PRESENTATION GIVEN AT THE TRANSLINKS VALUE CHAIN WORKSHOP ENTITLED:

"Value Chain Cases in the Context of Conservation Marketing and Certification"

JUNE 25-27, 2009
ARUSHA, TANZANIA

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Ecological regulation of ecosystem services

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Value Chain Cases in the Context of Conservation Marketing and Certification

WORKSHOP IN ARUSHA, TANZANIA – JUNE 25 - 27, 2009

Ecosystem service classification

Millennium Ecosystem Assessment categories (MA 2003):

Provisioning:
- Marketed and subsistence goods
  - food, wood, fiber, fresh water
- Genetic resources

Supporting:
- Ecosystem processes underlying provisioning ES
  - productivity, soil formation, nutrient cycling
  - some ecologists prefer simply "ecosystem processes"

Regulating:
- Play a regulatory role in ecological systems
  - pollination; water purification; regulation of climate, natural disasters, diseases and pests

Cultural:
- Aesthetic, spiritual, educational, and recreational benefits
  - attraction of tourism; shrine forests

The semantics of ecosystem service supply

Ecosystem processes … Ecosystem services … Ecosystem function … ???

Ecosystem Process (EP) — any transfer or transformation of energy or matter between pools (= stocks) in an ecosystem.

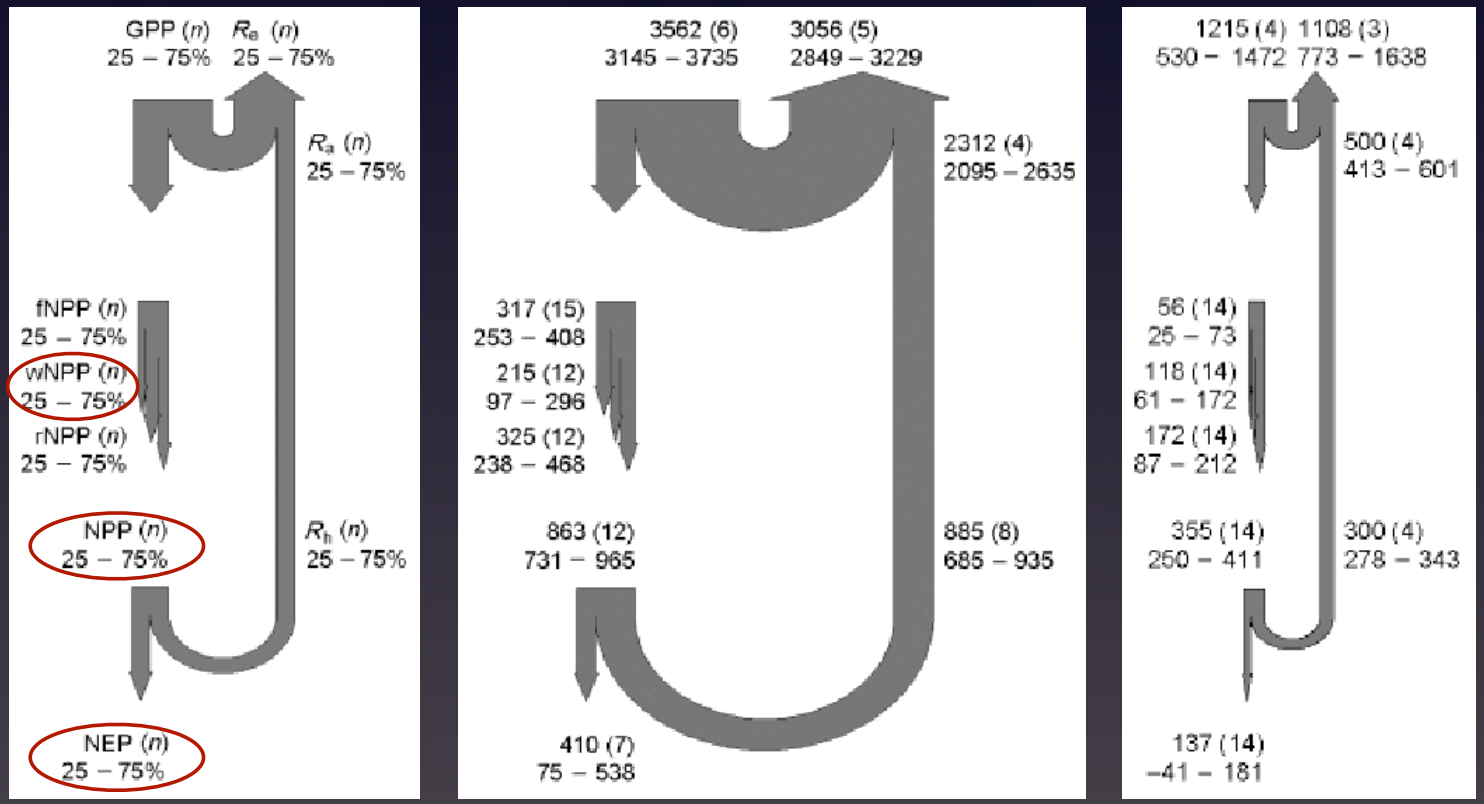
Key terrestrial ecosystem processes: productivity (NPP); decomposition; movement and cycling of carbon, water, nutrients, and energy; trophic interactions (predation, herbivory, etc.)

The semantics of ecosystem service supply

— Ecosystem processes & Ecosystem services —

Ecosystem services:

- Provisioning (wood)
- Supporting (productivity)
- Regulating (CO_2 sequestration)



Global Change Biology (2007) **13**, 2509–2537, doi: 10.1111/j.1365-2486.2007.01439.x

CO_2 balance of boreal, temperate, and tropical forests derived from a global database

The semantics of ecosystem service supply

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Key terrestrial ecosystem processes: productivity (NPP); decomposition; movement and cycling of carbon, water, nutrients, and energy; trophic interactions (predation, herbivory, etc.)

Ecosystem Service (ES) — any benefit to society from ecosystems, natural or managed (ecosystem disservices (EDS) are ecosystem costs to society)

Ecosystem Function — may be (i) an ecosystem process; (ii) an ecosystem property (stability, ecosystem modulators); or (iii) an ecosystem service.

Biophysical regulation of ecosystem services

Biome scales:

EP and ES are constrained by climate, soils, topography.

For example, forests store more C than grasslands, & provide more consistent water supply.

Local scales (& below):

EP and ES are regulated by variation in:

A) abiotic conditions; B) biotic communities; & C) land management.

***Fine-scale influences of organisms on ecosystems scale upward to regions & the globe.

Ecosystem service providers (ESPs): (Kremen 2005)

- ***ESPs:*** Biogeochemical cycles, plants, micro-organisms, invertebrates, birds, mammals

***Some ES rely on many (or all) ESP functional units, while others rely on a subset.

Biological diversity & functional traits:

- ***Functional traits:*** Determine the ES influence of organisms, organismal diversity, biotic communities, land use/cover and land use/cover diversity
- ***Key plant functional traits:*** Leaf chemistry (C; N; P; C quality; etc.), relative growth rate, photosynthate allocation pattern (wood; leaf; root; storage organs; secondary compounds; etc.)

Synergies & trade-offs between ES

ES Synergy*:** The supply of a given ES increases along with the supply of one or more ES (i.e., ***complementary production function)

ES Trade-off*:** The supply of a given ES decreases along with the supply of one or more ES (i.e., a ***competitive production function)

Spatial and temporal mediation of ES synergies & trade-offs:

- Some are purely spatial, or purely temporal, but often both are involved.
- ***Temporal mediation***: managing for an ES has lagging effects on other ES.
- ***Spatial mediation***: managing for an ES in one area affects other ES, in other areas.

Few synergies or trade-offs are universal — rather, they depend on:

- characteristics of the system (including seasonal variation)
- existing land management techniques
- available alternative land uses

Common trade-offs between ES in agroecosystems

Spatially-mediated trade-offs:

- Wood production / Livestock production
- Wood production / Food production
- Food production / Livestock production
- Food production / Water supply regulation, Water purification, Soil retention
- Food production / Regulation of pests, disease, & weeds
- Food production / Pollination
- Food production / Climate regulation (microclimate)
- Livestock production / Water supply regulation, Water purification, Soil retention
- Livestock production / Regulation of pests, disease, & weeds

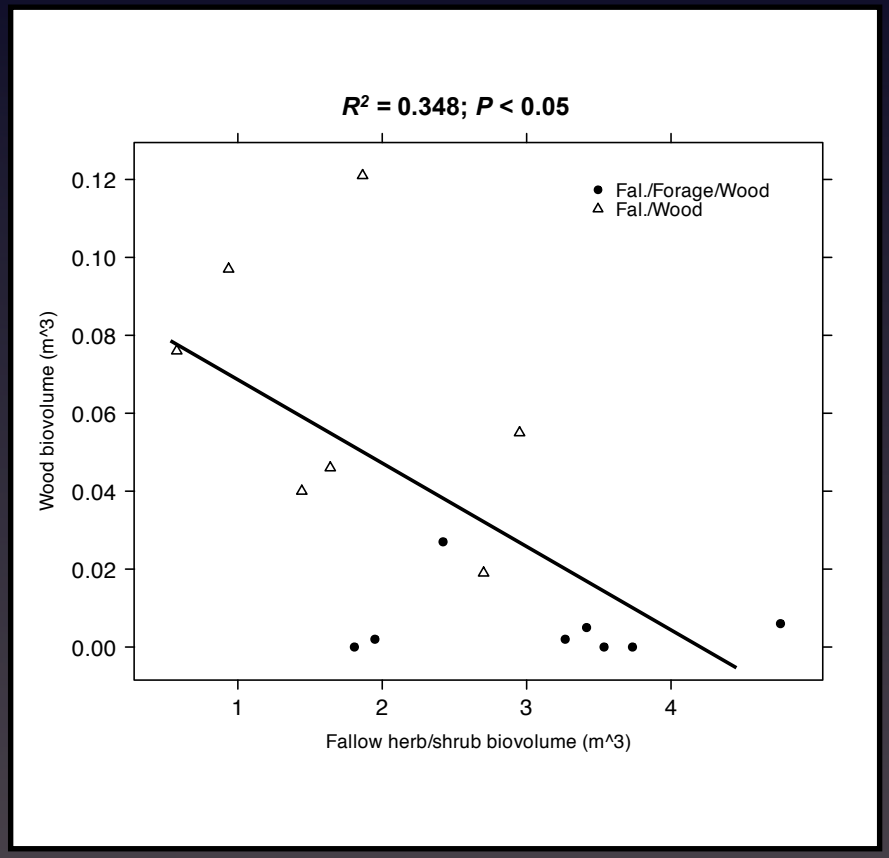
Temporally-mediated trade-offs:

- Food production / Soil sustainability (soil degradation)
- Food production / Climate regulation (global climate)

Trade-offs between provisioning ES

Sauri Millennium Villages Project site, Nyanza Province, western Kenya:

Wood production & Livestock forage production



Fallows producing:

- wood products only, or
- wood and livestock forage simultaneously

***<u>**Spatially-mediated trade-off:**</u>
How does this apparent biophysical trade-off relate to economic production through the fallow-crop cycle…?

Need to consider:

- market value of fallow goods produced: wood products, forage (livestock)
- productivity and market value of the subsequent maize crop

Common synergies between ES in agroecosystems

Spatially-mediated synergies:

Wood production / Water supply regulation, Water purification, Soil retention
Wood production / Regulation of pests, disease, & weeds
Wood production / Climate regulation (microclimate)
Wood production / Pollination

Temporally-mediated synergies:

Wood production / Soil sustainability (fallowing/land restoration)
Wood production / Climate regulation (global climate)

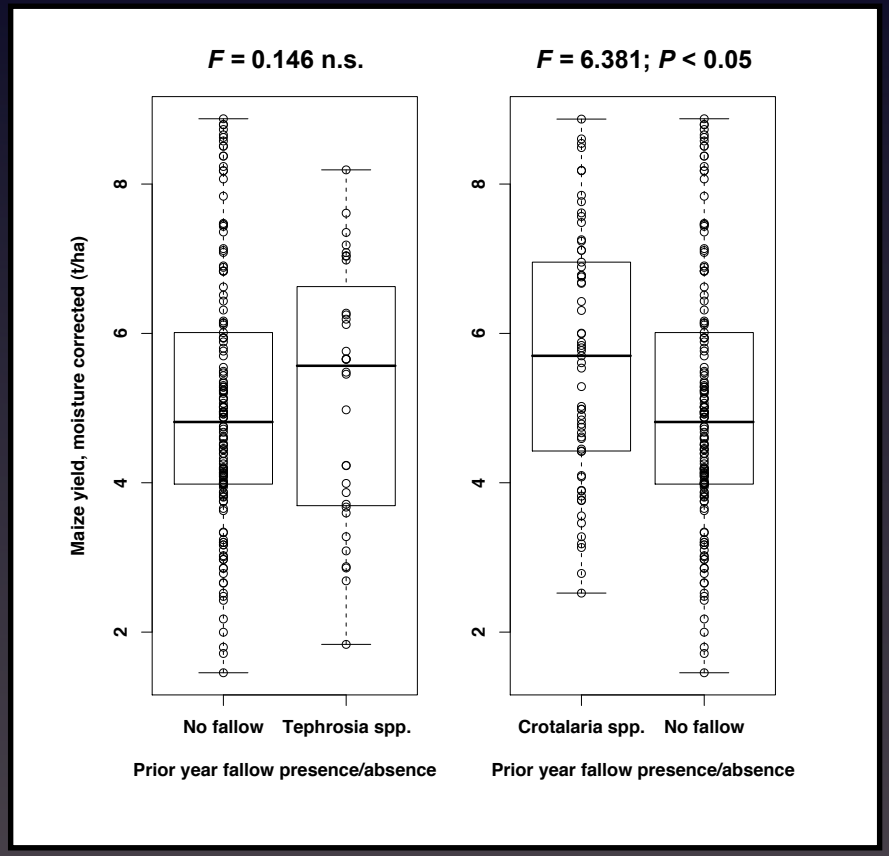
Synergies between provisioning ES

Sauri Millennium Villages Project site, Nyanza Province, western Kenya:

Wood production & Maize production

Maize fields:

- after an improved fallow, or
- no fallow in the prior season



***<u>**Temporally-mediated synergy:**</u>
How does this biophysical synergy relate to economic production through the fallow-crop cycle…?

Need to consider:

- opportunity costs of foregone maize cultivation (when the field is in fallow)
- productivity and market value of wood produced during the fallow period

ES Conservation & Markets

In conservation circles, ES-centered approaches are relatively new, and are somewhat controversial (most conservation remains centered on species and wilderness).

Ecosystem service projects:

- 'Wildlife-friendly' (WCS) and 'Frontier market' (WWF, TNC) programs:
  - Often use payments for ecosystem services (PES), or certification (Tallis et al. 2009).
  - Goals remain largely species-centered.
  - ES often used as a means to achieve these goals.
- Conservation certifications:
  - Leverage niche markets to value 'biological value chains', or 'biological production functions', which are often heavily discounted.
  - Goals include reducing rates of deforestation, over-harvest, and land degradation.
- ***How to handle trade-offs and synergies between ES?***
  - What are the most critical trade-offs and synergies for a particular product?
  - How can research and knowledge dissemination keep pace with practice?

Value Chain Development Tool

The ***value chain development tool*** (VCDT) is a first-pass toolkit for ES-based planning and management, by explicitly incorporating ES into supply-side decision-making.

Designed for use in agricultural systems, the VCDT considers both provisioning and non-provisioning ES that accrue from local (e.g., soil sustainability) to global scales (e.g., climate regulation).

The VCDT emphasizes the ecological basis of ES delivery, to improve practical linkages between social and ecological spheres:

- ***ES origins:*** Ecosystem service providers, and key components of biological diversity
- ***Resource management:*** Strategies to support ecosystem functioning

A key organizing concept is that an ES-oriented perspective on ES production illustrates trade-offs and synergies between ES, assisting in identifying…

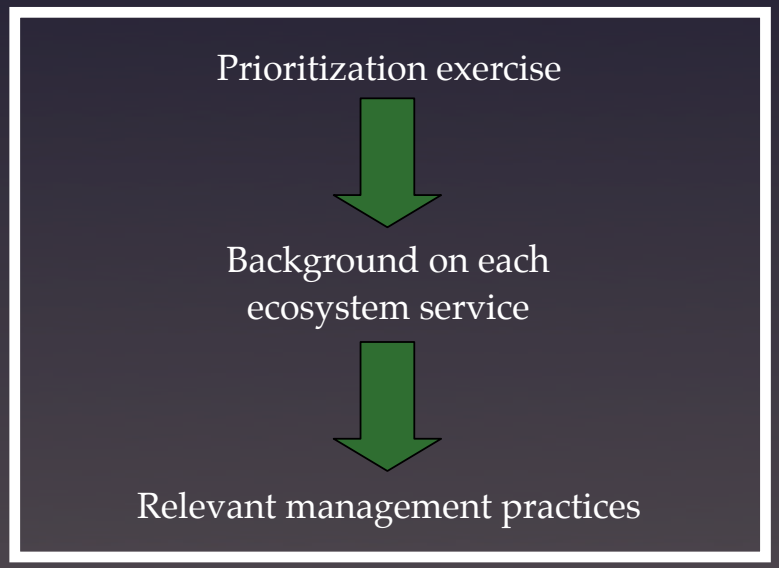
- pitfalls that may arise when 2+ ES have ***competitive*** production functions (**trade-off**)
- opportunities when 2+ ES have ***complementary*** production functions (**synergy**)

Value Chain Development Tool

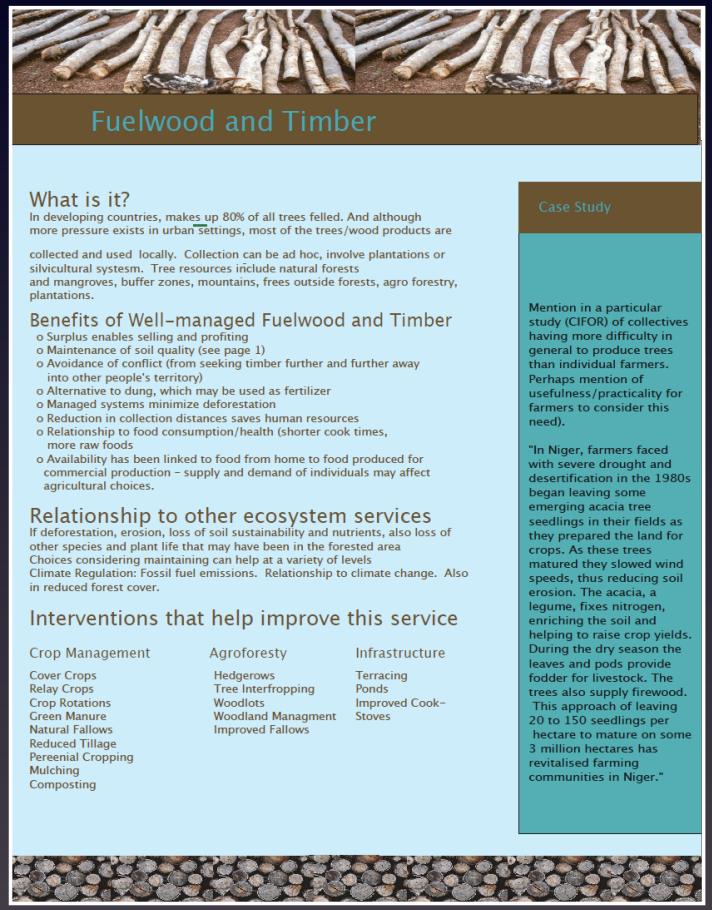
The first stage of creating the VCDT is the ***Ecosystem Services Primer***.

ES Primer: Provides an ES knowledge base, facilitating global VCDT application in a variety of conservation and development contexts.

ES Primer structure:



Ecosystem Services Primer; Draft



Fuelwood and Timber

What is it?

In developing countries, makes up 80% of all trees felled. And although more pressure exists in urban settings, most of the trees/wood products are collected and used locally. Collection can be ad hoc, involve plantations or silvicultural systesm. Tree resources include natural forests and mangroves, buffer zones, mountains, frees outside forests, agro forestry, plantations.

Benefits of Well-managed Fuelwood and Timber

- o Surplus enables selling and profiting
- o Maintenance of soil quality (see page 1)
- o Avoidance of conflict (from seeking timber further and further away into other people's territory)
- o Alternative to dung, which may be used as fertilizer
- o Managed systems minimize deforestation
- o Reduction in collection distances saves human resources
- o Relationship to food consumption/health (shorter cook times, more raw foods
- o Availability has been linked to food from home to food produced for commercial production – supply and demand of individuals may affect agricultural choices.

Relationship to other ecosystem services

If deforestation, erosion, loss of soil sustainability and nutrients, also loss of other species and plant life that may have been in the forested area
Choices considering maintaining can help at a variety of levels
Climate Regulation: Fossil fuel emissions. Relationship to climate change. Also in reduced forest cover.

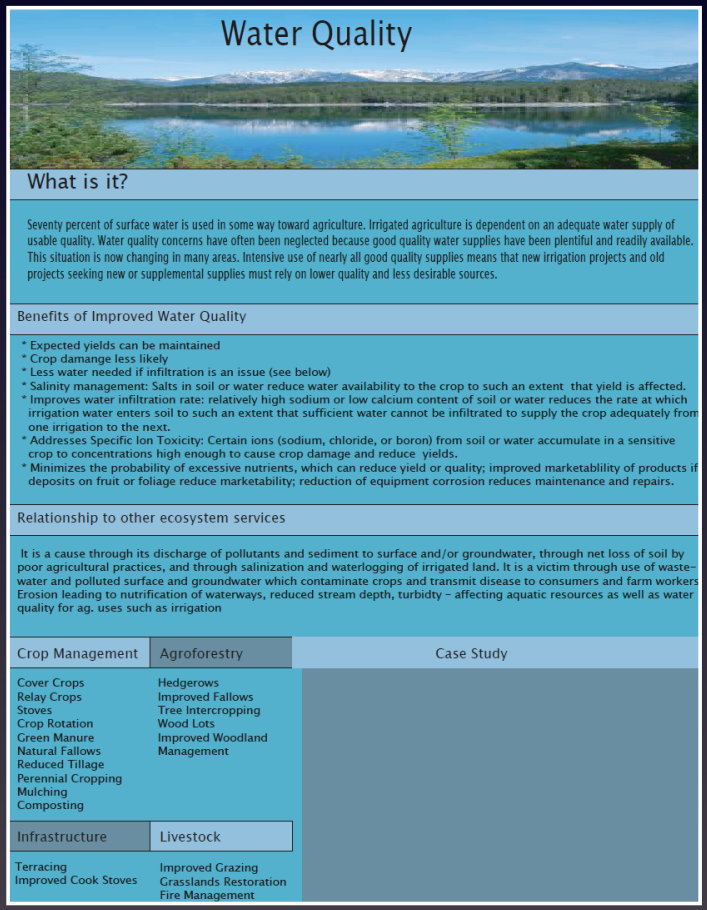
Interventions that help improve this service

Crop Management	Agroforesty	Infrastructure
Cover Crops	Hedgerows	Terracing
Relay Crops	Tree Interfropping	Ponds
Crop Rotations	Woodlots	Improved Cook-Stoves
Green Manure	Woodland Managment	
Natural Fallows	Improved Fallows	
Reduced Tillage		
Pereenial Cropping		
Mulching		
Composting		

Case Study

Mention in a particular study (CIFOR) of collectives having more difficulty in general to produce trees than individual farmers. Perhaps mention of usefulness/practicality for farmers to consider this need).

"In Niger, farmers faced with severe drought and desertification in the 1980s began leaving some emerging acacia tree seedlings in their fields as they prepared the land for crops. As these trees matured they slowed wind speeds, thus reducing soil erosion. The acacia, a legume, fixes nitrogen, enriching the soil and helping to raise crop yields. During the dry season the leaves and pods provide fodder for livestock. The trees also supply firewood. This approach of leaving 20 to 150 seedlings per hectare to mature on some 3 million hectares has revitalised farming communities in Niger."



Water Quality

What is it?

Seventy percent of surface water is used in some way toward agriculture. Irrigated agriculture is dependent on an adequate water supply of usable quality. Water quality concerns have often been neglected because good quality water supplies have been plentiful and readily available. This situation is now changing in many areas. Intensive use of nearly all good quality supplies means that new irrigation projects and old projects seeking new or supplemental supplies must rely on lower quality and less desirable sources.

Benefits of Improved Water Quality

- * Expected yields can be maintained
- * Crop damange less likely
- * Less water needed if infiltration is an issue (see below)
- * Salinity management: Salts in soil or water reduce water availability to the crop to such an extent that yield is affected.
- * Improves water infiltration rate: relatively high sodium or low calcium content of soil or water reduces the rate at which irrigation water enters soil to such an extent that sufficient water cannot be infiltrated to supply the crop adequately from one irrigation to the next.
- * Addresses Specific Ion Toxicity: Certain ions (sodium, chloride, or boron) from soil or water accumulate in a sensitive crop to concentrations high enough to cause crop damage and reduce yields.
- * Minimizes the probability of excessive nutrients, which can reduce yield or quality; improved marketablility of products if deposits on fruit or foliage reduce marketability; reduction of equipment corrosion reduces maintenance and repairs.

Relationship to other ecosystem services

It is a cause through its discharge of pollutants and sediment to surface and/or groundwater, through net loss of soil by poor agricultural practices, and through salinization and waterlogging of irrigated land. It is a victim through use of waste-water and polluted surface and groundwater which contaminate crops and transmit disease to consumers and farm workers Erosion leading to nutrification of waterways, reduced stream depth, turbidty – affecting aquatic resources as well as water quality for ag. uses such as irrigation

Crop Management	Agroforestry	Case Study
Cover Crops Relay Crops Stoves Crop Rotation Green Manure Natural Fallows Reduced Tillage Perennial Cropping Mulching Composting	Hedgerows Improved Fallows Tree Intercropping Wood Lots Improved Woodland Management	
Infrastructure	**Livestock**	
Terracing Improved Cook Stoves	Improved Grazing Grasslands Restoration Fire Management	

<u>Goals:</u> **Provide a practical guide to the essentials of ES delivery; (+) and (–) linkages between ES; prioritizing among ES; and commonly effective management strategies for various ES.**

<u>Target audience:</u> **Lower- to mid-level practitioners and managers, in the fields of conservation, rural development, and PES in agricultural landscapes.**

Value Chain Development Tool & Ecosystem Services Primer

The value chain development tool (VCDT) will build from the knowledge base provided by the ES Primer.

Potential ES Primer/VCDT applications include individuals and institutions engaged in:

- Sustainable and/or diversified agricultural production
- 'Wildlife-friendly' goods, 'frontier markets'
- PES programs
- Management and conservation of publicly-accruing ES (including PES)
- Landscape agricultural planning (including PES)

We're keen to discuss this work, and to receive feedback from a variety of views, to improve the ES Primer and the VCDT. Please don't be bashful…

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