Disrupting Degradation
Data-Driven Decisions

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Outline

• Global challenges: Growing population, climate change, and environmental degradation (=atmospheric, soil, water pollution)

• Climate smart agriculture: Enhance food productivity, improve resilience to climate change shocks, and mitigate the emissions of greenhouse gases (GHGs) & ‘Waste’

• Soil Carbon – the lynchpin of Climate Smart Agriculture (CSA) & Resilient, Non-Polluting Landscapes (Integrated Nutrient, Carbon, Waste Management)

• Landscape Scale Resilience, and Data-driven Decision Support for farmers, planners, policy makers
“For all of humanity’s sophistication, we owe our existence to the fact that it rains and 6 inches of topsoil” (anon)
Soil & Vegetation Mismanagement = Land Degradation!

**Loss of soil** (erosion of bare soil), **Loss of carbon** (60% of terrestrial C is in the top 2 m of soil), **Loss of nutrients** (especially nitrogen that is very mobile and washed down slope as evidenced in the above pic by yellowish vegetation (N deficient) and darker green colors where N is accumulating lower down the slope.)
Soil, Soil C, and the Economy

• Agriculture and Forestry (food, feed, fuel, fiber, timber)
• Soil Organisms – a teaspoon of soil can contain 4 billion microorganisms!
  • Most of our antibiotics were isolated from soil microorganisms
  • Biological nitrogen fixation (RNA, DNA, Proteins, life!!)
  • Mycorrhizal fungi (P + water for plants)
  • Decomposer fungi (breakdown plant litter)
• Nutrient and Water Holding Capacity (pollution control, drought/flood control)
• Carbon reservoir (~60% of terrestrial carbon in top 2m of soil!!)
Restoring Degraded Landscapes: The Role of Integrated Nutrient, Carbon & Waste Management

5 Principles for Climate Smart Landscapes

1. Protect the soil to conserve soil organic matter, reduce surface flows of water & enhance water infiltration into soil.
2. Rehabilitate degraded land & Stabilize slopes via contour plantings (that will eventually result in terraces),
3. Integrate perennial species, forests, and agroforestry in the landscape
4. Protect all stream and river banks (riparian zones) with native vegetation/forests
5. Combine best available science with adapted local best practices

Eight Steps to Enhance Global Soil Carbon

1. Stop Carbon Loss (protect forests, peatlands)
2. Restore degraded lands and enhance C sequestration (local to regional scales)
3. Deploy technologies (instruments)
4. Monitor, measure, verify outcomes
5. Test strategies (model, simulate, adjust)
6. Involve communities (engage & empower)
7. Coordinate policies (local, national, International)
8. Provide support (data, databases, knowledge, capacity enhancement, funding)

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Land Insecurity, Uneven Tenure, Land Rights, Indigenous Communities, Competition

Increase food production
Build resilience/ Reduce poverty / Share Prosperity
Increase Carbon Sequestration (& Reduce Carbon Emissions)

Forests & Agroforests: Wood + Fuel & Carbon + Water + Biodiversity

Ecosystem Services for Resilient Landscapes

Integrated Nutrient, Carbon & Waste Management for Resilient Landscapes

Climate Smart Agriculture

Land Insecurity, Uneven Tenure, Land Rights, Indigenous Communities, Competition
Examples of Rehabilitation of Degraded Lands

World Bank Group Programs with the Governments & Communities of

Brazil, China, India, Rwanda, & Turkey
Wasted Landscape

Restored & Productive Landscape
w Integrated Nutrient and Carbon Management

Uttar Pradesh (India) Sodic Lands Reclamation Project

“Wasted Landscape”

2 years

Restored & Productive Landscape

Community Ownership

WORLD BANK GROUP
Agriculture
Transforming degraded landscapes to vibrant, productive and resilient ‘farmscapes’

Loess Plateau, China
Helping Communities to Restore Degraded Landscapes
Eastern Anatolia, Turkey

Terracing to stabilize degraded slopes, enhance rainwater infiltration, conserve soil moisture.

Wild Crop Relatives (pears, almonds, hawthorns) Restored and contributing to landscape integrity.

Landscape Approach "Peaks to valleys".

Community Ownership Women empowered & Participating.

Forestry & Agroforestry for diversified products and income.

Water Courses and 'riparian zones' re-vegetated. Water Flows & Quality Restored.

Agricultural Productivity restored and enhanced.

Photos: Erik Termaat

World Bank Group Agriculture
Rwanda: Land Husbandry Project
- Terraces for nutrient & water conservation
- Riparian forests & bio-corridors
- Ecology
- Rehabilitation of degraded lands
- Legumes for biological nitrogen fixation
- Vegetation barriers for Erosion Control
- Managed drainage & Infiltration

Brazil: Rehabilitation of degraded pastureland
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- ~10 yrs
- High value timber + high carbon agroforests
- High protein-high energy feedstocks
- Lower GHG, intensive pastures
- Mahogany
DATA FRAMEWORK FOR ENVIRONMENTAL DECISION SUPPORT
INTERFACE FOR INTEGRATED PLANNING

DATA MODULES
- Political Boundaries
- Climate
- Infrastructure
- Landuse
- Soils
- Topography

COMPUTATIONAL ENGINE
- Geospatial Models

TO POLICIES
- Gas emission
- Hydro-Electricity
- Agricultural Production
- Droughts, Floods
- Soil Moisture
Geo-spatial & Multisector Data Grid
(Data Assembly, Organization, Access, Models)
Data & Decision Support for Territorial Planning

Examples from World Bank Group Programs
The WBG Ag Observatory

Harnessing Big Data and Machine Learning for productive and resilient agriculture
The WBG Ag Observatory

Providing agricultural intelligence for the World Bank Group and Partners

Gamechanger Disruptive Technologies & Innovation?

“Big Data + Artificial Intelligence + Machine Learning”

- 1.5 million Virtual Met Stations
- Every 9 km across the terrestrial surface of the earth
- 7 billion data points updated every 6 hours
Single Country & Transboundary Prototype

*Generation 1*
Model Input

"Dataframe" for VIC Aral model
(time step = daily, spatial scale ~25km)

Topography (SRTM)

Soil Layers (FAO)

Vegetation (MODIS)

Climate Forcing
Precip, Temp, Wind
(reanalysis, models)
Simulation & Visualizations for Decision Support to Policy Makers, Planners, and Land Users
Example from the Himalayas

EPT @ National Scale over 1 year

Rainfall, EPT, Surface Runoff over 1 year
WBG & Donor Community Supported (e.g. Govt. of Israel)
Capacity Enhancement of Multisector Teams from Public & Private Agencies
The Sahel: Frontier for displacement, migration and growing insecurity

Opportunities for enhancing local livelihoods & resilience

Source: Sigsael, 2017
~20 million Women Holding the Line in the Sahel!!
WBG helping communities w Data Driven Decisions
CONCLUSIONS

1. **Climate Change and Population Growth** require that countries undertake appropriate simulations of likely impacts on critical sectors for economic development at relevant spatial and time scales – **we are drowning in waste!!!**

2. **Integrated Waste Management has always been possible** and is now essential for productive and climate smart agriculture & landscapes

3. **Landscape Scale Planning and Decision Support Frameworks** are practical and necessary tools for governments and policy makers

4. **Cross sector (inter Ministry) data integration and linkages are essential** for effective local to national to regional/global analyses, synthesis, scenarios and decision-making

5. Many WBG partners in Latin America, Central Asia, South Asia, and Africa are implementing **Data-Driven Decision Support for Landscape Scale Resource Management and Planning**

6. **The World Bank is providing technical assistance and project financing** to assist client countries to develop their own Dynamic Cross-Sector Data Frameworks for Territorial Planning and Landscape Scale integrated management of natural resources, waste, and pollution and to conduct impact simulations for prioritizing investments for **Enhanced Resilience to Climate Change.**
Thank you!

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