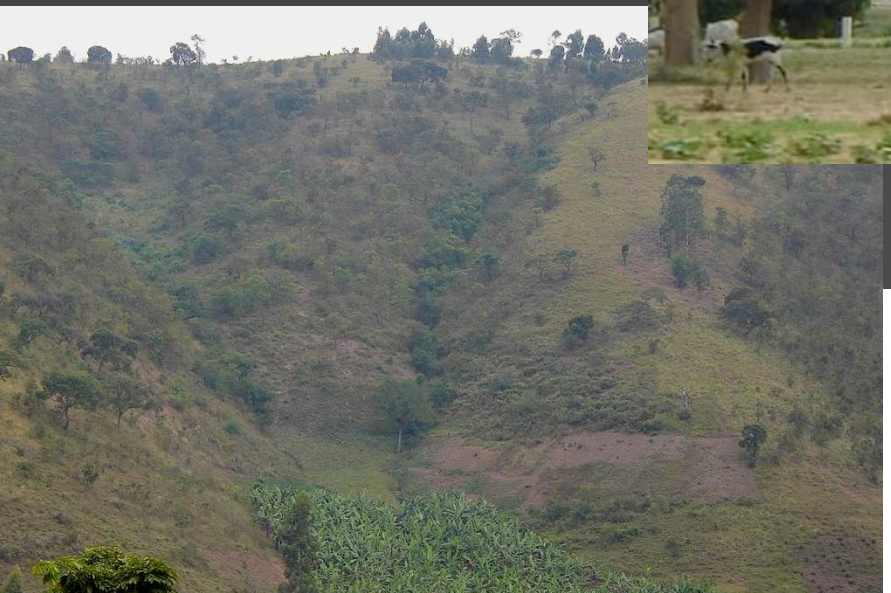
Ecological
of ecos
serv



Ecosystem service classifica

- 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”

The semantics of ecosystem servic

m processes … Ecosystem services … Ecosystem funct

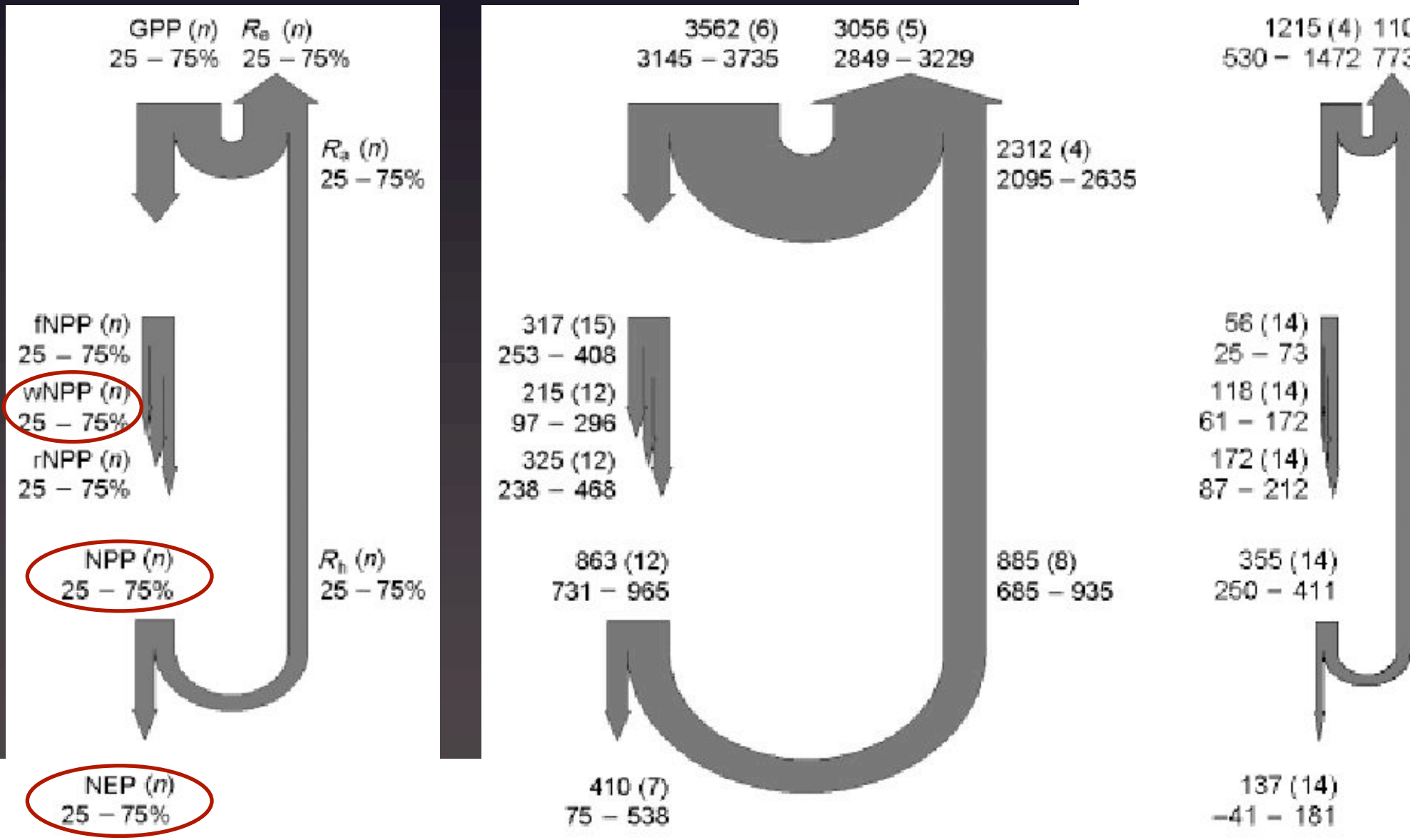
system Process (EP) — any transfer or transformation of e
veen pools (= stocks) in an ecosystem.

Key terrestrial ecosystem processes: productivity (NPP); decomposition; m
carbon, water, nutrients, and energy; trophic interactions (predation, h

— *Ecosystem processes & Ecosystem services* –

Legend

Tropical rainforest



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

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system Service (ES) — any benefit to society from ecosy
naged (ecosystem disservices (EDS) are ecosystem costs to society)

system Function — may be (i) an ecosystem process; (ii)
perty (stability, ecosystem modulators); or (iii) an ecosystem s

Biophysical regulation of ecosyste

- Biome scales:
- EP and ES are constrained by climate, soils, topography.
- For example, forests store more C than grasslands, & provide mo supply.
- Local scales (& below):
- EP and ES are regulated by variation in:

cosystem service providers (ESPs): (Kremen 2005)

- A) abiotic conditions; B) biotic communities; & C) land manage

ESPs: Biogeochemical cycles, plants, micro-organisms, invertebrates,

- ***Some ES rely on many (or all) ESP functional units, while others r
- ***Fine-scale influences of organisms on ecosystems scale upward

ological diversity & functional traits:– *Functional traits:* Determ

ganisms, organismal diversity, biotic

communities, land use/cover and land use/cover diversity

Synergies & trade-offs betwe

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

- ***ES Trade-off*:** The supply of a given ES decreases alon
  of one or more ES (i.e., a ***competitive*** production functio

- Spatial and temporal mediation of ES synergies & trade-
  - Some are purely spatial, or purely temporal, but often both are i

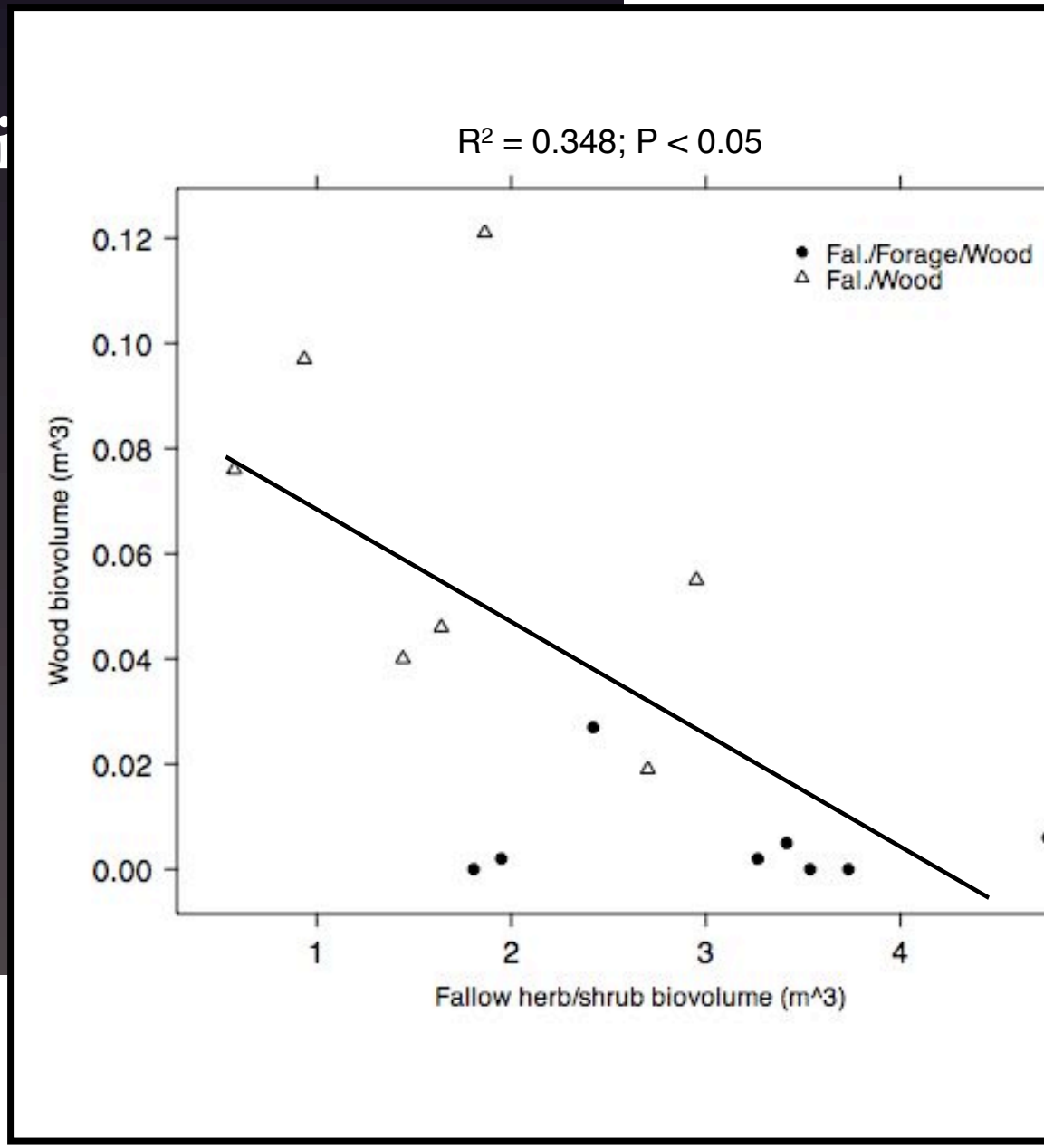
Common trade-offs between
in agroecosystems

- *Spatially-mediated trade-offs:*
  - Wood production / Livestock production
  - Wood production / Food production
  - Food production / Livestock production
  - Food production / Water supply regulation, Water purification, Sc
  - Food production / Regulation of pests, disease, & weeds
  - Food production / Pollination

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

Wood production &

Livestock forage producti



Fallows producing:

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

Common synergies between E
in agroecosystems

patially-mediated synergies:

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

emporally-mediated synergies:

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

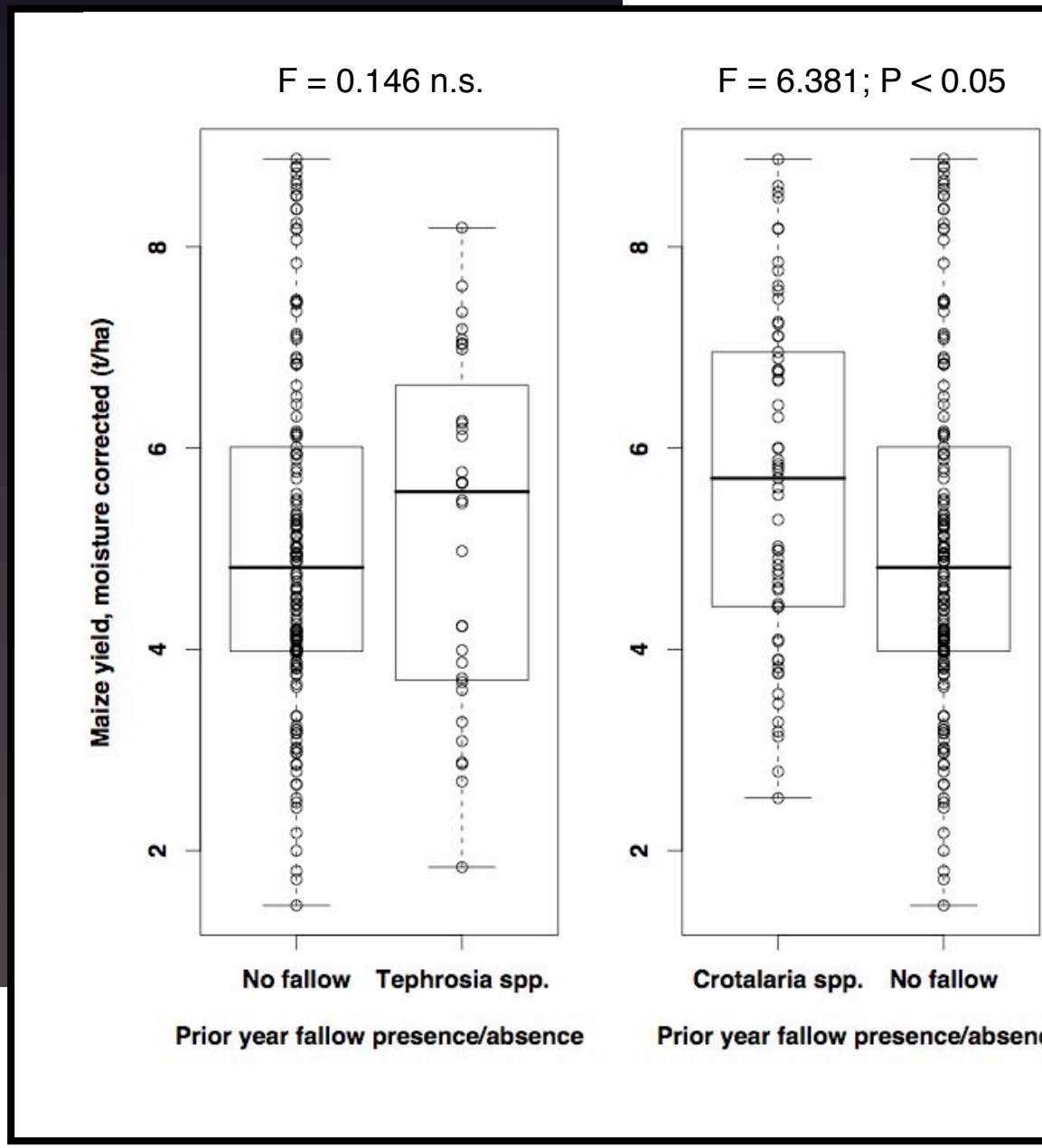
Sauri Millennium Villages Project site, Nyanza Province, western Kenya:

Wood production &

Maize production

Maize fields:

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



ES Conservation & Mark

- In conservation circles, ES-centered approaches are relat
somewhat controversial (most conservation remains centered on

- Ecosystem service projects:
  - 'Wildlife-friendly' (WCS) and 'Frontier market' (WWF,
    - Often use payments for ecosystem services (PES), or certifica
    - Goals remain largely species-centered.
    - ES often used as a means to achieve these goals.

Value Chain Development

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

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

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

  - *ES origins:* Ecosystem service providers, and key components o

  - *Resource management:* Strategies to support ecosystem functio

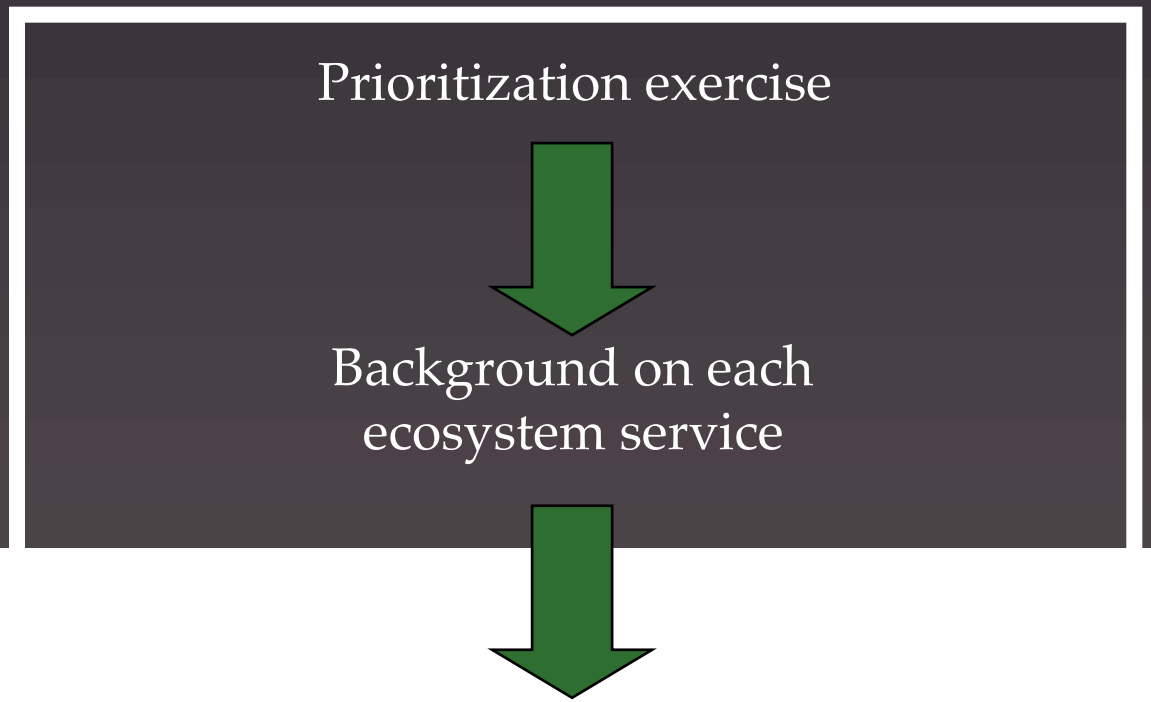
- A key organizing concept is that an ES originates from

Value Chain Development

he first stage of creating the VCDT is the *Ecosystem Se*

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

ES Primer structure:



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

Cover Crops
Relay Crops
Crop Rotations
Green Manure
Natural Fallows
Reduced Tillage
Pereenial Cropping
Mulching
Composting

Agroforesty

Hedgerows
Tree Interfropping
Woodlots
Woodland Managment
Improved Fallows

Infrastructure

Terracing
Ponds
Improved Cook-Stoves

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 fro 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 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 worker 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

Cover Crops
Relay Crops
Stoves
Crop Rotation
Green Manure
Natural Fallows
Reduced Tillage
Perennial Cropping
Mulching
Composting

Agroforestry

Hedgerows
Improved Fallows
Tree Intercropping
Wood Lots
Improved Woodland Management

Infrastructure

Terracing
Improved Cook Stoves

Livestock

Improved Grazing
Grasslands Restoration
Fire Management

Case Study

Ecosystem Services Prim

- The value chain development tool (VCDT) will build
  knowledge base provided by the ES Primer.
- Potential ES Primer/VCDT applications include ind
  institutions engaged in:
  - Sustainable and/or diversified agricultural production
  - 'Wildlife-friendly' goods, 'frontier markets'
  - PES programs
  - Management and conservation of publicly-accruing ES
  - Landscape agricultural planning (including PES)

This publication is made possible by the generous support of the American people through the United States Agency for International Development (USAID), under the terms of the TransLinks Leader with Associates Cooperative Agreement No.EPP-A-00-06-00014-00 to The Wildlife Conservation Society. TransLinks is a partnership of The Wildlife Conservation Society, The Earth Institute, EnterpriseWorks/VITA, Forest Trends and The Land Tenure Center. The contents are the responsibility of EnterpriseWorks/VITA and do not necessarily reflect the views of USAID or the United States Government.