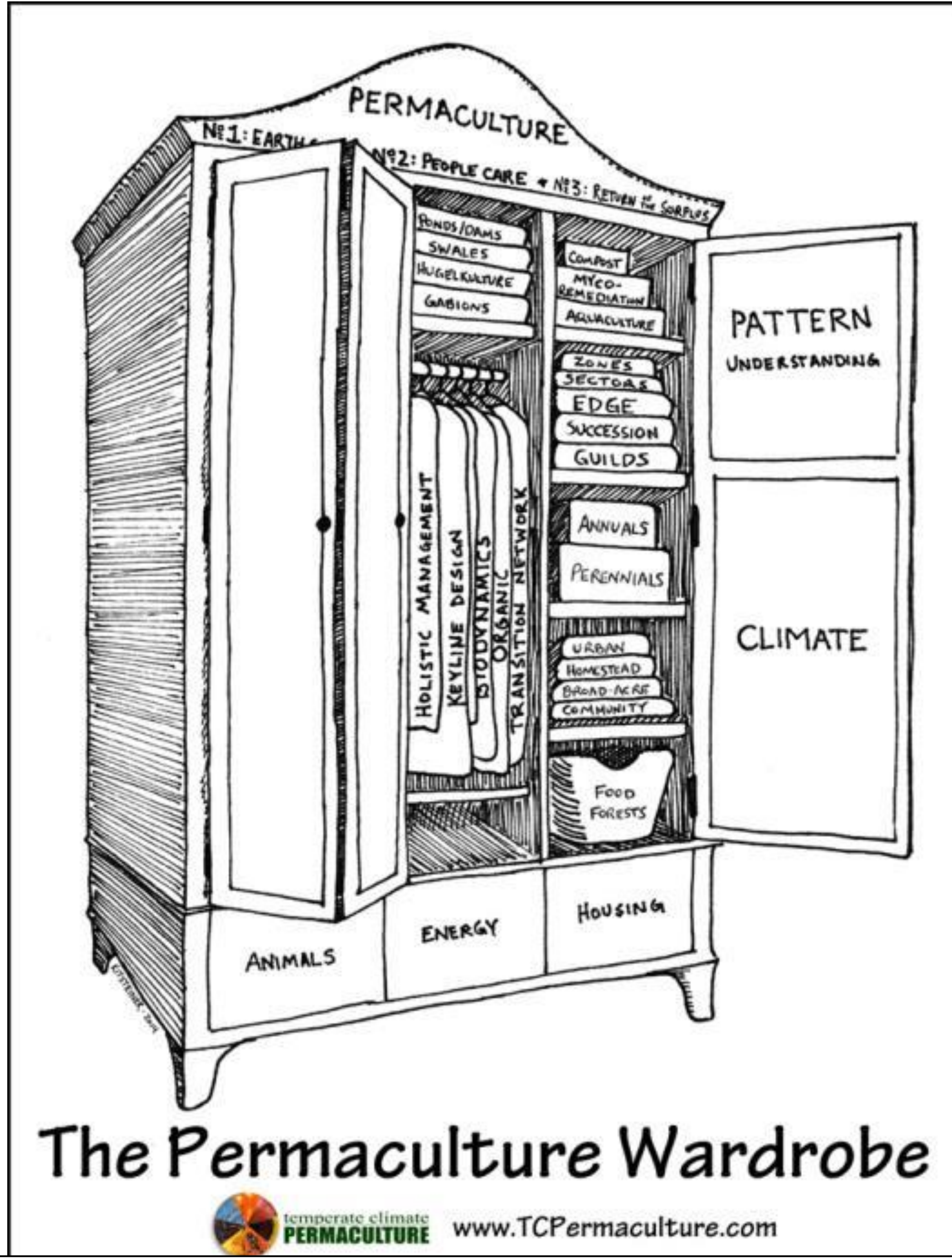
Permaculture and Regenerative Agriculture

Neil Bertrando
RT Permaculture

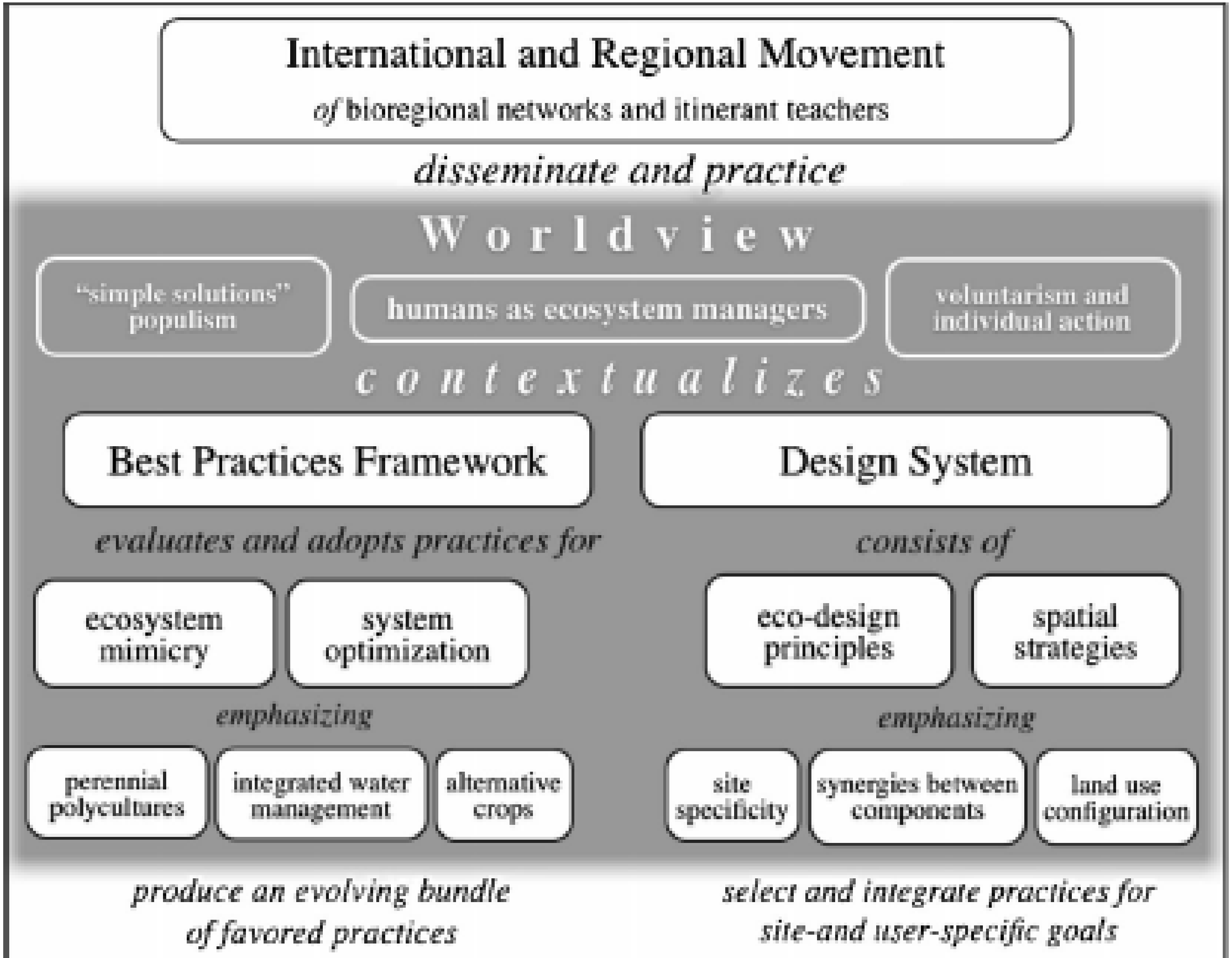
What is Permaculture?

- Whole Systems Design Science
- Ethical Basis
- Design Principles
- Wardrobe / Toolbox metaphor
- Context specific
- Soil Generating, Community Based, Appropriate Scale

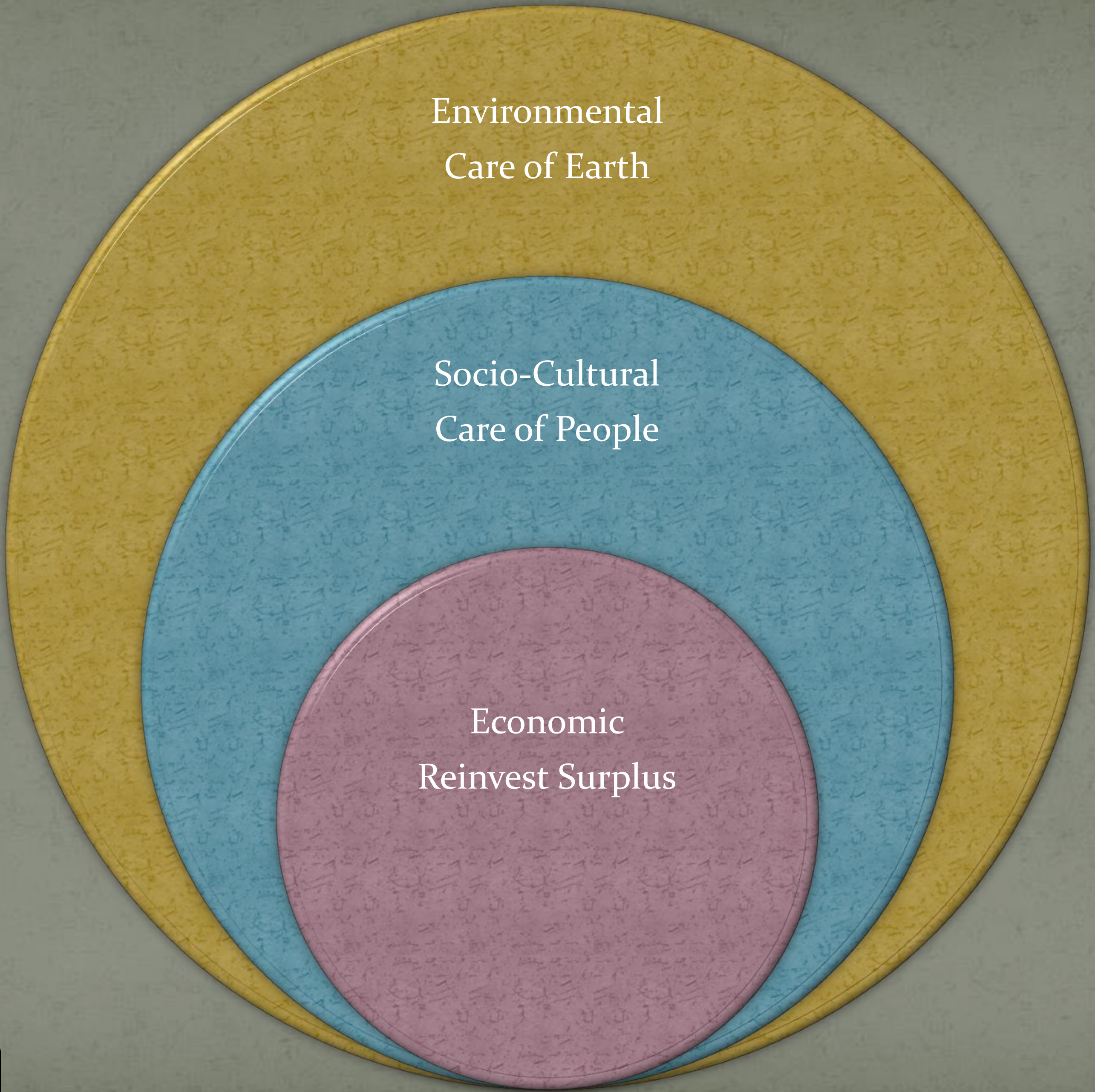


Source: http://tcpermaculture.com/site/2014/09/06/the-permaculture-wardrobe/

Various interpretations of Permaculture



Source: Ferguson and Lovell. 2014. Permaculture for agroecology: design, movement, practice, and worldview. A review. *Agronomy for Sustainable Development* 34:2, p251-274.


Environmental
Care of Earth
Socio-Cultural
Care of People
Economic
Reinvest Surplus

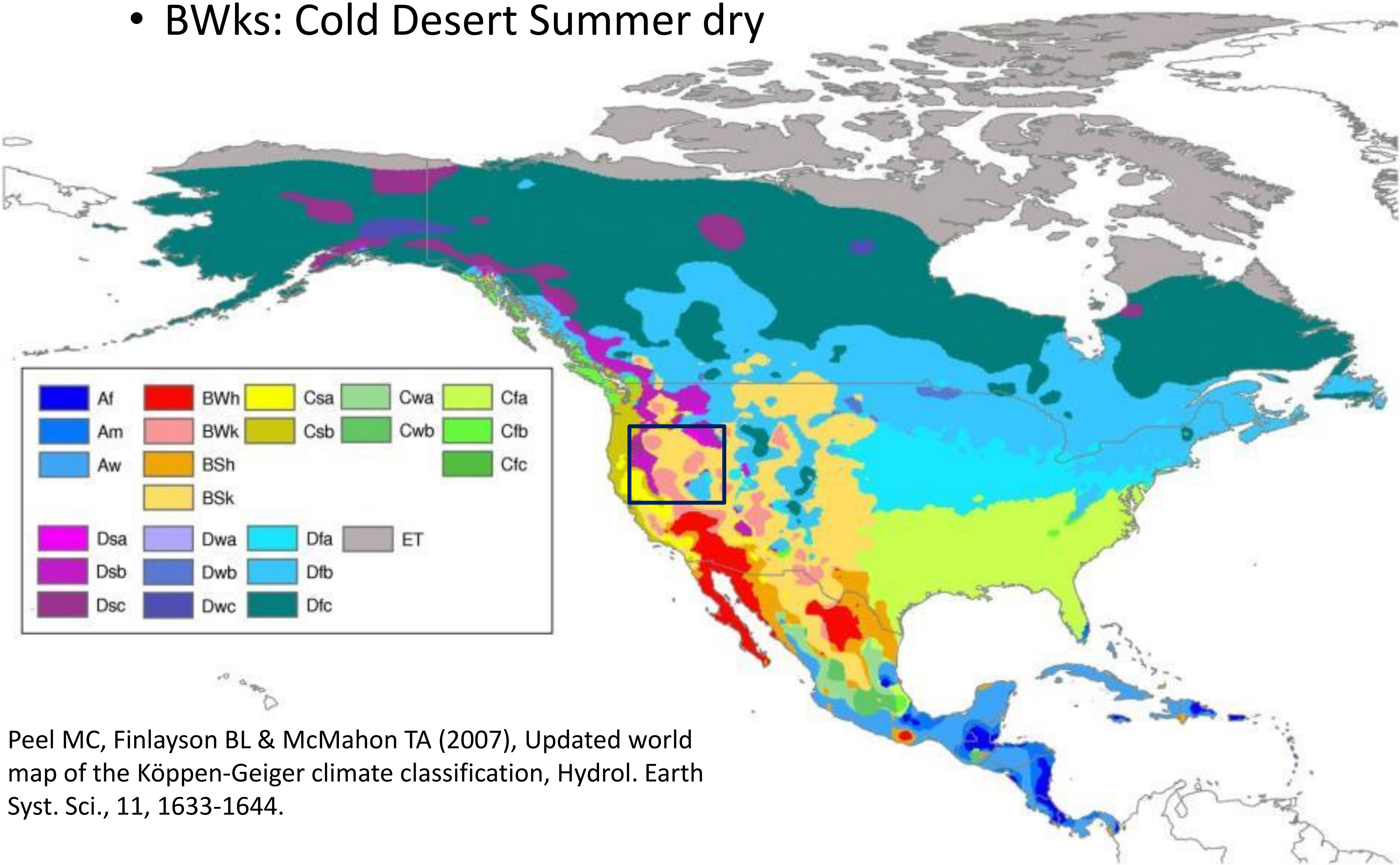
Diversification

- Yield:
  - Short-, Medium-, and Long-term yields
  - Harvest timing spread throughout growing season
  - Products and markets
- Biodiversity
  - IPM and Disease management
  - Habitat, nutrient cycling, and ecosystem services
  - Photosynthesis
- Structural Diversity
  - Mitigate evaporation and runoff
  - Manage wind and sun, harvest water and snow

Great Basin Climate

– Koppen Geiger climate class and analogs

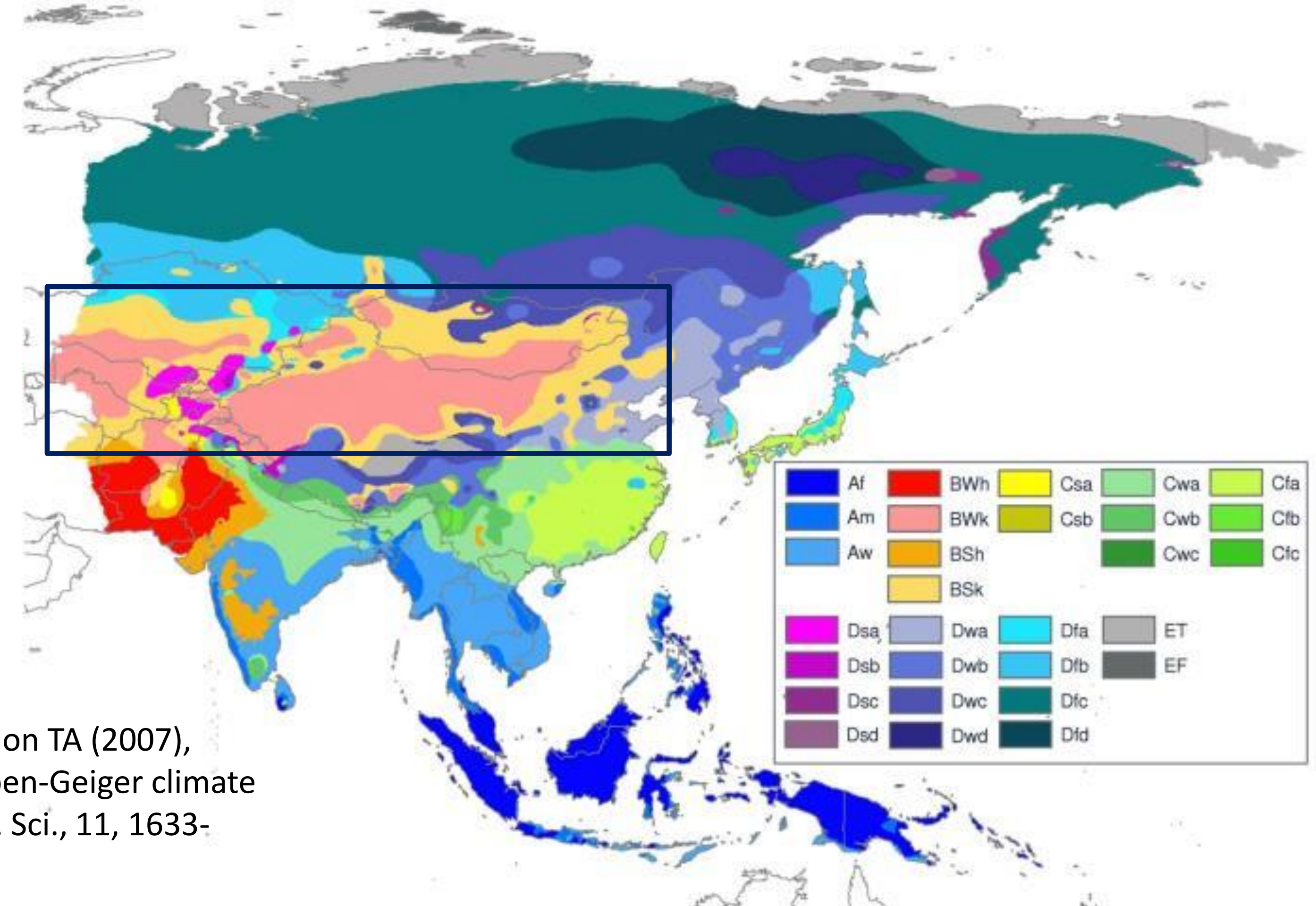
- BWks: Cold Desert Summer dry



Peel MC, Finlayson BL & McMahon TA (2007), Updated world map of the Köppen-Geiger climate classification, Hydrol. Earth Syst. Sci., 11, 1633-1644.

Climate

- Koppen Geiger climate class and analogs
    - Ladakh, India; Central Asian Deserts



Peel MC, Finlayson BL & McMahon TA (2007), Updated world map of the Köppen-Geiger climate classification, Hydrol. Earth Syst. Sci., 11, 1633-1644.

Humbolt River, NV

Indus River, Ladakh, India

Source: Wikimedia Commons

Products and Services

- Livestock Animals: Meat, Dairy, Eggs, Cloth and Fiber, Firebreaks, Weed mgmt, Decomposition (complete water cycle), litter-soil surface mgmt
- Nuts, Seeds, and Oils
- Fruits: mainly berries
- Leaves, Roots, Shoots
- Condensation surfaces and soil insulation
- Fuelwood
- Building Materials: Timber, Polewood,
- Hydrocarbons: fuels, plastics (harsh conditions -> high oil content)
- Medicines: harsh conditions create strong medicines
- Honey

Small Scale: SPIN Farming

Source: http://www.groaction.com/discover/3745/urban-farming-course/

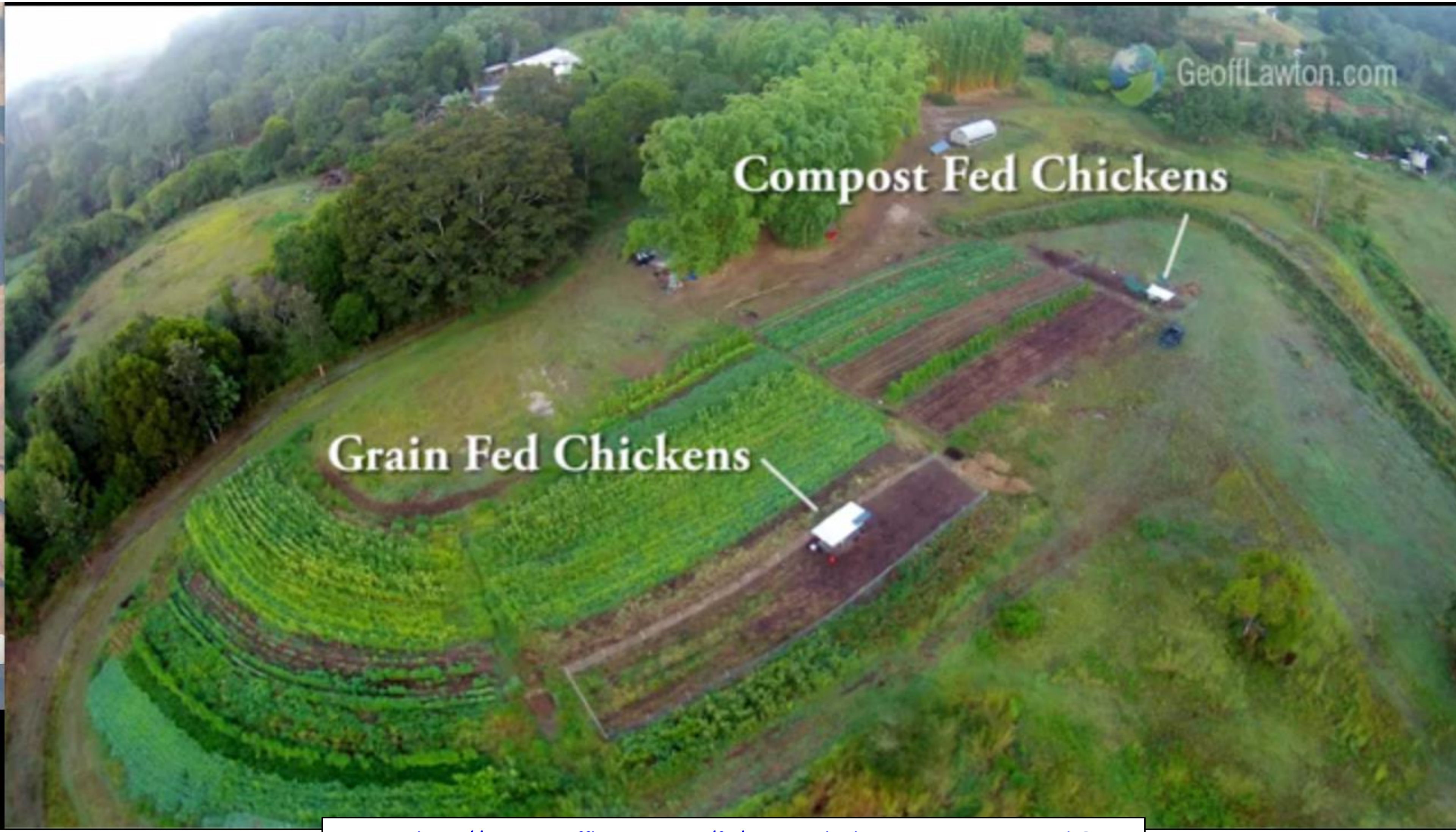
Micro Greens

Herbs: Chinese Medicinal, etc.

Mobility and Flexibility

- Mobile Animal Structures
  - Dairy
  - Coop and chicken tractor on steroids
  - Pig sheds
  - Livestock Guardian Dogs
- Temporary paddocks
  - Allow increased # of paddocks and variable size based on changes in production
  - Improve utilization based on high density, short duration
  - Forage Stockpiling: temporal production, strip grazing, ‘haystacking’,
- Mobile slaughterhouses, etc.

Source: http://permaculturenews.org/2014/03/14/building-chicken-tractor-steroids/



Source: http://www.geofflawton.com/fe/64322-chicken-tractor-on-steroids?r=y

Mobile Dairy

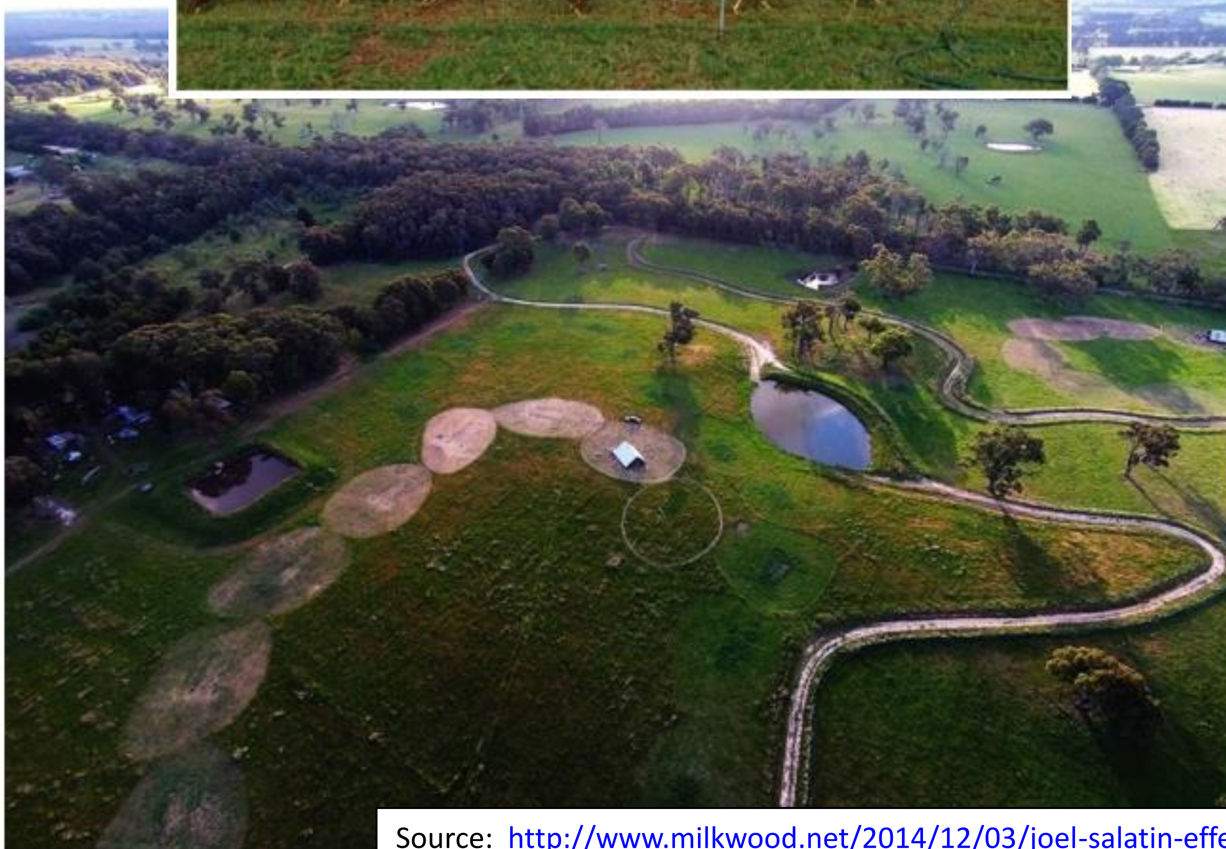
Source: http://citygardencountrygarden.blogspot.com/2012/10/a-day-at-taranaki-farm.html

Source: https://www.facebook.com/TaranakiFarm

Source: http://milkingonthemoove.blogspot.com/2012/10/the-mobile-milking-system.html

Sequence and Timing

Source: https://www.facebook.com/TaranakiFarm



Source: http://www.milkwood.net/2014/12/03/joel-salatin-effect-australia/

Source: https://www.facebook.com/TaranakiFarm

Source: https://www.facebook.com/TaranakiFarm

Source: https://www.facebook.com/groups/Regrarians/photos/

Shade Mobile

Source: https://www.facebook.com/TaranakiFarm

Open Source Tool Development

Farm Hack
Open Source Ecology

Regenerative Agriculture

- Integrates Ecological Agricultural methods with Socially equitable practices
- Agroforestry: perennialization
  - 5 methods
    - Alleycropping
    - Silvopasture
    - Windbreak/shelterbelt
    - Riparian Buffer Forestry
    - Forest Farming
  - Appropriate locations
  - Funding availability
    - USDA endorsed and studied
    - NRCS programs and cost-shares
- Holistic Management® and Planned Grazing
- Regrarians Platform®
- Keyline Design®

Credit: Jim Richardson/National Geographic Creative
Credit: Jim Richardson/National Geographic Creative

FOOD

REGENERATIVE AGRICULTURE

The Rodale Institute farm in Kutztown, PA: 333 acres of formerly degraded farmland restored to productivity and biosequestration through regenerative agriculture.

#11

RANK AND RESULTS BY 2050

23.15 GIGATONS
REDUCED CO2

$57.22 BILLION
NET IMPLEMENTATION COST

$1.93 TRILLION
NET OPERATIONAL SAVINGS

Conventional wisdom has long held that the world cannot be fed without

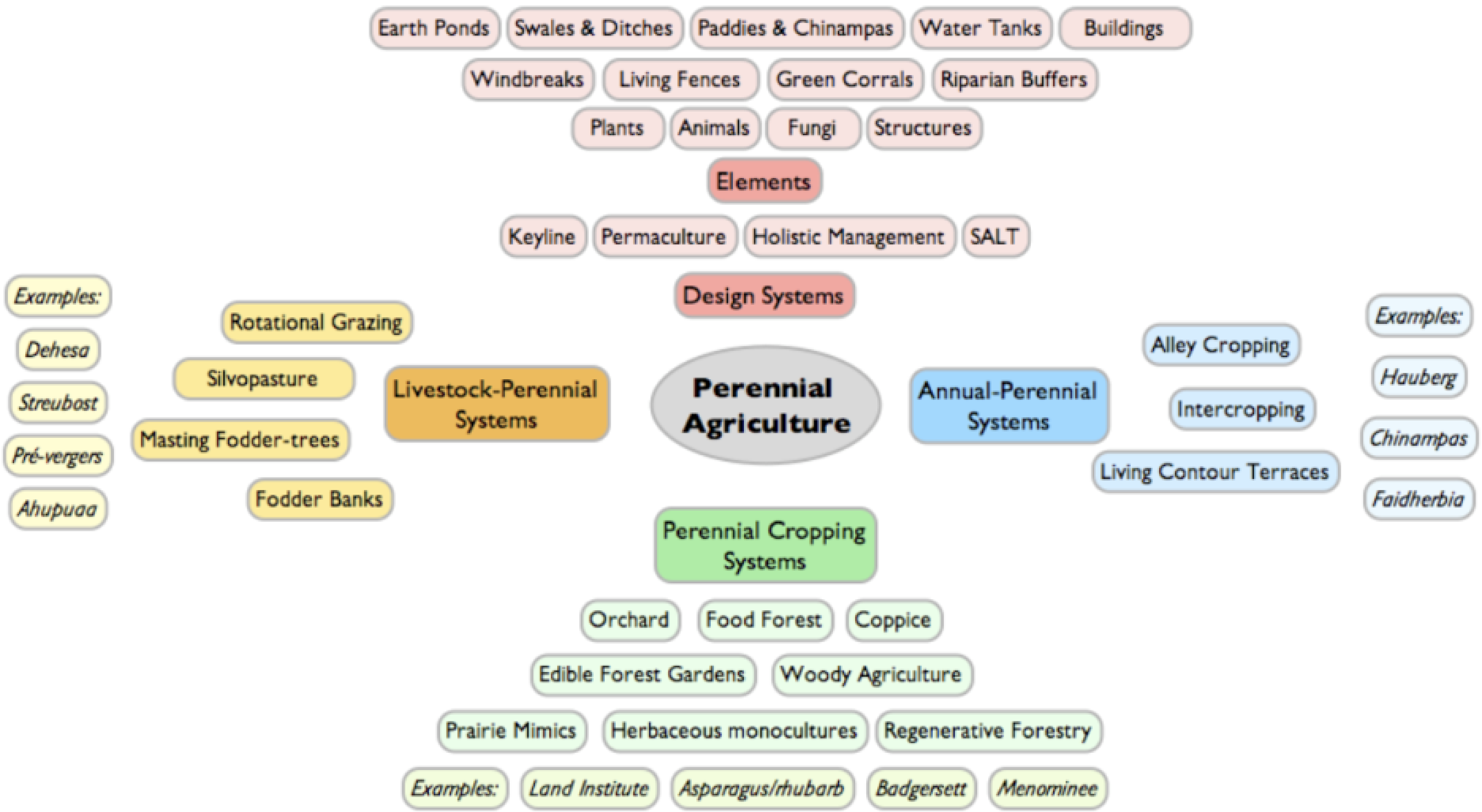
Regenerative Organic Certification

In 2018, we introduced a new, holistic, high-bar standard for agriculture certification. Regenerative Organic Certification, or ROC, is overseen by the Regenerative Organic Alliance, a non-profit made up of experts in farming, ranching, soil health, animal welfare, and farmer and worker fairness.

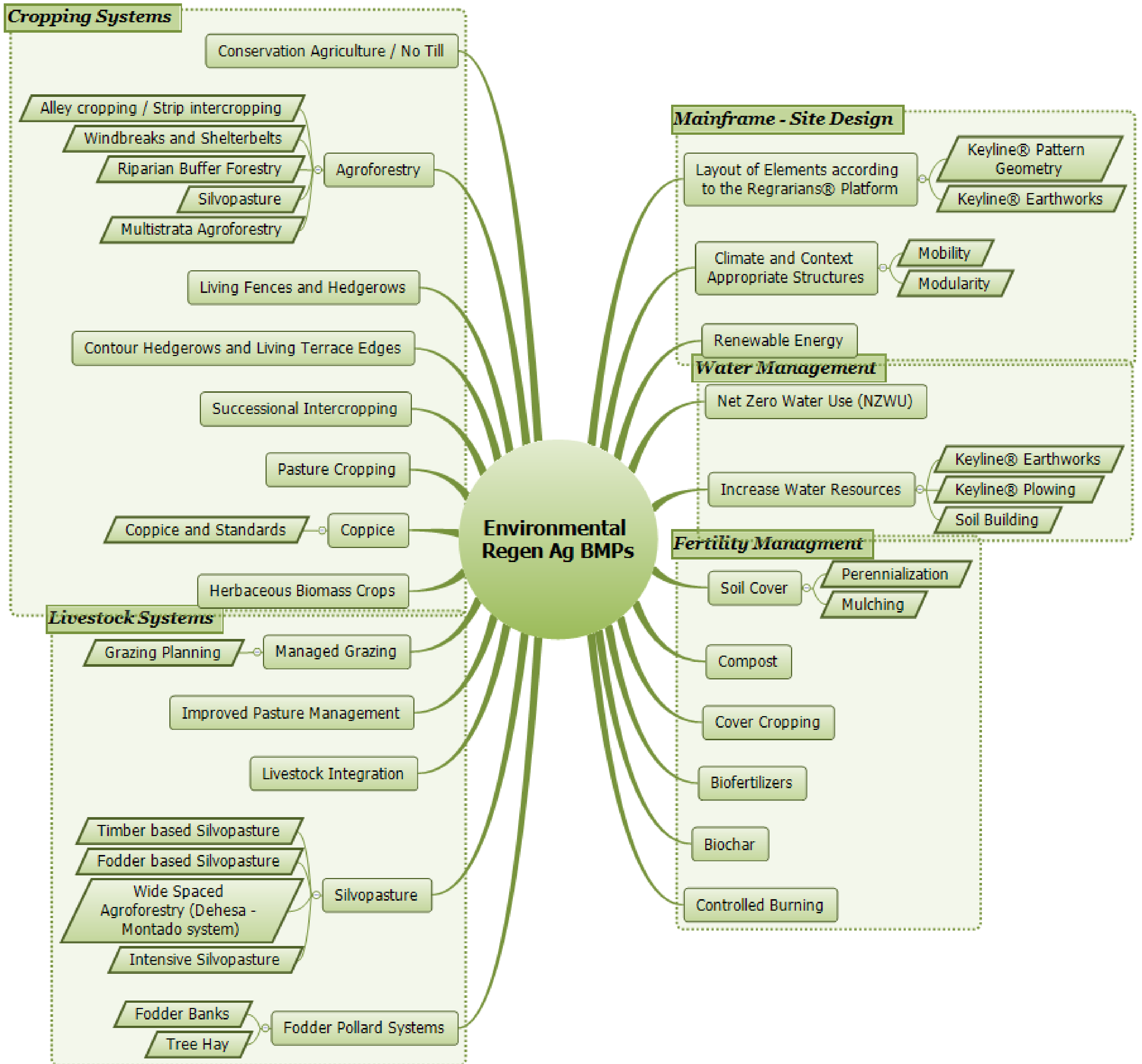
Systems of Perennial Agriculture

Version 1.5, Developed by Eric Toensmeier, mind-mapped by Ethan Roland

All systems & elements can be integrated

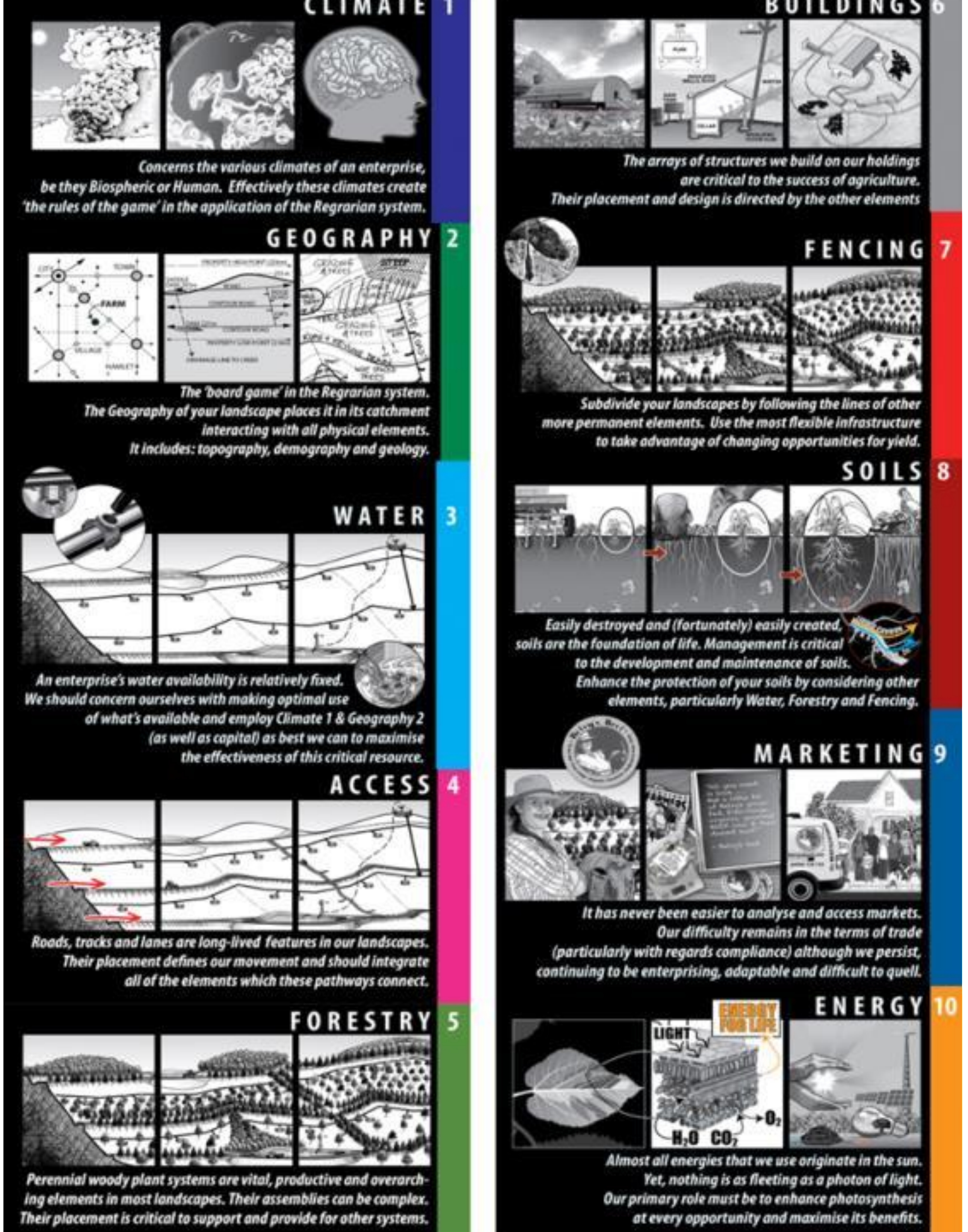


Source: http://www.perennialsolutions.org/carbon-sequestering-agriculture-global-warming-solution-piece-remove-co2-from-atmosphere-organic-garden.html

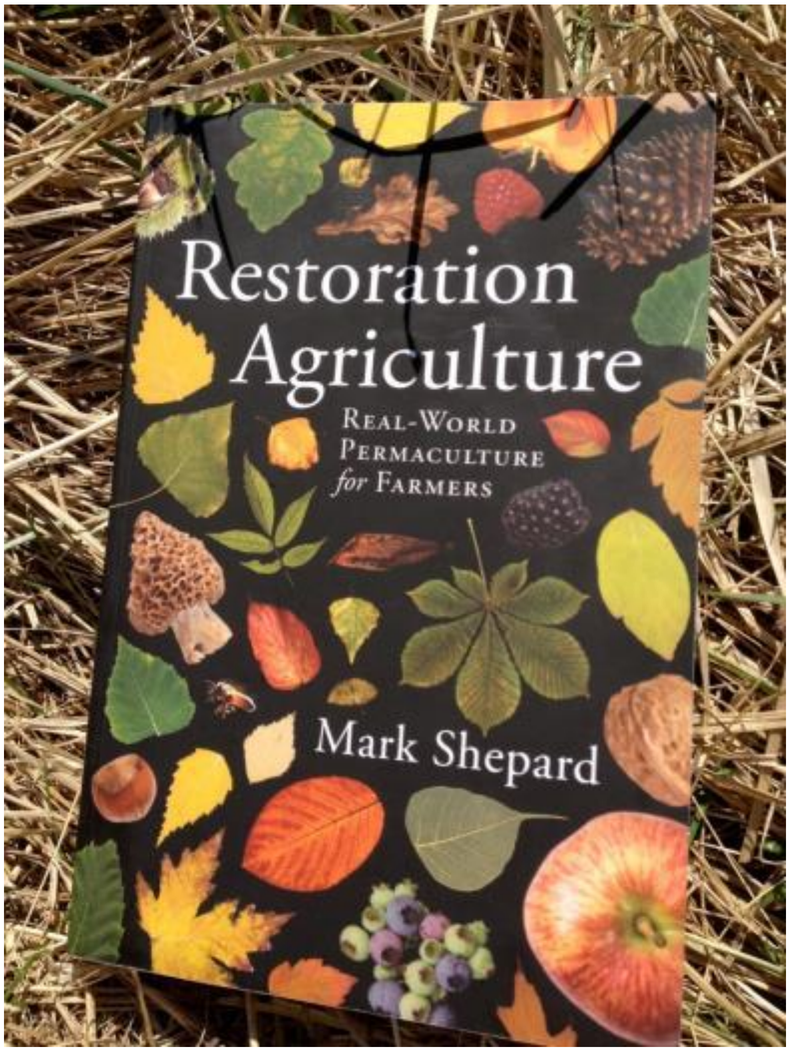

Environmental Regen Ag BMPs
Cropping Systems
Conservation Agriculture / No Till
Agroforestry
Alley cropping / Strip intercropping
Windbreaks and Shelterbelts
Riparian Buffer Forestry
Silvopasture
Multistrata Agroforestry
Living Fences and Hedgerows
Contour Hedgerows and Living Terrace Edges
Successional Intercropping
Pasture Cropping
Coppice
Coppice and Standards
Herbaceous Biomass Crops
Livestock Systems
Managed Grazing
Grazing Planning
Improved Pasture Management
Livestock Integration
Silvopasture
Timber based Silvopasture
Fodder based Silvopasture
Wide Spaced Agroforestry (Dehesa - Montado system)
Intensive Silvopasture
Fodder Pollard Systems
Fodder Banks
Tree Hay
Mainframe - Site Design
Layout of Elements according to the Regrarians® Platform
Keyline® Pattern Geometry
Keyline® Earthworks
Climate and Context Appropriate Structures
Mobility
Modularity
Renewable Energy
Water Management
Net Zero Water Use (NZWU)
Increase Water Resources
Keyline® Earthworks
Keyline® Plowing
Soil Building
Fertility Managment
Soil Cover
Perennialization
Mulching
Compost
Cover Cropping
Biofertilizers
Biochar
Controlled Burning

Regrarian Platform expansion on the Keyline Scale of Permanence

Source: http://www.regrarians.org/regrarian-handbook/



Restoration Agriculture



- Know your Primary Biomes
- Identify key economic families and species
- Keyline Water Management
- Agroforestry Practices

Integrated Design Layout:
Designing Connections in time and space

- On Farm
  - Natural Patterning for:
    - Water harvesting, Access, topsoil generation and fertility management, Animal husbandry, Anti-evaporation, …
  - Parallel equidistant Patterning for:
    - Management simplicity, Harvest efficiency, space filling, Paddock and Fencing modularity, Mechanization
  - Scale based differences
    - 1-10 acres
    - 10-100 acres
    - 100s-1000s of acres
- Within Farm Community
  - Shared infrastructure
    - Commercial Kitchens, harvest machinery, oil presses and distilleries
  - Collaborative marketing and distribution

ZERI and IFS

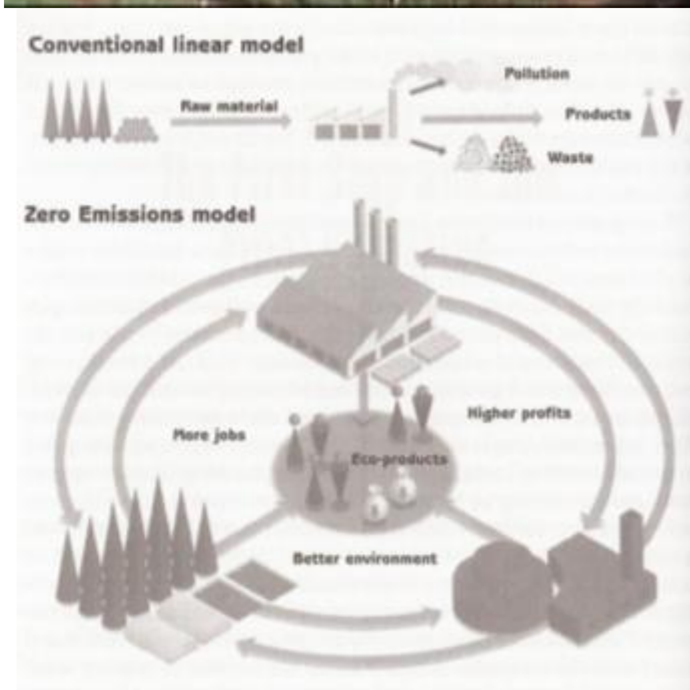
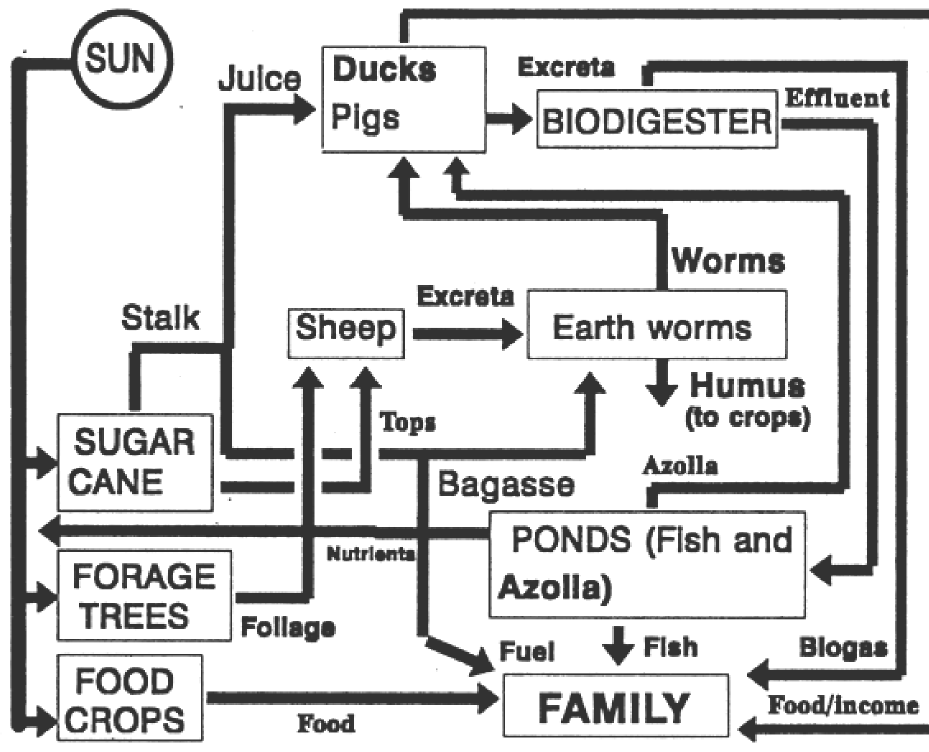


Figure 2: Conventional Linear Model versus Zero Emissions Model
Source: ZERI Foundation, Geneva



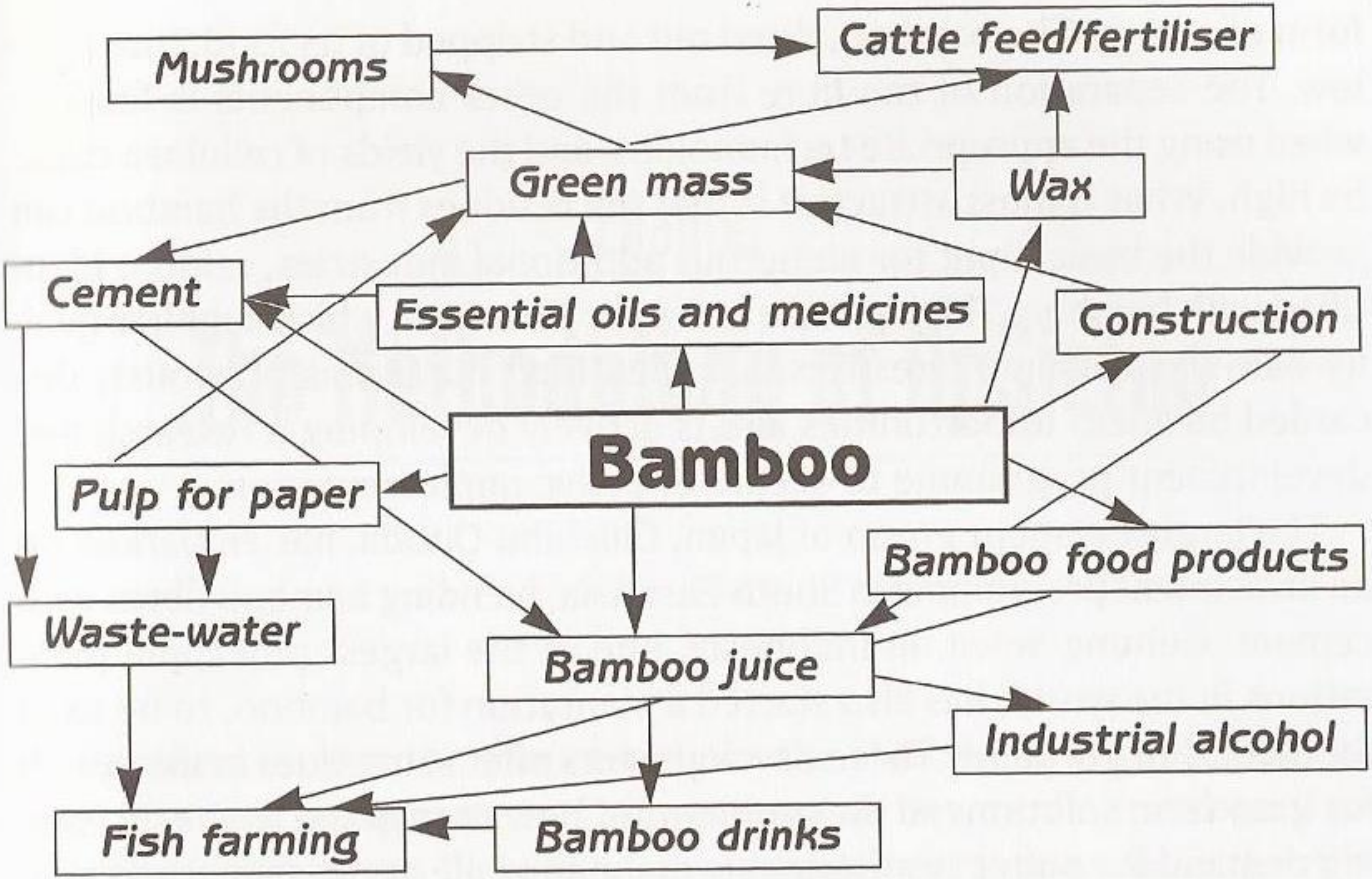
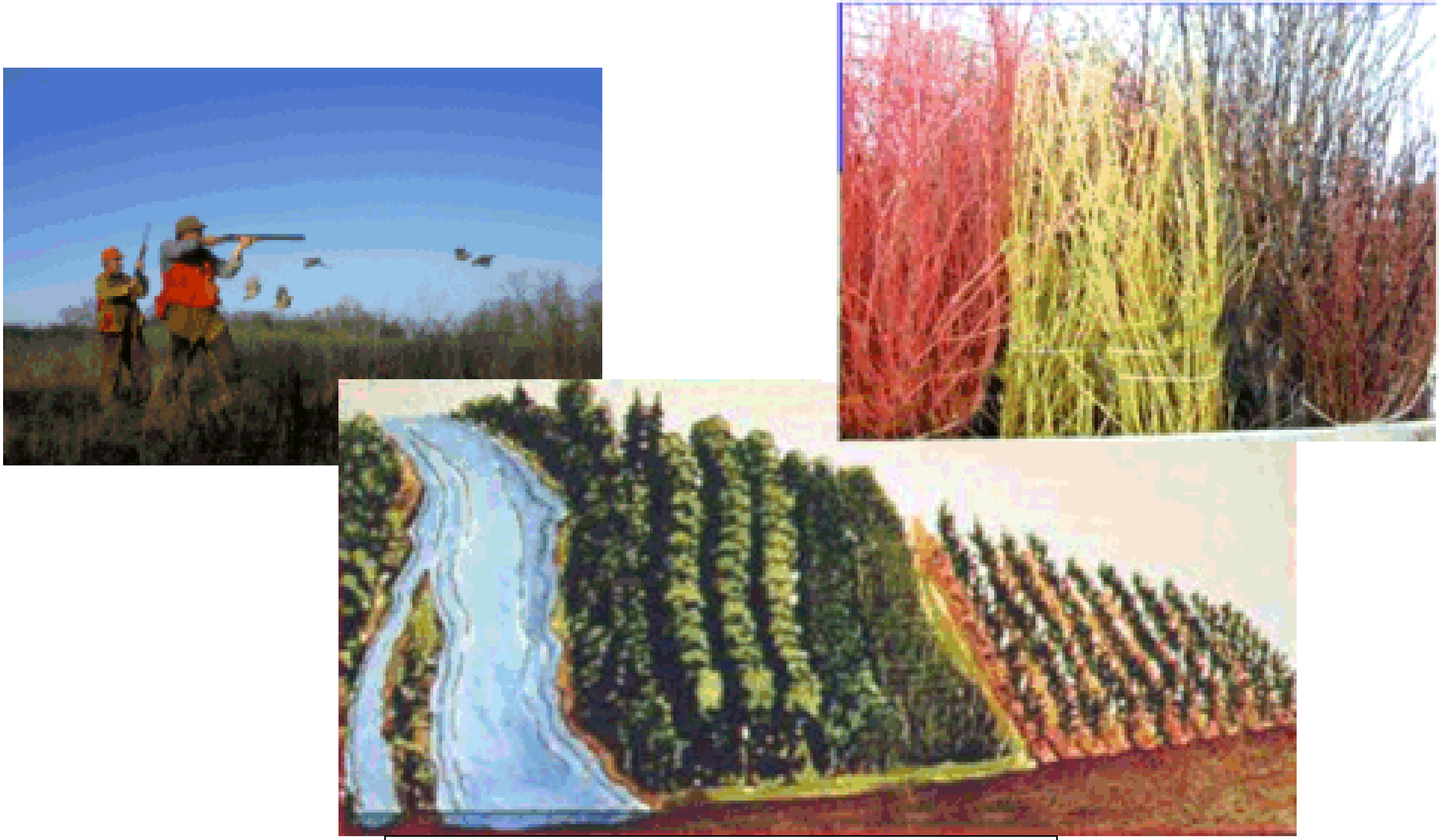


Figure 3: *The Cluster of Industries Around Bamboo*

Source: ZERI Foundation, Geneva

Agroforestry



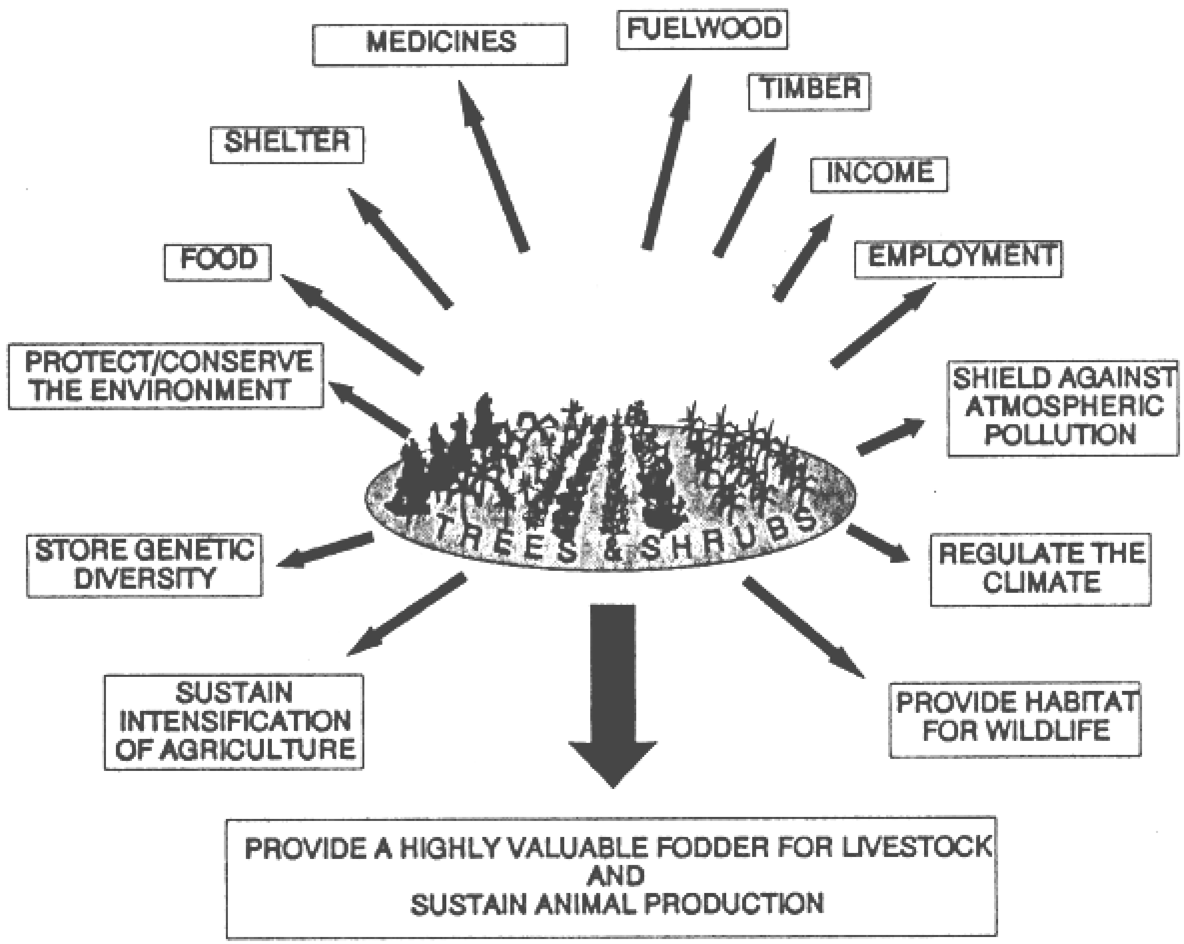
Source: http://www.centerforagroforestry.org/practices/rb.php

USDA Agroforestry Definition

- Agroforestry intentionally combines agriculture and forestry to create integrated and sustainable land-use systems. Agroforestry takes advantage of the interactive benefits from combining trees and shrubs with crops and/or livestock.
- USDA recognizes 5 Agroforestry practices, however…
- There are many types of agroforestry practices and layouts being managed and experimented with worldwide. In real world settings many times practices are hybridized and multiple practices exist on a farm. Consider the list here for basics and guidance, then adapt practices to fit your site and context.

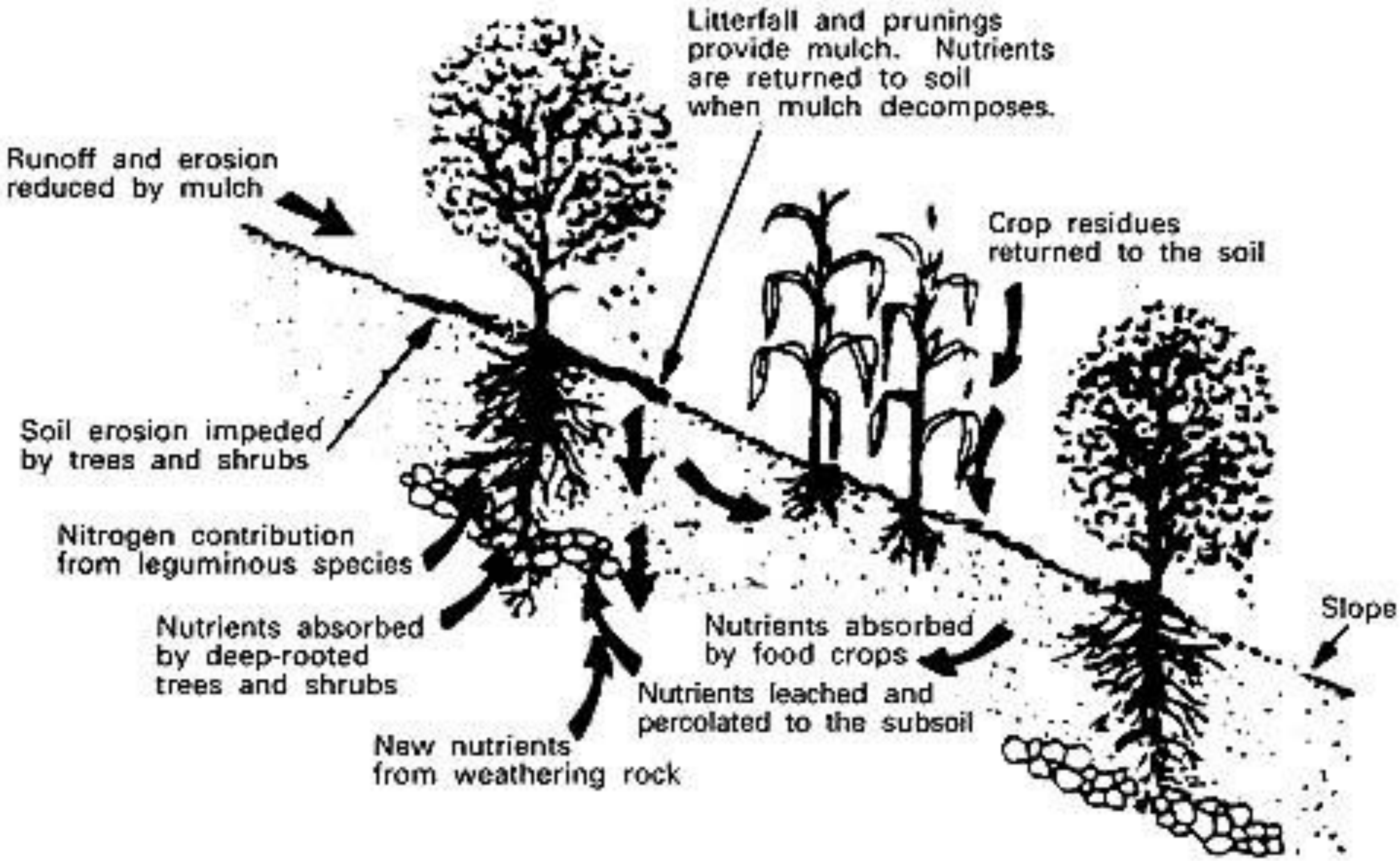
The Many Roles of Trees and Shrubs

FIGURE 1. **The different roles of trees and shrubs.**



Source: http://www.fao.org/docrep/003/T0632E/T0632E00.htm#TOC

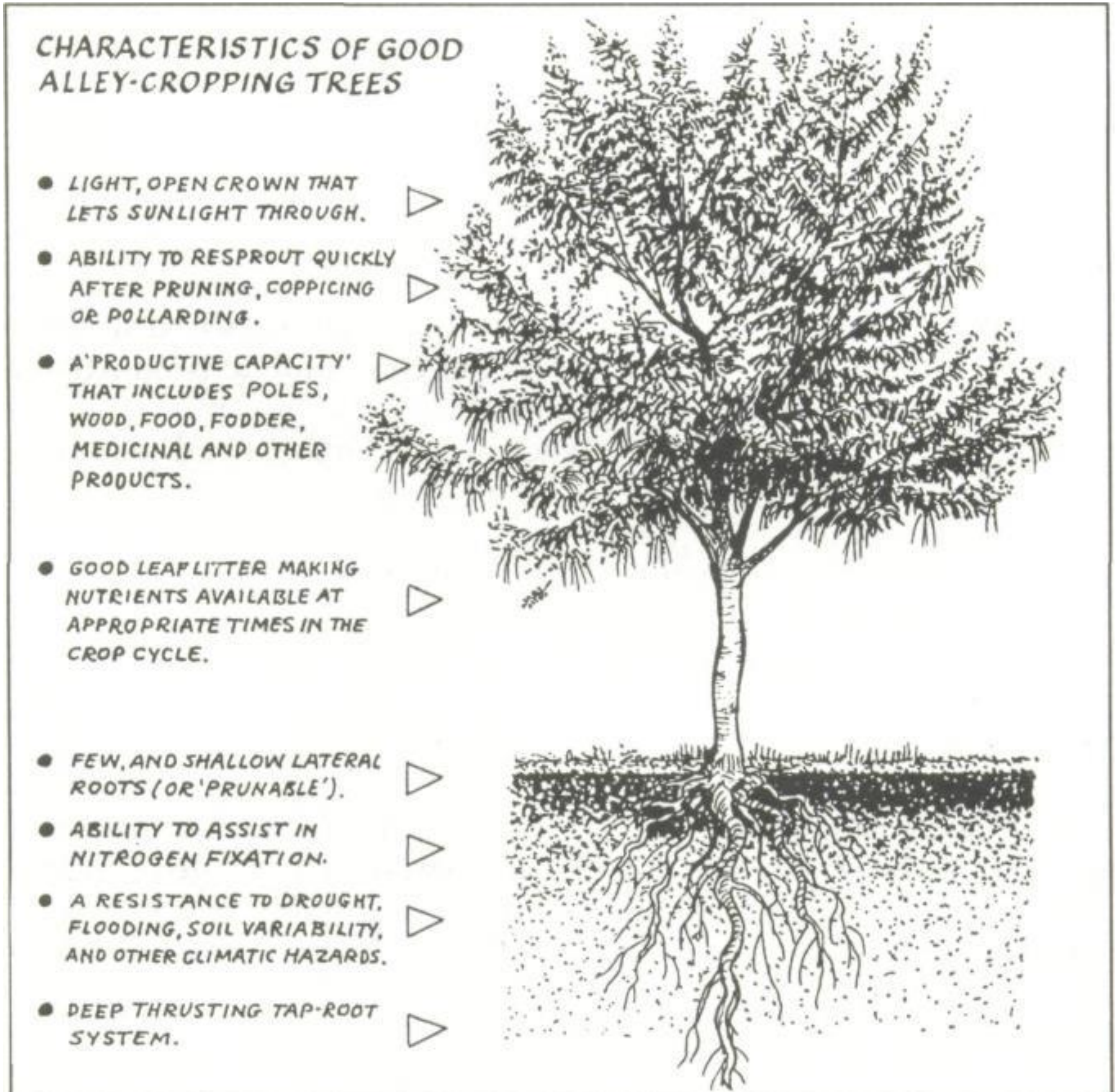
Alley Cropping



The alley cropping concept

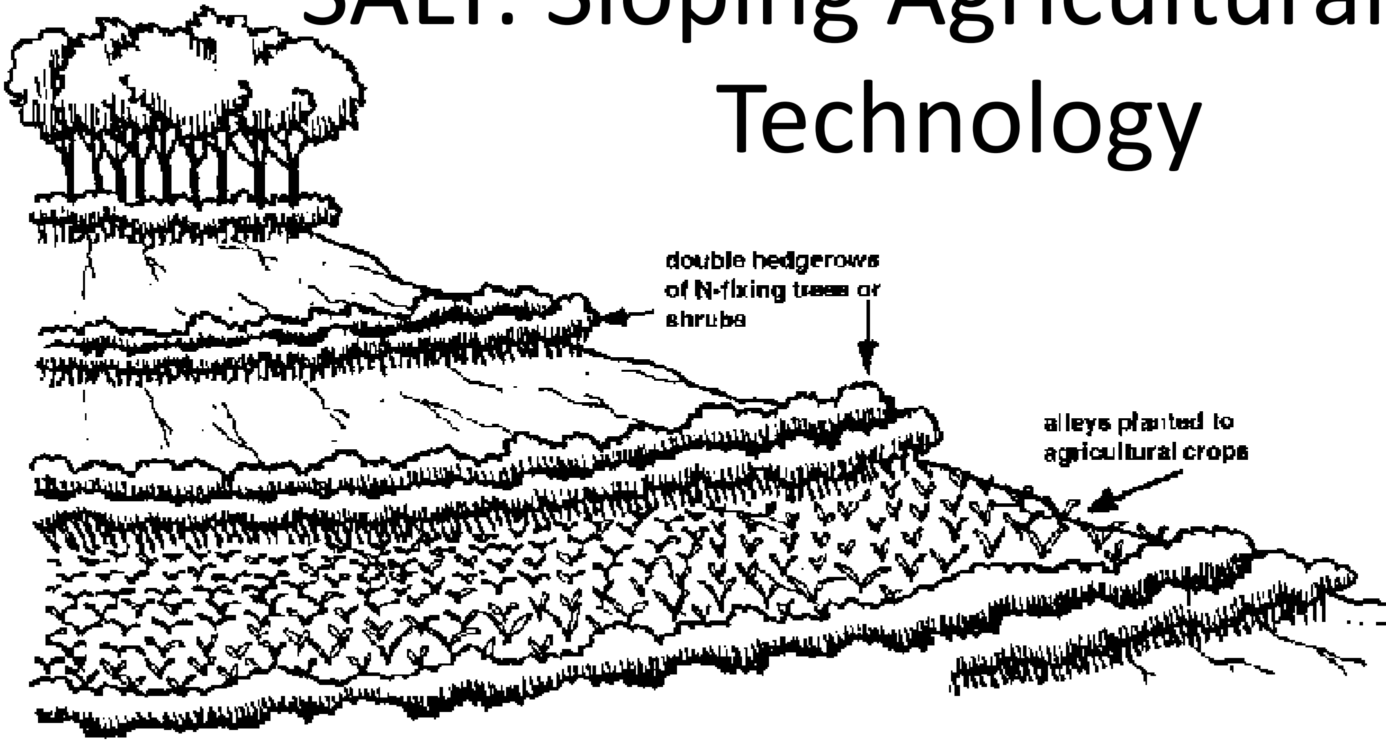
Source: http://www.agnet.org/library.php?func=view&id=20110804181442

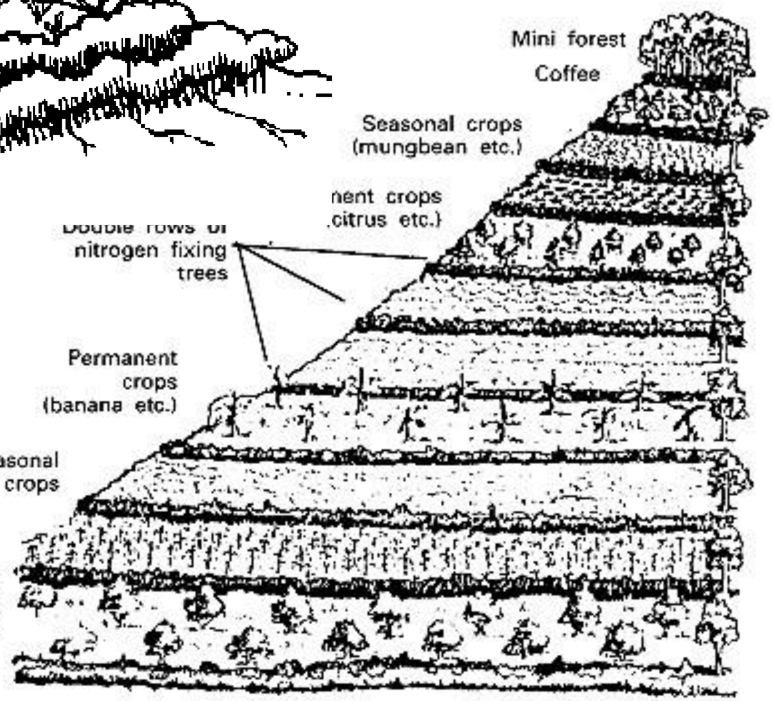
Source: http://thefruitnut.com/home-scale-alley-cropping-trial/
New Forest Farm



Source http://www.worldagroforestry.org/units/Library/books/Book%2006/html/7.2_criter_f_a_gd_agrfr_tre.htm?n=79

SALT: Sloping Agricultural Land Technology





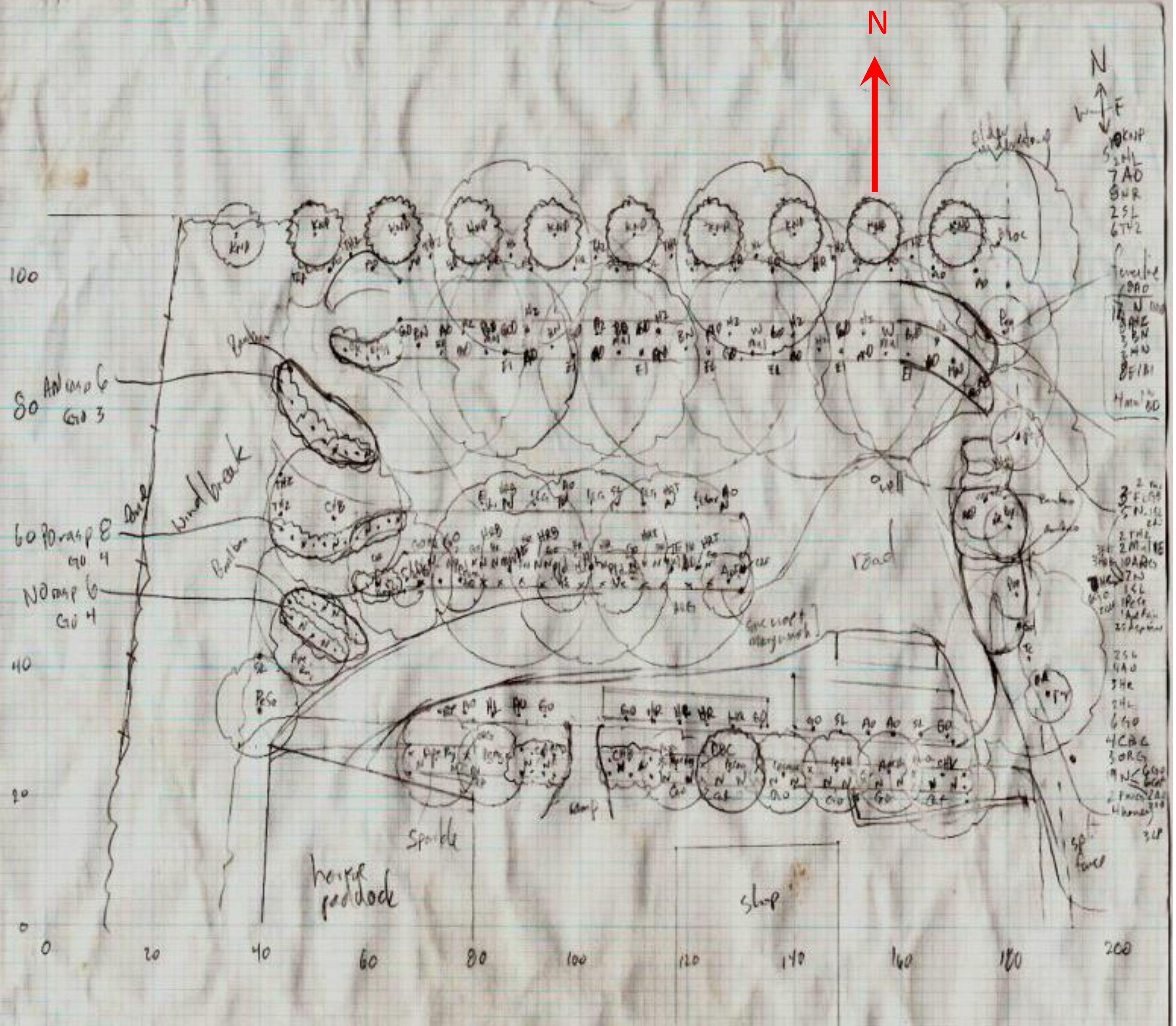
Source: http://www.agnet.org/library.php?func=view&id=20110722063823

Source: https://www.echocommunity.org/resources/2b54ae98-cea1-407d-9fc3-b7b0394102c3

Source:http://www.perennialsolutions.org/wp-content/uploads/2011/10/

Source: http://agrismartinc.com/pages/about-cote-divoire/cote-divoire-agriculture/cawt/

Photo: Neil Bertrando



Design by Neil Bertrando

Upper Pasture
Plan View
1”=20’

Goals:

1. Alley Cropping Fruit, Nut, and Berry Orchard with Hoophouse flash runoff in alley and Vehicle Access to Well and Upper elevations
2. N, W, and E Windbreaks to improve Suntrap microclimate
3. Curvilinear design for ease of planning, install, and harvest


Photo: Neil

Photo: Neil Bertrando

Mark Shepard's Restoration Agriculture Agroforestry System

Source: New Forest Farm
http://www.newforestfarm.net/

Source: New Forest Farm
http://www.newforestfarm.net/


Alley Cropping
New Forest Farm USA
Trees with roots trimmed regularly to force them to dive deep
Perenial vegetables ie. asparagas
PermacultureVisions.com

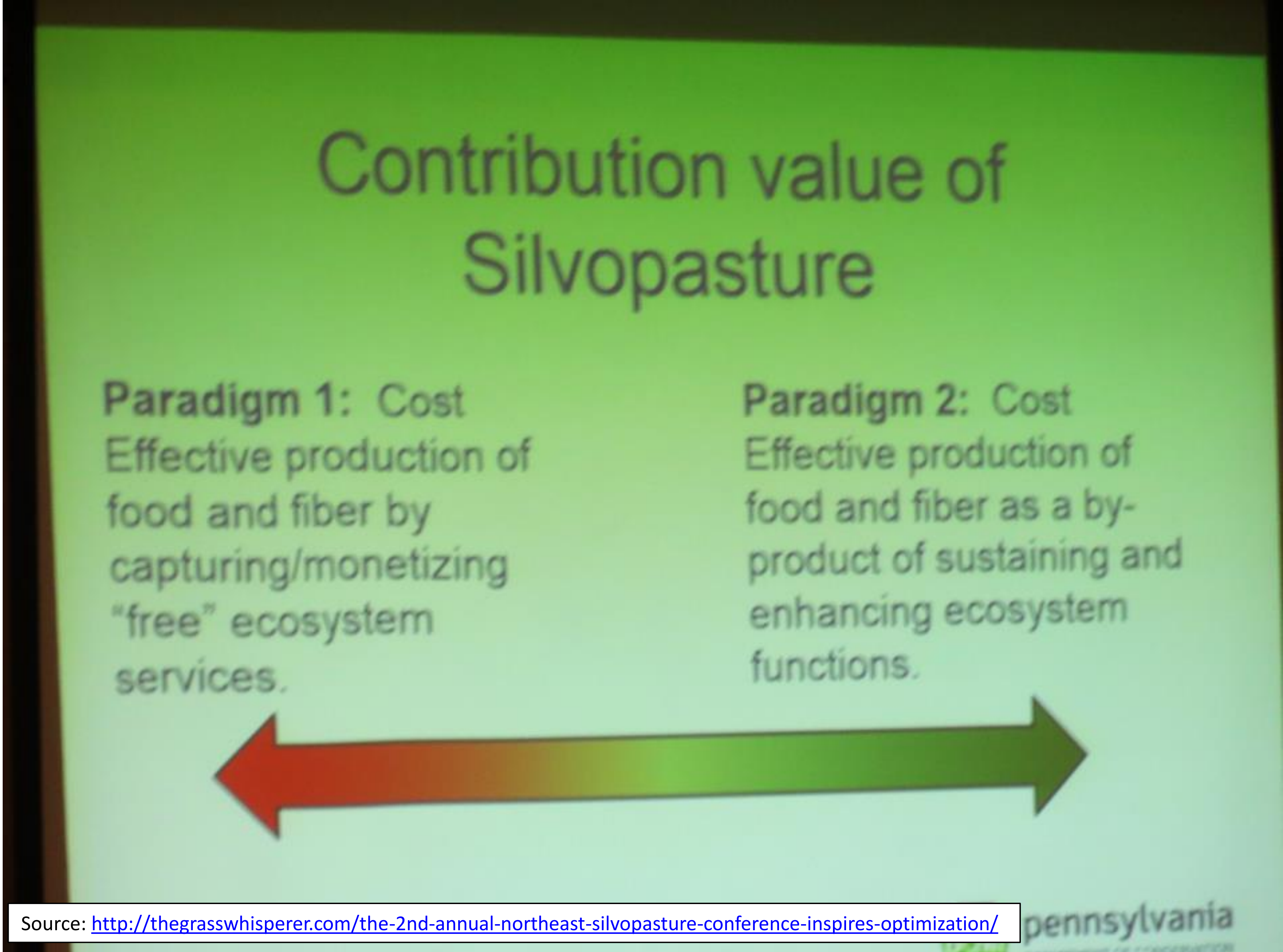
USDA Silvopasture Definition

- Silvopasture combines trees with forage and livestock production. The trees are managed for high-value sawlogs and, at the same time, provide shade and shelter for livestock and forage, reducing stress and sometimes increasing forage production. In plantations of conifers or hardwoods for timber or Christmas trees, managed grazing provides added products and income. Some nut and fruit orchards may also be grazed.
- http://nac.unl.edu/practices/silvopasture.htm

Management System Components

- Trees
- Forages
- Livestock

Silvopasture http://nac.unl.edu/practices/silvopasture.htm

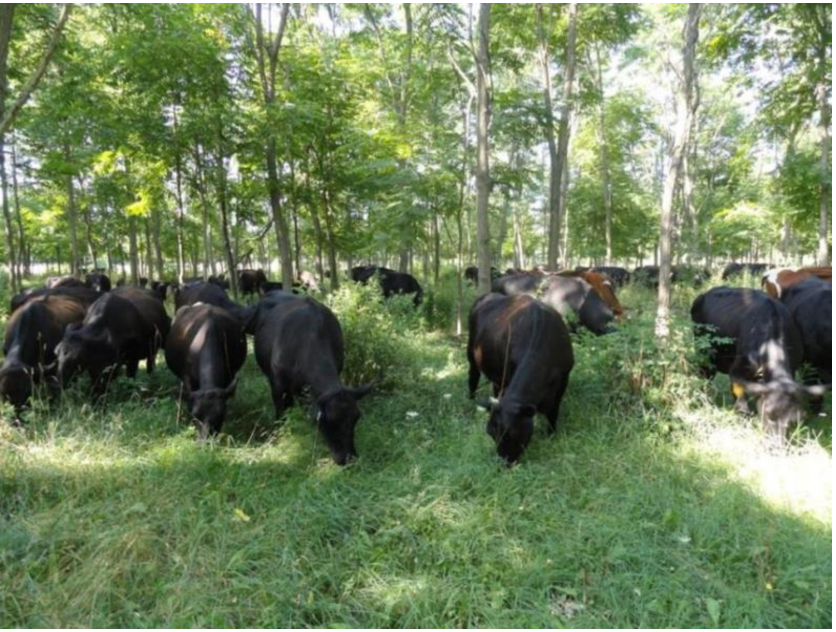


Source: http://thegrasswhisperer.com/the-2nd-annual-northeast-silvopasture-conference-inspires-optimization/

Source http://www.forestag.com/services.html

Source: http://www.oli-de-mallorca.com/cultivation-olive-grove-majorca.html

Source: http://brownsranch.us/



Source: http://smallfarms.cornell.edu/2011/10/03/the-art-of-silvopasturing-a-regional-conference/

Source: https://www.flickr.com/photos/baalands/2216308884/

Pine Trees planted on contour in twin rows with 40 ft alleys ~300 trees / acre

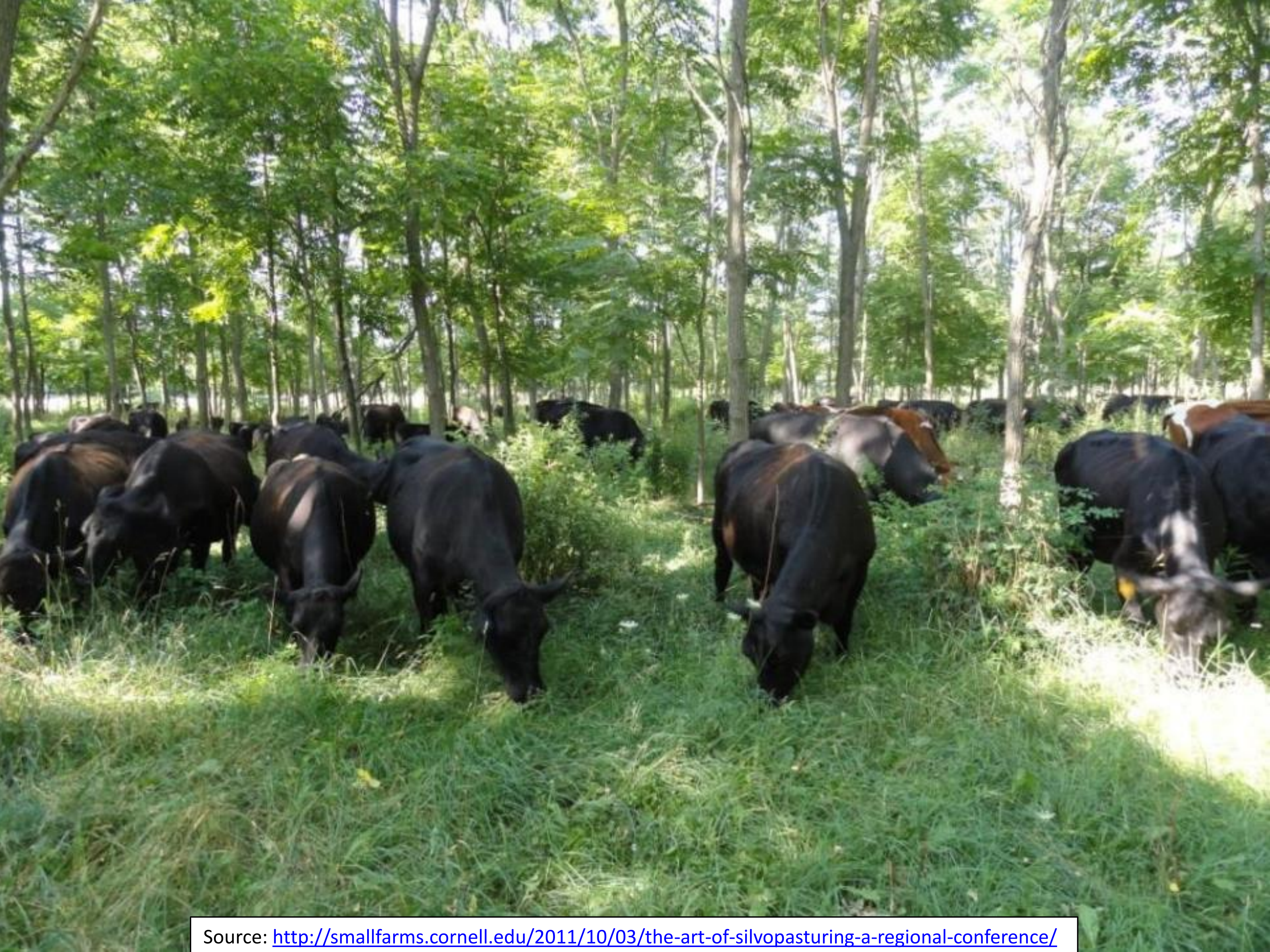
Source: http://www.aftaweb.org/latest-newsletter/temporate-agroforester/86-2004-vol-12/april-no-2/127-alabama-research-center-prepares-to-graze-silvopasture.html
Photo courtesy Sid Brantly

Source: https://www.flickr.com/photos/baalands/2216308884/

Source: http://www.centerforagroforestry.org/practices/sp.php

Source: http://silvopasture.ning.com/photo/pigs-at-hopkins-woods-low-res?context=user

Source: http://forest.mtu.edu/pcforestry/resources/studentprojects/silvopasture.html
Photo courtesy Dr. Jim McAdam at The Irish Scientist



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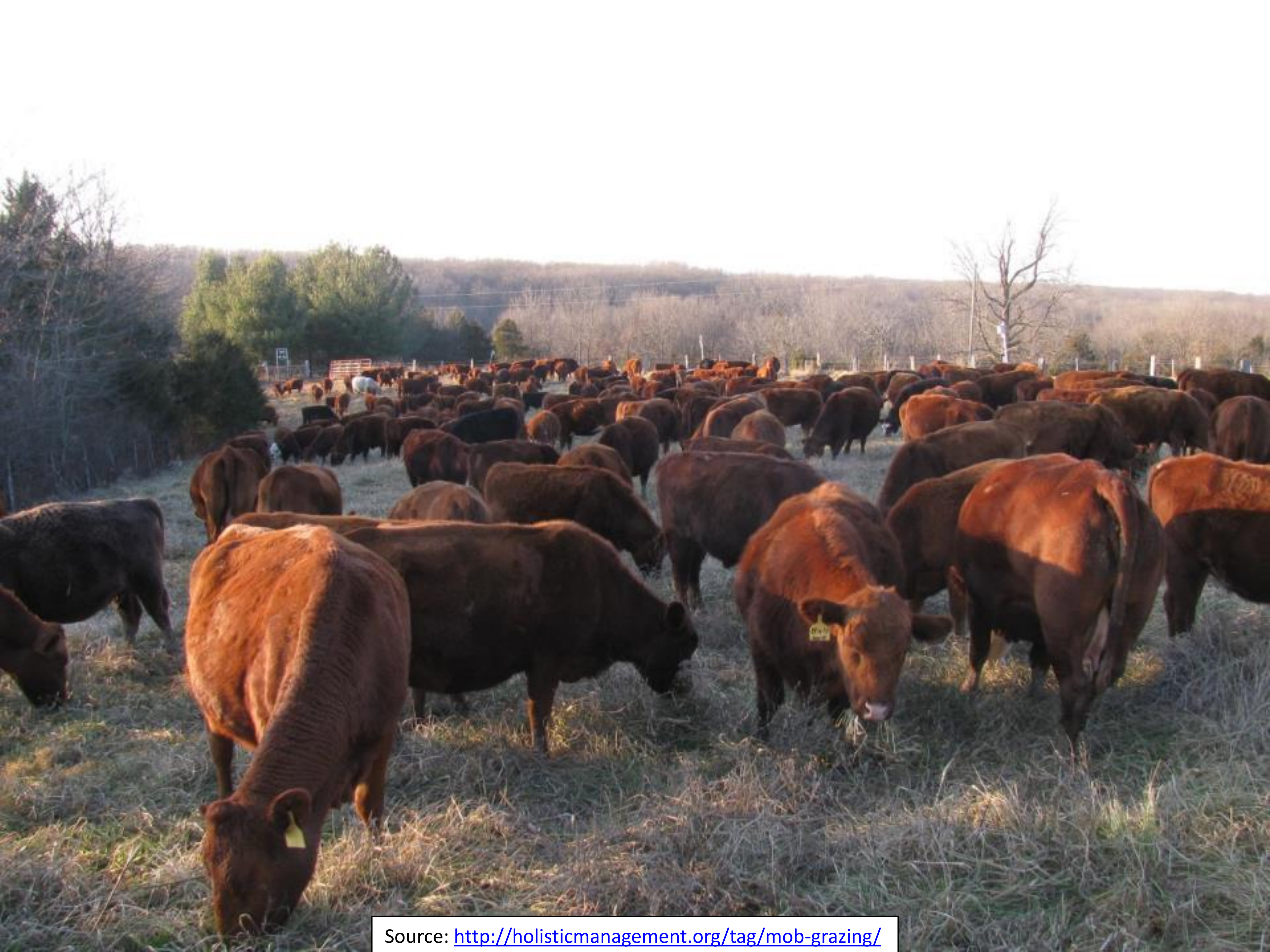


Source: http://holisticmanagement.org/tag/mob-grazing/

Dehesa Silvopasture

A typical dehesa farm with the average of about 45 trees per ha produces annually (per hectare):

- 1500-3000 kg grasses
- 450-500 kg acorns from holm and cork oaks
- 150-300 kg tree leaves for fodder
- 30 kg cork from cork oaks
- 37 kg charcoal from pruned branches
- 40-70 kg livestock

Source: http://www.aftaweb.org/latest-newsletter/temporate-agroforester/92-2005-vol-13/october-no-4/97-dehesa-agroforestry-systems.html

Source: http://www.alqueva-ibericos.com/dehesa_eng.html

Source: http://www.hoyfregenal.es/fotografia/fotos-delgadoexposito/hoyfregenal/dehesa-cuesta-agosto.-721015.html

Source: http://www.permaculturevoices.com/podcast/permaculture-voices-podcast-022-a-recap-of-darren-dohertys-workshop-and-the-dehesa-system/

Source: https://www.facebook.com/groups/Regrarians/photos/

Windbreaks

Source http://creating-a-new-earth.blogspot.com/p/important-hardscaping-terms-definitions.html

Source:
http://www.teara.govt.nz/en/photograph/15594/trimmed-macrocarpa-hedge

Source: http://forestandrange.org/modules/windbreak/index.htm
Photo courtesy of Rich Straight, National Agroforestry Center

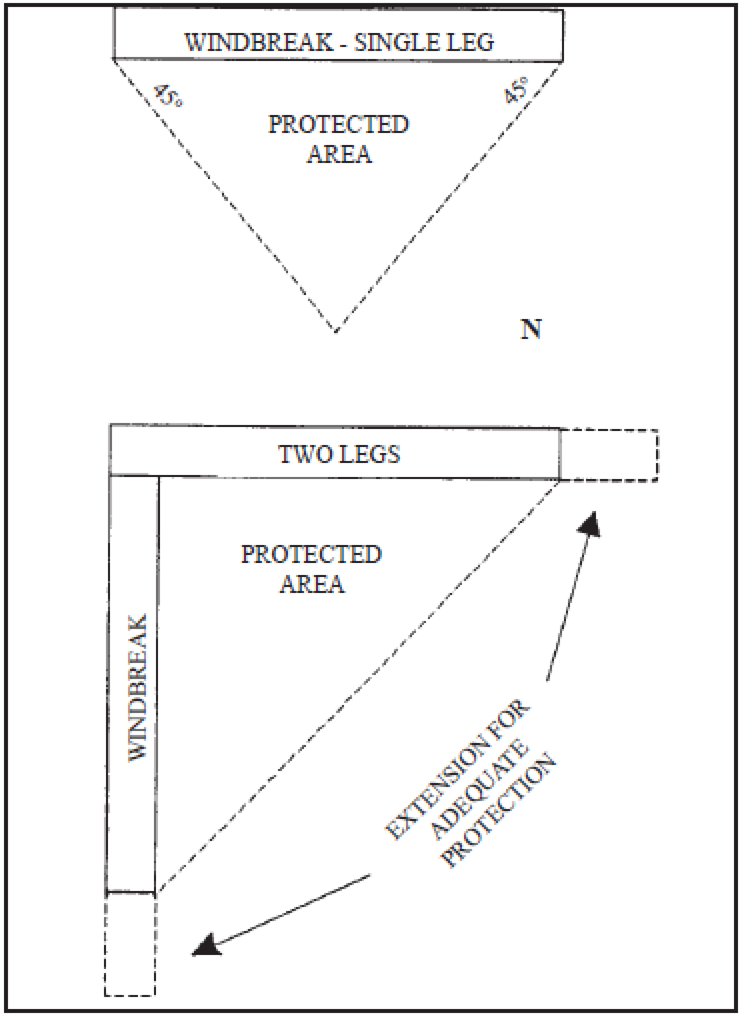


Figure 2. Windbreak design and corresponding zones of protection.

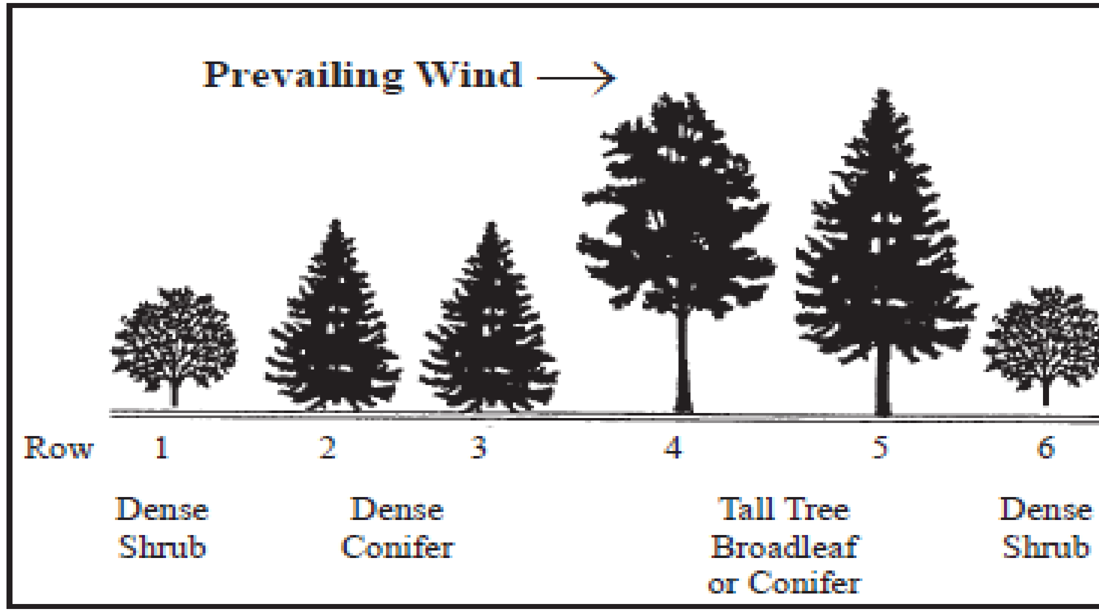


Figure 1. Typical windbreak profile.

Table I. General Spacing Guidelines for Windbreak

Windbreak Position	*Windbreak Component*	*Spacing (ft.) Between Trees in the Row*	*Spacing (ft.)* Between Tree Rows*
Windward Rows (Rows 1 or 2)	Dense Conifer	6-12	12-20
Leeward Rows (Rows 3+)	Dense Conifer	8-12	14-20
Leeward Rows (Rows 3+) Broadleaf /Conifer	Medium Ht. Trees	10-18	14-20
Leeward Rows (Rows 3+)	Tall Trees	12-20	20-25
Windward or Leeward Rows	Shrubs	4-6	8-10

*A general guide would be to use a between-row spacing 4 feet wider than the largest piece of equipment to be used to maintain the windbreak or provide access.

Source
http://www.teara.govt.nz/en/photograph/15593/the-canterbury-plains

Source http://www.teara.govt.nz/en/photograph/15599/native-trees-for-shelter

Photo: Neil Bertrando

Photo: Neil Bertrando

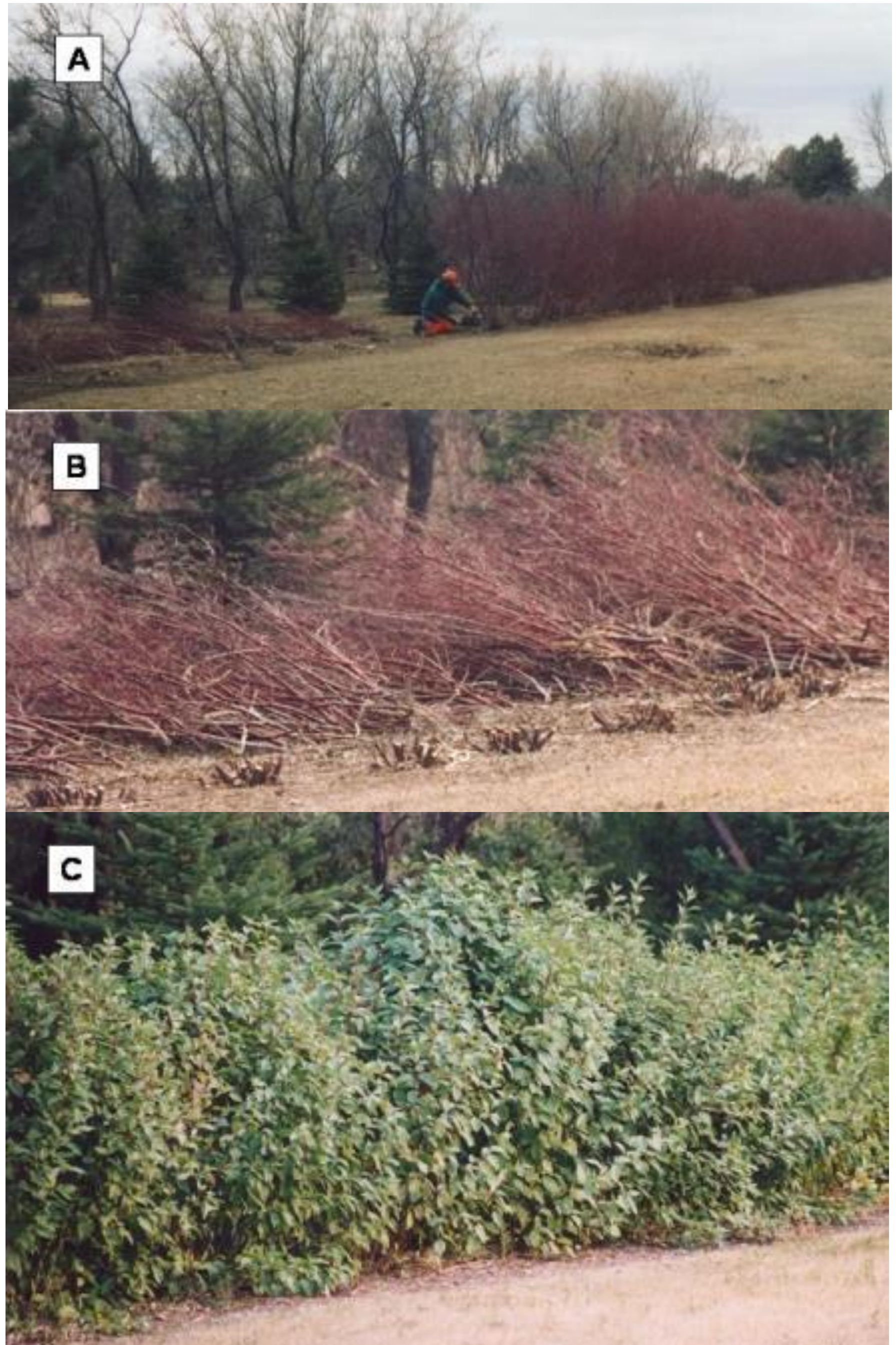
Photo: Neil Bertrando

Riparian Buffer Forestry

Source: http://www.mda.state.mn.us/protecting/conservation/practices/bufferforested.aspx
Photos courtesy USDA NRCS

Source: http://commons.wikimedia.org/wiki/File:Trout_Creek_in_southeastern_Oregon.jpg#mediaviewer/File:Trout_Creek_in_southeastern_Oregon.jpg
"Trout Creek in southeastern Oregon" by Bureau of Land Management

Source: http://forestandrange.org/modules/windbreak/WBRen3e.htm
Photo by Joe Zeleznik, near Horace, N.D.



Source http://forestandrange.org/modules/windbreak/WBRen3g.htm
Photos courtesy of Craig Stange, Natural Resources Conservation Service.

Provide harvestable crops

Riparian forest buffer

- Marketable products depend on current and future demand.
- Potential products:
  - –wood (sawlogs, post, poles, veneer)
  - –fiber (pulp, firewood, energy biomass)
  - –forage (livestock)
  - –fruit (nuts, berries)
  - –other crops (ginseng, mushrooms, herbs and floral greenery, etc.)

Source: USDA National Agroforesty Center
http://nac.unl.edu/riparianforestbuffers.htm

Forest Farming

Forest Farming Methods

- Woods cultivated
  - higher costs
  - farming in the forest
- Wild simulated
  - mimics nature
  - lower cost
  - less inputs

Source: USDA National Agroforesty Center
http://nac.unl.edu/practices/forestfarming.htm

Multistrata Agroforestry

- Multistrata agroforestry takes its cues from the defining feature of forests: layers.
- Blending an overstory of taller trees and an understory of one or more layers of crops, multistrata agroforestry maximizes both horizontal and vertical space.
- Most commonly practiced in the Tropics. The blend of plants varies by region and culture, but the spectrum includes macadamia and coconut, black pepper and cardamom, pineapple and banana, shade-grown coffee and cacao, as well as rubber and timber.

Credit: Pedro Paulo F. S. Diniz

Source: https://www.drawdown.org/solutions/food/multistrata-agroforestry

Mechanical Harvesters

Source http://www.seattlepi.com/local/article/Could-Washington-become-a-center-for-cider-3427616.php#photo-2726147
A repurposed raspberry harvester collects apples for cider.
Photo: Washington State University
'Raspberry harvesters are busy in the summer, but sit idle in the fall during apple harvest. That said, harvesters will need heavier "beater bars"

Source: http://www.fruitbreeding.co.uk/raspberrybreedingatscri.asp

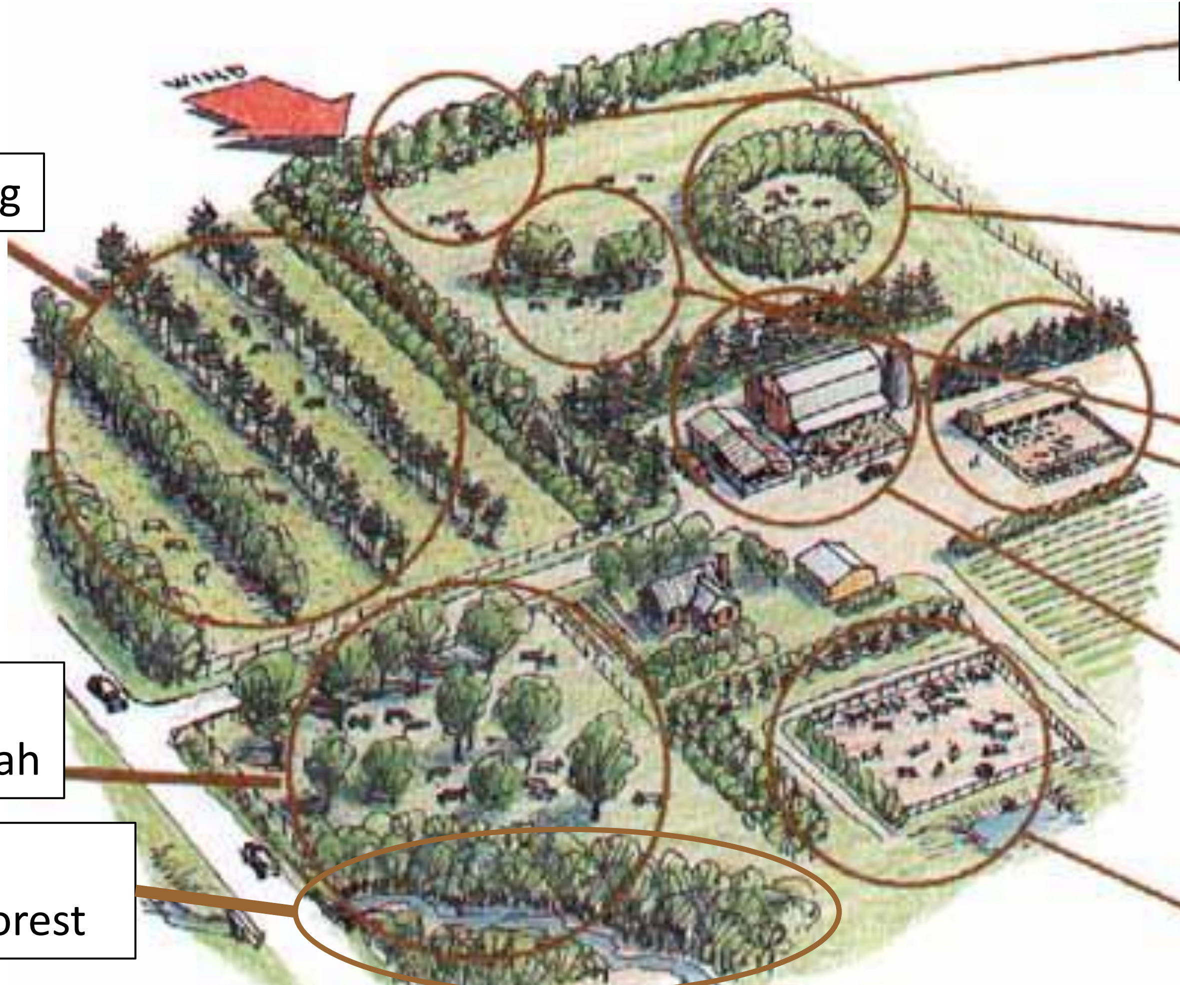
Shaker+Screen

Cherries, Plums
Source: http://aroniaharvest.com/berry_harvesting.html?module=product_info_page&id=13&cat_id=11

Siderow Harvester

Aronia, Currants, Gooseberries, Saskatoon, Haskap
Source: http://www.extension.iastate.edu/wine/growersnews/254-september-27-2013

Agroforestry without Permaculture and Keyline Design



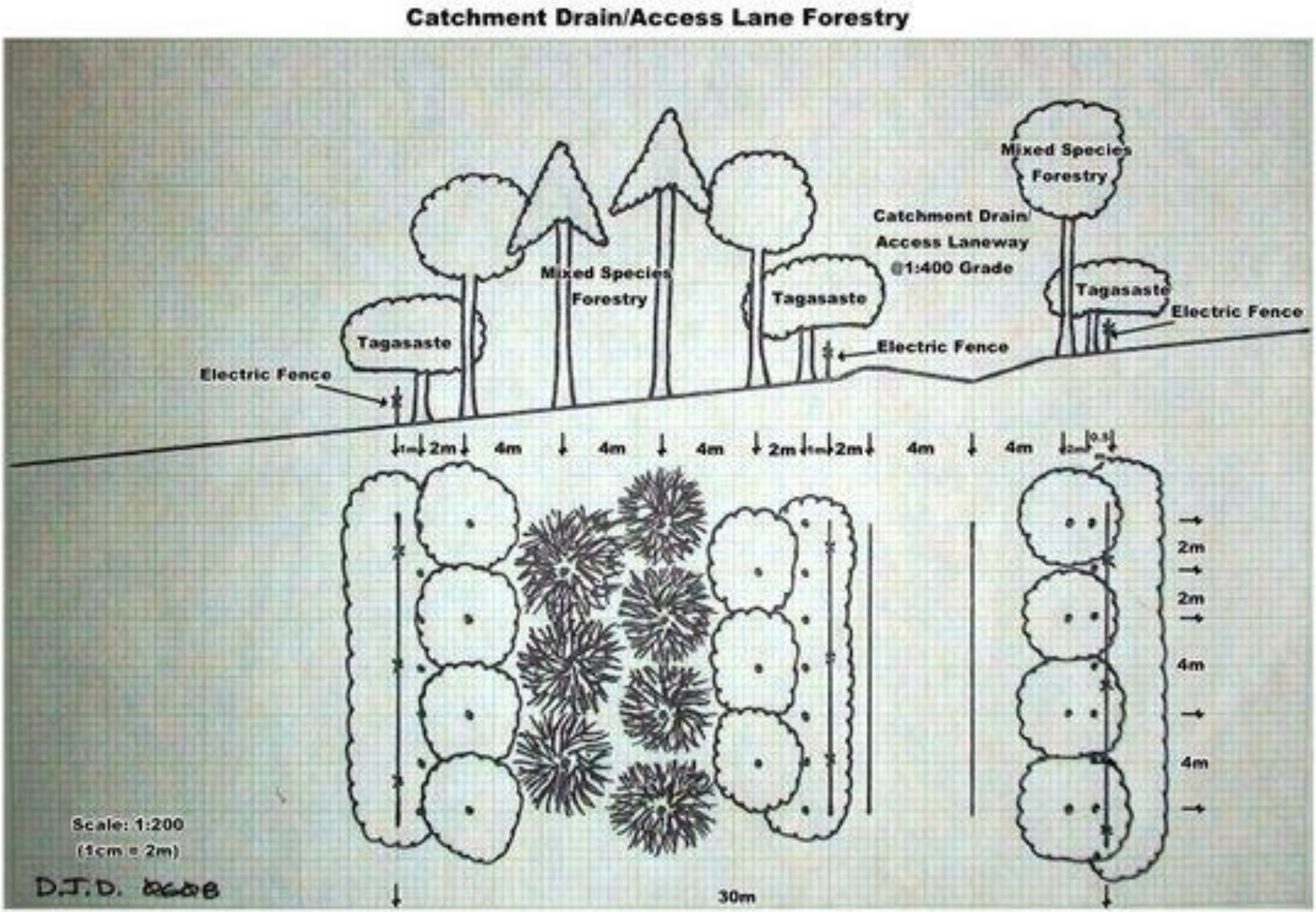
Source: http://forest.mtu.edu/pcforestry/resources/studentprojects/silvopasture.html
Image courtesy USDA National Agroforestry Center

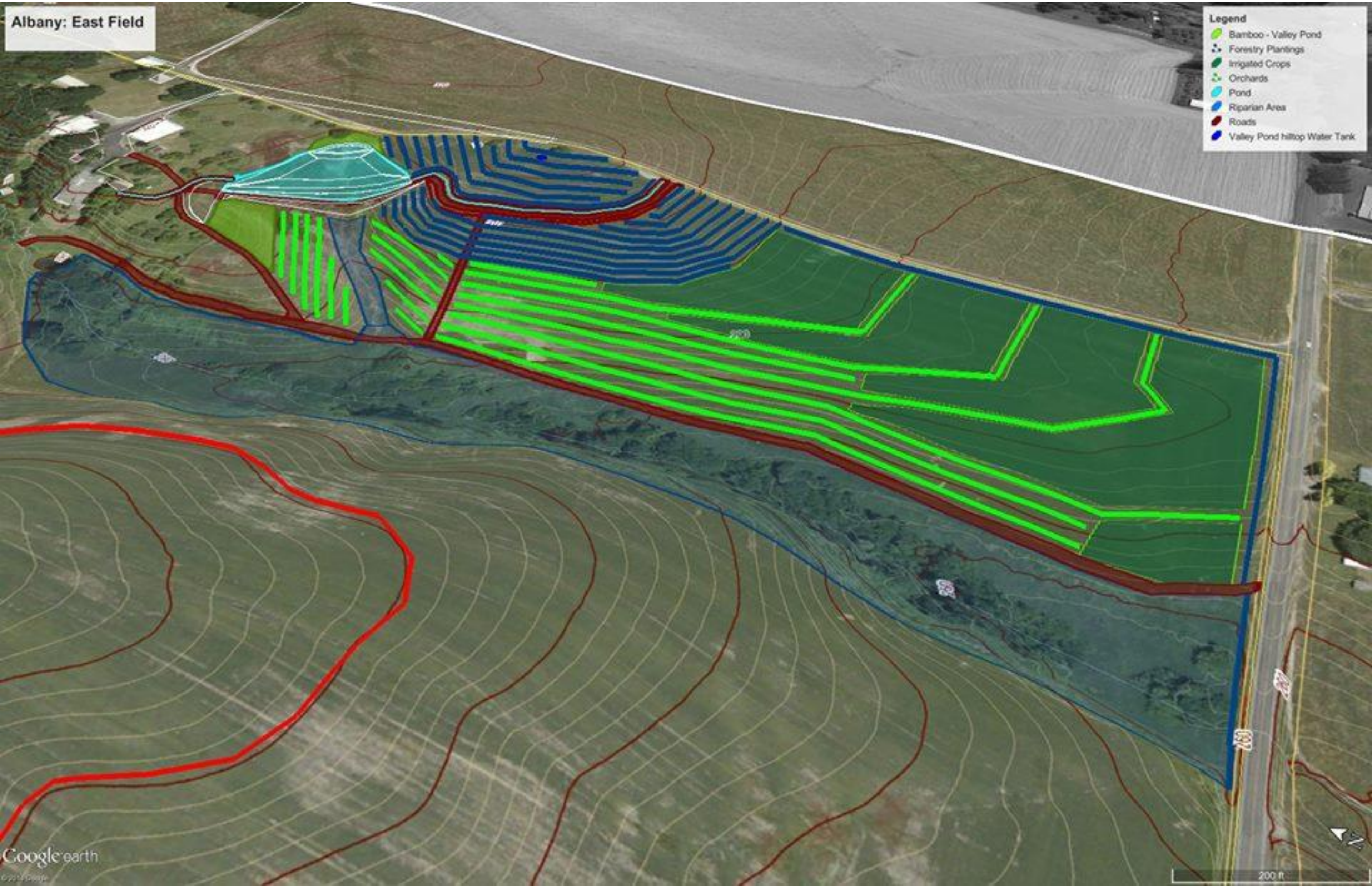
Adding Permaculture Design and the Regrarian Platform to Agroforestry

Water harvesting, topsoil generating layouts integrated with equidistant, parallel systems

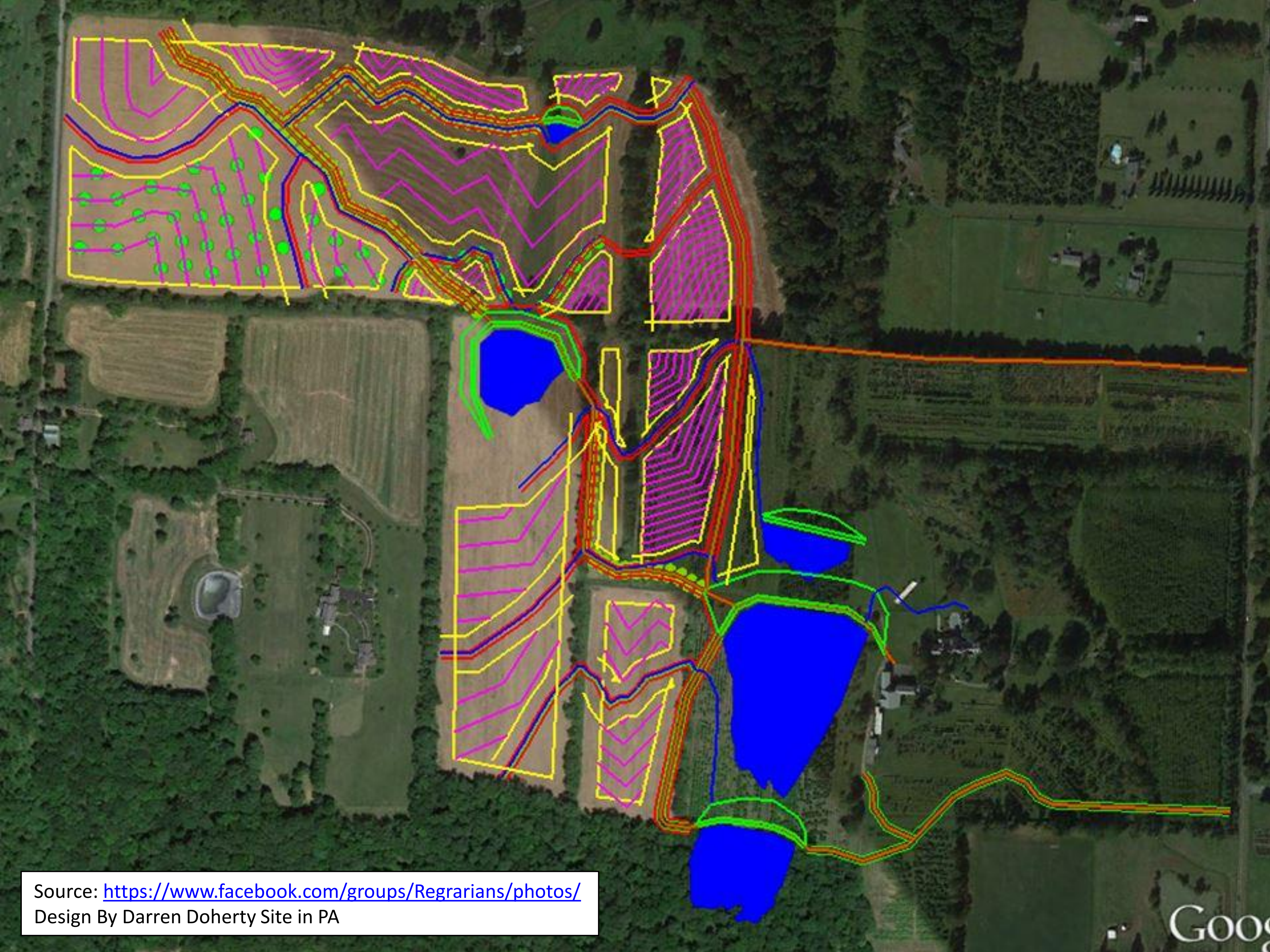
Source: http://www.appleseedpermaculture.com/tag/holistic-management/

Keyline Irrigation – Contour Strip Forests

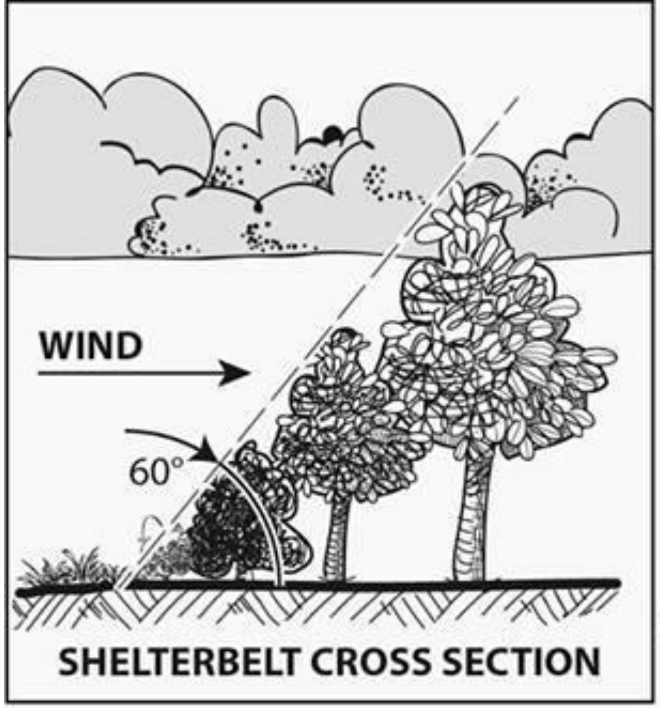


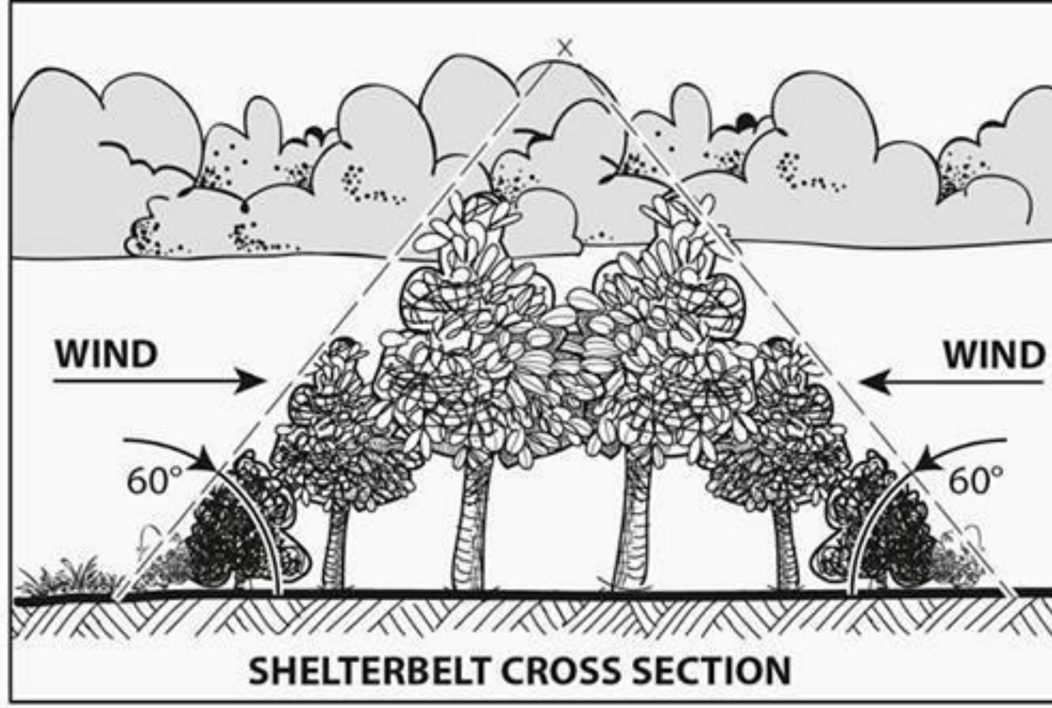


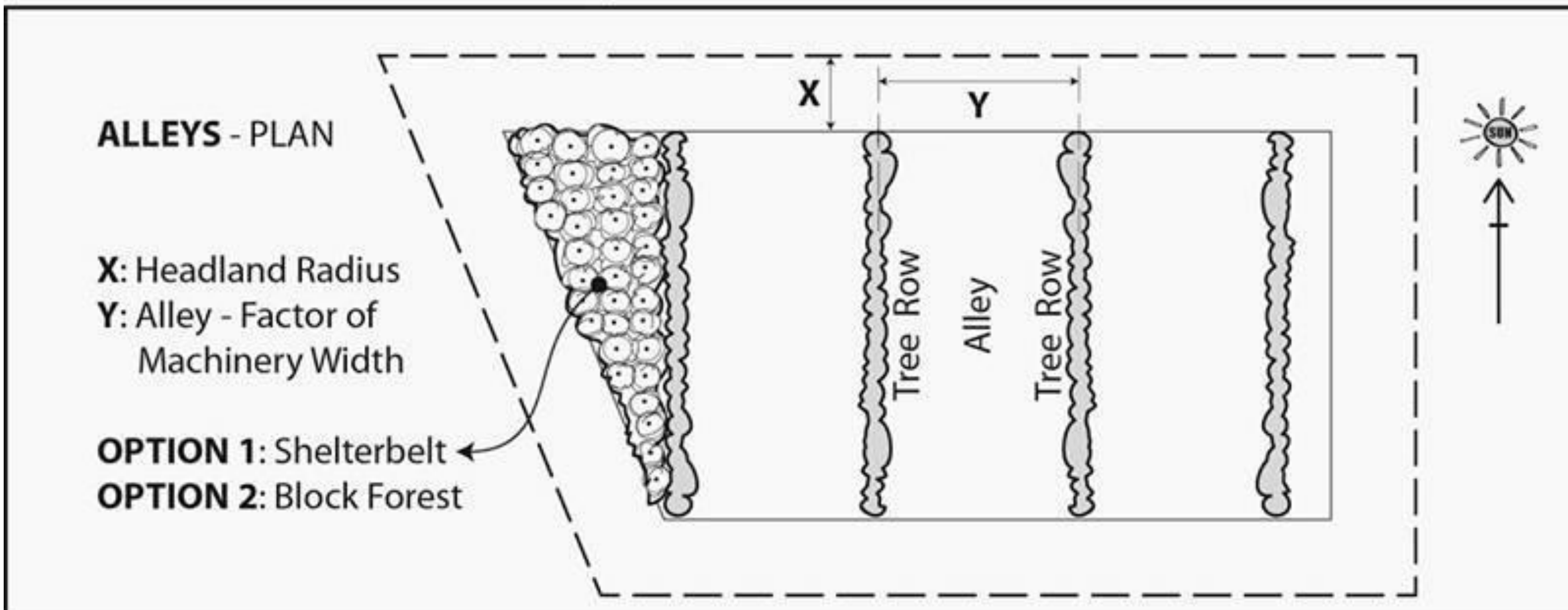
Source: https://www.facebook.com/groups/Regrarians/photos/
Design by Andrew Millison



Source: https://www.facebook.com/groups/Regrarians/photos/
Design By Darren Doherty Site in PA

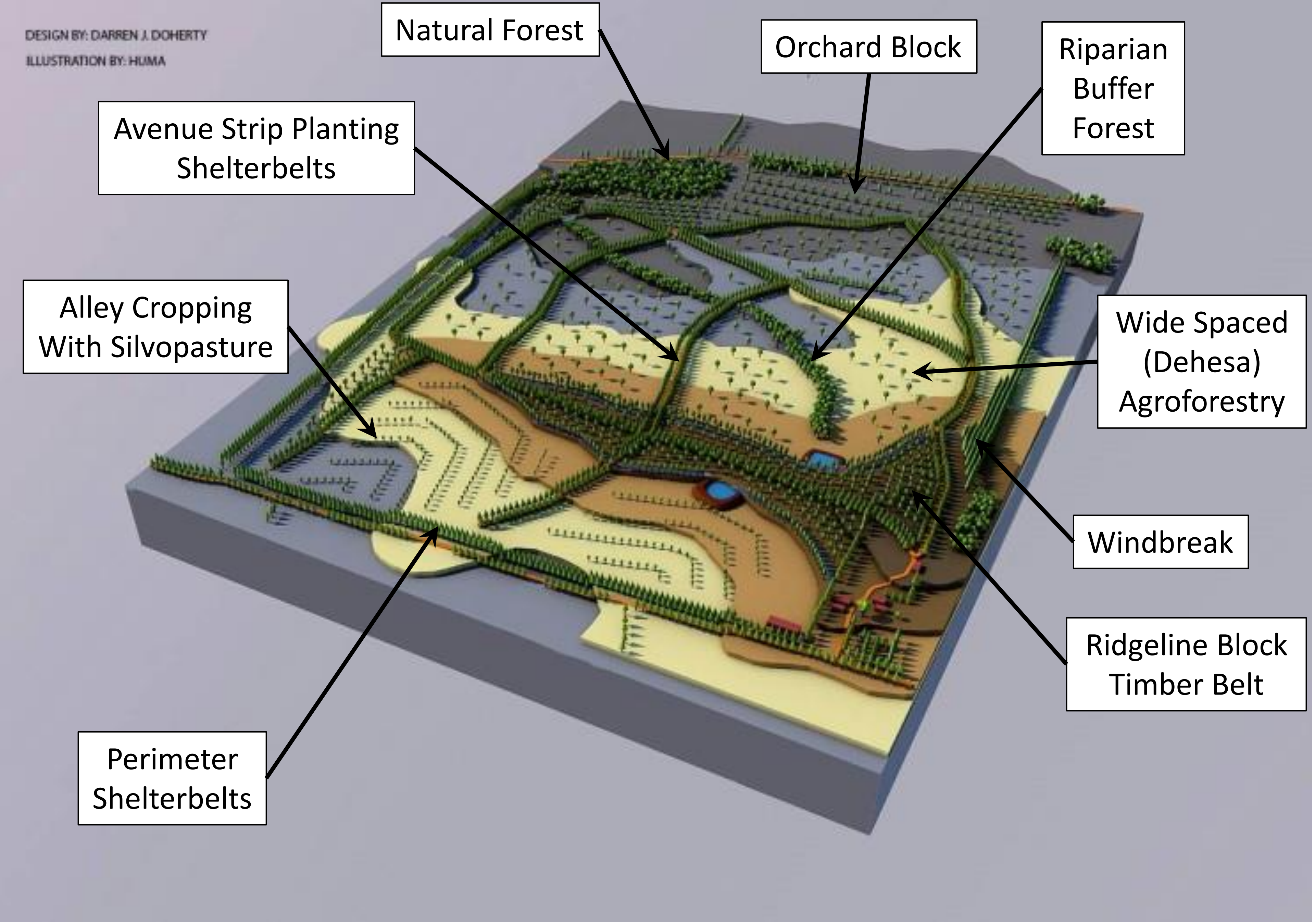






Source: https://www.facebook.com/groups/Regrarians/photos/

Source: https://www.facebook.com/groups/Regrarians/photos/
Design By Darren Doherty Site in Southern Australia



Integrated Mainframe design developed by Darren J. Doherty and Georgi Pavlov using Keyline® Design and the Regrarians Platform ®.
Source: http://www.regrarians.org/services/farm-planning/

Avenue Strip Planting Shelterbelts
Timber Block
Riparian Buffer Forest
Natural Forest
Wide Spaced (Dehesa) Agroforestry
Orchard Block
Silvopasture
Alley Cropping With Silvopasture
GAVIOTA GIVINGS
ORELLA RANCH
REGRARIANS
1. FARM FORESTRY
2. ORCHARDS
3. SHELTERBELTS
4. REVEGETATION
5. OAKS
6. MARKET GARDEN
7. WATER RETICULATION
8. WATER TANKS
9. FENCES
10. GATES
11. SILVOPASTURE
WOOD PROCESSING/ SAWMILL
QUONSET HUT/ WOOD DRYING BUILDING
FARM STAND
POWER
WELL
WATER TROUGHS
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Mexico Regrarians Project
Keyline Geometry for Water and Soil Management

Source: https://www.facebook.com/groups/Regrarians/photos/

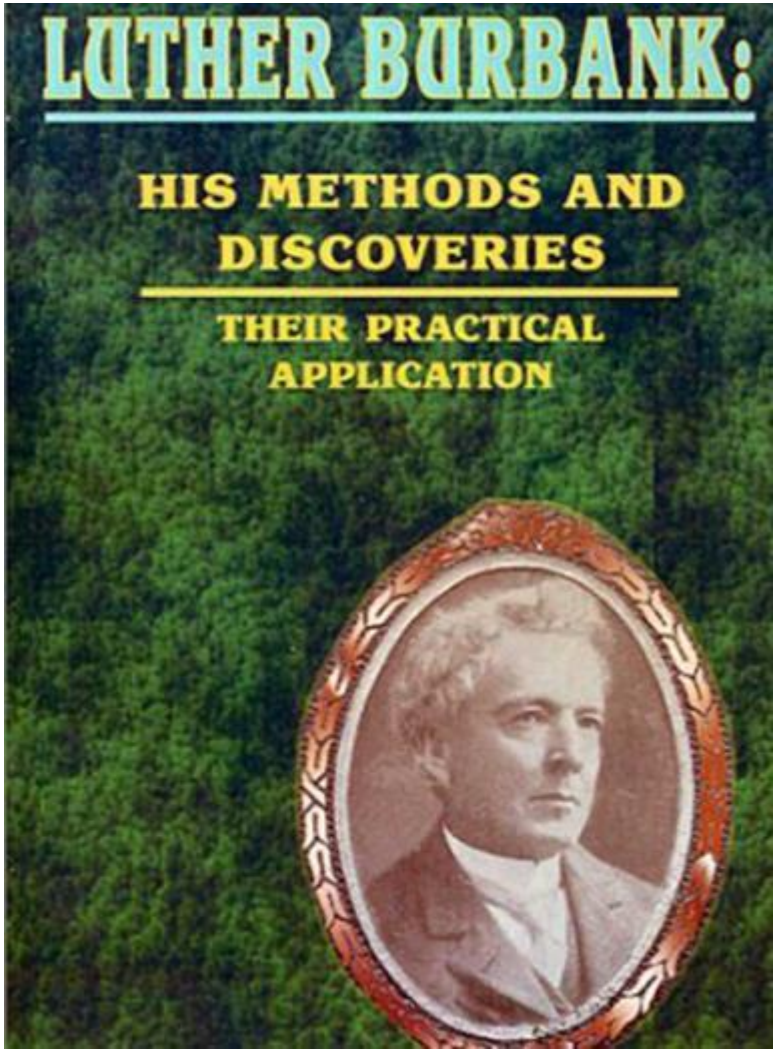
Source: http://www.ridgedalepermaculture.com/agroforestry.html
Keyline Silvoarable & Silvopasture systems, Mexico

VersaLand:
Re-perennializing an Iowa Corn Field

VersaLand:

Seeds and Mass Breeding

Source:
http://sustainableseedco.com/education/luther-burbank.html



Source:
http://www.rodhandeland.com/Energy%20Food%20Water%20Technology/Food%20Solutions.htm

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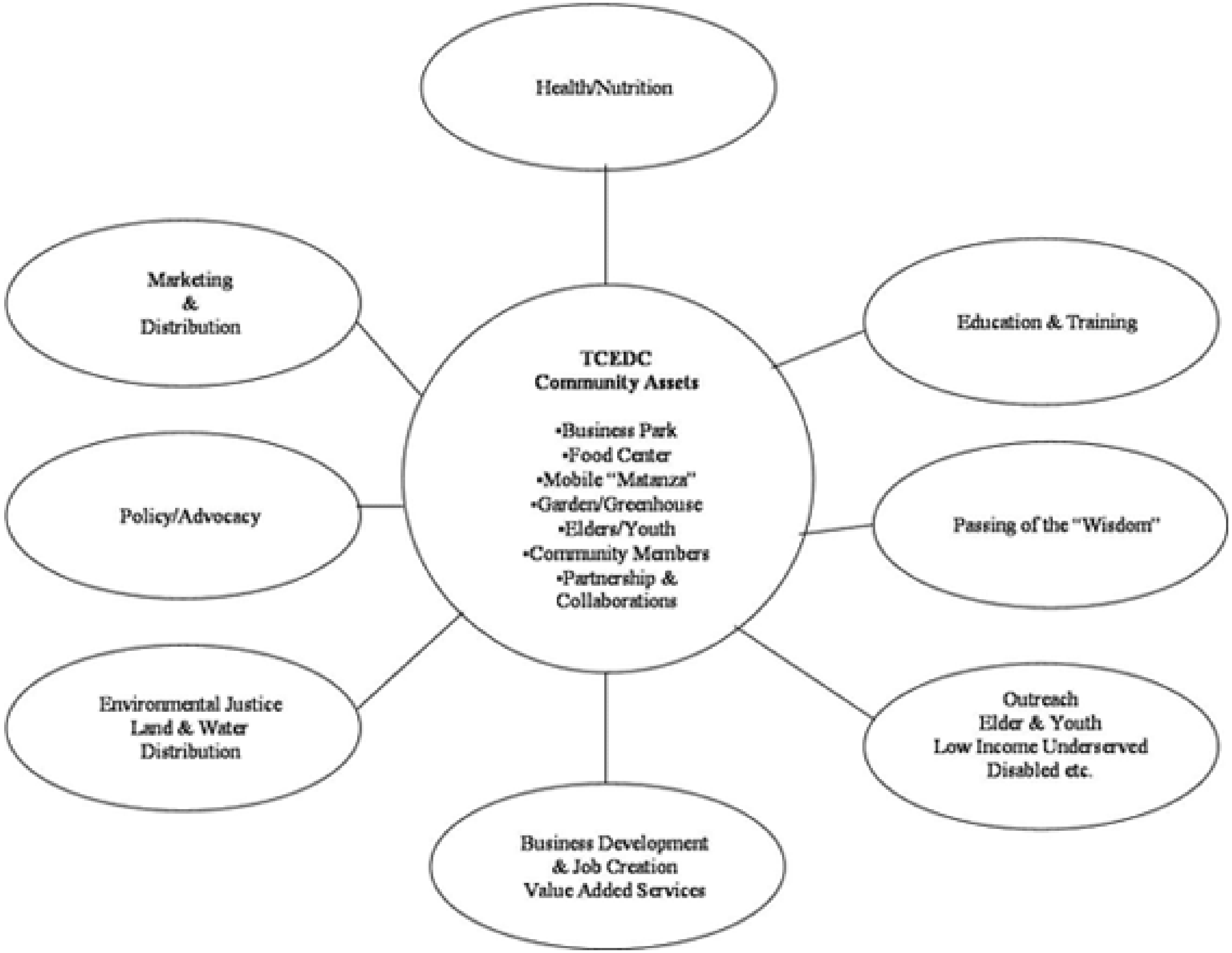
Taos County Economic Development Company

Source: http://www.tcedc.org/index.html

Taos County Economic Development Company



Source: http://www.tcedc.org/index.html

Taos County Economic Development Company

Source: http://www.tcedc.org/index.html

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Source: http://www.tcedc.org/index.html

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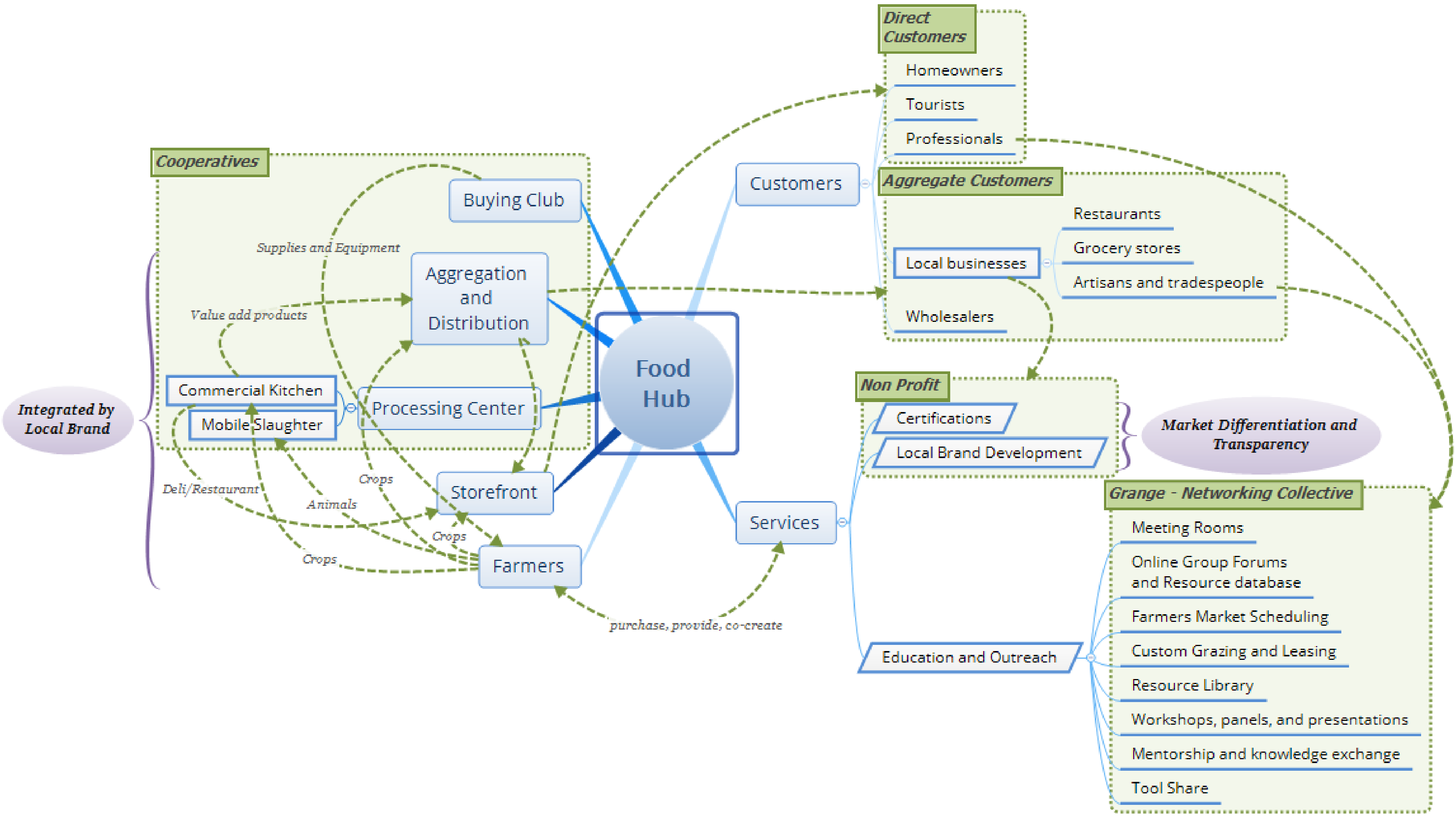

Direct Customers
Homeowners
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Mobile Slaughter
Processing Center
Integrated by Local Brand
Deli/Restaurant
Animals
Crops
Storefront
Crops
Farmers
Crops
purchase, provide, co-create
Food Hub
Customers
Aggregate Customers
Restaurants
Grocery stores
Local businesses
Artisans and tradespeople
Wholesalers
Non Profit
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Local Brand Development
Market Differentiation and Transparency
Services
Grange - Networking Collective
Meeting Rooms
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Farmers Market Scheduling
Custom Grazing and Leasing
Resource Library
Workshops, panels, and presentations
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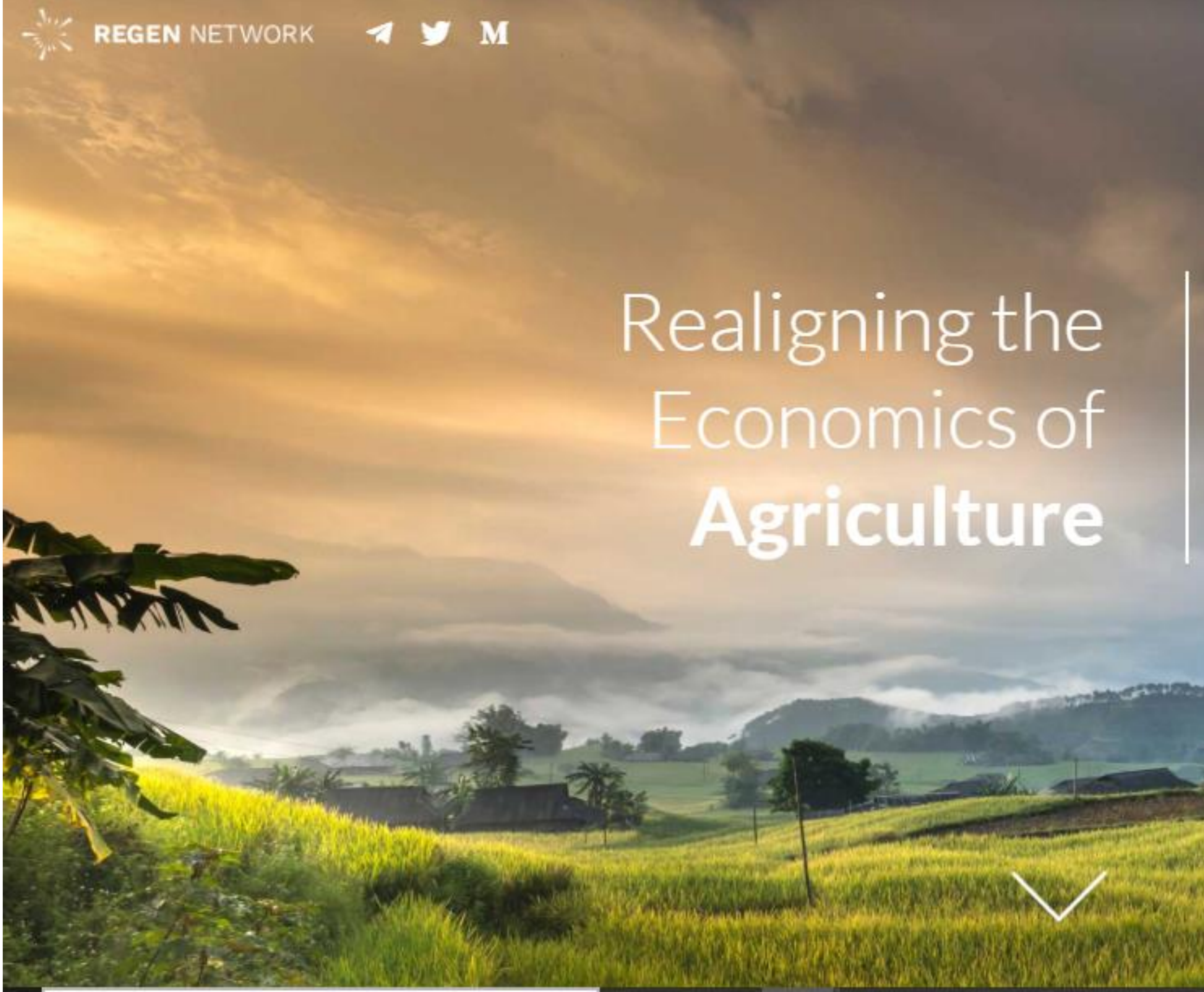
Tool Share
Education and Outreach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The future of agriculture is **regenerative**


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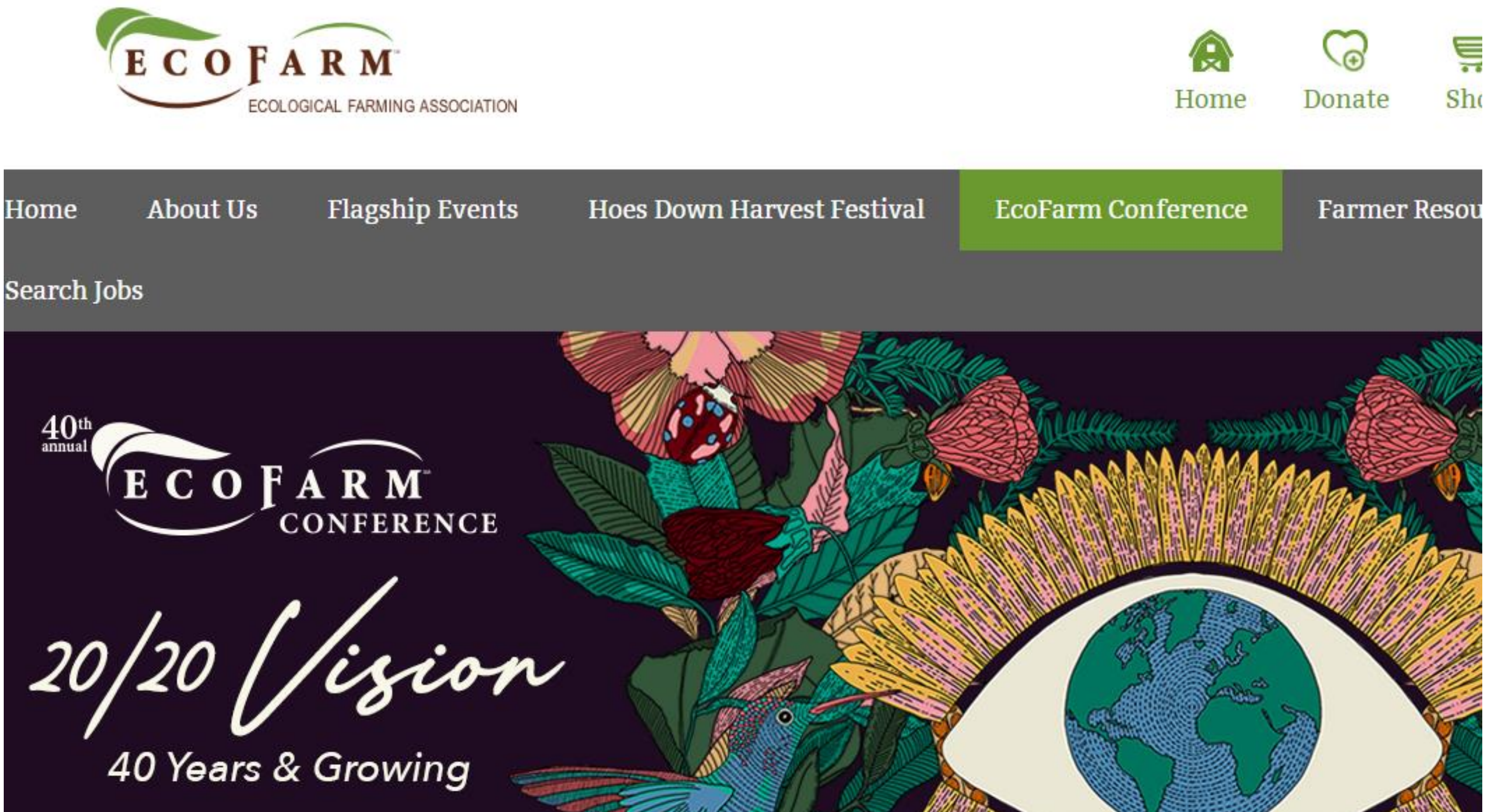
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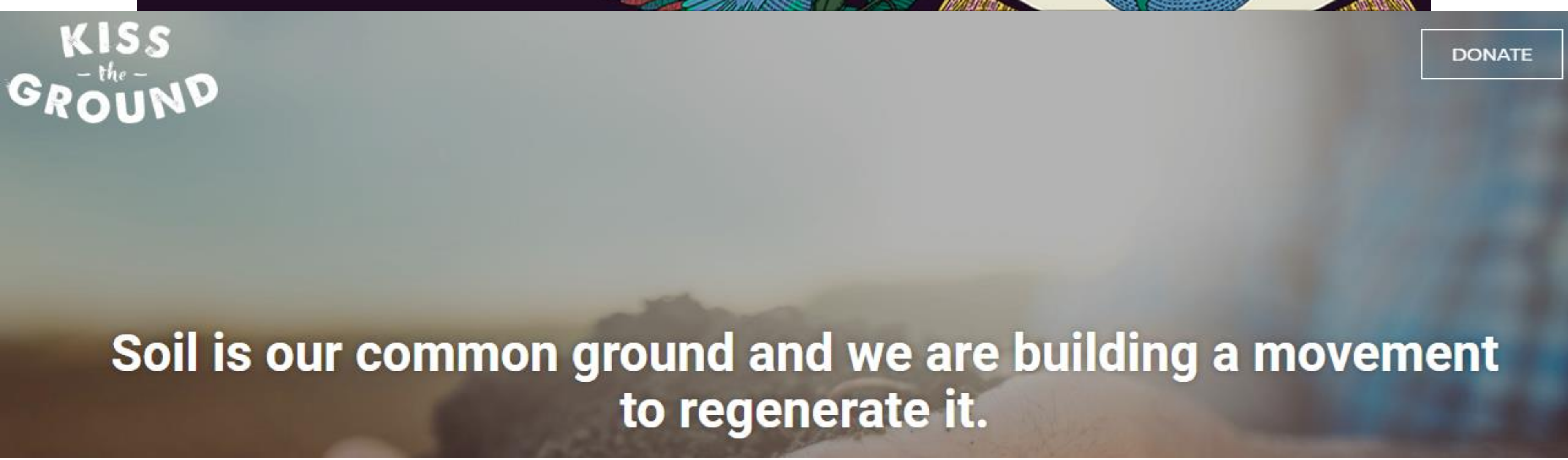
KISS the GROUND
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Soil is our common ground and we are building a movement to regenerate it.

Welcome to Brown's Ranch!

"Regenerating Landscapes for a Sustainable Future"

We believe that faith, family and working with the natural resources that God has provided allows us a meaningful life. We enjoy using these resources to regenerate landscapes for a sustainable future.

Our ranch is located just east of Bismarck, ND. Shelly and I purchased the ranch from Shelly's parents in 1991 and have grown the operation to 5000 acres of owned and leased land. Son, Paul, returned to the ranch after graduation from North Dakota State University and became a partner in the operation. Daughter, Kelly, lives and works in Fargo, ND and returns home to help whenever possible.

We believe in and practice Holistic Management, a part of which is farming and ranching in nature's image. We strive to solve problems in a natural and sustainable way. Improving soil health is a priority and no-till farming has been practiced since 1993. A diverse cropping strategy, which includes cover and companion crops are used. We have now elimnated the use of synthetic fertilizers, fungicides, and pesticides. We use minimal herbicide and are striving to eliminate it. We do not use GMOs or glyphosate. Our ever evolving grazing strategy allows most of our pastures a recovery period of over 360 days. These strategies have allowed the health of the soil, the mineral and water cycles to greatly improve. In other words, the natural resources have benefited. This results in increased production, profit and a higher quality of life for us. We are moving towards sustainability for not only ours but future generations as well.


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Links page

- Regrarians: http://www.regrarians.org/
- Polyface: http://www.polyfacefarms.com/
- Ridgedale Permaculture: http://www.ridgedalepermaculture.com/
- USDA National Agroforestry Center: http://nac.unl.edu/
- World Agroforestry Centre: http://www.worldagroforestry.org/
  - World Agroforestry Centre Flickr album: https://www.flickr.com/photos/icraf/sets/
- FAO Climate Smart Agriculture http://www.fao.org/climatechange/climatesmart/en/
- Perennial Solutions: http://www.perennialsolutions.org/
- University of Missouri Center for Agroforestry: http://www.centerforagroforestry.org/pubs/training/index.php
- Agroforestry Systems Journal: http://link.springer.com/journal/volumesAndIssues/10457
- The Permaculture Orchard: http://www.permacultureorchard.com/
- Mark Shepard New Forest Farm http://www.newforestfarm.net/
- Savanna Institute: R&D on Perennial staple crops systems http://www.savannainstitute.org/
- Oxbo harvesters: http://www.oxbocorp.com/Products/Berries.aspx
- Weremczuk Agromachines: http://aroniaharvest.com/berry_harvesting.html
- Savory Institute: http://www.savoryinstitute.com/
- Holistic Management: http://holisticmanagement.org
- Permaculture Voices: http://www.permaculturevoices.com/
- RT Permaculture: http://rtpermaculture.com/
- Agroforestry.net: http://agroforestry.net/
- Permaculture News: http://permaculturenews.org/
- Economic Budgeting for Agroforestry Practices: http://www.centerforagroforestry.org/pubs/economichandbook.pdf
- Blending Buffers with Business: ftp://ftp-fc.sc.egov.usda.gov/GLTI/technical/publications/blending-buffers.pdf
- Marketing Specialty Forest Products: http://nac.unl.edu/documents/morepublications/sfp1_MarketingSFP.pdf
- Farm Hack: http://farmhack.org/tools