers developed to adapt to the extreme conditions of the Korean peninsula?

Can those be translated to effective measures in the US to mitigate effects of climate change?

WATER MANAGEMENT

Drought

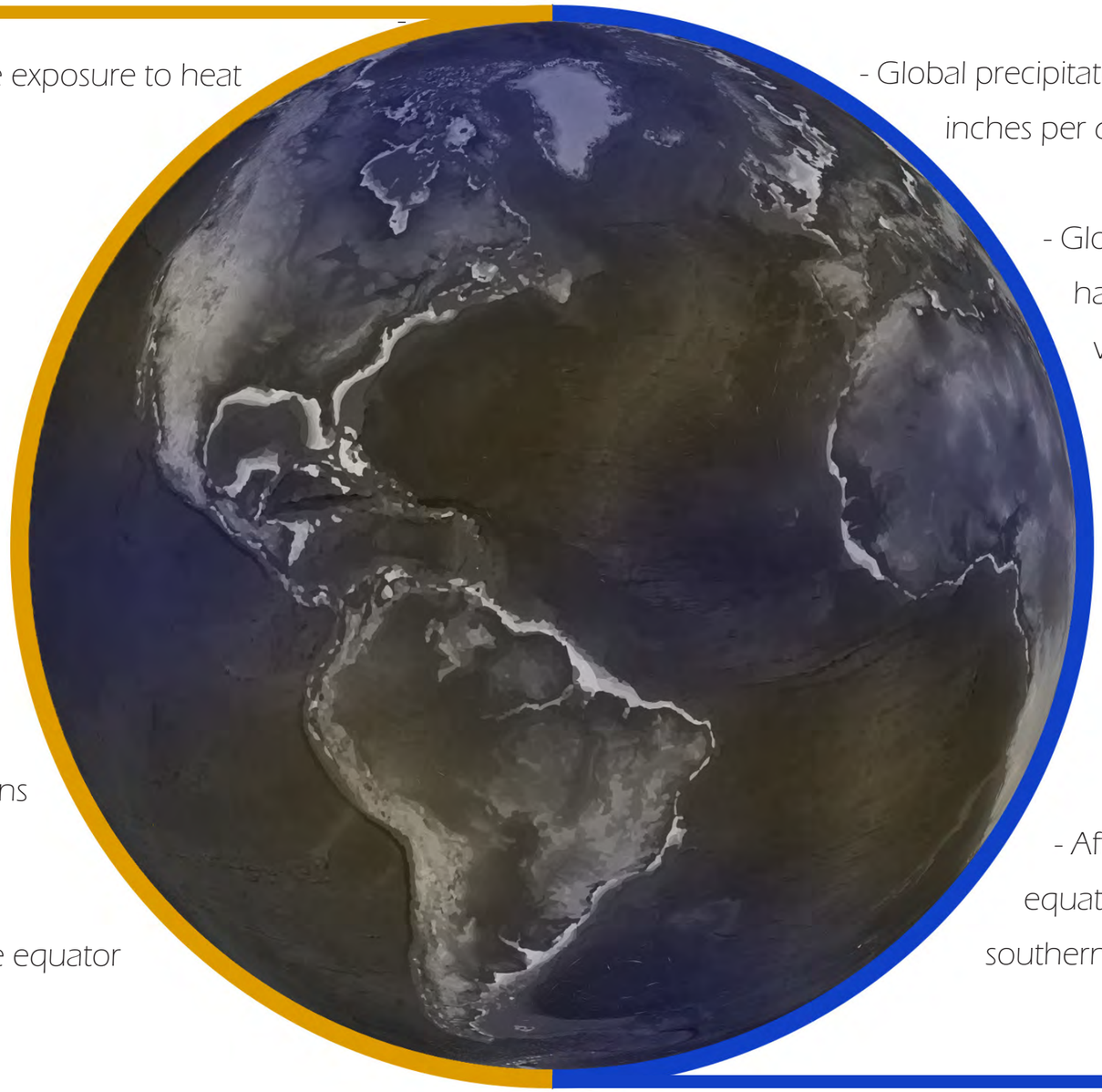
- Lack of plant cover leads to more exposure to heat and solar radiation.

- Hotter areas form high pressure systems, which prevent further rainfall.

- Dry ground is less porous, setting up flash flood conditions.

- Water intensive crops such as corn are projected to decline 5% globally, resulting in losses of around 60,000,000 metric tons of produce.

- Broadly affects areas between the equator and the poles.



- Global precipitation rates have increased by 0.04 inches per decade since 1901.

- Globally, 20% of total cultivated land has been affected by damage from rising water levels.

- Flooding affects agricultural infrastructure.

- Melting snow floods river basins, and deprives farmers of water sources later in the year.

- Affects tropical regions along the equator, as well as northernmost and southernmost latitudes.

Rainfall

GUDEULJANGNON IRRIGATED RICE TERRACES

구들장논

Through Rain or Shine

Water
Management

CHEONGSANDO ISLAND

High Point: 1,115 ft.
Avg. temp: 57.7 ° F
Acreage: 10,551ac.
34“ ° 11’ N, Longitude 126“ ° 53’ E

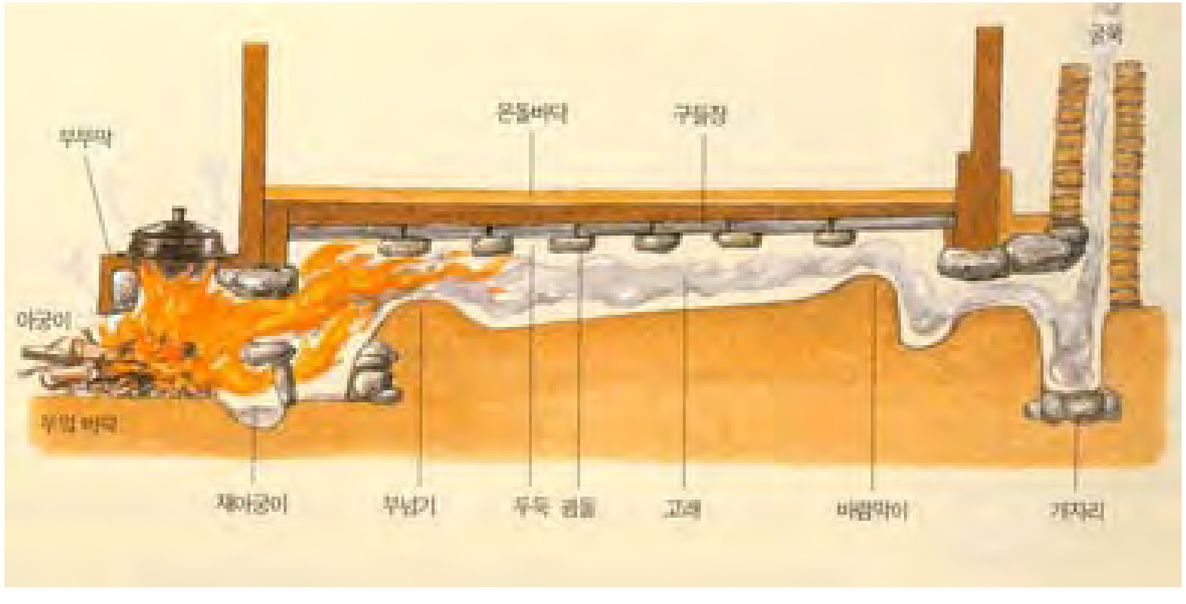
Hills and forests prevent conventional agriculture

Habitable intermountain basins

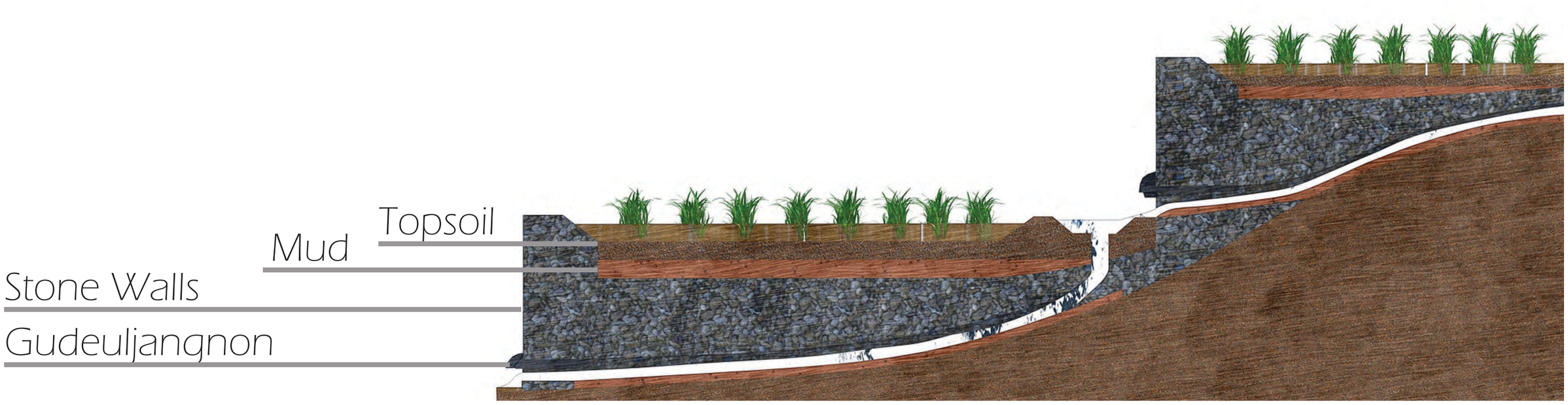
Steep, rocky slopes create runoff

Island susceptible to flood and storm damage

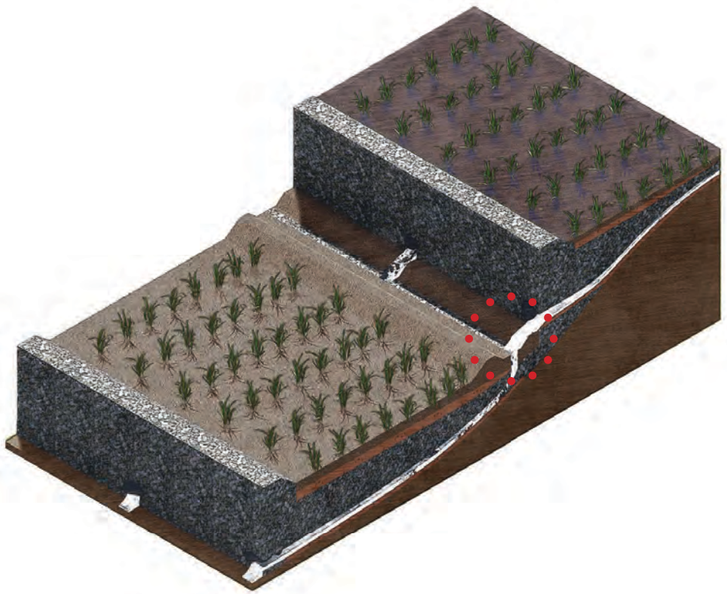
GUDEULJANGNON IRRIGATED RICE TERRACES



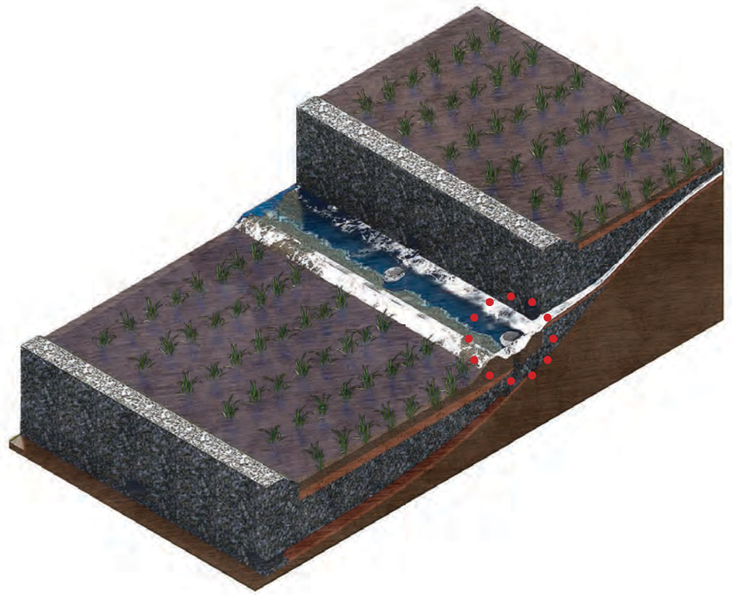
TERRACE SECTION



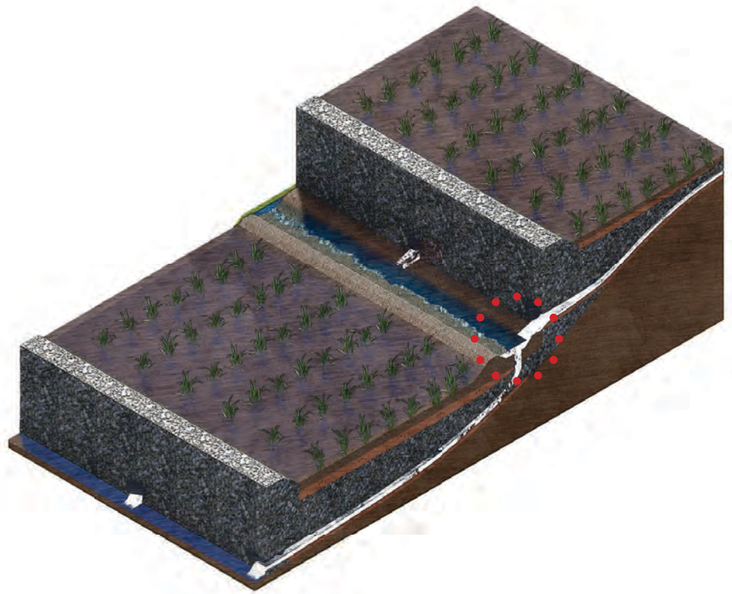
TARGETED IRRIGATION



Underground channels give more control over irrigation.

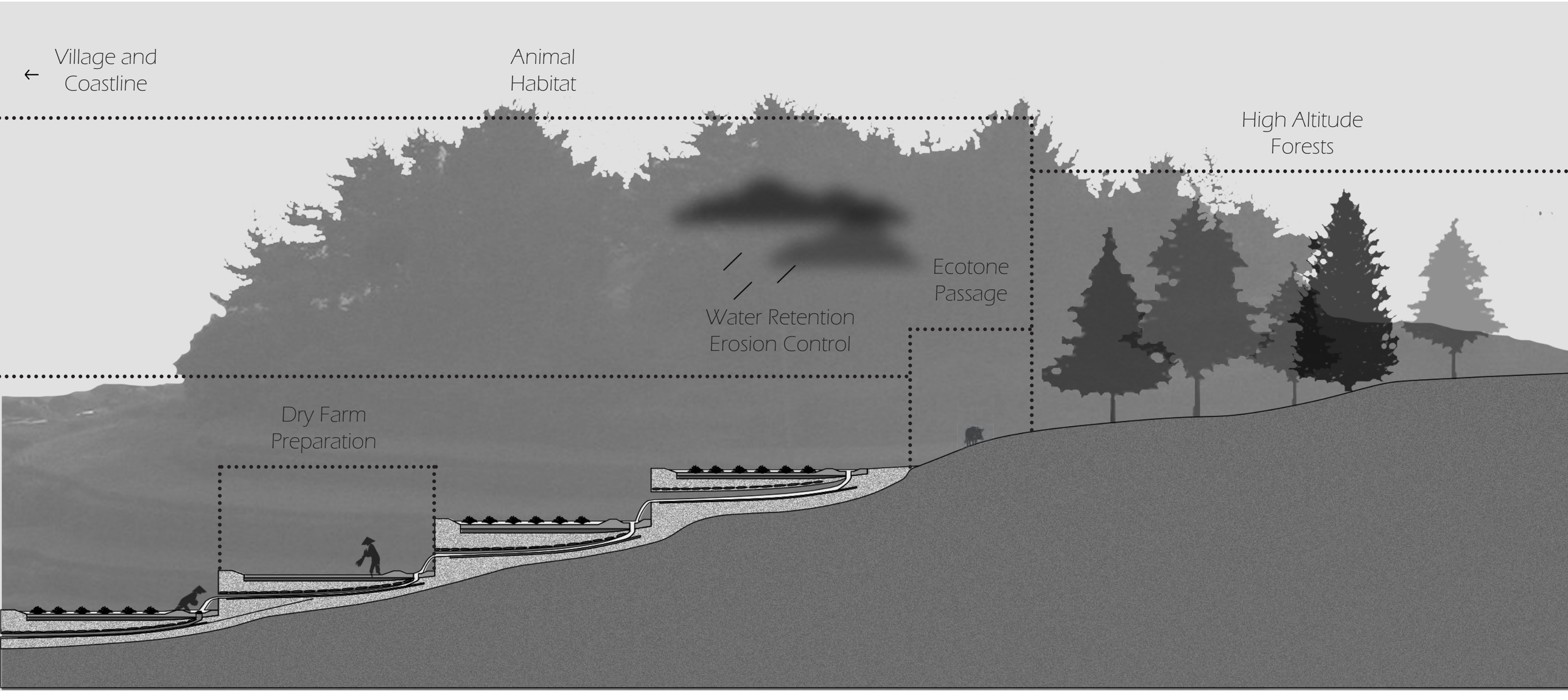


Stones are placed on top of channel entrances, filling paddies.



Stones are removed to continue irrigation flow.

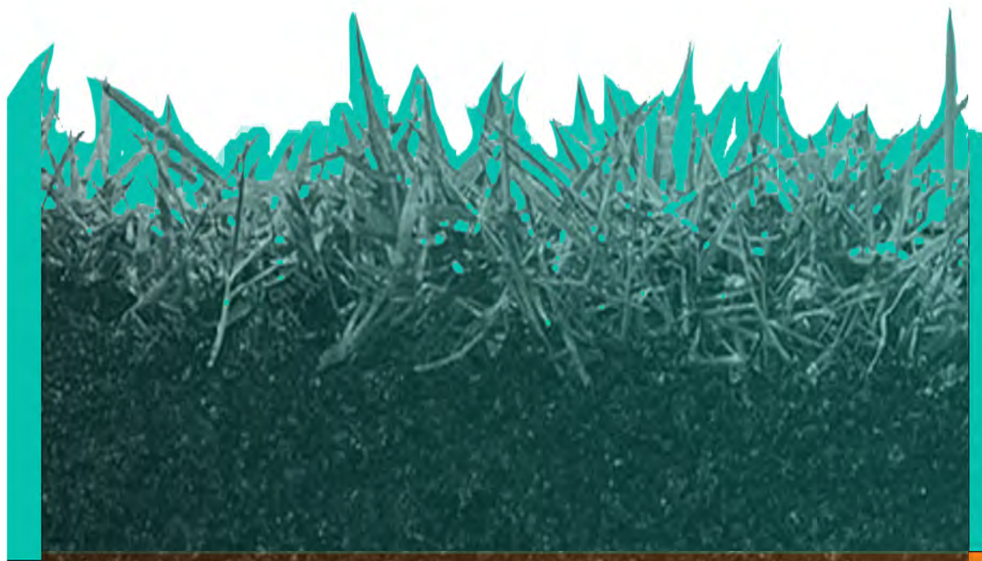
IRRIGATED TERRACE FARMING: WATER RETENTION AND CONTROL



0 5 10 20 ft.

SOIL HEALTH

PHYSICAL



- Soil Structure

- High temperatures degrade organic material, which results in a loss of nutrients, less water-retention, and increased erosion.

- Carbon sequestration in soil organic material is over 3 times that currently in the atmosphere.

CHEMICAL

- Soil pH is decreased due to increased rainfall, in the form of nitrate leaching.

- Negatively impacts availability of essential nutrients, and makes harmful compounds more soluble.

- Soil Salinity is increased in due to evaporation and accumulation of salt, deteriorating plants and reducing water intake.

BIOLOGICAL

- Soil Microbes have a direct symbiotic relationship with plants.

- Increased temperatures reduce biodiversity of microorganisms, resulting in loss of specific systems.

GEUMSAN GINSENG CULTIVATION

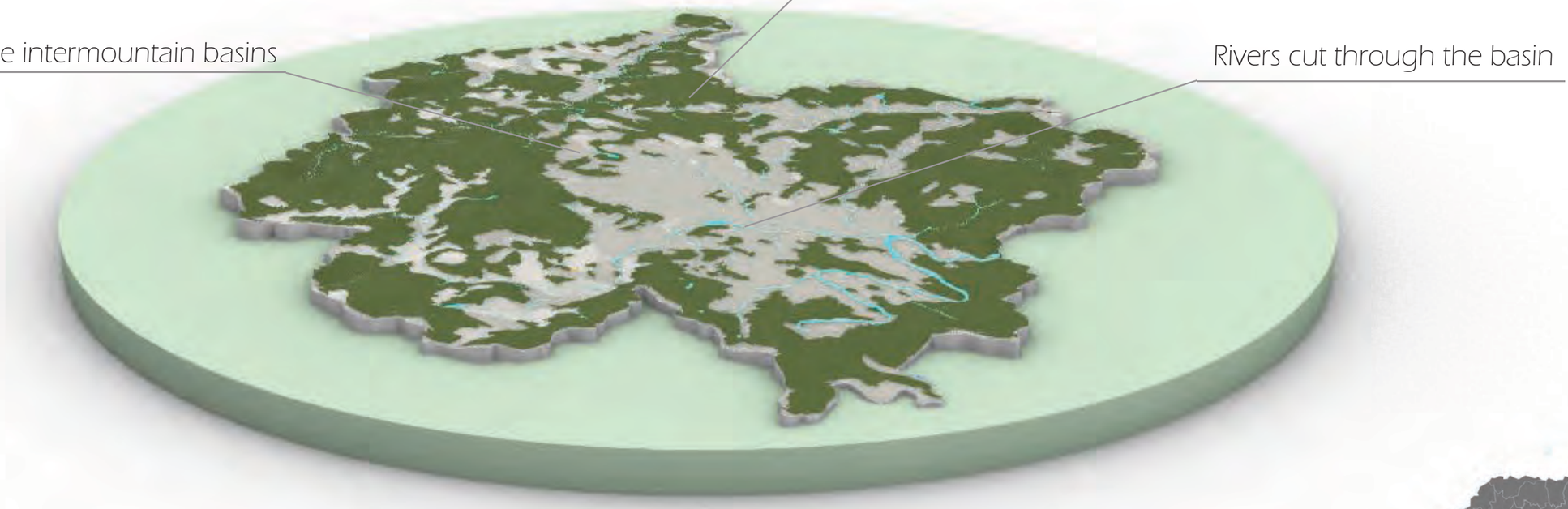
금산군

From the Ground Up

Soil
Health

GEUMSAN COUNTY

High Point: 2,821 ft.
Avg. temp: 57.7 ° F
Acreage: 142,086ac.
35“ ° 70’ N, Longitude 127“ ° 30’ E

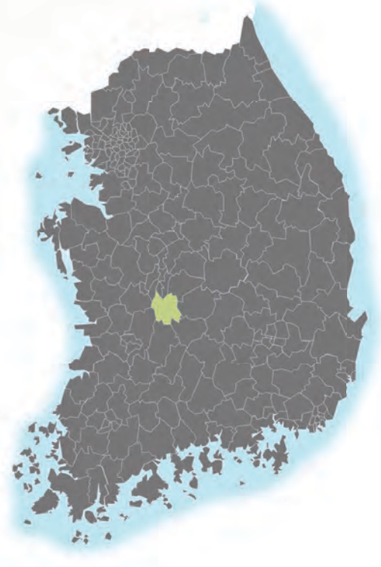


Korean Ginseng (panax ginseng)

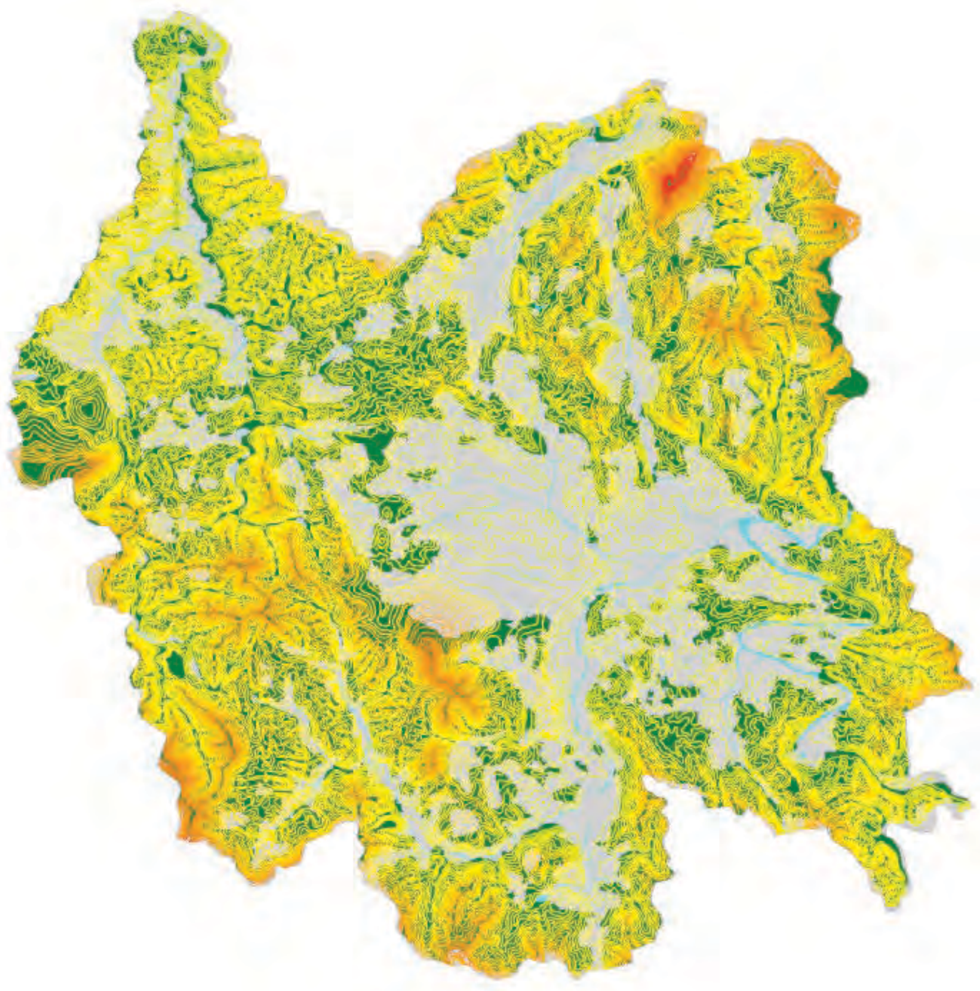
Dramatically decreases soil quality..

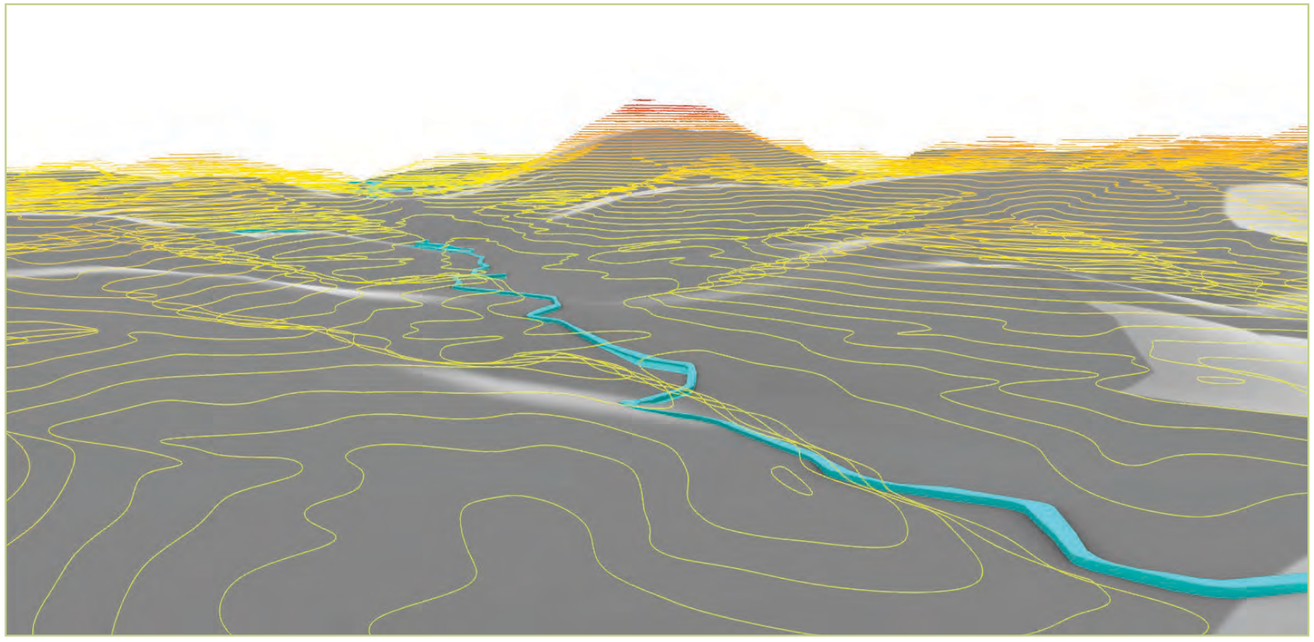
Extremely susceptible to heat.

Growth period of 3 years.



MICROCLIMATE COOLING SYSTEM





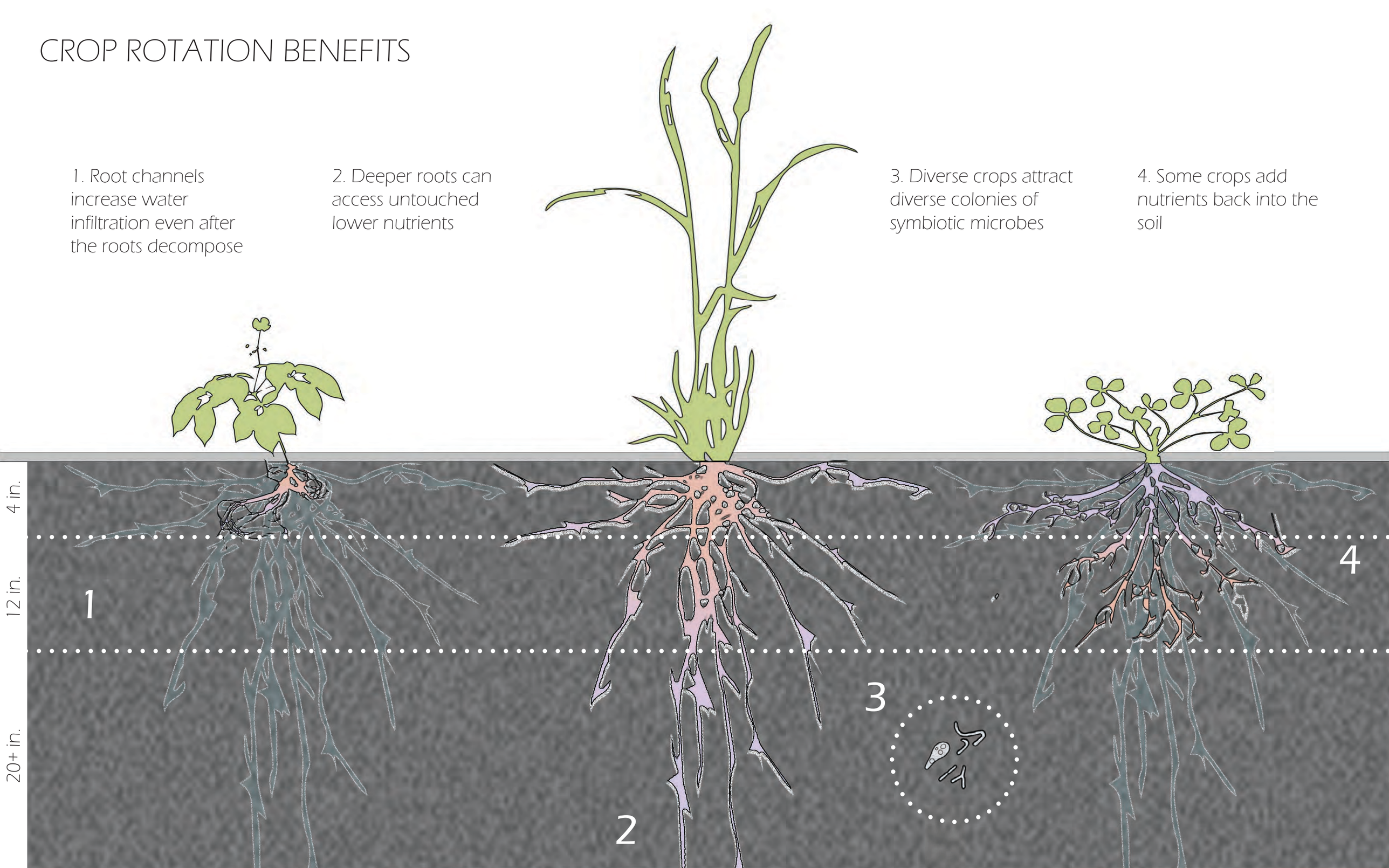
CROP ROTATION BENEFITS

1. Root channels increase water infiltration even after the roots decompose

2. Deeper roots can access untouched lower nutrients

3. Diverse crops attract diverse colonies of symbiotic microbes

4. Some crops add nutrients back into the soil



10 YEAR ROTATION

2011

Ginseng is planted and covered with windstream sunshades.

2014

Deep rooted crops are planted to take advantage of nutrient-rich lower soil levels.

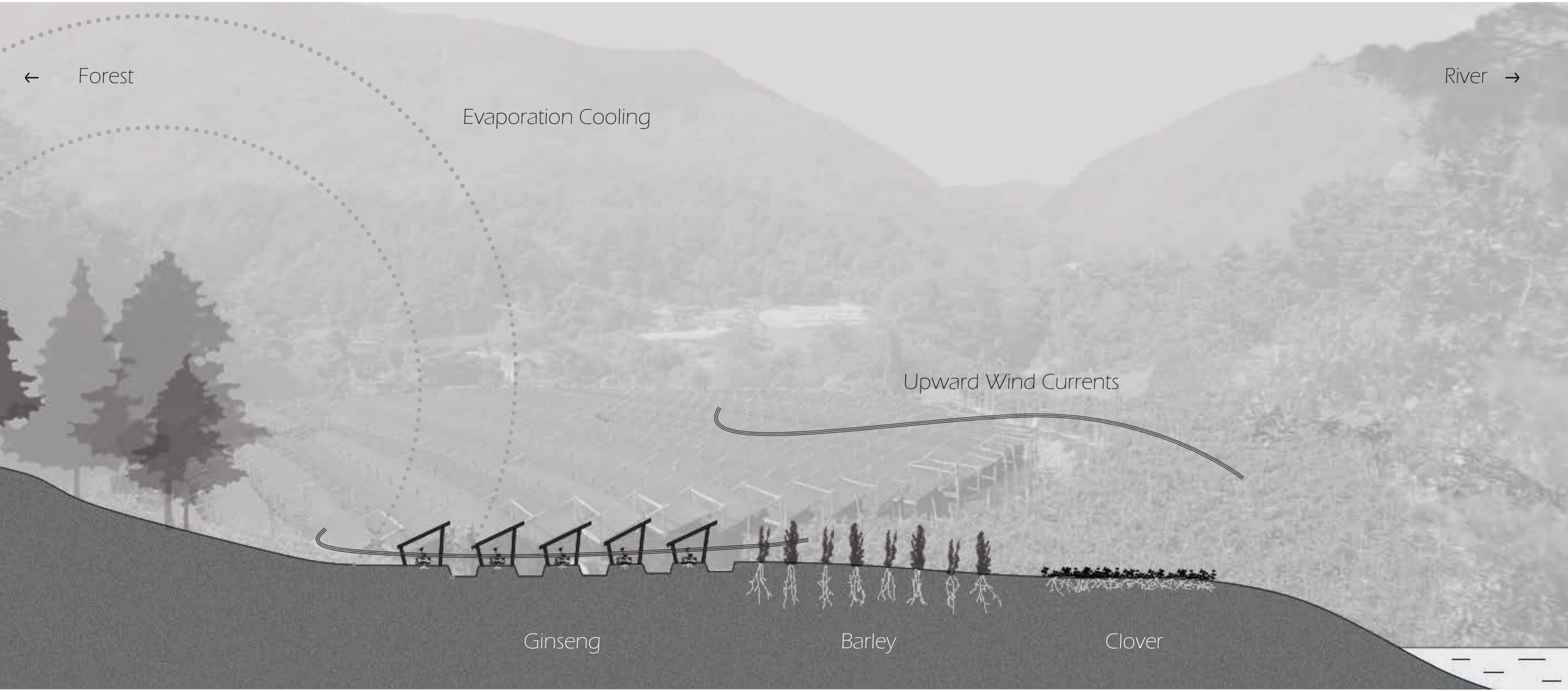
2017

Soil fixing crops, such as clover, are planted to replenish nutrients in the soil.

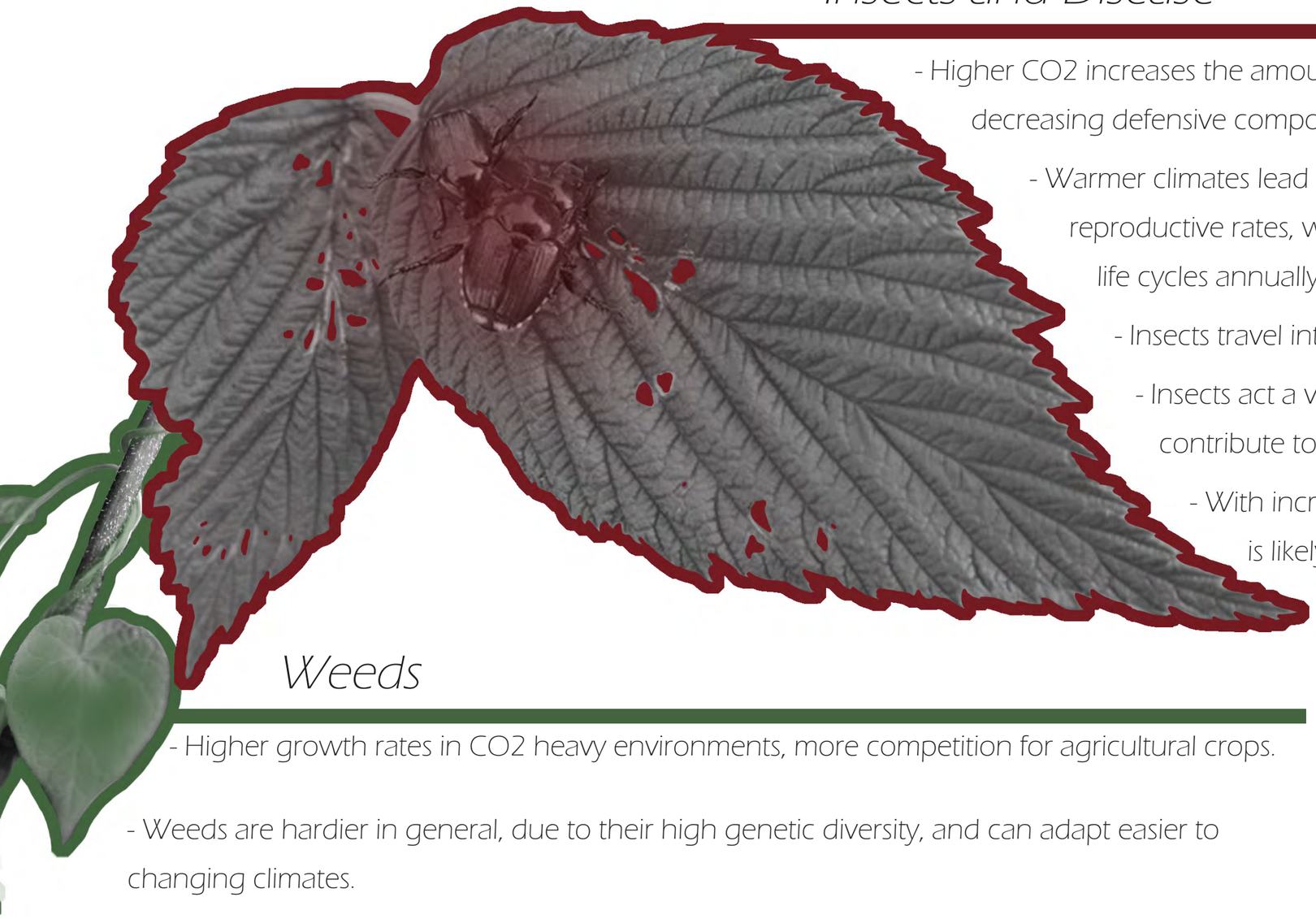
2020

Ginseng is planted and covered with windstream sunshades.

MICROCLIMATE CROP ROTATION: BOLSTERING THE NATURAL FLOW



PEST AND DISEASE PRESSURE



Insects and Disease

- Higher CO2 increases the amount of starch and sugars generated by plants, while decreasing defensive compound generation, increasing feeding rates.

- Warmer climates lead to decreased overwintering times and increased reproductive rates, with some species producing 1 to 5 additional life cycles annually.

- Insects travel into new areas, following their ideal climate range.

- Insects act a vector for many agricultural diseases, which contribute to 14.1% of crop loss world wide.

- With increased growth and survival rates, disease mutation is likely.

Weeds

- Higher growth rates in CO2 heavy environments, more competition for agricultural crops.

- Weeds are hardier in general, due to their high genetic diversity, and can adapt easier to changing climates.

HONGDONG INTEGRATED PEST MANAGEMENT

홍동 통합 해충 관리

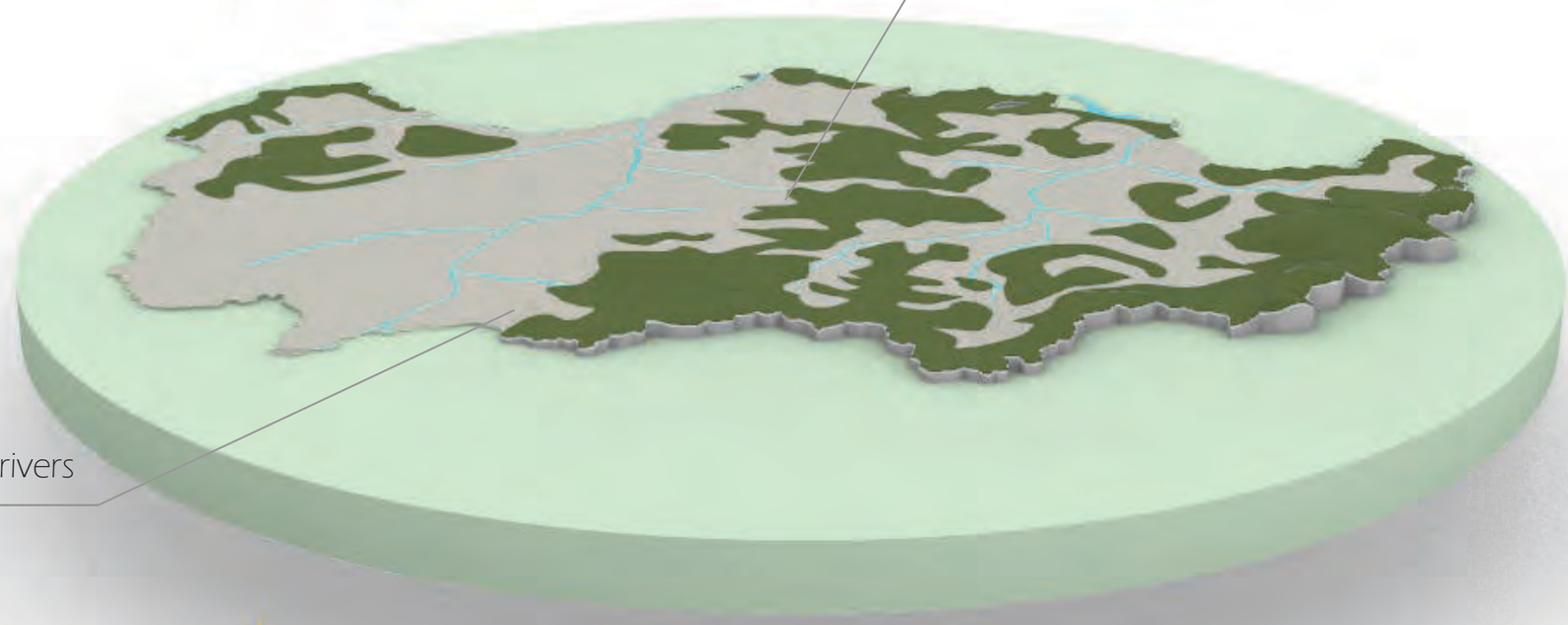
Friends and Food

Soil
Health

HONGDONG-MYEON VILLAGE

High Point: 984 ft.
Avg. temp: 53.8 ° F
Acreage: 9357ac.
36“ ° 33’ N, Longitude 126“ ° 42’ E

Fairly flat land, traditional rice paddy agriculture



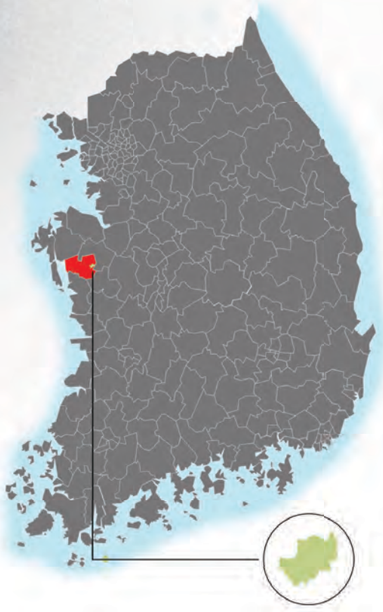
Wide network of rivers

Rural Village Population

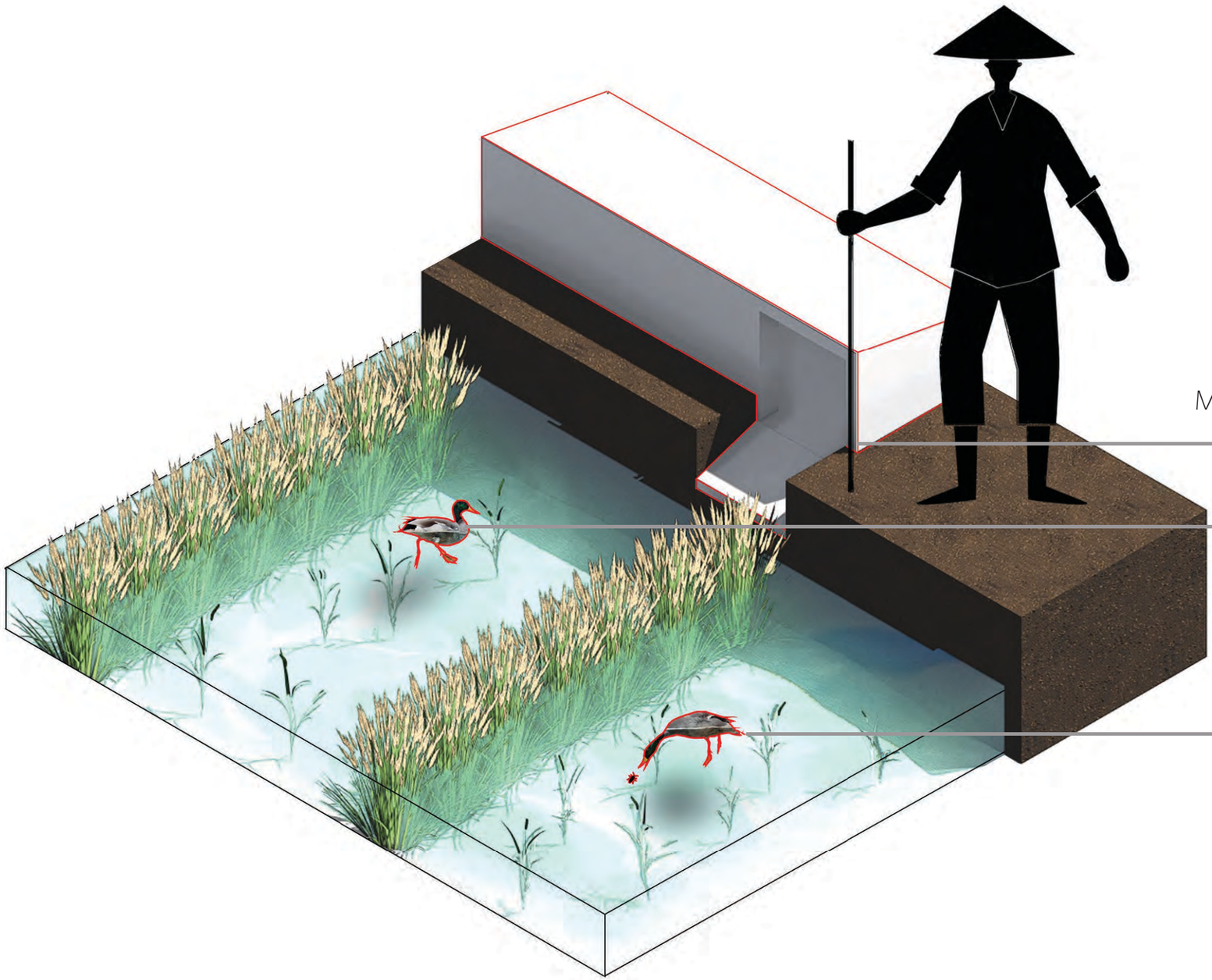
Urban movement

Aging population

Low Birth Rate



INTEGRATED RICE-DUCK FARMING

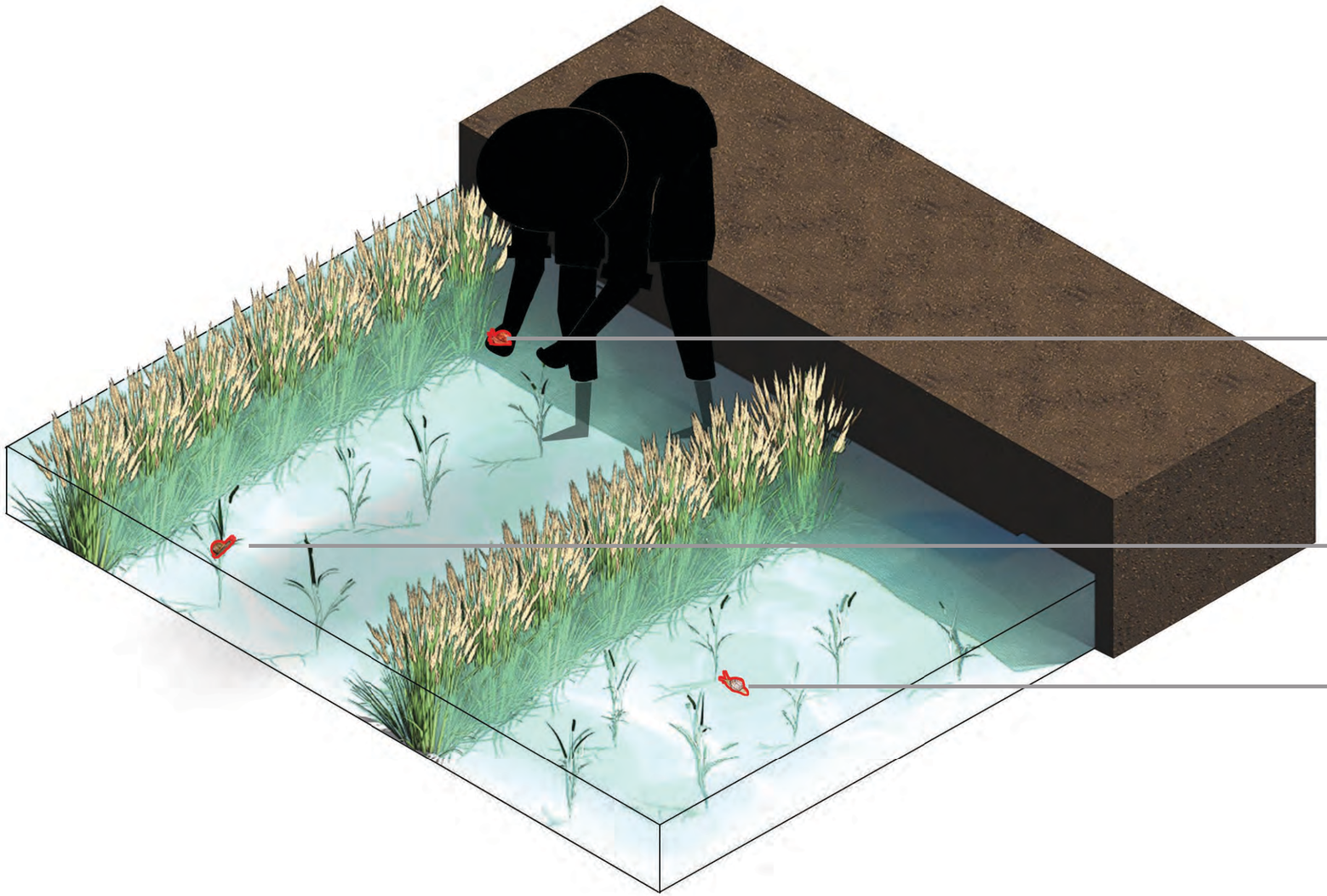


Minimal housing and training requirements

Income from eggs and meat

Reduces pests and fertilizes

INVASIVE APPLE SNAIL UTILIZATION

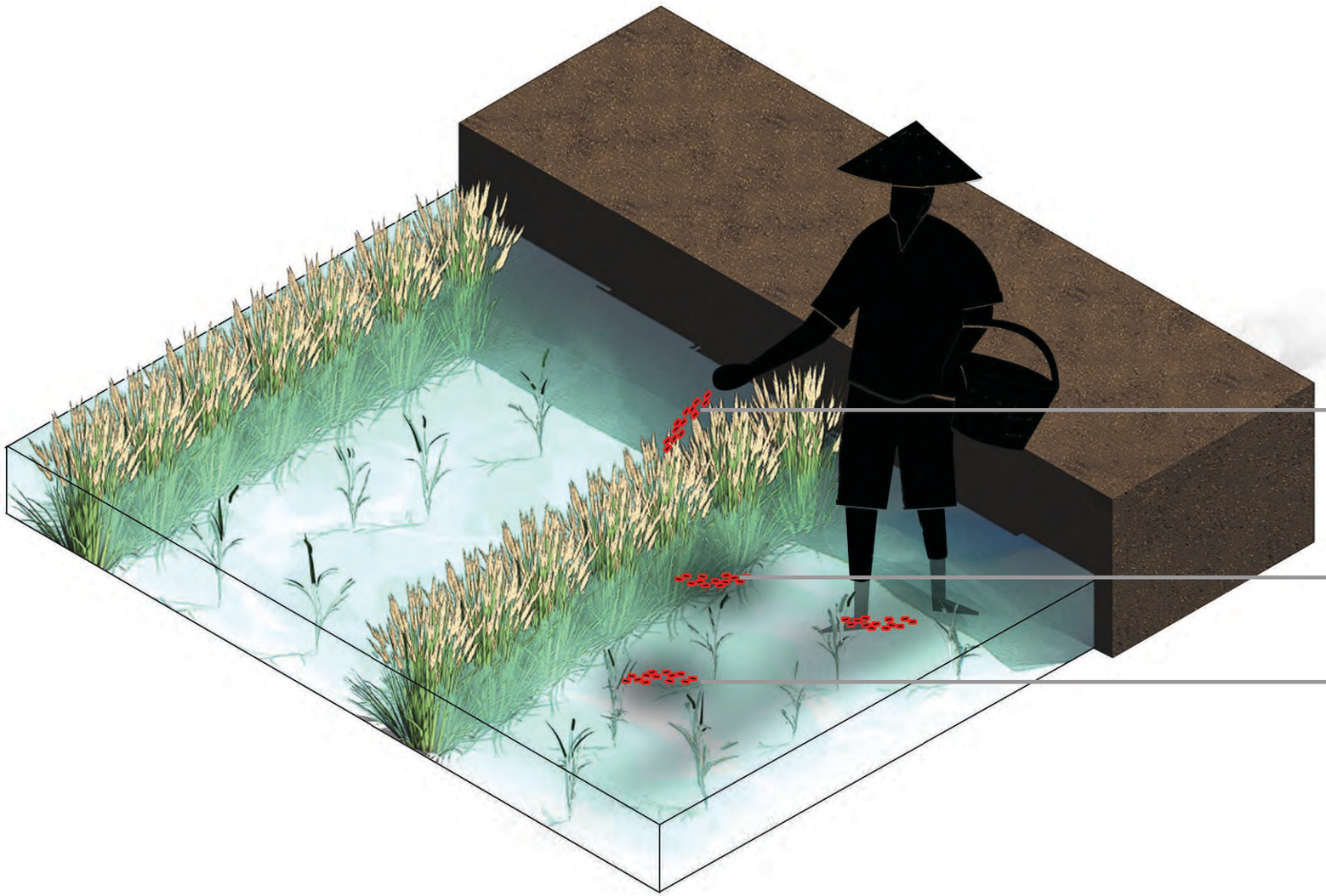


Snail harvest income

No upkeep costs

Reduces weeds and fertilizes

RICE-BRAN BYPRODUCT REUSE



Byproduct reuse

Weed suppressant

Generates microbial activity

INTEGRATED PEST MANAGEMENT: DETRIMENTS INTO BENEFITS

Weed Management

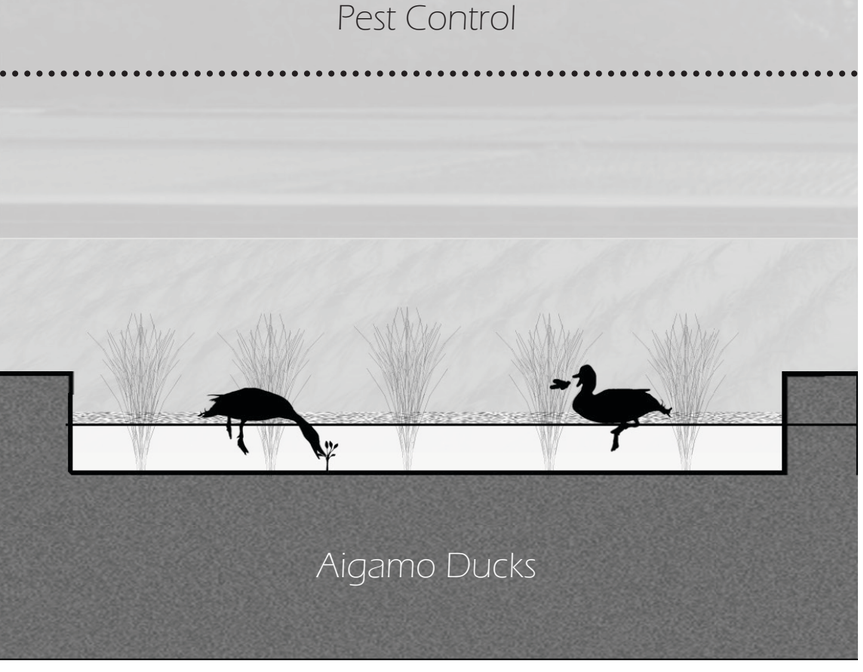
Manure Fertilizer

Livestock Income

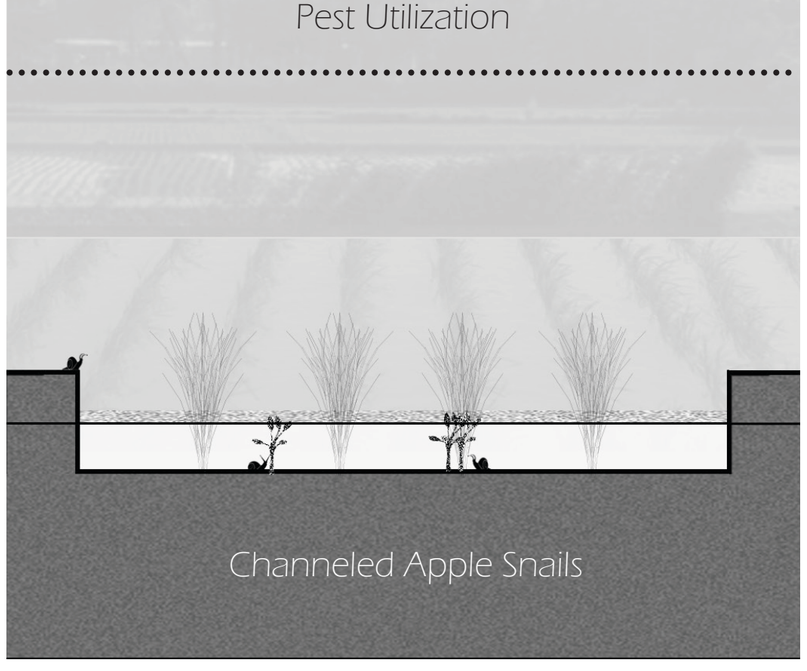
Plant Fertilizer

Pest Control

Pest Utilization



Aigamo Ducks



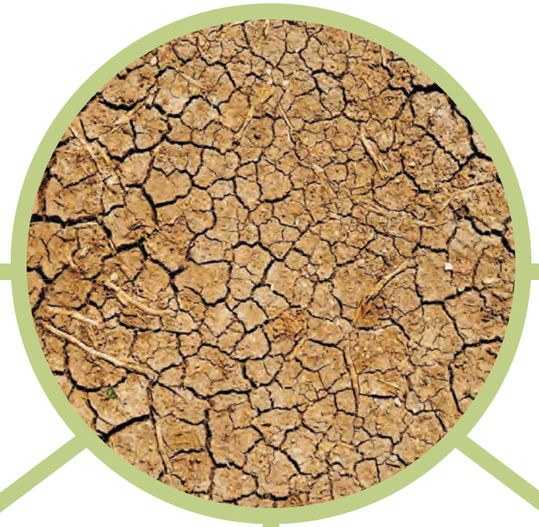
Channeled Apple Snails

Rice-Bran

SITES AND SYSTEMS

Water Adaptability

Soil Health



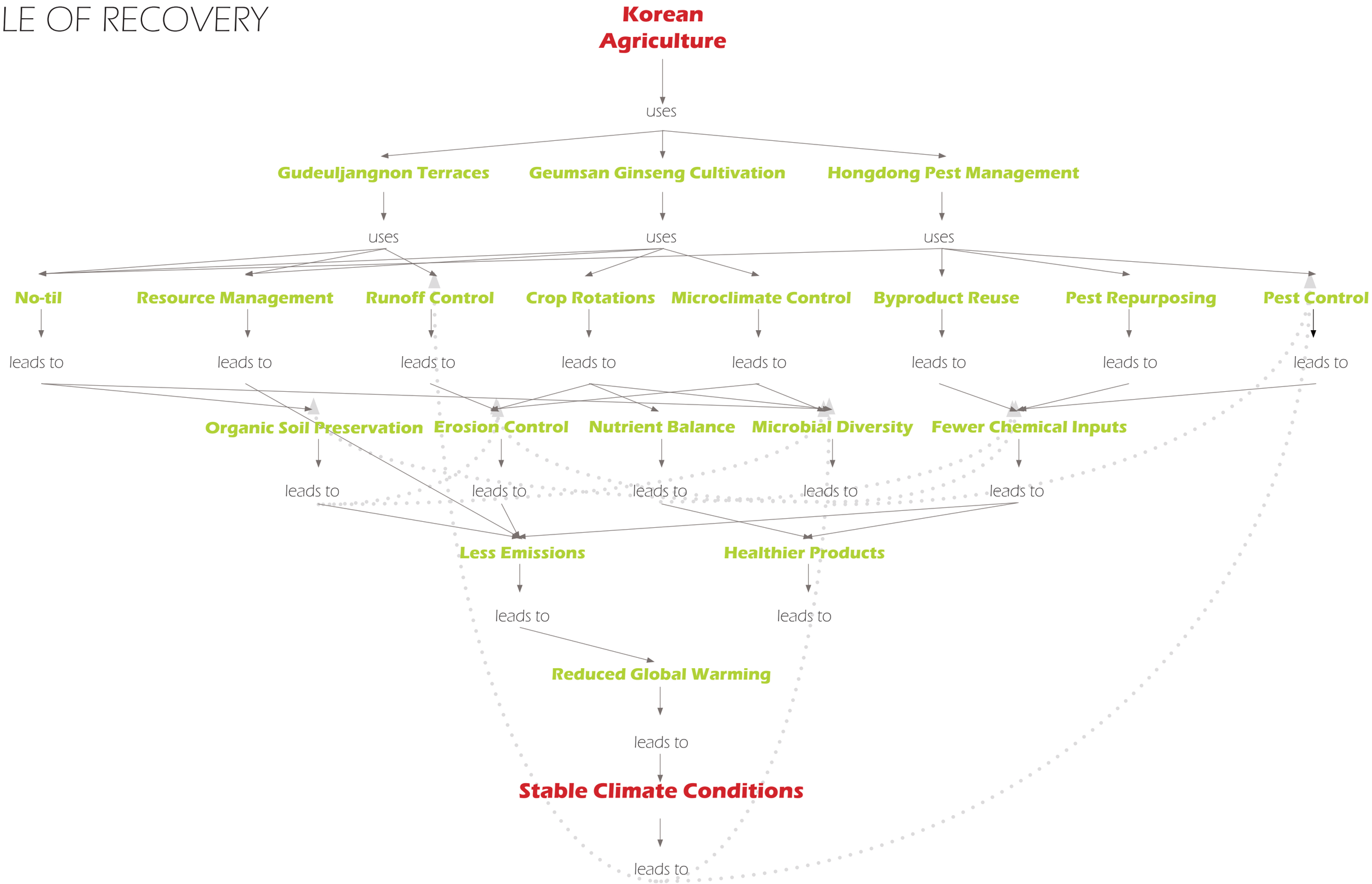
Pest and Disease Pressure

Island Terraces

Ginseng Farming

Paddy Management

CYCLE OF RECOVERY



USA APPLICATIONS

Terrace Farming

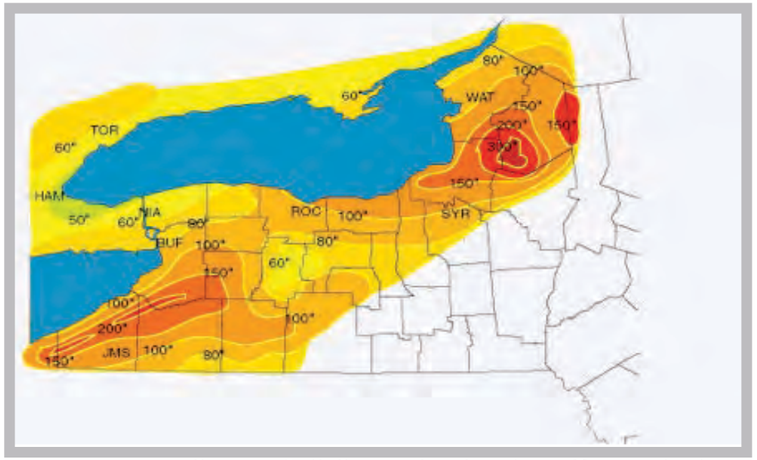
Microclimate Identification

Complex Crop Rotations

Korean Natural Farming

Integrated Pest Management

Contour Terracing in the Midwest



Snowfall Severity in the Great Lakes

Korean Natural Farming Inputs

Spotted Lantern Fly Control