Water Security and Biodiversity

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Water stress - globally

• "The ecological limits of water available for abstraction have probably already been reached". (IWMI 2009)
  – Already exceeded regionally

• In 2030, 47% of the world population will be living in areas of high water stress; 67% will not have improved sanitation
Climate change as a driver– changes in water availability 2050 (compared to 1961-1990) (IPCC projections)
Number of intense hurricanes

maximum wind speed

Number of hurricanes/category

Source: Emanuel, 2005
Biodiversity?

Population index 100 in 1970

- Ramsar Convention
- Rio Conventions-CBD, UNFCCC, UNCCD
- Terrestrial species
- Marine species
- Freshwater species
- All vertebrate species (Living Planet Index)

World Conservation Monitoring Centre
FIGURE 1.1 | Biodiversity, ecosystem functioning, ecosystem services, and drivers of change

**INDIRECT DRIVERS OF CHANGE**
- Demographic
- Economic
- Sociopolitical

**DIRECT DRIVERS OF CHANGE**
- Climate change
- Nutrient loading
- Land use change
- Species introduction
- Overexploitation

**HUMAN WELL-BEING**
- Basic Material for good life
- Health
- **Security**
- Good social relations
- Freedom of choice and action

**ECOSYSTEM GOODS AND SERVICES**

**GOODS** (provisioning services)
- Food, fiber and fuel
- Genetic resources
- Biochemicals
- **Fresh water**

**REGULATING SERVICES**
- Invasion resistance
- Herbivory
- Pollination
- Seed dispersal
- **Climate regulation**
- Pest regulation
- Disease regulation
- **Natural hazard protection**
- Erosion regulation
- **Water purification**

**CULTURAL SERVICES**
- Spiritual and religious values
- Knowledge system
- Education and inspiration
- Recreation and aesthetic values

**SUPPORTING SERVICES**
- Primary production
- **Provision of habitat**
- Nutrient cycling
- Soil formation and retention
- **Production of atmospheric-oxygen**
- Water cycling
An example: soils
DIREKTSAAAT
semis direct
zero tillage

PFLUG
labour
plow
Example: Mississippi River Delta
## Land cover/use values

### Mississippi Delta

<table>
<thead>
<tr>
<th>Land Cover Type</th>
<th>Acres</th>
<th>Low Value Estimate</th>
<th>High Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh Water Marsh</td>
<td>877,099</td>
<td>$2,833,616,569</td>
<td>$11,077,411,806.55</td>
</tr>
<tr>
<td>Intermediate Marsh</td>
<td>660,933</td>
<td>$1,823,993,642</td>
<td>$4,429,535,089.73</td>
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<tr>
<td>Brackish Marsh</td>
<td>547,445</td>
<td>$1,510,797,014</td>
<td>$3,668,942,825.58</td>
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<tr>
<td>Saline Marsh</td>
<td>421,561</td>
<td>$1,098,191,310</td>
<td>$2,760,038,549.65</td>
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<tr>
<td>Shrub-scrub wetland</td>
<td>172,106</td>
<td>$393,890,419</td>
<td>$1,531,460,185.19</td>
</tr>
<tr>
<td>Forested/Swamp Wetland</td>
<td>1,031,561</td>
<td>$3,335,203,387</td>
<td>$13,258,333,954.99</td>
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<tr>
<td>Open Fresh Water</td>
<td>992,127</td>
<td>$428,346,204</td>
<td>$2,959,631,369.64</td>
</tr>
<tr>
<td>Open Estuarine Water</td>
<td>3,549,990</td>
<td>$68,661,717</td>
<td>$6,822,566,401.65</td>
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<tr>
<td>Upland Shrub-Scrub</td>
<td>84,799</td>
<td>$9,090,572</td>
<td>$135,305,795.41</td>
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<tr>
<td>Upland Forest</td>
<td>172,106</td>
<td>$78,575,469</td>
<td>$699,135,025.33</td>
</tr>
<tr>
<td>Pasture-Agriculture</td>
<td>481,575</td>
<td>$37,997,389</td>
<td>$42,802,567.96</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>8,940,461</td>
<td>$11,953,060,333</td>
<td>$47,385,163,571.67</td>
</tr>
</tbody>
</table>
Example: natural and built infrastructure working together
Itaipu Dam, Brazil
Example: policies, economics, incentives
- use values of mangroves

All values are NPV over 9 years and a 10% discount rate given in 1996 US$.
water management
- water use and built infrastructure

impacts

ecosystems/biodiversity
(natural infrastructure)
Considered an unfortunate but a necessary “cost”
(- actually increased risk through unplanned and unmanaged impacts on water-related goals)

Old approaches:

New paradigm:

Water management
(including land management)

Water supply: built and natural infrastructure

Water for direct human use
(e.g., drinking, sanitation, food production) water security

other ecosystem services underpinned by water:
e.g., disaster risk reduction, nutrient cycling, coastal zone protection, water security, fisheries, recreation, etc.

Management goals:
Sustained ecosystem benefits
Putting it together:
- ecosystem influences on water and human development goals and targets in a landscape setting
The important Itaipu Dam in Brazil is one of the largest dams in existence. The Itaipu watershed includes deep red ferralsols, with good fertility potential, located in a humid subtropical climate characterized by hot, humid summers and mild winters. There is high agricultural productivity, but violent rain storms lead to high erosion and flows of sediments and nutrients into Itaipu Lake. Eutrophication and sedimentation reduce the productivity of the dam. This is being addressed through the community-based “Cultivando Água Boa” (Cultivating Good Water) programme, supported by the Brazilian Federation of No Till Farmers Associations (FEBRAPD), supported by Itaipu Binacional (Itaipu Dam Enterprise). Success is being achieved by simply transforming agriculture from tillage-based to no-till conservation agriculture (see Box 4). When the dam was built, its estimated working life was 60 years, but by managing soils as natural water infrastructure the life expectancy of the dam has increased tenfold, and farmers benefit through improved crop productivity and sustainability.
These trends in lost ecosystem services have global implications. For example: they suggest food supply is increasingly insecure, with all the potential ramifications for everybody of such a situation. Water loss from soils, in dry and sub-humid areas, is the direct cause of desertification (by definition). Although 78% of currently degrading land is in non-dryland areas, over 45 per cent of Africa is affected by desertification, 55 per cent of this area is at high or very high risk of further degradation and 2/3rds of Africa’s arable land could be lost by 2025 if this trend continues, land degradation directly affects 1.5 billion people globally and 74% of the poor are directly affected by land degradation (UNCCD Secretariat 2011). By 2030, about half of the world population will be living in areas of high water stress (OECD 2008), agriculture already accounts for 70% of global water withdrawals and is under increasing competition with other water uses (WWAP 2012), meanwhile water is already the major constraint to increased agricultural output (CA 2007).