



Ecosystem Goods and Services from Canadian Grasslands

Presentation to CFGA

Dimple Roy
November 2016

The International Institute for Sustainable Development (IISD)

- Independent, non-profit organization that undertakes policy analysis to help governments, institutions and companies make tangible advances in the development and implementation of policies that promote equity and a healthy planet
- Areas of focus: resilience, economic law and policy, energy, water and knowledge for integrated decisions
- Based in Canada with over 200 staff and associates, and offices in Winnipeg, Ottawa, Geneva and New York

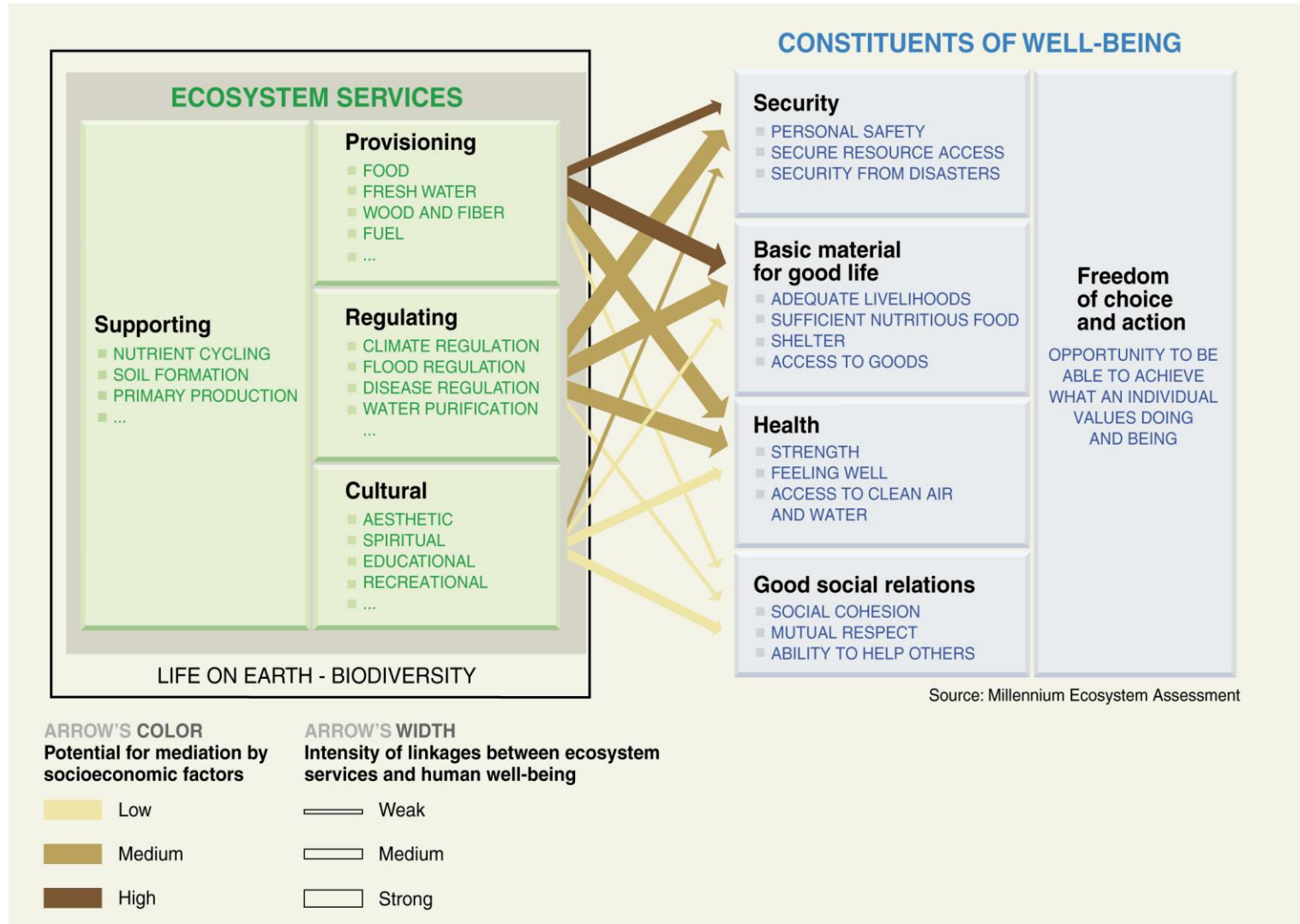




Outline

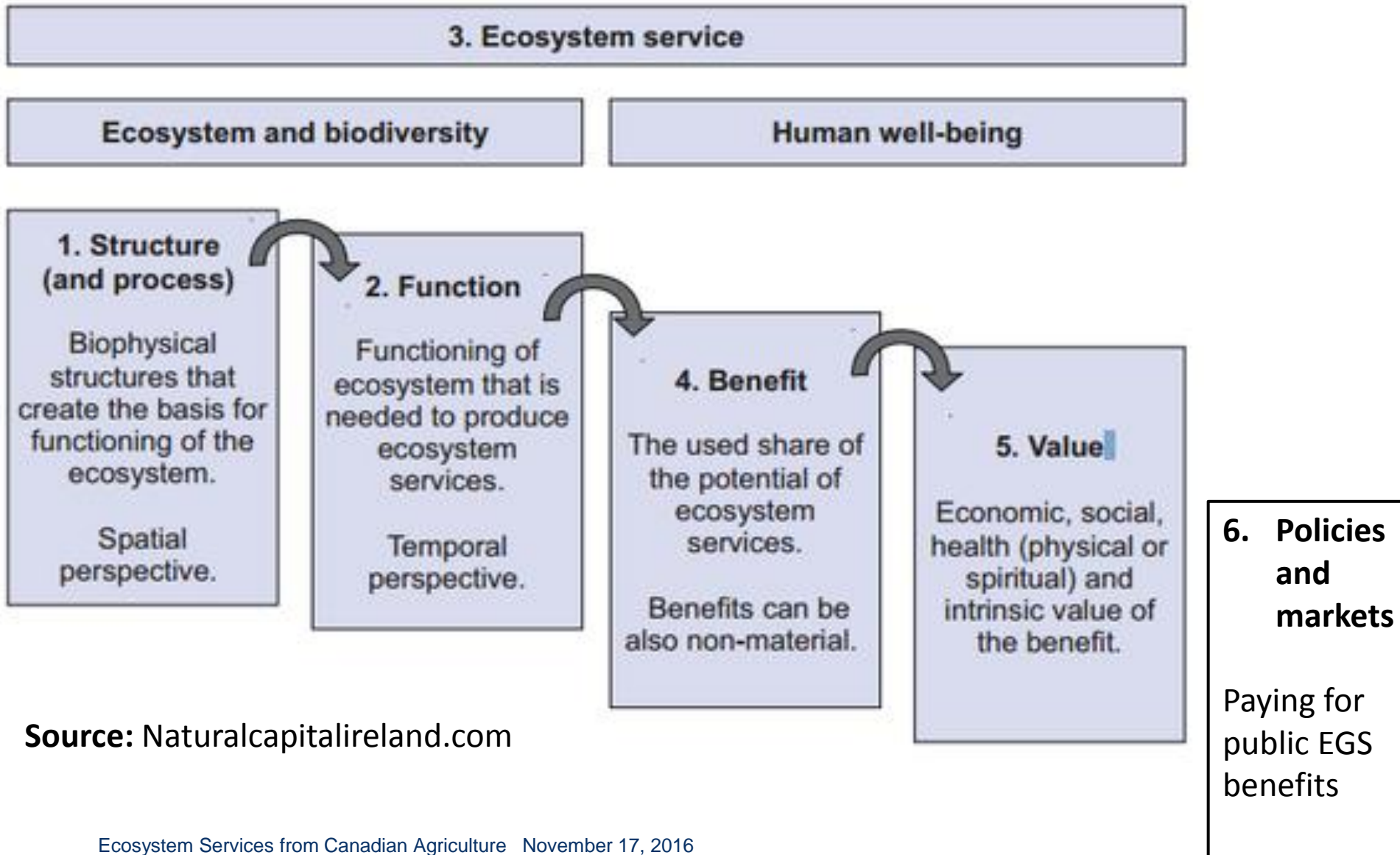
- Introduction to ecosystem services and relevance for management
- Introduction to grassland ecosystems and illustrative EGS
- Operationalizing EGS in agriculture (grasslands)
 - Quantifying ecosystem processes and services
 - Aggregating at a landscape scale
 - Valuing EGS benefits and trade-offs
 - Applying appropriate markets and policies
- Proposed next steps

EGS linked to human well-being



Source: Millennium Ecosystem Assessment, 2005

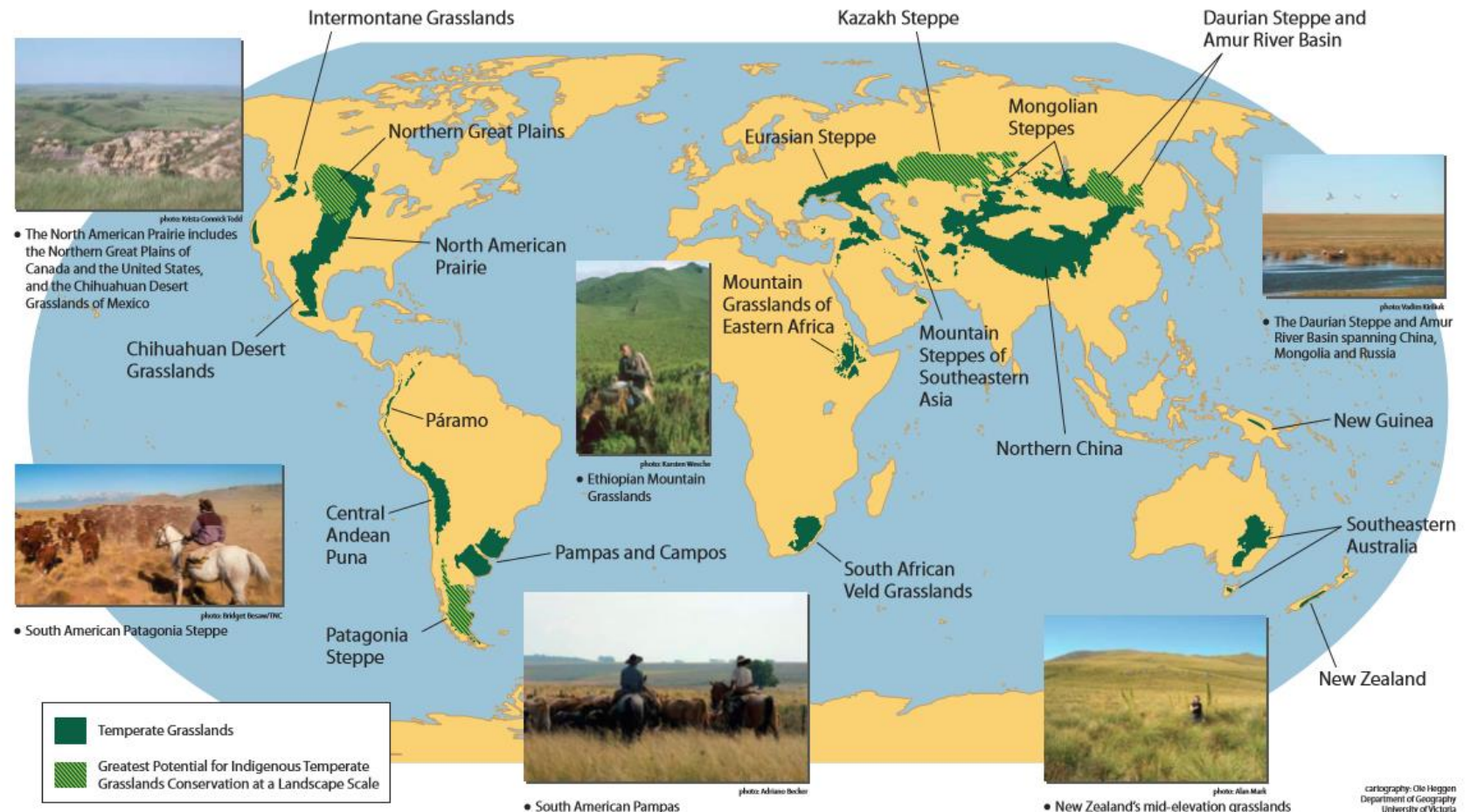
Connecting Ecological Processes-Benefits



Global Grassland Ecosystems



The World's Temperate Grasslands Conservation Priorities



Source: IUCN, 2013

Illustrative Ecosystem Services from Grasslands

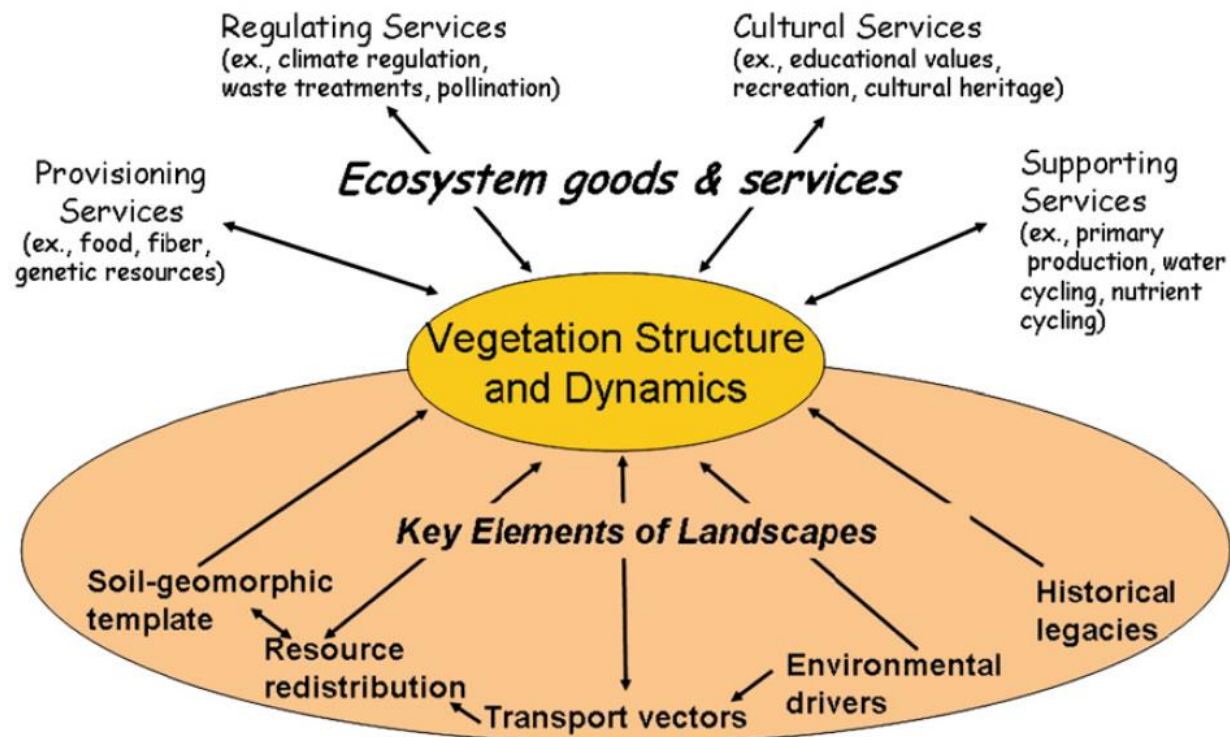


Carbon Sequestration: Deep-roots and perennial growth improves soil carbon.

Water Management: Perennial forage crops with their deep root systems can prevent nitrogen leaching during heavy rainfall better than shallow-rooted annual crops, whose root systems are only active during a shorter part of the year.

Biodiversity: Increasing focus on functional biodiversity (elements providing the same ecosystem service).

Source: Wilson et. al., 2016

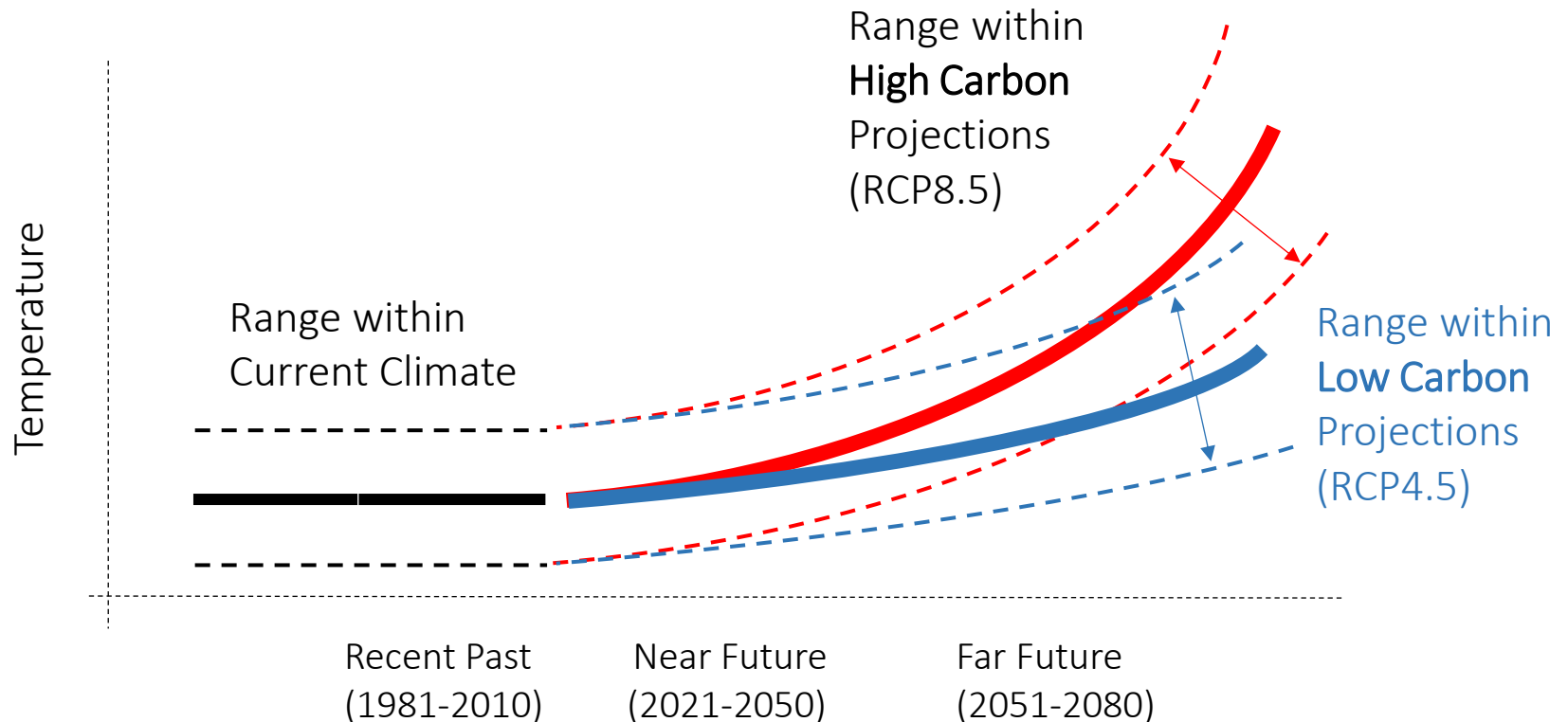


Source: Havstad, et.al. 2007

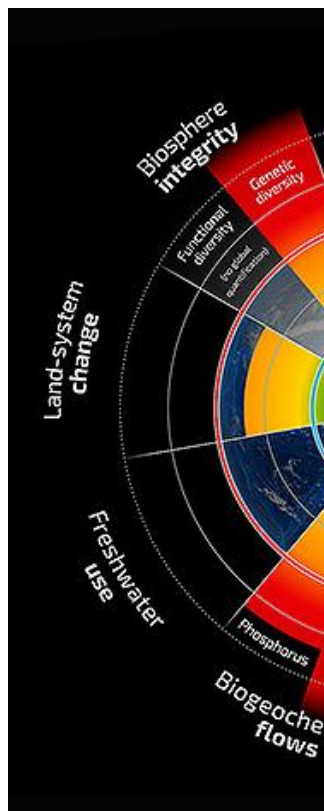
Climate Projections Summary



- Climate projections were extracted from:
 - 12 Global Climate Models, each using
 - 2 Carbon Emissions Scenarios (RCP4.5 and RCP8.5)

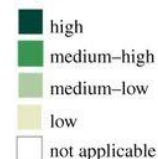


Quantifying Processes and Benefits (including trade-offs and uncertainty)

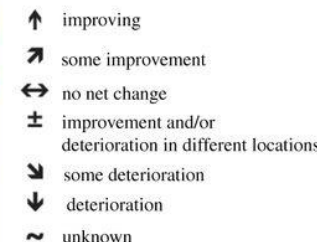


service group	final ecosystem service	mountains, moorlands and heaths	semi-natural grassland	enclosed farmland	woodlands	freshwater - openwaters, wetlands and flood plains	urban	coastal margins	marine
provisioning	crops		↔	↑		↓	↗	↘	
	livestock/aquaculture	↓	↗	↔	↔	↓	↔	↘	↗
	fish					↓	↔	↘	↓
	trees, standing vegetation, peat	↓	↔	↗	↗	↓	↔	↘	
	water supply	↔	↓	↓	↔	↓	↔	~	
	wild species diversity	↔	↓	↓	↗	↓	↔	↘	↓
cultural	environmental settings: local places	↔	↔	~	↑	↗	↔	↔	~
	environmental settings: landscapes/seascapes	↔	↔	↔	↗	↔	↔	↗	~
regulating	climate	↔	↔	↗	↗	↔	↓	↗	↘
	hazard	↓	↔	↓	↗	↓	↓	↔	↓
	disease and pests	↔	↔	±	↓	↓	~	±	↘
	pollution	↓	↓	↓	↔		↔	↔	
	water quality	↔	↗	±	↔	±	±	~	↑
	soil quality	↔	↓	↓	↔	↓	↓	↓	
	air quality	↔	↔	↗	↗	↔	↔	↔	~
	noise	↔	↔	~	↗	↔	↓	↔	↔

importance of habitat for delivering the ecosystem service



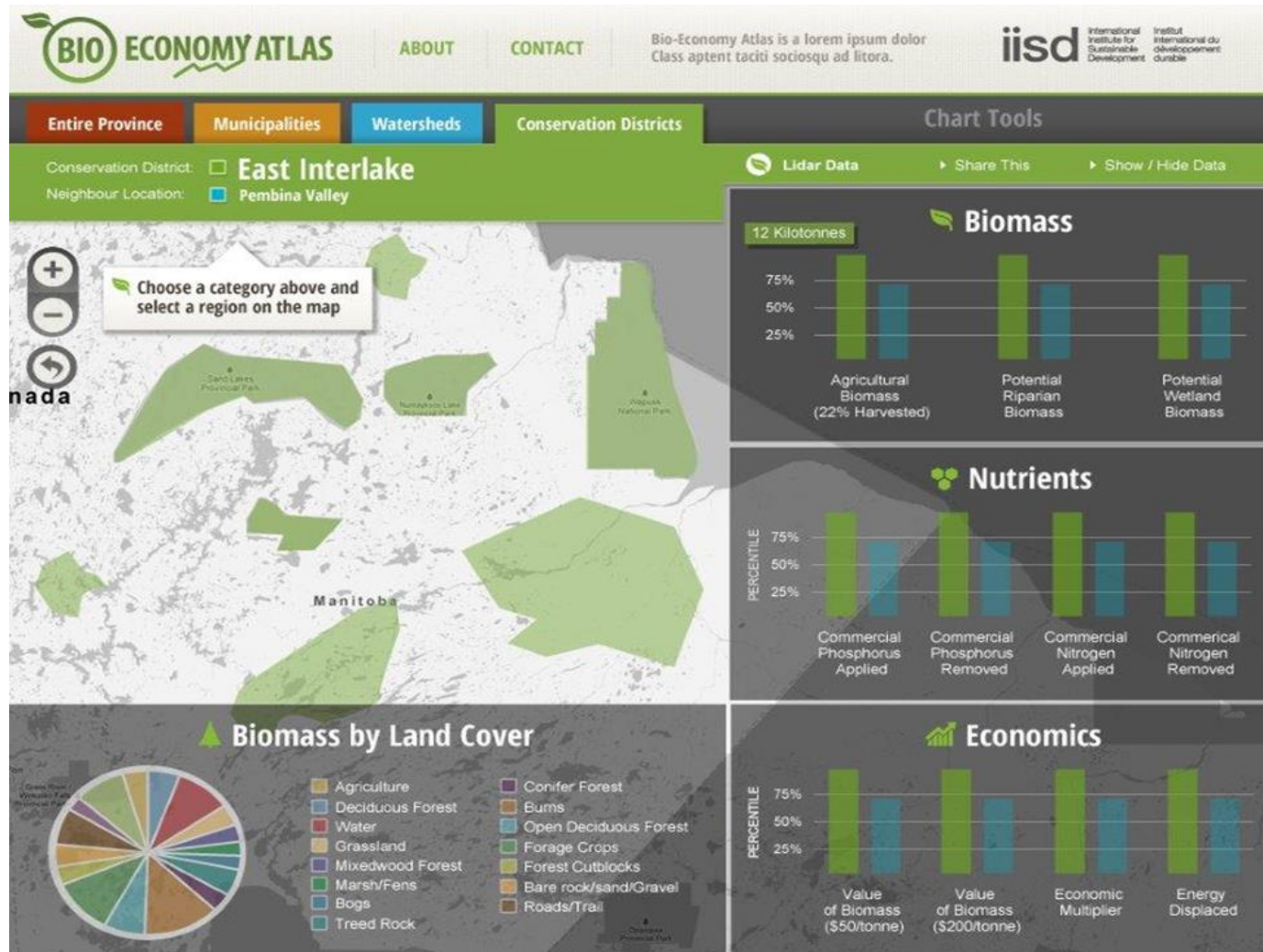
direction of change in the flow of the service



Source: Stockholm Environment Institute

Source: Watson, R.T., 2012

Quantifying Processes and Benefits Landscape Aggregation



Quantifying Values

Landscape Aggregation



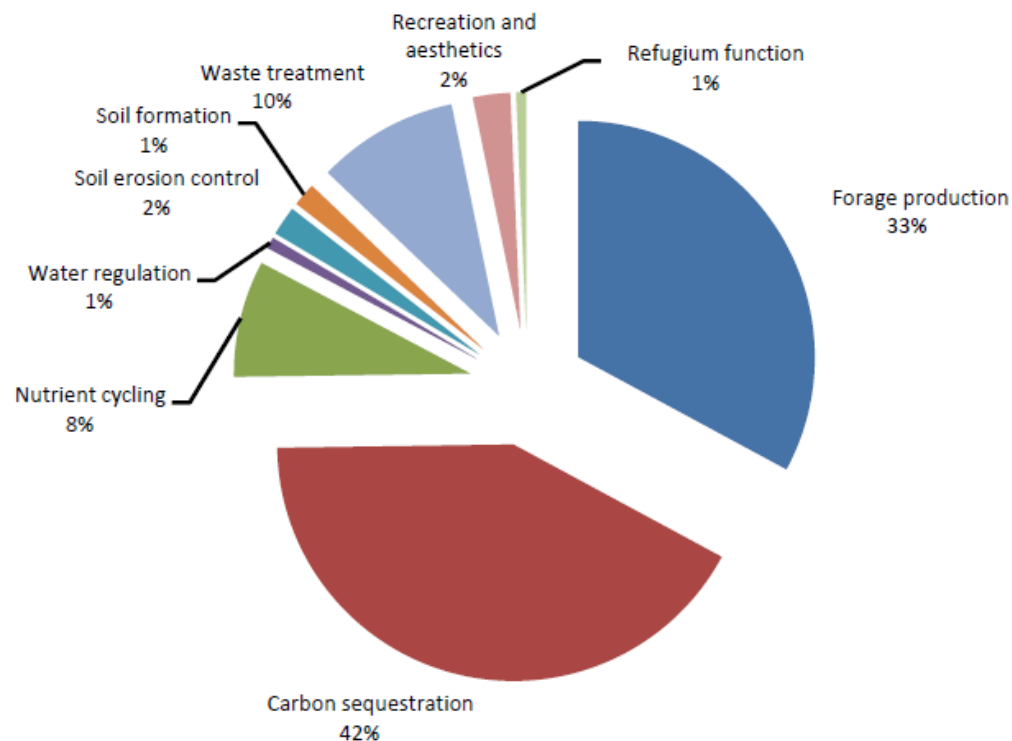
Valuation technique	Description
Market Price Technique	Looks at what it costs to buy or sell based on supply and demand, scarcity and marginal value.
Effect on Production technique	Attempts to relate to the changes in output of particular services and related production
Surrogate market approach	Include travel costs and hedonic pricing- relating to people's expenditures or prices of other market goods and services
Cost-based approach	Include replacement costs, preventative expenses or avoided damage costs, look at market trade-offs or avoided costs.
Stated preference approach	Ask consumers to state their preferences directly. Use contingent valuation, and often a combination of analyses and choice experiments.

Quantifying Values- MB Grasslands



Goods and services	Best value ¹		Low estimate		High estimate	
	Total (\$ million)	\$/ha	Total (\$ million)	\$/ha	Total (\$ million)	\$/ha
Provisioning services						
Forage production	524.61	219.89	419.69	175.93	629.54	263.87
Regulating services						
Carbon sequestration						
Low CO ₂ price	508.50	213.15	508.50	213.15		
Middle CO ₂ price	668.82	280.35	668.82	280.35		
High CO ₂ price	683.85	286.65	683.85	286.65		
Nutrient cycling	127.04	81.47	101.63	65.18		
Water regulation	12.26	5.14	3.54	1.48		
Soil erosion control	31.85	13.34	7.07	2.97		
Soil formation	25.52	10.70	8.94	3.76		
Waste treatment	153.92	64.52	153.92	64.52		
Cultural service						
Recreation and aesthetics	40.67	17.05	0.01	0.10		
Supporting services						
Refugium function	10.96	4.60	0.25	0.20		
Low CO ₂ price	1,435.33	629.86	1,203.55	527.29		
Middle CO ₂ price	1,595.65	697.06	1,363.87	594.49		
High CO ₂ price	1,610.68	703.36	1,378.90	600.79	2,055.74	883.43

¹Estimates are based on 2,385,660 ha of grassland except nutrient cycling (1,559,325 ha).



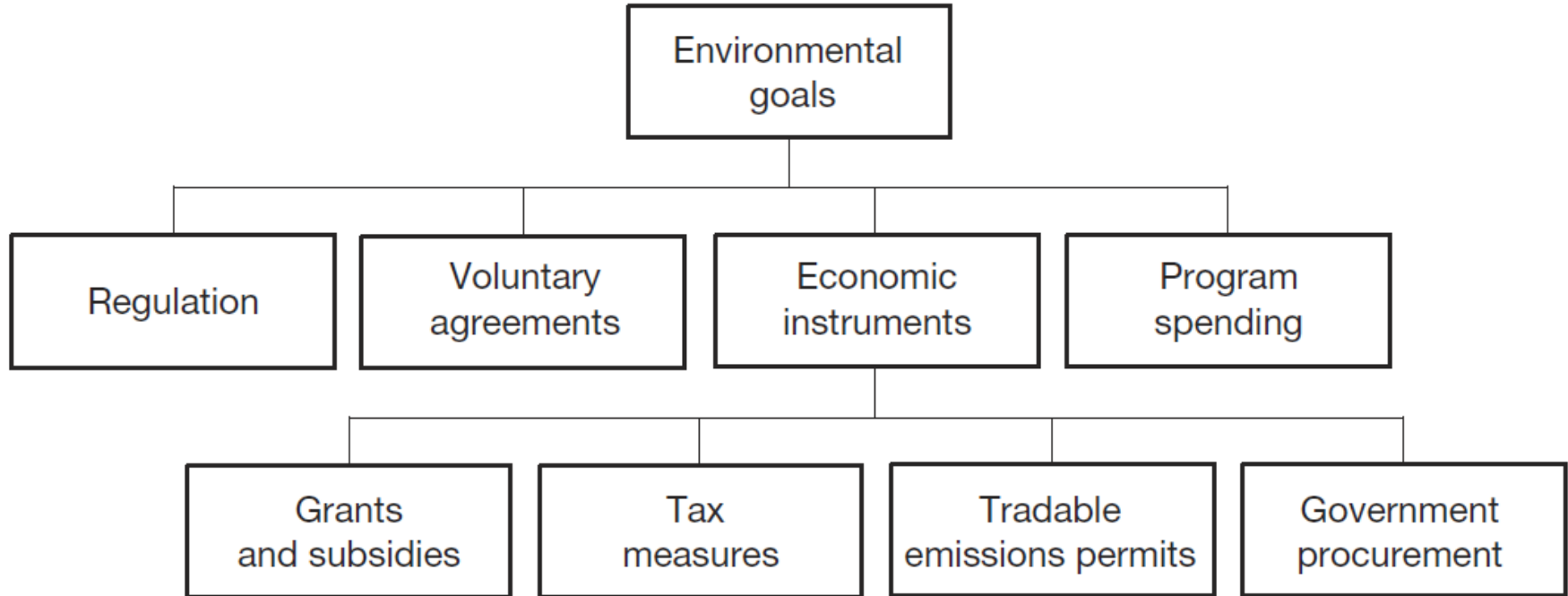
Source: Kulshreshtha, et. al., 2015

Ecosystem Services from Canadian Agriculture November 17, 2016

Markets and Policies: Some Considerations



Instruments for Pursuit of Environmental Goals



Source: Government of Canada, 2005

Establishing Markets and Policies



Emerging Carbon Markets and Policies: Paris agreement, Cap and Trade, Carbon Tax, etc.

Emerging Water Markets and Policies: Water Allocation Trading, Water Quality Trading, Wetlands Management Programs

Emerging Biodiversity Markets and Policies: Hunting and recreational; pollinators, pest control; Potential targeting in high biodiv. areas.

Emerging EGS Programs: ALUS, etc.

Farm of the Future



A FARM OF THE FUTURE

Ecosystem services previously taken for free could generate perhaps half the income of a farm, if markets for various kinds of environmental credits take off as hoped. Farmlands in the future may have a diverse portfolio of ecosystem services to offer to a wide range of customers.

BIODIVERSITY CREDITS

Conservation organizations are leasing development rights from the owners of undisturbed forests and other habitats that host threatened endemic species and fast-vanishing ecosystems.



CO₂ OFFSET CREDITS

When landowners plant new forests and promise never to cut or burn the trees, they can receive carbon dioxide offset credits that industries will buy to help them comply with restrictions on greenhouse gas emissions.



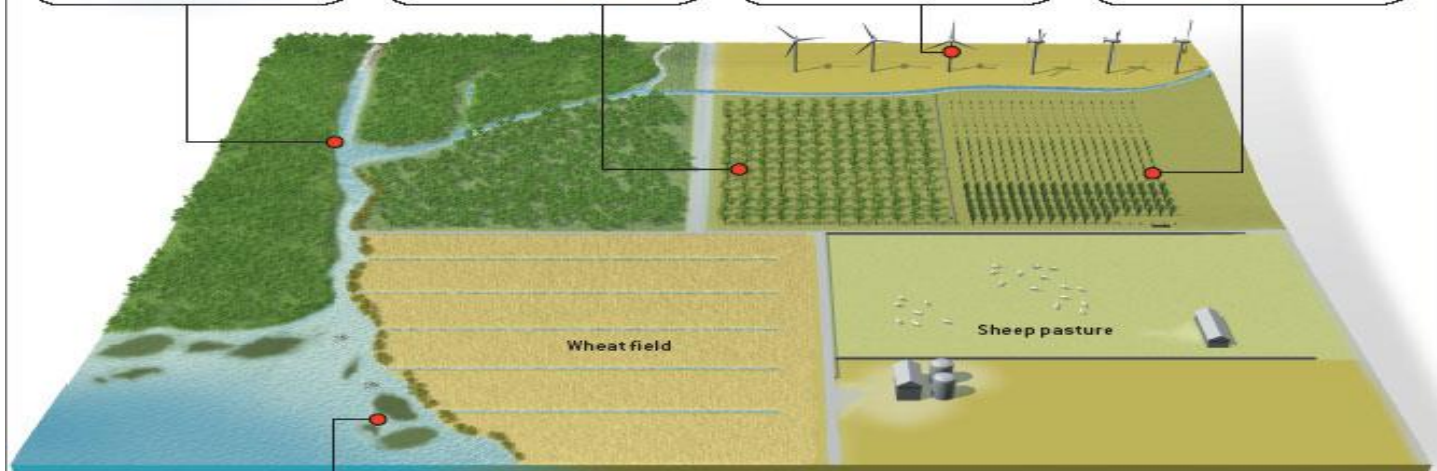
RENEWABLE ELECTRICITY

Wind farms generate nonpolluting electricity that commands premium prices in deregulated power markets. The turbines can also garner tax credits that subsidize their capital and operating costs.



CERTIFIED SUSTAINABLE TIMBER

Sustainably harvested timber is now one of numerous "eco-labeled" products that are certified as ecologically sound and sold at a premium in specialty markets.



WATER CREDITS

Careful management of water and wetlands is economically valuable for many reasons. Urban water authorities purchase water filtration credits to protect the quality of their watersheds; wetland owners can also receive compensation from government agencies for flood-control services, from conservation organizations for the preservation of

feeding areas,
operatives for
linity

increases caused by overdrawn
groundwater aquifers.



COMMODITY	PERCENT OF FARM'S INCOME	CUSTOMER
Biodiversity credits	5	Conservation trust
CO ₂ offset credits	10	Steelmaker
Renewable electricity	15	Power market
Certified sustainable timber	20	Specialty market
Water credits	20	Urban water market
Wheat	15	World market
Wool	15	World market

Source: Scientific American, 2005

EGS from Grasslands



Biodiversity Credits

Grasslands provide pollinators, pest control, hunting recreational values.

Water Credits

Deep-rooted, longer-growing grasslands reduce N and P loss to water systems as well as are resilient to variability in water.

Carbon Credits

Rangelands sequester more carbon by storing it above- and below-ground. Improving SOC has multiple benefits, including productivity.

Resilience Credits

Flood, drought and others disaster damage is mitigated by grasslands.

A FARM OF THE FUTURE

Ecosystem services previously taken for free could generate perhaps half the income of a farm, if markets for various kinds of environmental credits take off as hoped. Farmlands in the future may have a diverse portfolio of ecosystem services to offer to a wide range of customers.

BIODIVERSITY CREDITS

Conservation organizations are leasing development rights from the owners of undisturbed forests and other habitats that host threatened endemic species and fast-vanishing ecosystems.



CO₂ OFFSET CREDITS

When landowners plant new forests and promise never to cut or burn the trees, they can receive carbon dioxide offset credits that industries will buy to help them comply with restrictions on greenhouse gas emissions.



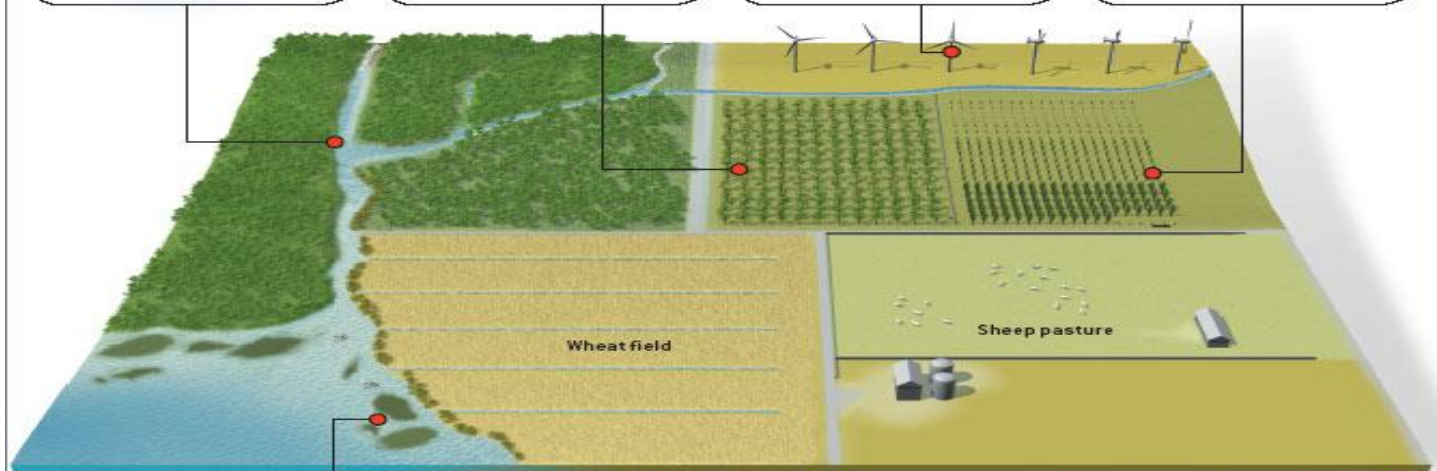
RENEWABLE ELECTRICITY

Wind farms generate nonpolluting electricity that commands premium prices in deregulated power markets. The turbines can also garner tax credits that subsidize their capital and operating costs.



CERTIFIED SUSTAINABLE TIMBER

Sustainably harvested timber is now one of numerous "eco-labeled" products that are certified as ecologically sound and sold at a premium in specialty markets.



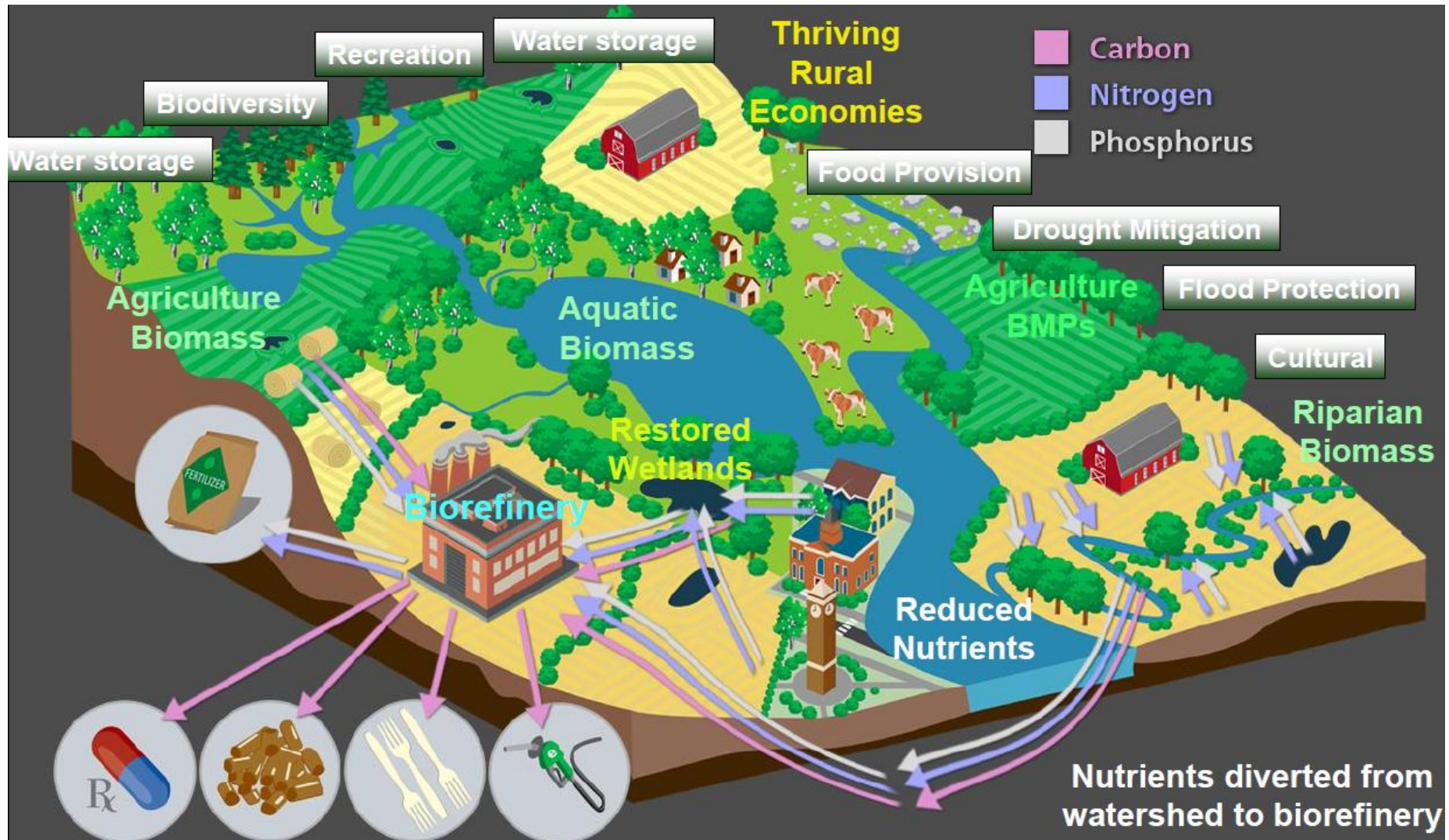
WATER CREDITS

Careful management of water and wetlands is economically valuable for many reasons. Urban water authorities purchase water filtration credits to protect the quality of their watersheds; wetland owners can also receive compensation from government agencies for flood-control services, from conservation organizations for the preservation of migratory waterfowl breeding areas, and from agricultural cooperatives for the prevention of soil salinity increases caused by overdrawn groundwater aquifers.



COMMODITY	PERCENT OF FARM'S INCOME	CUSTOMER
Biodiversity credits	5	Conservation trust
CO ₂ offset credits	10	Steelmaker
Renewable electricity	15	Power market
Certified sustainable timber	20	Specialty market
Water credits	20	Urban water market
Wheat	15	World market
Wool	15	World market

Watersheds of the Future



Aggregating to Multifunctional Landscapes



Water Credits

Large water users and management are accessing credits for water storage, and quality improvements

Biomass Credits

Biomaterials/ bioenergy markets pay for excess biomass from ditches, wetland maintenance.

Carbon Credits

An established carbon market compensates for land uses that store carbon for specific time periods.

Biodiversity Credits

Hunting, fishing and as established biodiversity market pays for improved functional biodiversity

Adaptation Credits

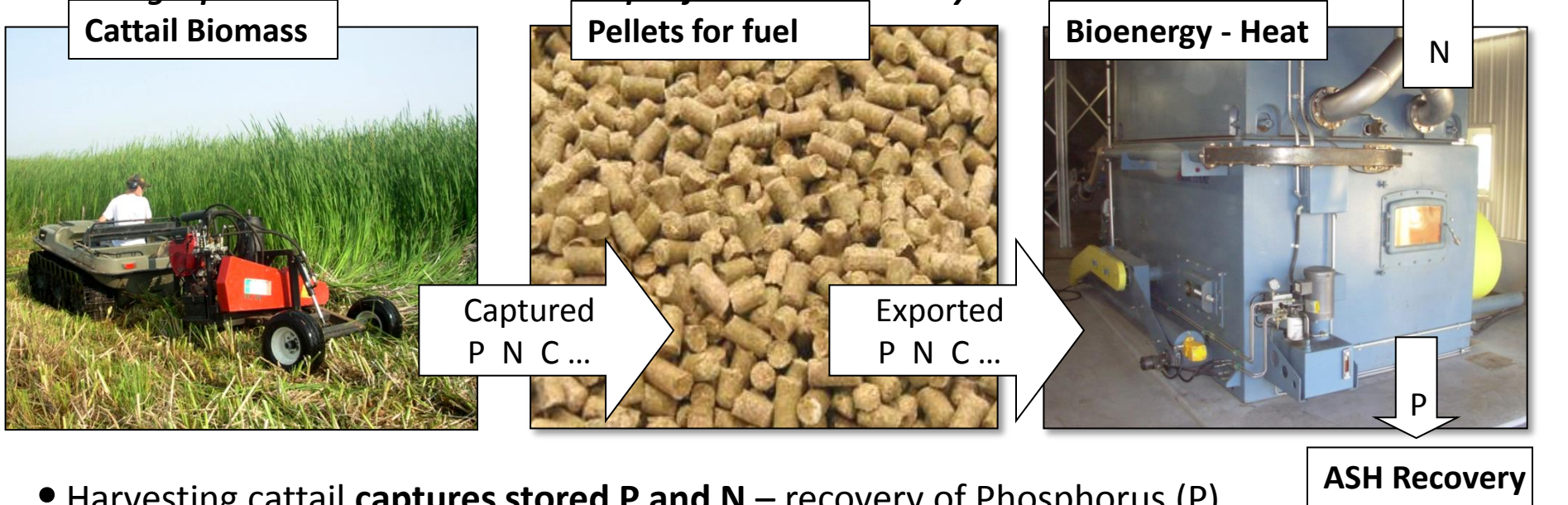
An emphasis on increasing flood/drought has led to clear markets for improving landscape resilience.



COMMODITY	% INCOME	MARKET DEMAND
Water Credits		Watershed Org.
CO ₂ Credits		Offsetters
Biomass Income		Bioenergy suppliers
Biodiversity Credits		Conservation Trust
Agricultural/Forest ry commodities		Regional/Global markets

From Research to Commercialization

turning a problem into a sustainable input for the Bioeconomy



- Harvesting cattail **captures stored P and N** – recovery of Phosphorus (P)
- **Sustainable renewable biomass** feedstock for bioenergy (displace fossil fuels, i.e. coal) or higher value bioproducts
- **Carbon credits** - production of “low carbon” bioenergy, while reaping benefits of P capture from Lake Winnipeg – “**Lake Friendly**” biomass
- Opening wetland site for wildlife habitat renewal
- **Bioremediation + habitat renewal + GHG reductions + + +**

ASH Recovery

88%

**Phosphorus
Recovery**

Markets and Policies: Some Considerations



- **Impact measurement and targeting** (Are we there yet?)
- **Value for Public money** (2011 OAG report)
- **Equity Vs. Additionally**
- **Adaptive Management**
- **Ease of Implementation**



Proposed Work

(CFGAs, MA, IISD, Univ. of SK.)

- 1. Synthesize EGS and best management practices for Canadian grasslands (literature review)**
- 2. TEV of grasslands and forages across Canada (University of Sask.)**
- 3. Analyze policies and programs to see how to deliver in the most efficient and effective way**
- 4. Test economic values through grasslands management scenarios through different sites**
- 5. Communicate, communicate, communicate!**

Thanks

Dimple Roy

droy@iisd.ca

