# LANDIS-II v8.0
# SOSIEL Harvest Extension v2.0
# User Guide

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# 1 Introduction

This document describes the SOSIEL Harvest Extension (SHE) for the LANDIS-II model. For information about LANDIS-II and its core concepts, see the LANDIS-II Conceptual Model Description. SHE is compatible with all succession extensions. To date, SHE has been tested only with the Biomass Succession extension. For this reason, parameterization instructions are provided for only Biomass Succession.

## 1.1 Overview

The SOSIEL Harvest extension (SHE) couples the agent-based SOSIEL (Self-Organizing Social & Inductive Evolutionary Learning) algorithm, which simulates boundedly-rational decision-making of one or more agents, with LANDIS-II and its Biomass Harvest extension (BHE). Each SOSIEL agent makes decisions using a cognitive architecture that consists of nine cognitive processes (anticipatory learning, goal prioritizing, counterfactual thinking, innovating, social learning, goal selecting, satisficing, signaling, and action-taking) and that enables each agent to interact with other agents, learn from its own experience and that of others, and make decisions about taking, and then take, (potentially collective) actions. SHE operates in two modes: on its own (Mode 1), which is primarily intended for simulating site-scale forest management, and with BHE (Mode 2), which is intended for simulating stand-to-landscape-scale forest management (Figure 1).

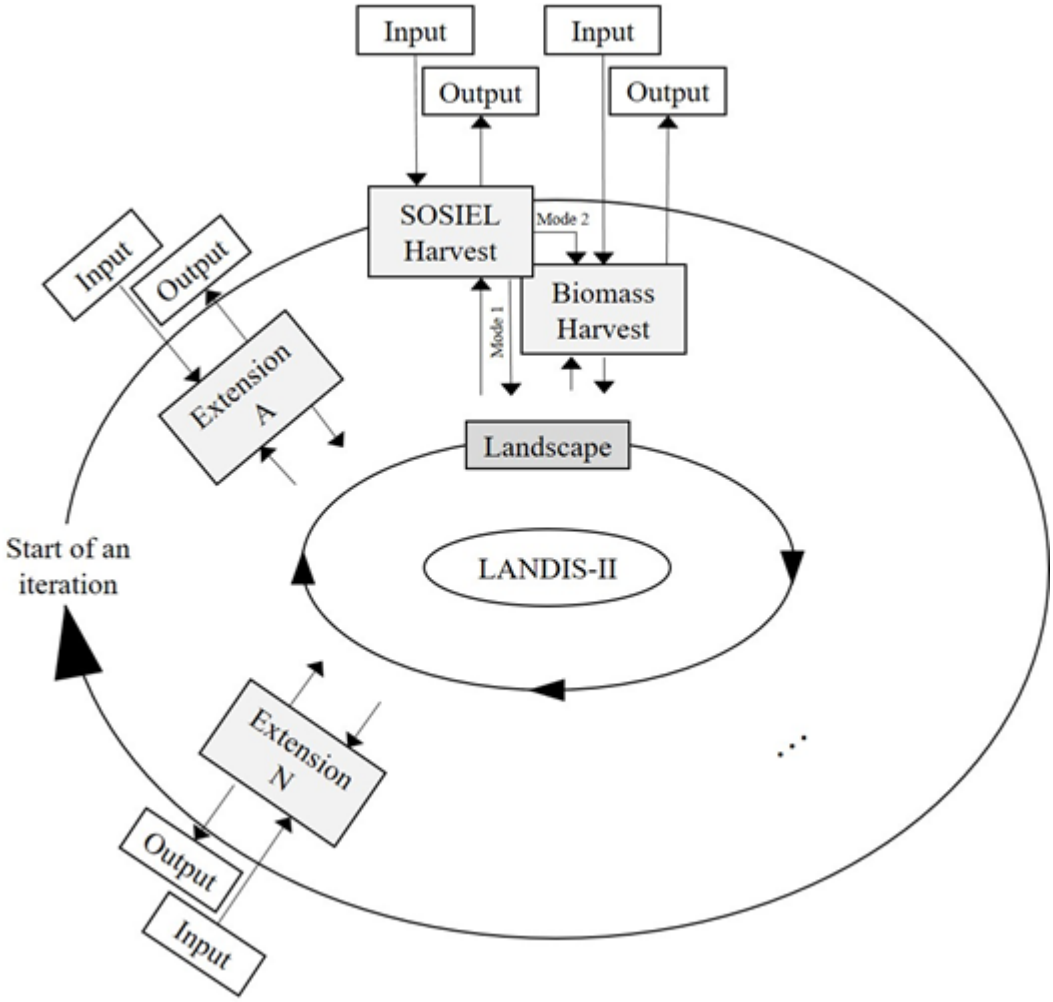



**Figure 1:** SHE in the context of LANDIS-II, BHE, and additional LANDIS-II extensions. At each timestep, LANDIS-II calls on different extensions to act on the landscape. In Mode 1, SHE calls on the SOSIEL algorithm to analyze landscape conditions and choose DOs and then uses LANDIS-II's harvest management library to implement them. In Mode 2, SHE calls on the SOSIEL algorithm to analyze landscape conditions and choose DOs and on BHE to implement them.

See Sotnik (2018) for a description of the SOSIEL algorithm's theoretical foundations and its specifications document for the pseudocode of its cognitive, behavioral, social, and demographic processes.

## 1.2 Releases

- ❑ Version 2.0 (July 2025): Updated to be compatible with Core v8.
- ❑ Version 1.2 (February 1, 2021).

- ❏ January 24, 2021: Original release (v1.0.0).

## 1.3 Relevant user guides

- ❏ Biomass Harvest User Guide provides guidance for parameterizing BHE, which is based on the Base Harvest Extension. The Base Harvest User Guide provides a more detailed description of the foundations of the two extensions. The guide is useful in Modes 1 and 2.
- ❏ Biomass Succession User Guide provides guidance for parameterizing BSE. The guide is useful in Modes 1 and 2.
- ❏ LANDIS-II User Guide provides guidance for parameterizing LANDIS-II. The guide is useful in Modes 1 and 2.
- ❏ SOSIEL Algorithm User Guide provides guidance for parameterizing SOSIEL. The guide is useful in Modes 1 and 2.

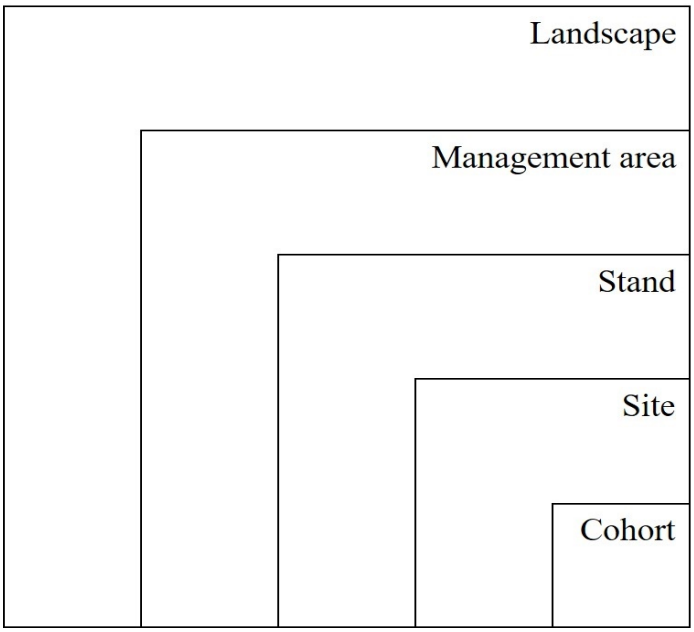
## 1.4 GitHub repository

The folder structure and contents in SHE's GitHub repository are described below.

- ❏ deploy
  - ❏ Installer // contains the most recent installer.
  - ❏ Past-releases // contains past installers.
- ❏ docs // contains the current and past user guides.
- ❏ src // contains source files.
- ❏ testing // contains examples for running the extension.

## 1.5 Acronyms and definitions of key terms

This section defines key terms used throughout the document and lists their sources. The below figure illustrates the hierarchical relationship of some of the key terms and, more generally, the structure of LANDIS-II's two-dimensional landscape from the perspective of its harvest extensions.




**BHE** – Biomass Harvest Extension

**BSE** – Biomass Succession Extension

**Cohort** – an abstract entity that includes an unspecified number of trees of one species and within the same age class/span (e.g., 1-10, 11-20, etc.). Each cohort has the following two attributes: (a) species type and (b) age class. Cohorts grow within sites, which may contain zero, one, or multiple cohorts of one or more species. The amount of biomass within any cohort is determined by its species and age, as well as parameterization of BSE during calibration. Source: LANDIS-II User Guide, Biomass Succession User Guide.

**Decision option (DO)** – a conditional IF/THEN statement that consists of one or more antecedents, which are the landscape, social, and/or personal conditions that lead to a specific action, and one consequent, which is the action. Source: SOSIEL Algorithm User Guide.

**LANDIS-II** – LANdscape DIsturbance and Succession

**Landscape** – a two-dimensional plane composed of a set of equally-sized sites. Source: LANDIS-II User Guide.

**ManageAreaBiomass** – a dynamic floating point variable indicating the amount of biomass in a specific MA during a specific timestep.

**ManageAreaHarvested** – a dynamic floating point variable indicating the amount of biomass harvested in a specific MA during a specific timestep.

**ManageAreaMaturityPercent** – a dynamic floating point variable indicating the percent of biomass that is equal to or greater than the age maturity threshold of the species in a specific MA.

**Management area (MA)** – a set of sites that sets the boundaries in which a prescription is implemented. The same prescription may be implemented in more than one management area. Source: Base Harvest User Guide.

**Mental model (MM)** – an agent's mental representation of a situation, in which the agent considers alternative DOs and potentially takes actions. Source: SOSIEL Algorithm User Guide.

**PercentOfHarvestArea** – a dynamic floating point variable in SOSIEL that corresponds to the Harvest Area parameter in BHE's HarvestImplementaitons table.

**Prescription** – a set of criteria specifying which stands, sites, and cohorts in an MA qualify or are excluded from management and how they are managed. Source: Base Harvest User Guide.

**Site (a.k.a. forest site or cell)** – a set of closely-located cohorts of trees. A site consists of one raster cell in the modeling environment, and all sites are of equal size. Source: LANDIS-II User Guide.

**SHE** – SOSIEL Harvest Extension.

**SOSIEL** – Self-Organizing Social & Inductive Evolutionary Learning. Source: SOSIEL Algorithm User Guide.

**Stand** – a set of sites that represents a typical or average landscape management block. A management area can consist of one or multiple stands. A stand can consist of one or multiple sites. Source: Base Harvest User Guide.

**TargetHarvestSize** – a static floating point variable ( $x \geq 0$ ) representing the total amount of biomass the agent wants to harvest with a specific DO during a timestep. It is used in Mode 1 and is located in SHE's input file (e.g., input_SHE.txt).

## 1.6 Acknowledgements

We are grateful to EffectiveSoft for programming support.

# 2 Configuration

SHE can simulate agents in one of three different modes or in any combination of the modes. Mode 1 is primarily intended for simulating agents that engage in site-scale forest management. Mode 2, which works with BHE, is intended for simulating agents that engage in stand-to-landscape-scale forest management. Mode 3 is for simulating agents that do not directly interact with the forest landscape.

SHE's simulation mode is specified in the input_SHE file. When simulating SHE in multiple modes, the mode numbers should be separated by commas (without spaces in between). When simulating in multiple modes, a specific mode needs to additionally be assigned to each agent in the input_SHE file's AgentToManagementArea table, using the SimulationMode parameter. If all the agents are simulating in the same mode, the SimulationMode parameter can be ignored and all the agents will be automatically assigned to the single mode.

Each mode's input files and their parameters are described below. All input files follow LANDIS-II's input rules. Please see the LANDIS-II Model v7.0 User Guide for related instructions. In the example tables, the ellipsis are not formal input entries. They are only used to note that other inputs may precede or follow.

The below input files are listed in alphabetical order. We recommend parameterizing input files in the following order: (1) SOSIEL's input file; (2) SHE's input file; (3) BSE's input file; (4) LANDIS-II's (scenario) input file; and, if implementing Mode 2, (5) BHE's input file.

In the case of Mode 2, and if an operational BHE file already exists (e.g., from another implementation of BHE), it may be more effective to start by first reconfiguring the prescription IDs in BHE to the SOSIEL format and then following with (1) through (4).

## 2.1 Mode 1: Input files and parameters

In Mode 1, SHE calls the SOSIEL algorithm to analyze forest conditions and choose DOs and then uses LANDIS-II's harvest management library to implement them. In this mode, a many-to-many relationship is possible between agents and forest management areas, which they can share. Additionally, decisions are made and implemented at the forest-site level, which permits the implementation of DOs at the neighborhood scale (0–50 m). Such DOs are typically implemented by community forest members, family forest landowners, wildlife (e.g., birds, bears,

deer, tigers, wolves), and may also be useful as part of forest management efforts aimed at biodiversity and overall management at multiple spatiotemporal scales. Agents can move through the landscape from one forest site to another and choose which of its DOs to implement, based on forest, personal, or social conditions (or combinations of all three).

Mode 1 requires parameterization of BSE's, LANDIS-II's, SHE's, and SOSIEL's input files.

### 2.1.1 BSE's input parameter

Configuring SHE for Mode 1 involves entering decision option (DO) IDs into the HarvestReductionParameters table of BSE's main input file (e.g., input_BSE.txt). The table specifies how much dead wood and litter will be removed and how much cohort wood and leaf biomass is moved off site during harvest. The table's first column lists DO IDs. Beginning with BSE's v5.2.1, the listed names can contain wildcards ('*'). For example, the DO ID 'MM*' can stand for DOs 'MM1-1_DO1' and 'MM2-2_DO2'. The asterisk must be at the end of the DO ID. The asterisk should be used when SOSIEL is set to Cognitive Level 4, during which agents can create new DOs. For all other aspects of parameterizing BSE, please refer to its most recent User Guide.

```
...
   HarvestReductionParameters
>> ----    ----------    ------   -----     ----------
>> Name    WoodLitter    Litter   Cohort    Cohort
>>         reduct        reduct   removal   leaf removal
>> ----    ----------    ------   -------   ----------
   MM*     0.0           0.0      0.85      0.0
...
```

### 2.1.2 LANDIS-II's input parameter

Configuring SHE for Mode 1 involves listing it and its initialization file in the Disturbance Extensions table of LANDIS-II's scenario file (e.g., input_scenario.txt). In Mode 1, both SHE and BHE may be included as disturbance extensions and will operate independently from one another. For all other aspects of parameterizing LANDIS-II, please refer to its most recent User Guide.

```
...
```

```
>> Disturbance Extensions      Initialization File
>> ----------------------      -------------------
...
   "SOSIEL Harvest"            input_SHE.txt
...
```

### 2.1.3 SHE's input parameters

Configuring SHE for Mode 1 involves parameterizing its main input file (e.g., input_SHE.txt) as follows:

List the title of the input file. Assign maps that specify on the landscape management areas and stands. Set SHE's mode to 1. Set the frequency of SHE's activation. Note that the timestep at which SHE activates can be different than the timestep for BSE, BHE, etc. List SOSIEL's main input file.

```
   LandisData  "SOSIEL Harvest"

   ManagementAreas      input_SHE_ManageAreas.img

   Stands               input_SHE_Stands.img

   Mode          1

   Timestep      10

>> --------------       -------------------
>> Component name       Initialization file
>> --------------       -------------------
   "SOSIEL Harvest"     input_SHE_SOSIEL.txt
...
```

List at least one DO in the DecisionOptions table. A DO consists of its ID, specified target harvest size, target forest type, and a method for removing cohorts. These parameters, except for the DOs ID and target harvest size, are identical to those used in other LANDIS-II harvest extensions and are defined in the Base Harvest extension's User Guide.

*DO ID* consists of two parts, DO and ID. The ID part needs to follow SOSIEL's naming convention for DOs (See SOSIEL's User Guide).

*TargetHarvestSize* is a static variable ( x ≥ 0 ) representing the total amount of biomass the agent wants to harvest with a specific DO during a timestep. The specified amount should be less than the amount of biomass in the areas managed by the agent implementing the DO. The variable plays the same role in Mode 1 that PercentOfHarvestArea plays in Mode 2. It is the consequent of a DO. The variable is time-step- (i.e., it starts accumulating from zero at the beginning of each timestep), MA-, and DO-specific. It uniquely accumulates for each agent that is implementing the DO in an MA during the timestep. The amount harvested during a timestep can surpass the TargetHarvestSize.

*ForestType* is a static variable represented by one or more species that meet specific age and presence criteria.

*CohortsRemoved* is a static variable indicating the cohorts to be removed by the DO. It is represented by a method for removing cohorts (currently the only valid value is SpeciesList) and one or more target species that meet specific age and presence criteria.

```
...
>> ---------------
   DecisionOptions
>> ---------------
DO MM1-1_DO1
   TargetHarvestSize       10000
   ForestType
   >> Species     Age     Percent
   >>             range   required
   >> ----------------------------
      Betualle    30-300  45
   CohortsRemoved     SpeciesList
   >> Species     Age     Percent
   >>             range   removed
   >> ----------------------------
      Betualle    30-300  80
...
```

Last, list agents in the AgentToManagementArea table and establish a one-to-one or one-to-many relationship between an agent and its MA(s). There is no specific naming convention for agent IDs, except for that they need to match across all of SHE's input files. Different agents can manage the same MA. In other words, an overall many-to-many relationship, part of which agents share management areas,

is permitted. MAs are separated by a comma. MAs that are not included in the table will be ignored by SHE.

```
...
>> ---------------------
   AgentToManagementArea
>> ------------------------------------------
>> Agent    MA     Site selection    SimulationMode
>> -----    ---    ------------------------------
   FM1      1,2    RandomWalk        2
```

RandomWalk is currently the only possible site selection algorithm. It follows the following steps:

1. For the first site, use the uniform distribution to randomly select an active site within the MA.
2. For the subsequent sites, use the uniform distribution to randomly select an active site within the MA that is adjacent to the previous site. In the case all the adjacent sites have been chosen or are inactive, expand the perimeter from the prior site by one level and conduct the same search.
3. Repeat Step 2 until all of the DOs' TargetHarvestSize are met or all sites have been processed.

### 2.1.4 SOSIEL's input files

Configuring SHE for Mode 1 involves parameterizing SOSIEL's main input file (e.g., input_SHE_SOSIEL.txt) and the supplementary files that it references. For parameterizing SOSIEL, please refer to its most recent user guide. SOSIEL's main input file references six supplementary .csv files to initialize agents and three supplementary .csv files (when activated) to initialize demographic processes. This section describes how to align SOSIEL's input files with SHE.

Use the ForestManager archetype, which is currently the only archetype that is allowed to engage in forest management activities. List goals with landscape-related reference variables in its GoalAttributes table. Currently, possible landscape-related reference variables are ManageArea Harvested (which prioritizes maximizing the area harvested per timestep) and ManageAreaMaturityPercent (which prioritizes maximizing or maintaining a specified proportion of mature cohorts in management areas).

```
...
   GoalAttributes
>> ---------------------------------------
>> Archetype        Goal  Goal      Reference
>> name             name  type      variable              ...
>> ---------        ----  ----      ---------
   ForestManager    G2    Maximize  ManageAreaHarvested
...
```

In the MentalModelAttributes table, use the ForestManager archetype. List roots of MMs (e.g., MM1-1) that match those specified in SHE's input file (e.g., input_SHE.txt)..

```
...
   MentalModelAttributes
>> ---------          ----------
>> Archetype          Mental
>> name               (sub-)model     ...
>> ---------          -----------
   ForestManager      MM1-1
...
```

When activating demographic processes, use the ForestManager archetype and list all the landscape-related variables in the AgentArchetypeVariables table. This will ensure their inheritance by newly-generated agents of the same archetype. Possible variables are: ManageAreaHarvested, ManageAreaMaturityPercent, and ManageAreaBiomass.

```
...
   AgentArchetypeVariables
>> ---------         ---------
>> Archetype         Variable
>> name              name               ...
>> ---------         ---------
   ForestManager     ManageAreaHarvested
...
```

Aligning SOSIEL with SHE also involves aligning the following four of its supplementary files for initializing agents:

- ❑ input_SOSIEL_AgentDOAttributes.csv. Use the ForestManager archetype abbreviation, FM, as part of the agent's ID. The agent IDs (e.g., FM1) need to be identical to the ones specified in SHE's main input file. The DO IDs (e.g., MM1-1_DO1) need to be identical to the ones specified in BHE's main input file. See SOSIEL's User Guide for configuration instructions of the entire input file.

| Agent | DecisionOptions |
|---|---|
| FM1 | MM1-1_DO1<G1<0.70>>;... |
| ... | ... |

- ❑ input_SOSIEL_AgentGoalAttributes.csv. Use the ForestManager archetype abbreviation, FM. The agent IDs need to be identical to the ones specified in SHE's main input file.

| Agent | ... |
|---|---|
| FM1 | ... |
| ... | ... |

- ❑ input_SOSIEL_DOAntecedentAttributes.csv. The DO IDs (e.g., MM1-1_DO1) need to be identical to the ones specified in BHE's main input file.

| DecisionOption | ... |
|---|---|
| MM1-1_DO1 | ... |
| ... | ... |

- ❑ input_SOSIEL_DOAttributes.csv. The DO IDs (e.g., MM1-1_DO1) need to be identical to the ones specified in BHE's main input file.

| DecisionOption | ... |
|---|---|
| MM1-1_DO1 | ... |
| ... | ... |

## 2.2 Mode 2: Input files and parameters

In Mode 2, SHE first calls the SOSIEL algorithm to analyze forest conditions and choose DOs, but then SHE calls BHE to implement the DOs related to forest management. In this mode, each DO in the SOSIEL algorithm pairs with a corresponding prescription in BHE (Figure 2). The name of a DO and its consequent serve as the link between it and the corresponding prescription. For SHE, each BHE prescription consists of two components: one that describes what to manage and how (parameterized through BHE's prescriptions table) and another that specifies the percentage of the management area in which the prescription is to be implemented (parameterized through BHE's implementation table). In the current version of SHE, the value of a DO's consequent corresponds to the percent of the management area to which the paired prescription is to be applied. If only one forest manager agent is being simulated, as is the case with BHE, there is a one-to-many relationship between the agent and forest management areas. If multiple agents are being simulated, there is a one-to-one relationship between the agents and management areas.

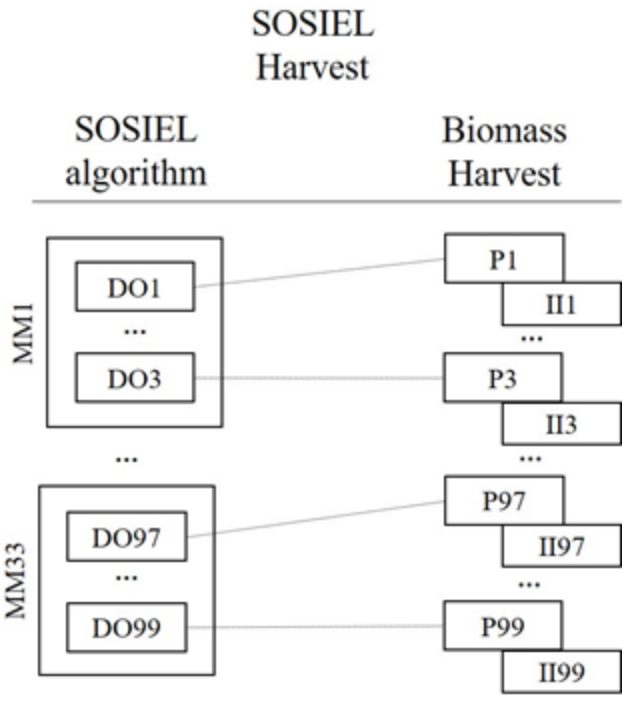



**Figure 2:** SHE's pairing of the SOSIEL algorithm's DOs with BHE's prescriptions (Ps) and implementation instructions (IIs). The SOSIEL algorithm organizes the DOs that are variants (substitutes) of one another into MMs.

Mode 2 requires parameterization of BHE's, BSE's, LANDIS-II's, SHE's, and SOSIEL's input files.

### 2.2.1 BHE's input parameters

For Mode 2, configure BHE's main input file (e.g., input_SHE_BHE.txt) and set BHE's and SHE's timesteps to be identical. For SHE to process a prescription in BHE, the prescription needs to have a corresponding DO with the same ID in SOSIEL's input files. The IDs of such prescriptions need to follow SOSIEL's format (e.g., MM1-1_DO1). BHE can also include prescriptions that, for whatever reason, do not need to be processed by SHE (e.g., their implementation does not require analysis). The IDs of such prescriptions do not need to follow SOSIEL's format. They will be implemented according to their specification in BHE.

```
...
   Timestep      10

   Prescription  MM1-1_DO1
...
```

MA IDs in the HarvestImplementations table need to be identical to the ones in SHE file's (e.g., input_SHE.txt) AgentToManagementArea table. Prescription IDs in the table need to be identical to the ones in the same file's Prescriptions table. The Harvest Area values (without the %) need to be identical to the corresponding ConsequentValue values in SOSIEL's input_DOAttributes.csv file. The prescriptions to be processed by SHE need to have "0" as their begin time and the duration of the simulation as their end time. The HarvestImplementations table needs to list all the MAs and corresponding DOs that are assigned to agents.

```
...
>> ----------------------
   HarvestImplementations
>> ----------------------
>> MA   Prescription/DO  Harvest Area  Begin Time  End Time
>> --   ---------------  ------------  ----------  --------
   1    MM1-1_DO1        10%           0           100
   1    MM1-1_DO2        20%           0           100
   2    MM2-1_DO1        30%           0           100
...
```

For all other aspects of parameterizing BHE, please refer to the most recent Base Harvest extension or BHE User Guide.

### 2.2.2 BSE's input parameters

Configuring SHE for Mode 2 involves parameterizing BSE's main (input_BSE.txt) and supplementary input files and does not differ among modes. Please see Section 2.1.1 for instructions.

### 2.2.3 LANDIS-II's input parameters

Configuring SHE for Mode 2 involves parameterizing LANDIS-II main (scenario) input file (e.g., input_scenario.txt) and the supplementary files that it references as follows:

In the Disturbance Extensions table of LANDIS-II's scenario file, list SHE and its corresponding initialization file and comment out BHE and its corresponding initialization file. BHE's file needs to be listed and its row commented out ('>>') in order for SHE to be able to call on BHE for implementation. For all other aspects of parameterizing LANDIS-II, please refer to its most recent User Guide.

```
...
>> Disturbance Extensions      Initialization File
>> ----------------------      -------------------
...
>> "Biomass Harvest"           input_SHE_BHE.txt
   "SOSIEL Harvest"            input_SHE.txt
...
```

### 2.2.4 SHE's input parameters

Configuring SHE for Mode 2 involves parameterizing its main input file (e.g., input_SHE.txt) as follows:

List the title of the input file. Set SHE's mode to 2. Set the frequency of SHE's activation and confirm that it is identical to BHE's timestep. List BHE and SHE and BHE's and SOSIEL's main input files. In the AgentToManagementArea table, establish a one-to-one or one-to-many relationship between agent and MA(s). MA IDs (e.g., 1, 2, etc.) need to be identical to those in BHE's Harvest-Implementations table.

```
   LandisData  "SOSIEL Harvest"

   Mode         2

   Timestep     10

>> --------------      -------------------
>> Component name      Initialization file
>> --------------      -------------------
   "SOSIEL Harvest"   input_SHE_SOSIEL.txt
   "Biomass Harvest"  input_SHE_BHE.txt

>> ---------------------
   AgentToManagementArea
>> ---------------------
>> Agent   MA
>> -----   --
   FM1     1
   FM1     2
```

### 2.2.5 SOSIEL's input parameters

Configuring SHE for Mode 2 involves parameterizing SOSIEL's main input file (e.g., input_SHE_SOSIEL.txt) and the supplementary files that it references. The parameterization of SOSIEL's input files differs among the two modes only in the parameterization of the supplementary file that SOSIEL references to initialize DO attributes (e.g., input_DOAttributes.csv). In Mode 2, the ConsequentVariable needs to be set to PercentOfHarvestArea and the ConsequentValue must be identical to the Harvest Area value of the corresponding prescription listed in BHE's main input file's (e.g., input_SHE_BHE.txt) HarvestImplementations table. In the MentalModelAttributes table, the roots of MMs (e.g., MM1-1) need to align with those used in naming prescriptions in BHE's main input file.

| DecisionOption | ... | ConsequentVariable | ConsequentValue | ... |
|---|---|---|---|---|
| MM1-1_DO1 | ... | PercentOfHarvestArea | 10.255 | ... |
| ... | ... | ... | ... | ... |

For all other aspects of parameterizing SOSIEL for Mode 2, please refer to Section 2.1.4.

# 3 Output files

SHE outputs two file types: the event log .txt file and at least one agent variables and activity .csv file. The latter is generated for each agent.

## 3.1 SHE's event log file

SHE generates an event log file (e.g., output_SHE.txt) that includes the following information about each timestep that SHE is activated:

- ❑ Timestep,
- ❑ Information about the newly generated DOs including their MA, name, parent DO, consequent variable, and consequent variable value.
- ❑ Names of all the DOs selected for implementation.

## 3.2 Agent variables and activity file

SHE generates a variables and activity file (e.g., output_FM1.csv) for each agent that includes the following information for each timestep that SHE is activated:

- ❑ Timestep,
- ❑ ManagementArea,
- ❑ ActivatedDOValues are the consequent values of the DOs that were selected for action-taking,
- ❑ ActivatedDO are the consequent variables of the DOs that were selected for action-taking,
- ❑ MatchedDOs are the DOs that met the conditions for selection,
- ❑ MostImportantGoal is the goal that drove DO selection,
- ❑ TotalNumberOfDOs is the number of DOs in the MMs of the agent,
- ❑ ManageAreaHarvested, if one of the agent's goal variables,
- ❑ ManageAreaMaturityPercent, if one of the agent's goal variables,
- ❑ ManageAreaBiomass, if one of the agent's goal variables.

# 4 Example input files

## 4.1 Example SHE input files

### 4.1.1 Mode 1

```
  LandisData  "SOSIEL Harvest"

   ManagementAreas      input_SHE_ManageAreas.img

   Stands               input_SHE_Stands.img

   Mode        1

   Timestep    5

   "SOSIEL Harvest"   input_SOSIEL.txt

>> ---------------
   DecisionOptions
>> ---------------

DO    MM100-1_DO1
      TargetHarvestSize     1000
      ForestType
      >> Species Age   Percent
      >>         range
      >> ----------------------------
```

```
         confsens      30-300     45

      CohortsRemoved   SpeciesList
      >> Species Age   Percent
      >>         range removed
      >> ----------------------------
         confsens      30-300     80

DO    MM101-1_DO1
      TargetHarvestSize     1000
      ForestType
      >> Species Age   Percent
      >>         range
      >> ----------------------------
         brdlsens      50-250     45

      CohortsRemoved   SpeciesList
      >> Species Age   Percent
      >>         range removed
      >> ----------------------------
         brdlsens      50-250     80

   AgentToManagementArea
>> -----   --     ---------
>> Agent   MA     Site
>>                  selection
>> -----   --     ---------
   FM1     1,2,3  RandomWalk
   FM2     2,3,4  RandomWalk
```

### 4.1.2 Mode 2

```
   LandisData  "SOSIEL Harvest"

   Mode        2

   Timestep    5

>> ---------           ---------
>> Extension           Extension
>> name                file
>> ---------           ---------
   "SOSIEL Harvest"    input_SHE_SOSIEL.txt
   "Biomass Harvest"   input_SHE_BHE.txt

   AgentToManagementArea
>> -----     ----------
>> Agent     Management
>>           area
>> -----     ----------
   FM1       2
```

## 4.2 Example SOSIEL input file

```
   CognitiveLevel     CL4

   GoalAttributes
>> ---------     ----  --------              ---------          --------------  ----------
>> Agent         Goal  Goal                  Reference          Change focal    Is
>> archetype     name  tendency              variable           value on prior  cumulative
>> ---------     ----  --------              ---------          --------------  ----------
```

```
   ForestManager  G1    EqualToOrAboveFocalValue  ManageAreaMaturityPercent   no        yes

   MentalModelAttributes
>> ---------      --    ----------  --------  ------------  ---------- ---------- ---------
>> Archetype      MM    Modifiable  Maximum   DO goal       Associated Consequent Consequent
>> name                             # of DOs  relationship  with       value      value
>>                                                          goals      range      rounding
>> ---------      --    ---------  ---------  ------------  ---------- ---------- ----------
   ForestManager  MM1-1 yes         3         G1<->         G1         0.001-100  3

   DecisionOptionAttributes     input_SOSIEL_SHE_DecisionOptionAttributes.csv

   DecisionOptionAntecedentAttributes    input_SOSIEL_SHE_DecisionOptionAntecedentAttributes.csv

   AgentArchetypeAttributes
>> ----------          ---------  ---------- ---------------
>> Archetype           Archetype  Dataset    Goal importance
>> name                prefix     oriented   adjusting
>> ----------          ---------  ---------- ---------------
   ForestManager       FM         yes        yes

   AgentArchetypeVariables
>> ---------         ---------           --------   --------
>> Archetype         Variable            Variable   Variable
>> name              name                type       value
>> ---------         ---------           --------   --------
   ForestManager     ManageAreaHarvested Integer    0

   AgentGoalAttributes               input_SOSIEL_AgentGoalAttributes.csv

   AgentVariables                    input_SOSIEL_AgentVariables.csv

   AgentDecisionOptionAttributes     input_SOSIEL_AgentDOAttributes.csv
```

```
   DemographicAttributes             input_SOSIEL_DemographicAttributes.csv

   ProbabilityAttributes
>> ---------      --------     ----                                  ------------
>> Variable       Variable     File                                   Ignore first
>> parameter      type          name                                  line
>> ---------      --------     ----                                  ------------
   Birth          Integer      input_SOSIEL_Birth_probability.csv     yes
   Death          Integer      input_SOSIEL_Death_probability.csv     yes
   General        Integer      input_SOSIEL_General_probability.csv   yes
```