Agricultural Productivity and Ecosystem Sustainability: Solutions from Farm to Landscape Scale

Sara J. Scherr, EcoAgriculture Partners
Navigating the Global Food System in a New Era
IAMA, Boston, June 21, 2010
Challenges for agricultural production in the 21st century

- Meet food & fiber demand for 9 billion people (↑50-100% by 2030)
- Reduce rural food insecurity and poverty; secure urban food supply
- Contribute to sustainable energy through biofuels
- Adapt to climate change
- Restore degraded resources critical for production
- Shift from a major source of greenhouse gases, to a net sink
- Contribute to and restore critical ecosystem services
Can we solve this challenge with “super-farms” + protected areas?
Importance of agric’l landscapes for ecosystems and biodiversity

PAGE Agricultural Extent

[Map showing agricultural extent worldwide with different land cover categories indicated]
Agriculture and land use: ~ 31% of global greenhouse gas emissions

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Annual Emissions</th>
<th>GHG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>6,558</td>
<td></td>
</tr>
<tr>
<td>Soil fertilization</td>
<td>2,128</td>
<td>Nitrous oxide</td>
</tr>
<tr>
<td>Food digestion in cattle</td>
<td>1,792</td>
<td>Methane (CH4)</td>
</tr>
<tr>
<td>Biomass burning</td>
<td>672</td>
<td>CH4, NO2</td>
</tr>
<tr>
<td>Paddy rice pdn</td>
<td>616</td>
<td>CH4</td>
</tr>
<tr>
<td>Livestock manure</td>
<td>413</td>
<td>CC4, NO2</td>
</tr>
<tr>
<td>Chemical fertilizer pdn</td>
<td>410</td>
<td>CO2, NO2</td>
</tr>
<tr>
<td>Delivery of irrigation water</td>
<td>369</td>
<td>CO2</td>
</tr>
<tr>
<td>Farm machinery</td>
<td>158</td>
<td>CO2</td>
</tr>
<tr>
<td>Deforestation</td>
<td>8,477</td>
<td>CO2</td>
</tr>
<tr>
<td>For agric or livestock</td>
<td>2,900</td>
<td></td>
</tr>
</tbody>
</table>

• Sources: IPCC AR4, data from 2004 and 2005.
  (note: fossil fuel burning-- 27,734 million tons CO2 eq
Rainfed maize yields decline 17% by 2050.
Probability of precipitation less than 75% of long-term mean annual value
Integrating the agendas to feed 9 billion & protect ecosystems

1) Help farmers raise production in the context of climate risks

2) Mitigate climate threats-shift agriculture from major source to net sink of greenhouse gas

3) Restore degraded croplands and pastures

4) Secure water for agriculture by protecting water quality and watershed functions

5) Support farmers to be major stewards of ecosystems
Ecoagriculture landscapes

Agricultural landscapes managed to enhance rural livelihoods and sustainable agricultural production (of crops, livestock, fish and forest), while conserving or restoring ecosystem services and biodiversity.
## Maintaining ecosystem services in agricultural landscapes (mosaics)

<table>
<thead>
<tr>
<th>In conservation areas</th>
<th>In production areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Natural areas that benefit local farming communities</td>
<td>• Minimize agricultural pollution (incl. GHG)</td>
</tr>
<tr>
<td>• Provide watershed protection, habitat connectivity thru non-farmed areas</td>
<td>• Manage water flow, use &amp; infiltration-plot,farm,landscape</td>
</tr>
<tr>
<td>• Reduce or reverse land conversion by increasing farm productivity</td>
<td>• Increase carbon storage in soils and vegetation</td>
</tr>
<tr>
<td>• Develop species conservation plans</td>
<td>• Modify farming systems to mimic natural ecosystems</td>
</tr>
<tr>
<td></td>
<td>• Maintain diversity of crop species &amp; varieties</td>
</tr>
</tbody>
</table>
Linking agribusiness supply chains with landscape initiatives

Kabale, Uganda

Willamette Valley, USA

Niger

Kikuyu Escarpment, Kenya
Towards ‘win-win-win’ solutions: Reduce tradeoffs, realize synergies
Crop genetic selection, breeding and conservation

- Adapt to/mitigate climate change
- For biodiverse systems
- Domestication of wild species
- Minor crops/breeds
- Increasing yields, biomass
- Increasing resilience
- Perennialize annuals
- Reduce input requirements
- Productive in polycultures
- Reduce GHG emissions

**But only**
**part of the solution**
Cropping systems improve soils, input efficiency, carbon sequestration

- Conservation agriculture
- Minimum tillage
- Cover crops
- Vegetative erosion barriers
- Precision agriculture
- Intercrops
- Nitrogen fixation
- Bio-char
Incorporating perennials in production systems

- Fertilizer trees & shrubs
- Fruits, grasses, palms, bamboos
- Timber, fuelwood
- Live fences, windbreaks
- Natural regeneration
More climate- and ecosystem-friendly livestock production systems

- Intensive grazing systems
- Perennial feeds, fodder
- Manure management
- Bio-digesters
Restoring degraded watersheds & rangelands

- Riparian re-vegetation
- Reforestation
- Managed regeneration
- Rangeland rehabilitation
- Improved fallows
Conserving natural habitats and habitat networks in ag’l landscapes
The Landscape Measures Resource Center (LMRC) is a collection of ideas and tools to aid in managing areas where interests in protecting biodiversity, producing food and securing rural livelihoods converge. The LMRC is rooted in the premise that measurement enhances management. Learning to measure how landscapes perform in delivering food, biodiversity and livelihood outcomes is anticipated to endow management systems with the capacity to sustain these multiple functions while reducing or reversing the degradation of natural resources.

The creators of the LMRC recognize producers of crops, livestock, fish and forest resources as stewards of ecosystems and biodiversity. The LMRC is designed to bring the knowledge of these natural resource managers and their supporters to bear on the challenges of landscape measurement and management.

A web-based hub for a virtual learning network

Testing in “learning landscapes”

www.landscapemeasures.org
Emerging markets for “green” & “climate-friendly” products & services

- Min. regulatory standards
- Eco-labeling & certification
- Public procurement rules
- Food industry standards (Sust. Food Lab, Sust Ag Init, Keystone, Roundtables)
- Processing and quality standards for minor products
- Payments for ecosystem stewardship
- Offsets for C, BD, H2O
- Shifting subsidies
Emerging business opportunities

- Crop varieties with traits benefitting ecosystems (e.g., shade tolerance, deep-rooting, high-yield polycultures)
- Technologies for diverse systems (e.g., improve minor/perennial crops; multi-species marketing; machinery for polyculture & precision farming)
- Knowledge & information services on farm & landscape mgmt
- Products & processes to facilitate land, water, habitat rehabilitation
- Spatial monitoring tools: PES, regulation, certification, footprinting
Thank you....

www.ecoagriculture.org