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Designing a pilot ecosystem account

Overview

- Pilot and/or national? Considerations
- Basic ecosystem account:
  - Classifications
  - Tables
  - Other data
- Think nationally! What's the priority?
  - Selecting pilot study area
- Think spatially! What do you already have?
  - Spatial units
  - Downscaling, overlaying and aggregating
- Think statistically! Estimation
  - Sampling, weighting, allocation, imputation
- Nationally, spatially and statistically!!!

Pilot and/or national? Considerations

- SEEA-EEA Rapid Diagnostic (Michael V. version)
  1. Vision: establish national priorities: water, forest, tourism, biodiversity, agriculture, poverty…
  2. Institutions: Stakeholder strengths and weaknesses: environment, planning, statistics, finance…
     - Is there an appropriate institutional mechanism to support and use the results?
     - Working level group; senior level steering
     - At national and regional level (for priority area)
  3. Knowledge: what data, studies already available?
  4. Progress: existing assessments, SEEA accounts?
  5. Priority area and services: coastal, uplands, drainage area; tourism, water supply, agricultural production…
  6. Feasibility: ready to test, needs data, capacity, or inst.
  7. Priority actions: pilot or national; data, capacity or inst.

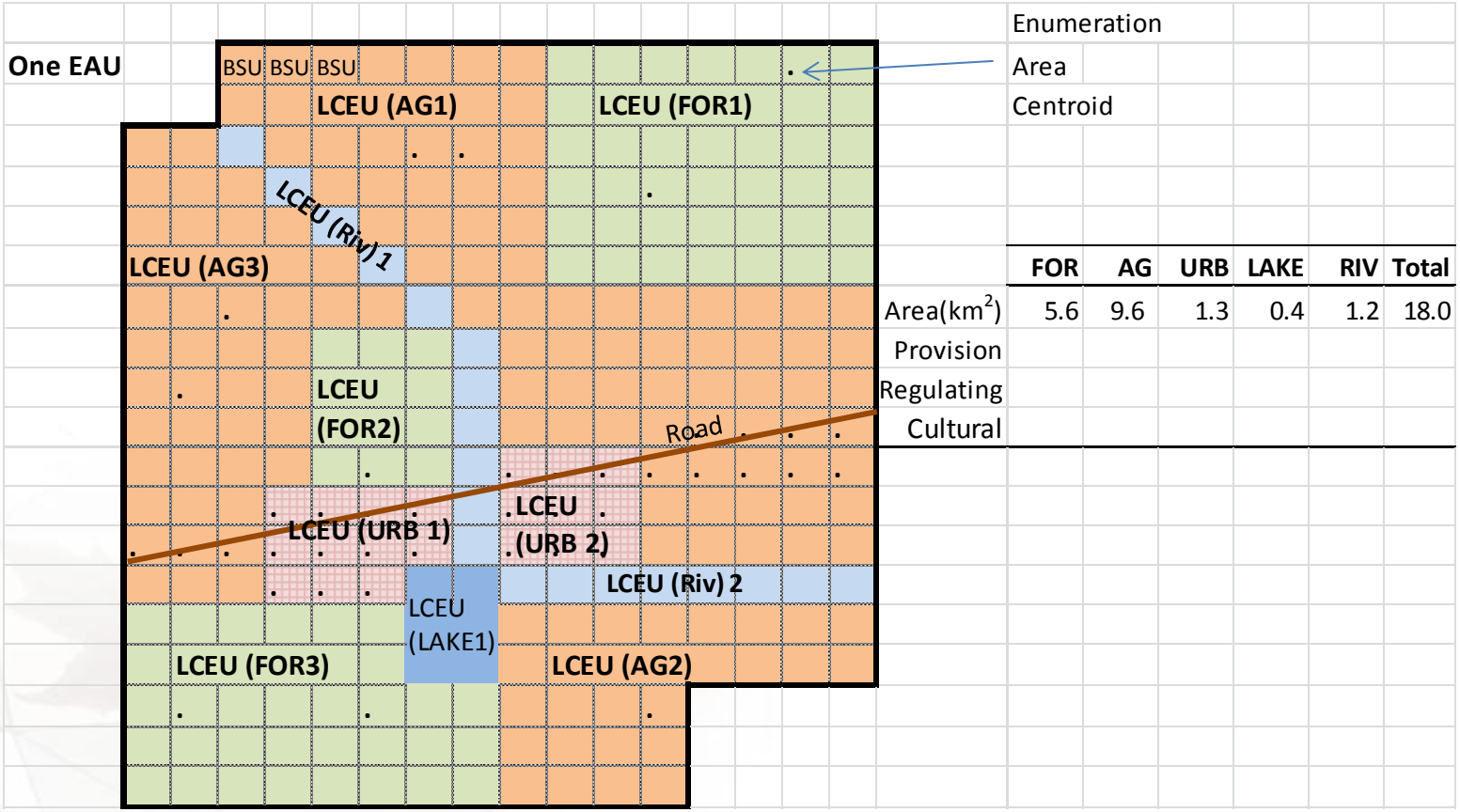
Pilot and/or national? Considerations

- Need national stakeholders involved
- Addressing national priorities
- Some data available at national level (land cover, population)
- Studies may be available for selected areas (inside and outside study area)
- May be areas similar to study area (could link to interests there)
- **Suggest:** Putting pilot area in national context
  - Selecting pilot to be nationally significant
  - Compiling national data where available

Basic ecosystem account

- Classifications
  - Spatial units:
    - BSU: Basic spatial unit = cell
      - Could be based on satellite "pixel", cadastre, or grid
    - LCEU: Land cover ecosystem/functional unit = "ecosystem"
      - Generally land cover + other physical (elevation, soil…)
      - **Suggest:** Also splitting by criteria to be used for EAU
        - » Rivers, administrative boundaries, watersheds…
    - EAU: Ecosystem accounting unit = reporting unit
      - e.g., admin area, drainage area, management area…

BSU, LCEU and EAU



Enumeration Area Centroid

	FOR	AG	URB	LAKE	RIV	Total
Area(km^2)	5.6	9.6	1.3	0.4	1.2	18.0
Provision						
Regulating						
Cultural						

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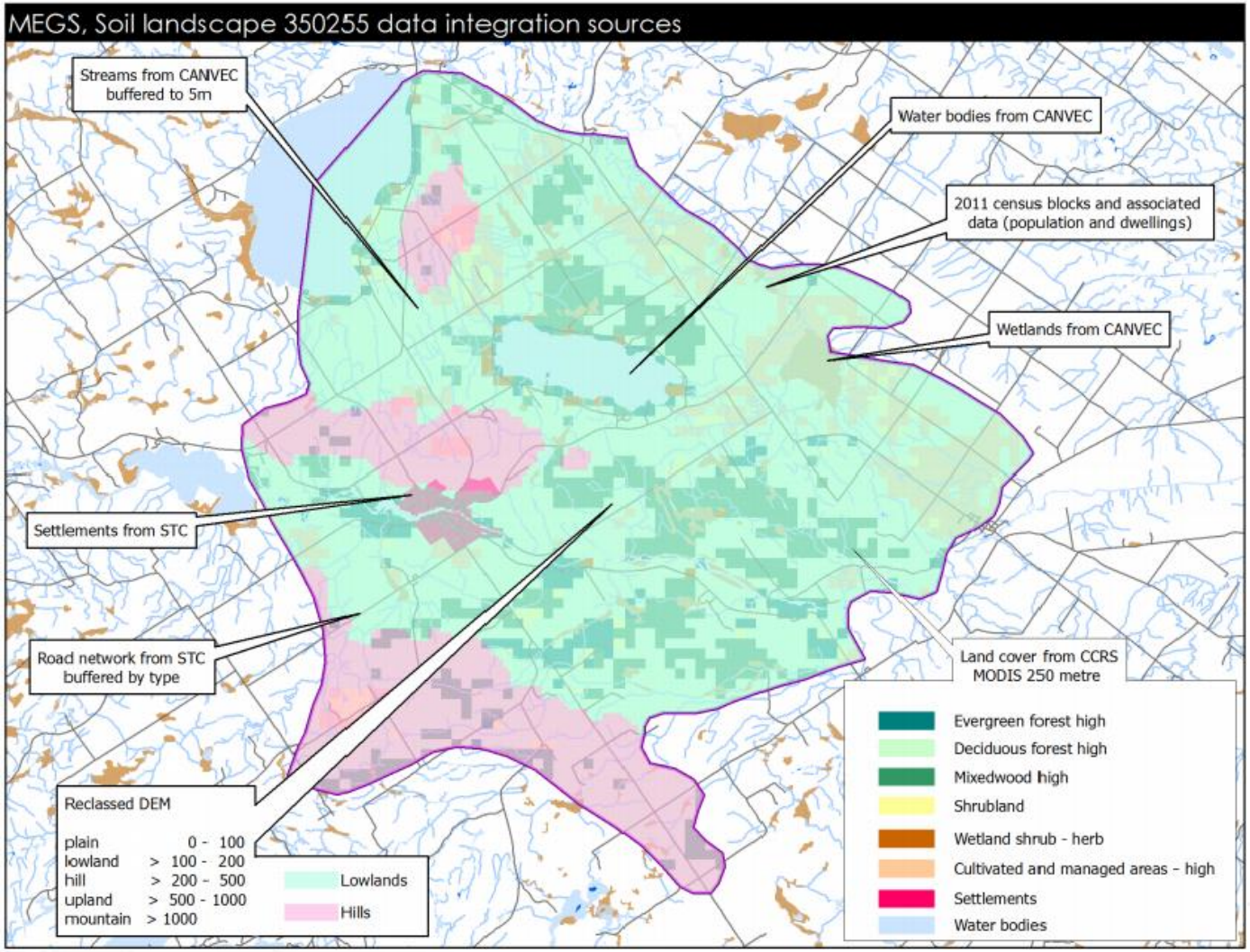
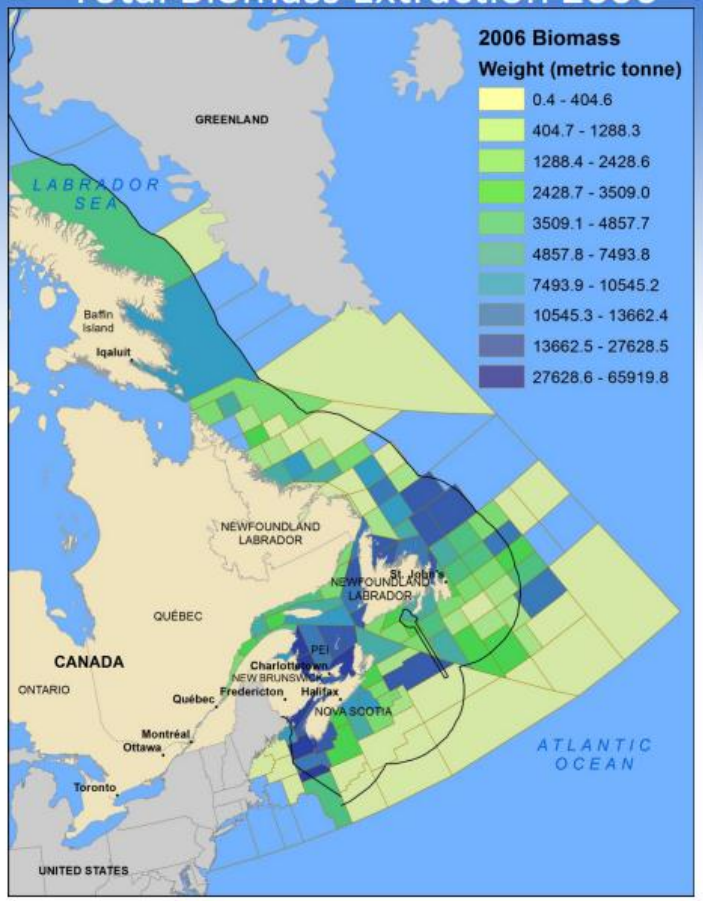
Ecosystem accounts: delineating units



Total Biomass Extraction 2006



Species Group

	Metric tonnes
Groundfish	108,948.7
Shellfish	464,519.0
Pelagics	261,385.3
Other	46,772.8
Total	881,625.8

Department of Fisheries and Oceans, Zonal Interchange Format File (ZIFF) Catch and Effort Database.

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Basic ecosystem account

- Classifications
  - Spatial units:
    - **Suggest:**
      - local pilot based on EAU or contiguous groups of LCEU
      - creating "register" at BSU level
        - » consistent over time
        - » allocating all data (upscaling & downscaling) to BSU
        - » creating final tables based on aggregation "rules" for each characteristic

Basic ecosystem account

- Classifications
  - LCEU Type (Table 2.1)

Table 2.1 Provisional Land Cover/Ecosystem Functional Unit Classes

Description of classes
Urban and associated developed areas
Medium to large fields rainfed herbaceous cropland
Medium to large fields irrigated herbaceous cropland
Permanent crops, agriculture plantations
Agriculture associations and mosaics
Pastures and natural grassland
Forest tree cover
Shrubland, bushland, heathland
Sparsely vegetated areas
Natural vegetation associations and mosaics
Barren land
Permanent snow and glaciers
Open wetlands
Inland water bodies
Coastal water bodies
Sea

Basic ecosystem account

- Classifications
  - LCEU Type (Table 2.1)
  - Services: CICES as starting point (Table 3.1)
    - "Final" services providing benefits to people
    - **Not** the contribution to well-being (("security, basic materials for a good life, health, good societal relations, freedom of choice and action") (Millennium Ecosystem Assessment, 2005)
    - Economic units:
      - Households includes individuals
      - Government includes public goods
      - Private industry
    - Who owns? Who/where are beneficiaries?

CICES Summary

Section(1-digit)	Division(2-digit)	Group(3-digit)
Provisioning	Water	Water
	Materials	Uncultivated terrestrial plants and animals for food
		Uncultivated freshwater plants and animals for food
		Uncultivated marine plants, algae and animals for food
		Nutrients and natural feed for cultivated biological resources
		Plant and animal fibres and structures
		Chemicals from plants and animals
		Genetic materials
	Energy	Biomass based energy
	Other provisioning services	Other provisioning services, n.e.c.
Regulating	Remediation and regulation of biophysical environment	Bioremediation
		Dilution, filtration and sequestration of pollutants
	Flow regulation	Air flow regulation
		Water flow regulation
		Mass flow regulation
	Regulation of physico-chemical environment	Atmospheric regulation
		Water cycle regulation
		Pedogenesis and soil cycle regulation
		Noise regulation
	Regulation of biotic environment	Lifecycle maintenance, habitat and gene pool protection
		Pest and disease control (incl. invasive alien species)
Cultural	Physical or experiential use of ecosystems [environmental setting]	Non-extractive recreation
		Information and knowledge
	Intellectual representations of ecosystems [of environmental settings]	Spiritual and symbolic
		Non-use

Basic ecosystem account

- Classifications
  - Others in SEEA-CF
    - Physical flow accounting (Section 3.2)
      - Natural inputs
      - Products
      - Residuals
    - Aquatic resources (Section 5.9)
    - Water resources (Section 5.11)
    - UNFC (Fossil Energy and Mineral Reserves and Resources) (Ch. 5)
    - Environmental activities (Annex 1)
      - Environmental protection
      - Resource management
    - Land Use (Annex 1)
    - Solid Wastes (Annex 1)

Basic ecosystem account

- Works at local, sub-national and national levels
- Tables
  - LCEU (Land cover ecosystem/functional unit) type
    - General classes in SEEA-EEA (Table 2.1)
    - → land covers workable as sub-classes
      - e.g., mangrove → open wetland
  - Types of ecosystem services by LCEU (Table 2.2)
    - Use CICES as guideline to define "final" services
    - Include as many physical measures as available & relevant
      - e.g., tonnes of wheat produced, tonnes of CO_2 sequestered, number of visitors

Basic ecosystem account

- Tables
  - Ecosystem condition and extent at end of accounting period (Table 2.3); changes (Table 4.4)
    - For each type of LCEU, compile measures of condition (e.g., leaf area index, biomass index, species diversity, soil fertility, water quality, net carbon balance…)
    - Not all are necessary or available
    - **Suggest:** Choose condition indicators relevant to services
    - Each has own "rules" for aggregation and scaling
      - Indices, rates, proportions → average (pro-rate by area)
      - Counts, areas → sum
      - Dissimilar measures: index to reference condition, assign "common currency"

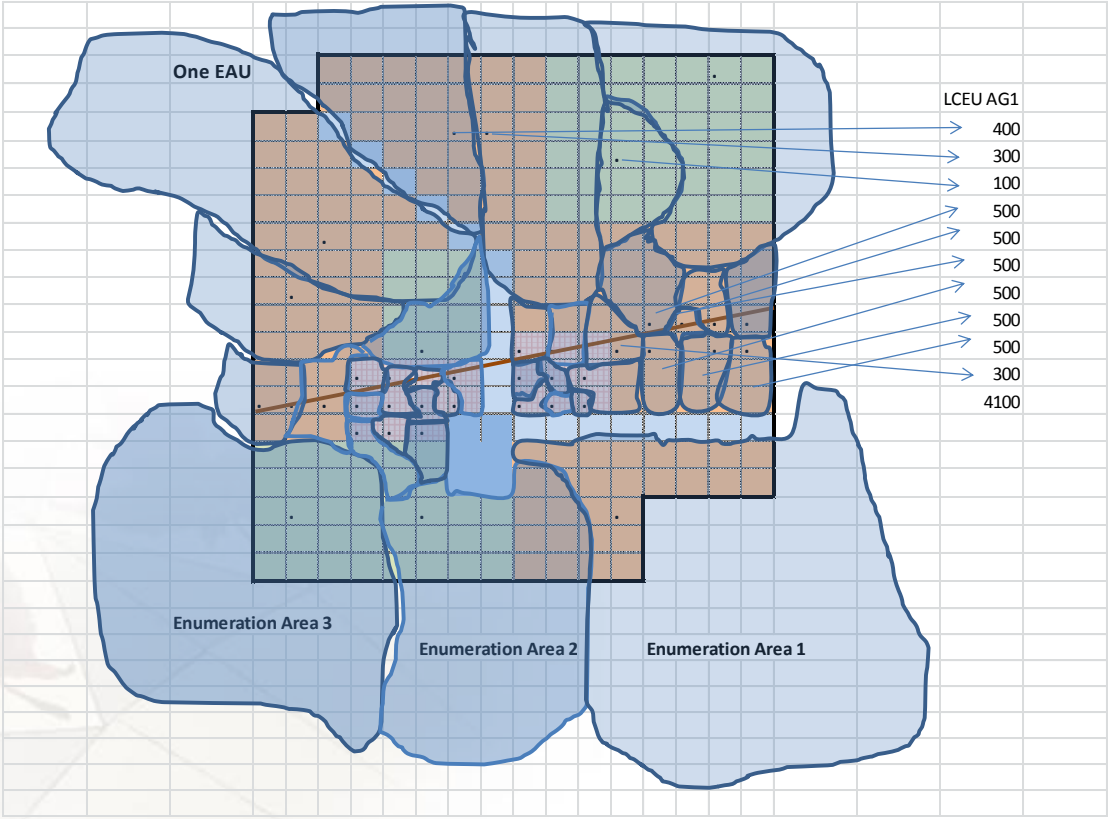
Basic ecosystem account

- Tables
  - Expected service flow (Table 2.4)
  - Generation (by economic unit) and use of services (by beneficiaries) (Table 3.3)
  - Carbon stock account (Table 4.5)
  - Biodiversity account (Table 4.7)
  - Threatened species (Table A4.1)
  - Sequence of accounts (Table A6.1)

Basic ecosystem account

- Other data
  - Statistical from national/provincial statistics:
    - Population, income, employment, industry of employment, household facilities, household activities (recycling, energy consumption…), incidence of disease*
    - Industry (manufacturing, agriculture, mines…) by precise location
    - May need to be estimated for EAU (pilot area)
      - Best to know (at least) population precisely
        - » Aggregate census data from smallest unit
        - » Estimate from survey data (overlay & allocate based on population and income)

Allocating population statistics



Basic ecosystem account

- Other data
  - Spatial from national and international sources (e.g., FAO)
    - Land cover
    - Ecological classification (e.g., Canada)
    - Hydrology
    - Soil type
    - Species distributions
    - Existing valuation studies (EVRI, TEEB…)
    - Water quality
    - Land use, ownership, protection status and management
  - **Reference:** Maes, J., Paracchini, M. L., & Zulian, G. (2011). *A European assessment of the provision of ecosystem services Towards an atlas of ecosystem services*. European Commission Joint Research Centre-Institute for Environment and Sustainability. http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/16103/1/j.maes.pdf

Think nationally: What's the priority?

- Selecting pilot study area:
  - **Suggest:** Establish criteria for selection
    - Is the issue to be demonstrated (wetlands, habitat, water availability) nationally important?
      - Does it link to national priorities
      - Is there a problem that could be addressed with the pilot?
      - Could the issue be analysed with SEEA-CF (e.g., water, energy, soil, timber, emissions, EPEA…)
    - Does the area demonstrate an important service?
    - Do data exist? (especially local research on ecosystem functions and services)
    - Are local and national stakeholders engaged? What are their needs? Do they have the capacity?

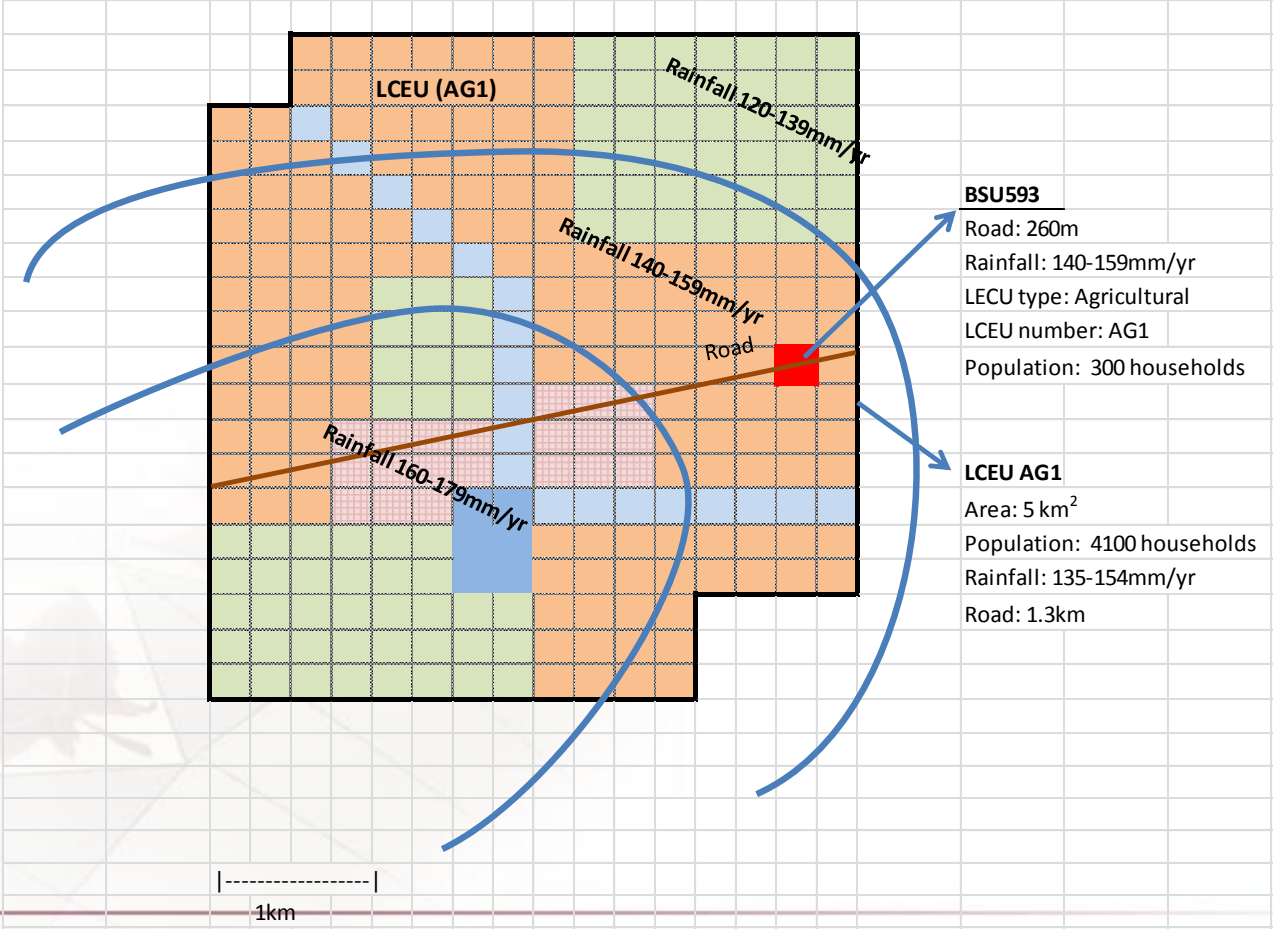
Think nationally! What's the priority?

- Selecting pilot study area:
  - Establish consistent boundaries (e.g., administrative, drainage area, coastal zone, park…)
    - Determine LCEUs included
    - Determine upstream/downstream influences
      - May expand study area if there are strong linkages
  - One study area, multiple areas or national?
    - Much information available at national level
      - Population, land cover, hydrology, agricultural production, leaf area index, net carbon balance
      - Need this anyway to allocate to study area(s)
    - Some areas may have more data but less relevance*
      - Could do different accounts for each & transfer data

Think spatially! Estimation

- Spatial units (discussed previously)
- Downscaling, overlaying and aggregating
  - National data can be cookie-cut to study area(s)
  - **Downscaling:** is estimating values for smaller area
    - e.g., know average rainfall for broad bands
    - If BSU within a band, attribute that average rainfall
  - **Overlaying** is useful for calculating the length of linear features to the BSU
    - e.g., length of roads and rivers
  - **Aggregation** is summing point values within a BSU
    - e.g., locations of mines, industrial establishments…
  - May need combinations: e.g., allocation

Example of downscaling, overlay and aggregation



Think statistically! Estimation

- Sampling, weighting, allocation, imputation
  - Sampling:
    - If conducting original data collection, stratify by LCEU
      - i.e., select representative numbers from all LCEU types
    - Can scale up based on known values (better BT)
    - e.g., measure water quality at representative points within sampled LCEUs
      - if representative of LCEUs, stream types, conditions (e.g., downstream from population, industry, agriculture, pristine) should be able to allocate to similar areas
      - should work within EAU and others if conditions are similar
    - Measuring only in problem areas is "storm chasing" not statistics
    - Should think of sampling strategy nationally (rather than within study area); e.g., nationally representative sample of lakes

Think statistically! Estimation

- Weighting
  - Challenge in aggregating biophysical measures and indices
  - e.g., measure 3 services for one forest LCEU: recreation (53,453 visitors per year), habitat (for 934 individuals of a protected species), CO_2 sequestration (498 tonnes per year)
  - One (unsatisfactory) approach is to monetize all 3
  - Another (less unsatisfactory) is to calculate an index (weight=1)
  - Could determine social/scientific preferences (i.e., contribution to well-being)
  - Could do multi-criteria (some monetary; some physical)

Service	Measure	Monetary value		Index (1974=100)	Contribution to welfare Weight	Total
Recreation	3,453	$10/visitor	$34,530	80	1	80
Habitat	934	$50/bird	$46,700	75	2	150
CO_2	498	$42/ton	$20,916	67	4	268
Total			$102,146	74	7	71.1

Think statistically! Estimation

- Allocation:
  - Know total value
    - e.g., know national corn production (tonnes) and area of production (ha);
    - know area of corn production in all provinces; volumes in some provinces

	Corn production			proportion	estimated	All	
	area (ha)	tonnes		of area	tonnes	tonnes	tonnes/ha
Prov 1	4,593	43,453				43,453	9.46
Prov 2	1,892	23,423				23,423	12.38
Prov 3	985	?		0.69	11,825	11,825	12.00
Prov 4	435	?		0.31	5,222	5,222	12.00
National	**7,905**	**83,923**				**83,923**	**10.62**
Unallocated				1,420	17,047		

Think statistically! Estimation

- Imputation:
  - Impute unknown based on known characteristics
    - e.g., know area, streamflow and temp of wetland
    - can impute P absorption rate from wetlands with similar area, streamflow and temp

	Area (ha)	Streamflow (m3/hr)	Average temp (°C)	P absorption (t/yr)	Imputed
Wetland 1	5	6	15	53	
Wetland 2	3	5	12	42	
Wetland 3	5	6	10	32	
Wetland 4	5	6	15	?	53
Wetland 5	5	6	10	?	32
Wetland 6	3	5	12	?	42
Wetland 7	10	2	12	?	?

Nationally, spatially and statistically

- **If careful,** can infer some national characteristics from pilot
  - Not "naïve" benefits transfer
  - Can ecosystem functions be transferred?
    - e.g., in wetlands imputation example → could impute P absorption to wetlands with similar characteristics
    - May not cover all wetlands
  - Values can be transferred but better to model the value and apply the model to appropriate areas
    - e.g., value of recreation, habitat and CO_2 sequestration in weighting example: **Why** is the LCEU valued at $102K?
    - the values are largely determined by proximity to population and incomes of that population
    - need several areas to calibrate model
    - could also consider property values (hedonic)

Nationally, spatially and statistically!!!

- could do meta-analysis of known studies to make estimates of more of the country
  - e.g., perhaps wetlands sampled represent 30% of wetlands
    - best to sample more with unknown types and conditions
  - e.g., have 20 studies in EVRI (www.evri.ca), 2 of which are in pilot area
    - use detailed knowledge of pilot area to scale to similar areas
    - construct models to calibrate within pilot area and test outside of pilot area
  - e.g., use detailed knowledge of study area to calibrate national indicators such as leaf area index, net carbon balance and net landscape ecological potential

Discussion points

- What is the level of guidance needed? For whom?
- Is it useful to use SEEA implementation guide steps?
  - Where are we in the process?
- Are NSOs involved?
- Will projects be implemented by experts or national government staff?
- Are projects expected to continue beyond pilot?
- What is the expectation that existing models will be used?
- Is it necessary to conduct only a small-area pilot?
  - Are there opportunities to link pilot to national data?