

(Bullets are generic elements, dashes are potential subclasses/examples; all elements are probably not represented in most models. Required elements are marked with an \*.)

#### I. Information/Data classes (Figure 1)

- 1. Landscape Representation
  - Structure (Functionality)
    - \*Realism
      - Theoretical (SLUDGE, SOME,FEARLUS)
      - Real-world (SOME,LUCIM,SYPRIA)
    - \*Spatial data structure:
      - cell-based (raster, hex, etc.) (SLUDGE,SOME,FEARLUS,LUCITA,SYPRIA)
      - vector (SYPRIA)
    - \*Parcel structure
      - Fixed (SLUDGE,SOME,,FEARLUS,LUCITA)
      - Variable (SYPRIA)
    - \*Agent/parcel relationships
      - One parcel per agent (SLUDGE,SOME,LUCITA)
      - Multiple parcels per agents (FEARLUS,SYPRIA)
      - Multiple agents per parcel (SOME)
    - \*Decision-making units
      - Single decision/land use per parcel (SLUDGE,SOME,FEARLUS,SYPRIA)
      - Multiple uses/management units per parcel (LUCITA)
  - Data Layers/Themes
    - \*Land use (SLUDGE,SOME,FEARLUS,SYPRIA)
    - Land ownership (FEARLUS)
    - Parcel definitions (LUCITA)
    - Land cover (LUCITA,SYPRIA)
    - Land rent (SLUDGE)
    - Productivity/output (SLUDGE)
    - Aesthetic quality (SOME)
    - Biophysical characteristics (FEARLUS)
    - Land manager subpopulations (FEARLUS)
    - Climate (FEARLUS,SYPRIA)
    - Soil type/quality (LUCITA,SYPRIA)
    - Topography (SYPRIA)
    - Roads (SYPRIA)
    - Market locations (SYPRIA)
    - Census data (SYPRIA)

2. Other spatial data inputs (potentially, GIS functionality)

- Network models
  - Transportation
    - Euclidean Distance (SLUDGE,SOME)
    - Road network (SOME,SYPRIA)
  - Information diffusion (SYPRIA)
  - Hydrology (SYPRIA)
- Neighbourhood effects
  - Fixed-radius
    - Nearest-neighbour spatial externalities (SLUDGE)
    - Fixed radius neighbourhood density (SOME)
    - Fixed radius (land market and social) (FEARLUS)
    - Environmental process models (SYPRIA, II.1)
  - Variable radius
    - Distance to service centres (SOME)
  - Diffusion/distance decay

3. Non-spatial networks

- Social
  - Information/Imitation (FEARLUS,SYPRIA)
- Trade
- Affiliation (SYPRIA)

4. Institutional/Political rules and constraints

- \*Land tenure rules
  - Occupancy rights (SOME,LUCITA)
  - Use rights (SLUDGE,FEARLUS,LUCITA, SYPRIA)
  - Acquisition rights (SOME,FEARLUS)
  - Transfer rights
- Zoning
  - Density restrictions (SOME)
- Regulations related to taxation, subsidies, etc. (SYPRIA)

5. Economic structures

- Local markets for land inputs and outputs (functions)
  - Urban land demand (SLUDGE)
  - Labour pool (LUCITA)
- Economic data values (data)
  - Input prices (LUCITA,SYPRIA)
  - Output prices
    - Agricultural output (SLUDGE,FEARLUS,LUCITA,SYPRIA)
  - Transportation costs (SLUDGE,SYPRIA)
  - Externality benefits/costs (SLUDGE)
  - Break-even threshold (FEARLUS)
  - Subsistence costs (LUCITA,SYPRIA)
  - Taxes
  - Subsidies (SYPRIA)

6. Potential Land Uses

- Urban residential (SLUDGE,SOME)
- Agriculture
  - Generic (SLUDGE)
  - Multiple abstract (FEARLUS)
  - Multiple annual, perennial, pasture, forest (LUCITA)
  - Subsistence vs. market (multiple) (SYPRIA)
- Service centres (SOME)
- Open space (SOME)

7. Factors affecting land productivity

- Parametric settings for each land use (SLUDGE)
- Match between land use, climate, and economic bitstrings (FEARLUS)
- Assessed by agents as function of input layers (SYPRIA)

## II. Interfaces to other models (Figure 2)

### 1. Biophysical process models

- Hydrology
- Species colonization (SYPRIA)
- Secondary succession (LUCITA,SYPRIA)
- Soil fertility/crop yields (LUCITA,SYPRIA)
- Disease outbreaks
- Carbon sequestration
- Climate

### 2. Socioeconomic models

- Population (SYPRIA)
- Land demand
- Global/regional markets

### III. Demographic classes (Figure 3)

#### 1. \*Agent class

- Generic land owner (SLUDGE)
- Residential (SOME)
- Service centre (job and service provider) (SOME)
- Land manager/farm household (FEARLUS,LUCITA,SYPRIA)
- Institutional (SYPRIA)
- Land Lord
- Estate Owner (Laird)

#### \*Agent decision model (function)

- \*Calculate payoffs
  - Profit (SLUDGE,FEARLUS)
  - Utility based on aesthetics and distance to service centres (SOME)
  - Expected yield (LUCITA, SYPRIA)
- \*Decision strategy
  - Boundedly rational profit maximization (SLUDGE,FEARLUS, SYPRIA)
  - Utility maximizing, but with incomplete information (SOME)
  - Adaptive (FEARLUS, SYPRIA)
  - Imitative (FEARLUS, SYPRIA)
  - Heuristic (FEARLUS,LUCITA)
  - Satisficing (SYPRIA)

#### Internal characteristics (Data)

- Age (FEARLUS)
- Parameters governing imitative and decision strategies (FEARLUS)
- Aspiration threshold (FEARLUS)
- Minimum wealth threshold for land bids (FEARLUS)
- Cultural identity/affiliation (FEARLUS,SYPRIA)
- Cultural preferences/norms
  - Residential preferences (SOME)
  - Cultivation preferences (SYPRIA)
- Human capital
  - Education (SYPRIA)
  - Expertise
    - Knowledge of soil/crop relationships (LUCITA)
    - Memory of climatic, economic, yield, and land use histories (FEARLUS)
  - Experience (SYPRIA)
- Household composition (if household)
  - Gender and age (LUCITA,SYPRIA)
- Time horizon and discount rate
  - Variable (FEARLUS)
- Attitudes towards risk

#### External resources (Data)

- Available farm labour (LUCITA, SYPRIA)
- Physical capital (LUCITA,SYPRIA)
- Financial capital (LUCITA,FEARLUS,SYPRIA)
- Social capital
  - Reputation
  - Connections in social network

2. Demographic dynamics (global functions and data)
  - In-migration (SOME,FEARLUS,LUCITA,SYPRIA)
  - Out-migration (FEARLUS,LUCITA,SYPRIA)
  - Reproduction
    - Fertility rates by cohort (LUCITA)
  - Birth/death (LUCITA,SYPRIA)
  - Household division/agglomeration
  - Life cycle dynamics
    - Aging (LUCITA,SYPRIA)
    - Marriage (LUCITA)
    - Succession

#### IV. Land-use decision class (Figure 4)

1. \*Land-use decision
  - \*Agent decision model (function, (III.1) (SLUDGE,FEARLUS,LUCITA,SYPRIA)

Data

  - Agent Internal and External characteristics (III.1) (FEARLUS,LUCITA,SYPRIA)
  - \*Potential land uses (I.6) (SLUDGE,FEARLUS,LUCITA,SYPRIA)
  - Parcel accessibility (I.2) (SLUDGE,SYPRIA)
  - Neighbourhood effects (I.2) (SLUDGE,FEARLUS,SYPRIA)
  - Institutional rules and constraints
    - \*Land-tenure rules (I.4) (SLUDGE,FEARLUS,LUCITA,SYPRIA)
    - Institutional interactions (SYPRIA)
  - Economic data values (I.5) (SLUDGE,FEARLUS,LUCITA,SYPRIA)
  - Biophysical suitability/capability (I.1, I.7, or II.1)
    - Varies by land use, externalities, and productivity (SLUDGE)
    - Spatially heterogeneous, constant over time (FEARLUS)
    - Expected yield (based on last obtained yield) (LUCITA)
    - Taken from biophysical succession, fertility and yield models (SYPRIA)

## V. Land exchange class (Figure 5)

1. Suppliers of land
  - Motivation for supply
    - Profit
    - Out-migrating bankrupt agents (FEARLUS/ELMM,LUCITA)
    - Migration
    - Household dynamics
  - Parcels supplied
    - All parcels owned (FEARLUS,LUCITA)
  - Terms offered
    - No compensation required (SOME)
    - Minimum bid accepted (FEARLUS)

2. Acquirers of land
  - Motivation for acquiring land
    - SOME: Relative utility based on:
      - Parcel accessibility (I.2)
      - Neighbourhood effects (I.2)
      - Biophysical suitability/capability
    - Profit (FEARLUS,SYPRIA)
    - Migration (FEARLUS,LUCITA,SYPRIA)
    - Subsistence (SYPRIA)
    - Household dynamics
  - Parcels they hope to acquire
    - Random sub-sample (SOME)
    - Dependent on Land Parcel Purchasing decision strategy (FEARLUS)
    - Determined by distance to main road and nearest town (LUCITA)
    - Based on expected yield/profit (SYPRIA)
  - Terms offered
    - Based on expected profits (FEARLUS)

3. Exchange rules
  - Event sequencing/triggers for land transfers
    - In-migration (SOME,SYPRIA)
    - Out-migration (SYPRIA)
    - Profit expectation threshold
    - Bankruptcy (FEARLUS,LUCITA)
    - Death
  - Allocation mechanism
    - Agent occupies chosen parcel (SOME,LUCITA,SYPRIA)
    - Bidding mechanism
    - Auction (FEARLUS)
    - Negotiation
    - Bequest
    - Involuntary transfer

## VI. Model operation class (Figure 6)

### 1. Model initialization

- \*Initial landscape structure (I.1)  
(SLUDGE,SOME,FEARLUS,LUCITA,SYRPIA)
- Transport networks and initial accessibility/travel costs (I.2)  
(SLUDGE,SOME,SYRPIA)
- Neighbourhood effects (I.2) (SLUDGE,SOME,FEARLUS,SYRPIA)
- Non-spatial networks (I.3) (FEARLUS,SYRPIA)
- \*Institutional rules and constraints (I.4)  
(SLUDGE,SOME,FEARLUS,LUCITA,SYRPIA)
- Economic data values (I.5) (SLUDGE,FEARLUS,LUCITA,SYRPIA)
- Initial input from external biophysical and socioeconomic models (II)  
(LUCITA,SYRPIA)
- \*Agent types, numbers, and resource endowments (III)  
(SLUDGE,SOME,FEARLUS,LUCITA,SYRPIA)
- Random seeds (FEARLUS)

### 2. Temporal Dynamics

- \*Number of iterations
  - Less than 20 (SLUDGE)
  - Variable, dependent on agent numbers to allocate (SOME)
  - Around 200 (FEARLUS)
  - 30 (LUCITA)
  - 10-40 (SYRPIA)
- \*Event Scheduling
  - Discrete time (synchronous or asynchronous)  
(SLUDGE,SOME,FEARLUS,FEARLUS,SYRPIA)
  - Discrete event (SYPIRA)