Topics

1. Land evaluation concepts (with in-class exercises)

2. Models in land evaluation

3. Current land evaluation research

4. Difficulties, towards solutions (new directions)
Part 1 – Concepts

Paradigm:

- Land **provides** a resource

- Land use is **affected by** the resource
  - areas **differ** in their characteristics, potentials and performance
  - opportunities, constraints

- Land use **affects** the resource
  - sustainability, degradation, improvement . . .

- Idea: **match** land use and land resource
Different soils...

source: STATSGO
...different land uses

source: Google Earth
Why formalize?

• Since before history humans have known about differential land suitability!

• Under **unchanging** or **slowly-changing** conditions humans can easily adapt by **trial-and-error**

• Even major changes can happen by adaptation / experimentation
  – e.g., introduction of New World crops to Europe (but this took about 200 yr to become widespread)

• Modern times: changes must be more **rapid**; penalties for failed experiments are greater (?)
Viewpoints

1. **Known land area**, what use?
   - depends on strategic objectives
   - e.g., raise yields, enhance income, integrate into cash economy, diversify/reduce risk, reduce degradation . . .

2. **Known use**, what area?
   - e.g., new technology, new crop, new use for crop . . .
Examples: known land area

- single farm/field

- catchment upstream of new reservoir
  - land use must be controlled to prevent sedimentation

- identified rural development area
  - target for living standards / carrying capacity

- transmigration/resettlement with defined area
Land characteristics radically changed, what are suitable uses / management for resettlement? (Mt. Merapi, Yogjakarta, Java)
Examples: known use

- “green revolution” technologies
  - where are different “packages” applicable?

- transmigration/resettlement with known agricultural systems

- new production systems
  - conservation tillage, early planting, split fertilizer application . . .
  - these are successful/profitable on some soils, not on others
  - these are feasible within some production systems, not within others

- crops used for biomass vs. grain or fodder
  - accumulate starch/sugars, not protein
Example: New technology for existing systems

Promoting Reduced Tillage in Vegetables

- **People** - Reduced tillage team and cooperating growers.
- **About** - Goals, funding, annual reports.
- **Equipment** - Planters, tillage and cultivation tools.
- **Case studies** - How cooperating farmers use less tillage.
- **Trials** - Our research results.
- **Resources** - Factsheets, FAQs and other information.
- **Cover Crops** - How to incorporate them into RT systems

Source: [http://www.vegetables.cornell.edu/reducedtillage/index.htm](http://www.vegetables.cornell.edu/reducedtillage/index.htm)

System is not applicable (or must be adapted) in some soils.
Land evaluation

Broad definition: The **prediction** of land performance over time under **specific uses**

Note:

- No such thing as “good” or “bad” land in general, only with respect to a **specified use**

- “This land is highly suitable for maize” – meaningless statement
  
  - production system, crop cycle, variety, use, market . . .

- **prediction** “is dangerous, especially about the future” – Niels Bohr
Land evaluation vs. land-use planning

- **Land evaluation** provides **objective** and (semi-)quantitative information on the probable success of proposed land uses.

- **Land use planners**
  1. **solicit** this information (set boundary conditions, terms of reference)
  2. **use** this information in their multi-criteria, politico-social decision-making

‘Cui bono?’ (Who benefits?)

1. Land and associated resources (esp. water) are increasingly scarce
   (a) population and wealth pressure
   (b) growth-oriented economy / life style

2. Competition for resources
   - Any change in land use benefits some group, very often at the expense of another or of the general good (e.g., loss of ecological services)
   - Example: new large commercial farms in Africa, so-called “land grabbing”

Activist view: [http://farmlandgrab.org/](http://farmlandgrab.org/), [http://www.grain.org/e/4626](http://www.grain.org/e/4626) “Brazilian megaproject in Mozambique set to displace millions of peasants”

Land evaluation is always political

1. The knowledge of which land uses will perform well on which land areas
   - knowledge is power
   - local populations vs. “metropolis”

2. Who hires the land evaluator? Who sets the terms of reference?
Land evaluation vs. land valuation

- **land valuation**: assign a monetary value to each land area for taxation, land taking, land exchange
  - typically from land market, current production, or production of dominant crop in typical technology; not a prediction
  - e.g., German “bonitas” system
  - can use land evaluation for a dominant land use type as a basis
  - land evaluation unit is either a field or farm

- **land evaluation**: predict performance of various land uses on a specific land area
  - land evaluation unit can be field, farm, soil map unit, landscape unit . . .
Exercise (1)

Describe a setting where land evaluation may be needed:

- Social or environmental problem
- Possibilities for land use change
- *Cui bono?*
History

- Soil survey interpretations (1899 ff.): best practices per soil type

- Land Capability Classification for conservation farm planning (USDA SCS, 1930’s)
  - widely used (abused) for other purposes
  - ranks land in general terms, not for specific use systems
  - implied context

- Irrigation Suitability Classification (USBR, 1950’s)


- Land-use systems modelling, GIS (1990’s)
FAO Framework for Land Evaluation

- International consultation early 1970’s
- Attempted to consolidate previous practice worldwide
- A general approach to land evaluation projects
- Framework 1976
- Guidelines for application in different land uses 1980’s
FAO Framework principles

- Evaluate land areas for a **set** of **specific uses**
  - each use has its own **requirements**

- Various relevant and feasible options are **compared**
  - including “no change” option
  - decision-makers then decide among the options

- Evaluations are in **context**: physical, economic, social, political

- Suitability is defined by **objective criteria**
  - productivity, environmental benefits, ecosystem services, economic, social

- Land uses must be “**sustainable**” (undefined / undefinable?)
  - in practice, use quantifiable indicators
FAO definition: Land


. . . including all reasonably stable, or predictably cyclic, attributes of the biosphere vertically above and below this area . . .

. . . including those of the atmosphere, the soil and underlying geology, the hydrology, the plant and animal populations, . . .

. . . and the results of past and present human activity . . .

. . . to the extent that these attributes exert a significant influence on present and future uses of the land by humans.”
**FAO definition: Land Use (Utilization) Type**

A **specific** manner of occupying and using the land:

- with specified **management**;

- in a defined technical and socio-economic **setting** (context).

A LUT may include any number of activities and products, as long as they form part of one system of management on one parcel of land.
Determinants of a LUT

All aspects of the use that might be affected by the land resource

- product(s); market(s)

- technology: land preparation, harvest

- inputs: water, fertilizers, agro-chemicals

- source of power (esp. for tillage)

- management techniques (e.g., type of irrigation, method for scheduling)

Much more than a botanical species!
Paten village, Magelang Regency, Yogjakarta, Indonesia
Exercise (2)

Describe a LUT:

- relevance to the land evaluation
- major determinants
More FAO definitions

**LEU**  Land Evaluation Unit: an area evaluated as a unit (no subdivision)

**LUS**  Land Use System: A LUT carried out on a LEU

**LC**  Land Characteristic: directly measurable attribute of the land

**LUR**  Land Use Requirement: something necessary (demand) for the success of a LUS

**LQ**  Land Quality: same, seen from the viewpoint of what the LEU supplies
Land Use Requirements

(LUR)

Definition: A **general condition** of the land necessary for successful and sustained implementation of a specific LUT

- The **demand** side of the LUT – LEU matching procedure: the LUT **requires**

- Matches with a single **Land Quality** (LQ)

- The land use requires, the land supplies

- The LUR can be (partially) met by **inputs** – this depends on the definition of the LUS
  - compare LUT {with/without/with different levels} of inputs

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Land Quality

(LQ)

- Sorry for the confusion with “soil quality” (inherent ‘goodness’ of soil – another lecture)

- The supply side of the LUT – LEU matching procedure: the LEU has a certain quality

- Can (partially) compensate for a lower quality with inputs – this depends on the definition of the LUS
  - compare LQ within LUT {with/without/with different levels} of inputs

- More abstract than an LC

- Distinction between LQ and LC is somewhat fuzzy; usually an LC can be measured directly but a LQ must be inferred by some model
### Groups of LUR/LQ

<table>
<thead>
<tr>
<th>A</th>
<th>Agro-ecological</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.1</td>
<td>Sufficiency of ecological factors for production</td>
</tr>
<tr>
<td>A.2</td>
<td>Constraints to production</td>
</tr>
<tr>
<td>B</td>
<td>Management</td>
</tr>
<tr>
<td>C</td>
<td>Spatial</td>
</tr>
<tr>
<td>D</td>
<td>Land improvement</td>
</tr>
<tr>
<td>E</td>
<td>Conservation &amp; environment</td>
</tr>
<tr>
<td>E.1</td>
<td>On-site (sustainability)</td>
</tr>
<tr>
<td>E.2</td>
<td>Off-site (environmental issues)</td>
</tr>
<tr>
<td>F</td>
<td>Social &amp; political</td>
</tr>
<tr>
<td>G</td>
<td>Management and economic constraints</td>
</tr>
<tr>
<td>H</td>
<td>Whole-area</td>
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</table>
### Group A: agro-ecological (1 of 2)

<table>
<thead>
<tr>
<th><strong>Agro-climate</strong></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>A1.1</td>
<td>growing period</td>
</tr>
<tr>
<td>A1.2</td>
<td>radiation</td>
</tr>
<tr>
<td>A1.3</td>
<td>temperature</td>
</tr>
<tr>
<td>A1.4</td>
<td>moisture</td>
</tr>
<tr>
<td>A1.5</td>
<td>oxygen</td>
</tr>
<tr>
<td>A1.7</td>
<td>air humidity</td>
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<table>
<thead>
<tr>
<th><strong>Agro-climate at specific points in the cycle</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A2.1</td>
<td>establishment conditions</td>
</tr>
<tr>
<td>A2.2</td>
<td>rooting conditions</td>
</tr>
<tr>
<td>A2.3</td>
<td>maturity conditions</td>
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</table>

<table>
<thead>
<tr>
<th><strong>Soil conditions</strong></th>
<th></th>
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<tbody>
<tr>
<td>A3.1</td>
<td>nutrient sufficiency</td>
</tr>
<tr>
<td>A3.1.1</td>
<td>nutrient supply</td>
</tr>
<tr>
<td>A3.1.2</td>
<td>nutrient retention</td>
</tr>
<tr>
<td>A3.2</td>
<td>salinity</td>
</tr>
<tr>
<td>A3.3</td>
<td>sodicity</td>
</tr>
<tr>
<td>A3.4</td>
<td>soil toxicities, including direct effects of pH</td>
</tr>
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</table>
## Group A: 2 of 2

<table>
<thead>
<tr>
<th>Agro-environment</th>
<th></th>
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<tbody>
<tr>
<td>A4.1</td>
<td>diseases, pests, weeds</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Natural hazards</th>
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</thead>
<tbody>
<tr>
<td>A5.1</td>
<td>flood hazard</td>
</tr>
<tr>
<td>A5.2</td>
<td>physiographic hazards - landslide</td>
</tr>
<tr>
<td>A5.3</td>
<td>climatic hazards</td>
</tr>
<tr>
<td>A5.3.1</td>
<td>fire</td>
</tr>
<tr>
<td>A5.3.2</td>
<td>frosts</td>
</tr>
<tr>
<td>A5.3.3</td>
<td>wind</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Animal production</th>
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</thead>
<tbody>
<tr>
<td>A6.1</td>
<td>drinking water quantity and quality</td>
</tr>
<tr>
<td>A6.2</td>
<td>minerals</td>
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# Group B: Management

<table>
<thead>
<tr>
<th>B1</th>
<th>water management</th>
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<tbody>
<tr>
<td>B1.1</td>
<td>water availability for irrigation</td>
</tr>
<tr>
<td>B1.2</td>
<td>water quality (short-term)</td>
</tr>
<tr>
<td>B1.3</td>
<td>water application for irrigation</td>
</tr>
<tr>
<td>B1.4</td>
<td>drainage</td>
</tr>
<tr>
<td>B2</td>
<td>tillage</td>
</tr>
<tr>
<td>B3</td>
<td>pre-harvest management</td>
</tr>
<tr>
<td>B4</td>
<td>harvest management</td>
</tr>
<tr>
<td>B5</td>
<td>post-harvest management</td>
</tr>
<tr>
<td>B6</td>
<td>storage and processing</td>
</tr>
<tr>
<td>B7</td>
<td>mechanization</td>
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## Group C: Spatial

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
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<tr>
<td>C1</td>
<td>transportation costs</td>
</tr>
<tr>
<td>C2</td>
<td>adjacency to other uses</td>
</tr>
<tr>
<td>C3</td>
<td>distance from other uses</td>
</tr>
<tr>
<td>C3.1</td>
<td>proximity (closer is better)</td>
</tr>
<tr>
<td>C3.2</td>
<td>separation (further is better)</td>
</tr>
<tr>
<td>C3.3</td>
<td>ideal distance</td>
</tr>
<tr>
<td>C4</td>
<td>accessibility to the production unit</td>
</tr>
<tr>
<td>C5</td>
<td>access within the production unit</td>
</tr>
<tr>
<td>C6</td>
<td>shape and size of the parcel</td>
</tr>
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</table>
## Group D: Land improvement

<table>
<thead>
<tr>
<th>D1</th>
<th>clearing</th>
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</thead>
<tbody>
<tr>
<td>D2</td>
<td>land shaping</td>
</tr>
<tr>
<td>D3</td>
<td>flood protection</td>
</tr>
<tr>
<td>D4</td>
<td>drainage</td>
</tr>
<tr>
<td>D5</td>
<td>leveling (topography)</td>
</tr>
<tr>
<td>D6</td>
<td>physical, chemical &amp; organic amendments</td>
</tr>
<tr>
<td>D7</td>
<td>leaching</td>
</tr>
<tr>
<td>D8</td>
<td>recuperation period</td>
</tr>
<tr>
<td>D9</td>
<td>irrigation works (construction)</td>
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</table>
### Group E: Conservation & environment

<table>
<thead>
<tr>
<th>On-site (sustainability)</th>
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<tbody>
<tr>
<td>E1</td>
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<tr>
<td>E2</td>
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<tr>
<td>E3</td>
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<tr>
<td>E4</td>
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<tr>
<td>E5</td>
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</table>

<table>
<thead>
<tr>
<th>Off-site (environmental issues)</th>
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</thead>
<tbody>
<tr>
<td>E6</td>
</tr>
<tr>
<td>E7</td>
</tr>
<tr>
<td>E8</td>
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</table>
### Group F: Social & political

<table>
<thead>
<tr>
<th>F1</th>
<th>political entity</th>
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<tbody>
<tr>
<td>F2</td>
<td>land tenure</td>
</tr>
<tr>
<td>F3</td>
<td>farmer attitudes</td>
</tr>
<tr>
<td>F4</td>
<td>labour availability</td>
</tr>
</tbody>
</table>

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Group G: Management and economic constraints

| G1  | seasonality (opportunity) |
# Group H: Whole-area

<table>
<thead>
<tr>
<th>H1</th>
<th>sufficient total area for development (e.g., to invest in a processing plant)</th>
</tr>
</thead>
<tbody>
<tr>
<td>H2</td>
<td>presence of contrasting land areas (e.g., winter and summer pasture)</td>
</tr>
</tbody>
</table>
Selection of LUR

The simplest model that successfully predicts performance is best; how to limit the LUR to the smallest sufficient set?

• Important for use, i.e., have an **effect** on LUT success

• Existence of **critical values** in study area
  - Some sub-optimum, varying over the area
  - otherwise, variables become constants

• **Data** to evaluate are available
  - diagnostic Land Characteristics

• **Knowledge** on how to evaluate is available
  - selection of diagnostic Land Characteristics
  - models
Economic land evaluation

- **LQ**: can link lower levels to economic loss:
  - lower yields
  - delayed yields
  - higher costs to obtain the optimum yield

- **LUT**: compute financial value as:
  - gross margin (does not take into account time value of money)
  - Net Present Values (NPV) – requires the specification of a *discount rate*
  - Benefit/Cost ratio (B/CR) – from the NPV over the life of the project

- NPV, BC/R apply to multi-year LUT
  - e.g., fruit plantations, irrigation projects
Exercise (3)

1. List relevant LUR for the chosen LUT

2. How does a sub-optimal level of the corresponding LQ affect suitability?
   - fewer benefits (e.g., lower yield)?
   - higher costs? (e.g., more labour or inputs)?
   - off-site damages?

3. List possible LC to evaluate the LQ
Part 2 – Land evaluation research

- narrowly defined: terms “land evaluation” or “land suitability” in the title

- broadly defined: terms also in the keywords or abstract
Newest land evaluation research (Web of Science search) 20–May–2018

1. Quantifying the uncertainty of a model-reconstructed soilscape for archaeological land evaluation
   - By: Finke, P. A.; Safari, A.; Zwetslooth, A.; et al.
   - GEODERMA Volume: 330 Pages: 74-81 Published: JUN 2018

2. A framework for assessing the resilience of a disaster debris management system
   - By: Kim, Jooch; Deshmukh, Abhijeet; Hastak, Makarand
   - INTERNATIONAL JOURNAL OF DISASTER RISK REDUCTION Volume: 28 Pages: 674-687 Published: JUN 2018

3. A land use suitability model for rainfed farming by Multi-criteria Decision-making Analysis (MCDA) and Geographic information System (GIS)
   - By: Kazemi, Hossein; Akinci, Halil
   - ECOLOGICAL ENGINEERING Volume: 116 Pages: 1-6 Published: JUN 2018

4. A dynamic viticultural zoning to explore the resilience of terroir concept under climate change
   - By: Bonfante, A.; Monaco, E; Langella, G.; et al.
   - SCIENCE OF THE TOTAL ENVIRONMENT Volume: 624 Pages: 294-308 Published: MAY 2018

5. Trio-V Wind Analyzer: A Generic Integral System for Wind Farm Suitability Design and Power Prediction Using Big Data Analytics
   - By: Fawzy, Dina; Moussa, Sherin; Badr, Nagwa
   - JOURNAL OF ENERGY RESOURCES TECHNOLOGY-TRANSACTIONS OF THE ASME Volume: 140 Issue: 5 Article Number: 051202 Published: MAY 2018

6. The development of land use planning scenarios based on land suitability and its influences on eco-hydrological responses in the upstream of the Huaibei River basin
   - By: Yu, Dan; Xie, Ping; Dong, Xiaojuan; et al.
   - ECOLOGICAL MODELLING Volume: 373 Pages: 53-67 Published: APR 2018
<table>
<thead>
<tr>
<th>Rank</th>
<th>Title</th>
<th>Times Cited</th>
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<tbody>
<tr>
<td>1.</td>
<td>Climate change mitigation: A spatial analysis of global land suitability for clean development mechanism afforestation and reforestation</td>
<td>201</td>
<td>from Web of Science Core Collection</td>
<td></td>
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<tr>
<td>2.</td>
<td>Spatial sensitivity analysis of multi-criteria weights in GIS-based land suitability evaluation</td>
<td>148</td>
<td>from Web of Science Core Collection</td>
<td>Highly Cited Paper</td>
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<tr>
<td>3.</td>
<td>Land evaluation for peri-urban agriculture using analytical hierarchical process and geographic information system techniques: A case study of Hanoi</td>
<td>74</td>
<td>from Web of Science Core Collection</td>
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<tr>
<td>4.</td>
<td>A GIS-integrated fuzzy rule-based inference system for land suitability evaluation in agricultural watersheds</td>
<td>60</td>
<td>from Web of Science Core Collection</td>
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<td>5.</td>
<td>Wind farm land suitability indexing using multi-criteria analysis</td>
<td>55</td>
<td>from Web of Science Core Collection</td>
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<td>6.</td>
<td>Analysis of land suitability for the siting of inter-municipal landfills in the Cuitzeo Lake Basin, Mexico</td>
<td>48</td>
<td>from Web of Science Core Collection</td>
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<tr>
<td>1</td>
<td>The prehistoric and preindustrial deforestation of Europe</td>
<td>Kaplan, Jed O.; Krumhardt, Kristen M.; Zimmermann, Niklaus</td>
<td>QUATERNARY SCIENCE REVIEWS</td>
<td>28</td>
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<td>2</td>
<td>Climate change mitigation: A spatial analysis of global land suitability for clean development mechanism afforestation and reforestation</td>
<td>Zorner, Robert J.; Trabucco, Antonio; Bossio, Deborah A.; et al.</td>
<td>AGRICULTURE ECOSYSTEMS &amp; ENVIRONMENT</td>
<td>126</td>
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<tr>
<td>4</td>
<td>Protected area zoning for conservation and use: A combination of spatial multicriteria and multiobjective evaluation</td>
<td>Geneletti, Davide; van Duren, Iris</td>
<td>LANDSCAPE AND URBAN PLANNING</td>
<td>85</td>
</tr>
<tr>
<td>5</td>
<td>Siting MSW landfill using weighted linear combination and analytical hierarchy process (AHP) methodology in GIS environment (case study: Karaj)</td>
<td>Moelmaddini, Mazaher; Khorasani, Nematoollah; Danehkar, Afshin; et al.</td>
<td>WASTE MANAGEMENT</td>
<td>30</td>
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<tr>
<td>6</td>
<td>Land evaluation for peri-urban agriculture using analytical hierarchical process and geographic information system techniques: A case study of Hanoi</td>
<td></td>
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</tbody>
</table>
Part 3 – Models in land evaluation

• Models: **simplified** representations of systems, capturing their essential behaviour
  
  - **process-based**: represent presumed processes mathematically
  - **empirical**: establish predictive statistical relations
  - In practice the line is blurry: empirical are motivated by presumed processes, process-based have many empirical calibrations


• Land evaluation: simulate land use systems or components
Classification of Models

On three axes:

1. **Scale** of process

2. degree of **computation**

3. degree of **complexity**

Most models “jump” in this space; i.e., have parts at different scales and with different computation and complexity.

Some types of model knowledge

K1 user expertise (empirical, qualitative)
  • often at more general scales; difficult to extrapolate

K2 expert knowledge (mechanistic, qualitative)

K3 generalized holistic models (empirical, quantitative)

K4 complex holistic models (semi-mechanistic, quantitative)

K5 complex models of system components (mechanistic, quantitative)
  • often at more detailed scales

Examples of models in land evaluation

K1 extensionist’s knowledge

K2 FAO Framework implemented/extended in ALES


K3 multivariate regressions of yield etc. on environmental factors


K4 WOFOST, APSIM, DSSAT . . . agrosystem simulation models

K5 LEACHM (pesticide / nitrate transformations in soils)

Part 4 – Difficulties & new directions

There is still activity in land evaluation . . .

... but what is its quality?

... is it relevant?

... is it used?
Difficulties

1. **Complicated reality** → prediction is difficult

2. Inappropriate / oversimplified **evaluations**

3. Inappropriate **models**

4. Lack of **information**
   - on land resource
   - on **response** of land resource to uses

5. Poor relation with **stakeholders**
**Difficulty: Complicated reality**

- Success/failure of a land use system depends on many inter-related factors

- Notable failure: Tanganyika Groundnut Scheme (late 1940’s)
  

  - short time-series of rainfall records (drier than anticipated)
  - topsoils too clayey for nut development/harvesting
  - no reliable irrigation or drinking water
  - inadequate equipment for land clearing:
  - no experienced managers or workers; undeveloped labour market

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Difficulty: Oversimplified evaluations

- evaluations often required by projects as an output, not in response to specific demand

- so, evaluators take the easy way out:
  - using botanical species as a LUT
  - blind application of Sys tables or similar
  - not considering locally-important factors, especially management methods
Difficulty: improper application of models

Refer to previous section on modelling

- not the output that the client needs
- wrong scale
- poor description of process
- model not locally calibrated
Lack of information on land resources

- Many areas of the world with coarse or unreliable information on soils
  - “legacy” data: difficult to interpret / incorporate in GIS
  - SoilGrids (ISRIC) [https://soilgrids.org/](https://soilgrids.org/)
  - GlobalSoilMap.net project [http://www.globalsoilmap.net/](http://www.globalsoilmap.net/)

- Sparse distribution, short/unreliable time series of weather, stream flow records etc.

- However, some excellent fine-resolution data sources
  - **DEM** → terrain characterization
  - satellite imagery
  - compiled global datasets
**Difficulty: poor relation with stakeholders**

Land evaluation is aimed at providing reliable information on land use options to various interested parties ("stakeholders").

If the results do not meet their needs, the effort is wasted or (worse) mis-directed.
Problems with current practice

- top-down, bureaucratic, technocratic

- supply-driven (organizational / donors require)
  - “have model, will travel”

- based on evaluator expertise, not user needs
  - lots of time wasted on unrealistic options
Solutions

- demand-driven land evaluation
- research chain
- better data sources and models
Demand-driven land evaluation

• fact: most contexts are **highly constrained**
  - except for totalitarian states – even there, grass-roots pressure constrains
  - spectacular failures in large-scale unconstrained schemes, so top-down planners are more cautious

• in settled areas, most options are **adaptations**
  - most land users have little room for maneuver
  - example: zone tillage; frost tillage (NE USA)

• only evaluate for **realistic options**, agreed-on with stakeholders
“Interpreted information” = land evaluation
Research chain


• Insight: most land use changes are highly constrained

• Insight: most ready-made models only cover part of what is needed

• So: Land evaluation is only carried out on demand, with a clear problem definition and agreed output specification – what the user needs to make a decision

• So: models are coupled *ad hoc* as appropriate to produce the required output may require new model components or linking models
Research chain

1: problem definition

2: output specification

3: model selection

4: data requirements

5: model application

6: quality assessment

7: presentation
End