SEGAE Teacher’s Guide V3

# Guide for teachers using the game SEGAE

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## 1. Introduction

### 1.1. What is SEGAE?

The serious game SEGAE is a simulation game of a mixed crop-livestock farm oriented in dairy production. It aims at making students aware of the need to integrate all the components of the farming system, for sustainable agro-ecological transitions.

In the basic version of the game, it’s a typical farm from western France, but it can also be set up with parameters resembling more a typical Belgian, Polish or Italian farm with conventional farming practices. The SEGAE game allows realistic simulation, making decisions on crop and livestock management in annual time increments. During the game, random weather, market or disease incidents can modify the state of the farm, requiring different decisions in subsequent years.

This game includes a diversity of agroecological practices, related to crop and livestock management, and gives the players a possibility to assess the impacts of these practices on the three pillars of sustainability: economic, environmental and social sustainability.

The serious game SEGAE is a free online game accessible at <https://tinyurl.com/segae0>.

However, SEGAE cannot be used as a decision aid tool, since it is not detailed enough to provide context-relevant results and to represent all the processes occurring in a farm.

### 1.2. What is the purpose of this guide?

This pedagogical guide provides teachers with the information and tools they need to set up a successful learning session with SEGAE, the online serious game on agro-ecology.

SEGAE has been designed to help understanding how farming practices influence the sustainability of a farm. Quick video tutorials on how to play the game itself are available here: <http://mc.wipie.ur.krakow.pl/segae/>

The game is a farm simulator and does not contain learning modules in itself, although anyone could learn about farming practices, simply by exploring the game. Ideally, SEGAE is used in a group learning session, either an actual classroom or a remote class, to compare outcomes and to allow a discussion between the learners and with the educator. The game itself does not contain an embedded chat feature. For remote learning, the class should meet in a virtual classroom on a platform that has the possibility to interact and share the screens, at least the screen of the teacher.

### 1.3. What will you find in this guide?

This guide is built with an “outcome-based” philosophy, to help teachers setting up one or several learning sessions with SEGAE. It starts with the setup of the classroom, learning objectives adapted to the profile of the students, session setup, session scenarios, and eventually evaluation tools. There are also links to additional resources on agro-ecology and sustainability.

## 2. Classroom setup and requirements

SEGAE was designed to be played in short sequences, combining hands-on experimenting with the virtual farm, feed-back and discussing the results in the classroom.

The expected duration varies from 2h to 4h, depending on the extent of learning objectives that are set to the students for this session.

For virtual classrooms, teachers may prefer to play individual scenarios in shorter sequences e.g. 45 min (scenario + discussion), to avoid a drop in attention.

Ideally, a class requires two teachers for 30 students, in order to have dynamic interactions and to provide inter-disciplinary background.

**Hardware: One computer is needed per student, with internet access. Please note that this online game is not well adapted to be accessed by mobile phone, because the screen would be too small.**

**Software: There is no need to install the game on the computers. This online game runs independently on a remote server (dedicated website) and is accessed through any available browser. The browser merely provides the clickable interface and stores the change history.**

A teacher can create a group session and view the scores of the players in his/her group on his own computer.

There is no possibility to play SEGAE offline.

### 2.1. Real classroom

**Each student and the teacher all have a computer with a browser and an internet link, with access to the SEGAE website, through any available browser.**

It helps the discussion if the teacher can display the screen of his computer, to be visible to all students and to demonstrate some actions during the class.

Each student should be given a paper **sheet with instructions** on how to connect, which actions to take for each scenario and some space to write down outcomes, scores, observations… Indeed, it would be inconvenient for the teacher to switch between the game and the game instructions, on the projected screen.

Alternatively, the instruction sheet could be provided as a text document, opened in another window, on the computer of each participant.

**The serious game platform does not provide a quiz feature. Quiz questions depend on the learning objectives that each teacher sets. Sample quizzes will be available on the project website.**

**Quizzes for evaluation** can be given on paper or as text file, or provided as an internet questionnaire in another browser window (like H5P <https://h5p.org/> , which can be displayed in a browser window, or even embedded with scoring in a learning platform like Moodle). It can be fun to play the quiz as an independent online game (like Kahoot! <https://kahoot.com/> ). For each, you should open a different browser tab, that will not interfere with the ongoing SEGAE game.

### 2.2. Virtual classroom

**Each student and the teacher all have a computer with a browser and an internet link, with individual access to the SEGAE website, through any commercially available browser.**

The class connects in a **virtual classroom**, like Zoom, Jitsi Meet, Microsoft Teams, Big Blue Button…, or even by phone. **If the virtual classroom lives in a browser, take care to open it in a different window/tab from SEGAE, or you will be disconnected. Students mostly have only one screen, so in the beginning of the session, you should check that everyone is comfortable with using the different windows for playing the game.**

Whatever the system that is used for the virtual classroom, it should feature a possibility to **discuss the results between the participants** via chat or microphone/speakers, as SEGAE doesn’t have a chat feature. It helps the discussion, if the **teacher can share the screen of his browser window of SEGAE**, to be visible to all students and to demonstrate some actions in the game, during the class.

The previous paragraphs about **instruction sheets** and **quizzes** in the real classroom apply here.

If the virtual classroom system features a **common notepad**, it can be used for instructions, and if it features a **voting device**, there can be in-training quiz games.

Plan for the case where technical difficulties or an internet crash disrupt your scheduled session: provide a back-up solution, e.g. provide the instructions as a text file, so when the system is restored, the students can play independently at their own pace, and send back their answers and questions through a forum.

### 2.3. A note about individual training

As SEGAE stands alone as a website accessible by browser, a teacher could also provide an individual training session, by guiding the learner from basic to more complex tasks on SEGAE with a text document. The learner could use the document as a guide, but would not benefit from the interaction with other players or an educator.

## 3. Learning objectives

### 3.1. General learning objectives

The serious game SEGAE is designed to teach agroecology. Players have to improve the sustainability of a dairy farm by implementing agroecological practices. To do it, they have to understand links between the different parts of the system and develop a global strategy, by playing coherently on different levers related to crop and animal production. The aim is to optimize all three pillars of sustainability: the economical, the ecological and the social aspects.

In addition, the player acquires practical knowledge by learning various agroecological practices and understanding their impacts on the farm. This practical knowledge is in essence interdisciplinary, since several scientific fields (plant science, animal and veterinary science, soil science, ecology, economics and social sciences) are included in the game. The player should acquire a systems approach by assessing the combined impacts of multiple practices on the farming system.

The player can improve his/her skills on transition management, by testing several options to reach given goals with limited resources.

### 3.2. Detailed learning objectives for outcome-based evaluation e.g. quiz building (Bloom’s taxonomy)

Bloom’s taxonomy of learning objectives distinguishes between cognitive processes, some basic, others more complex. What can be learned with the help of SEGAE ranges from “remembering” (basic vocabulary) to “creating” (a farming system adapted to new farming conditions), although it has to be underlined again that SEGAE is not a realistic simulation game, neither is it a decision tool.

<https://en.wikipedia.org/wiki/Bloom%27s_taxonomy>

French: <https://fr.wikipedia.org/wiki/Taxonomie_de_Bloom>

Italian: <https://it.wikipedia.org/wiki/Tassonomia_di_Bloom>

Polish: <https://pl.wikipedia.org/wiki/Taksonomia_Blooma>

Flemish/Dutch: <https://nl.wikibooks.org/wiki/Onderwijsprofessional/Begrip/Leerdoel#Soorten>

Detailed objectives help with narrowing down the scope of each learning session. Then it is possible to evaluate progress with e.g. a quiz of questions directly related to the learning goals.

In Annex 1, you will find some proposals of detailed learning objectives in agroecology, of growing complexity.

The first two objectives can be pre-requisites to playing the game, for more advanced players:

• list the basic vocabulary for describing the elements of a farming system (crops, categories of animals, green infrastructure, pests, parasites, diseases, chemicals and fertilizers, workforce, basic economic indicators, main varieties of cultivated plants and grasslands, main animal breeds),

• cite the definition and describe on an example of a cropping system, a feeding ration, a breeding system, of the three pillars of sustainability.

The next objectives can be achieved by playing the game and discussing the results.

## 4. Session building blocks

### 4.1. How to build a learning session

A class of 2 h can incorporate 1 or several games, depending on the player’s previous knowledge and the learning objectives.

A game of 5 - 10 rounds (“years”) typically has a duration of 15 minutes.

To build a learning session, start by defining:

* the profile of the learners
* their previous knowledge (pre-requisites)
* the learning objectives to be achieved in this session
* the scenario(s) to play (we provide 3 examples of scenarios of growing complexity)
* an end-of-session evaluation of the learning objectives

In Annex 3, we suggest two sample training session instructions, for a 2h practical with undergraduate students in higher education. They are built on the same model, each with three scenarios, depending on the field with which they are most familiar. One sample session is designed for students more interested in animal production, the other for students more interested in crop production.

### 4.2. If it is the first time the students play SEGAE

Let them watch beforehand the short video tutorials here: <http://mc.wipie.ur.krakow.pl/segae/>

Check that they have a basic knowledge of the specific vocabulary that is used, see Annex 2.

Check that they have a basic knowledge of cropping systems (i.e. crops and crop rotations), feeding systems (i.e. feeds, grazing, basic and complementary rations for each category of animals), breeding systems (i.e. basic understanding of how cattle are bred for milk and meat production). Complementary short videos are provided on the website for these notions.

### 4.3. Scenario 1: “Sandbox” Hands-on discovery of SEGAE and Discovery of farming practices

#### Learner profiles

• Life-long learning students

• Students in formal education: High school or university students (under and post-graduate) in fields related to agriculture

#### Prerequisite

• Knowing the basic elements of a farming system (crops, categories of animals, green infrastructure, pests, parasites, diseases, chemicals and fertilizers, workforce, basic economic indicators, main varieties of cultivated plants and grasslands, main racial types of animals).

• Knowing the definition of a cropping system, a feeding ration, a breeding system, the three pillars of sustainability.

#### Overall objective

Discover the game and the farm.

#### Scenario

The players explore the various strategic dimensions of the game and the related practices, coupled with an easy goal of sustainability improvement. This scenario allows players to begin to understand the impacts of various practices and the links between animal and crop productions.

To do this, suggest that the players click on the white tabs that represent “strategic dimensions” of the farm “Soil management”. In each dimension, several categories of practices are available, each has a set of practices to choose from.

Ask them to click on each of the categories of practices (e.g. “Tillage management”, “Soil cover”, “Residues management”) and look at the indicators that are impacted by this category of practices, in the right panel. Let them write down the current values of these indicators. Let them click on one “i” button, to display the explanation of the practice.

Ask the player to choose any practice, change it and click on the “Next year” tab. Be careful to specify that they must click on the “Next year” tab to validate the practices and to make the game simulate the impacts.

Explain to the players where to find the information to analyze the results. The report window with the trends, that pops up after you click the Next Year button, can also be accessed via the Report button at the bottom left. The main relationships between the elements of the farm are shown in the Warehouse tab).

Ask the players to repeat this 4 times, each year in a new strategic dimension (choose a category, change a practice, validate by clicking on “Next Year”, observe the effects in the report panel).

Highlight that each player has his own score. Ask the players if they do not understand the meaning of certain practices, certain indicators or if the results of the simulations seem inconsistent to them. N.B: by choosing several practices in one year and validating them through the “Next year” tab, the impacts of chosen practices add up. To return to the initial situation, you must reload the webpage (or type F5).

### 4.4. Scenario 2: Basics of system thinking: relating animal feed demands to crop production

Rationale: A fundamental feature of a mixed crop/dairy farm is that a great part of the feeds for the animals are produced on the farm. To explore this, the students are first asked to describe the current feeding system and crop system. Then they look in the “Warehouse” in the tab “feed balance”, to compare products and demands, and which quantity has to be bought by the farmer to feed the animals. They will then try to play the game to improve feed autonomy (producing feeds on the farm) and watch how their choices impact other sustainability indicators. The players can choose various strategies to optimize the feed-demand balance, the discussion shows how different choices play out.

### 4.5. Scenario 3: Transition to agro-ecological farming while enhancing one particular sustainability indicator

Rationale: often, the motivation to engage in major changes in farming practices comes from one particular concern, e.g. improving animal welfare, preventing soil erosion or reducing pesticide use. This scenario gives the players an assignment to improve one particular aspect, while keeping the best possible sustainability on the three pillars.

If the player achieves a set of practices that unlock the choice “Organic farming” in the category “Type of Agriculture” of the “Strategic Decisions” domain, the farmer will obtain higher prices for his products, but also pay higher prices for inputs.

## 5. Additional resources

The links to “basics” videos, other sample scenarios, a bank of quiz questions and portable quiz files, and further reading will be available on the website of the SEGAE project.

## Annex 1 Proposal of detailed learning objectives in agroecology, of growing complexity, based on Bloom’s taxonomy.

#### Basics

• list the basic vocabulary for describing the elements of a farming system (crops, categories of animals, green infrastructure, pests, parasites, diseases, chemicals and fertilizers, workforce, basic economic indicators, main varieties of cultivated plants and grasslands, main racial types of animals).

• cite the definition and describe on an example of a cropping system, a feeding ration, a breeding system

#### Practices and outcomes

• list the broad categories of agroecological practices (AEPs)

• list the 3 main indicators of sustainability (main dashboard)

• explain in your own words the main sources of income for the farmer and the main costs of operation

#### Links between animal and plant production

• explain the link between plant production (crops, grass) and feeding rations

• explain the link between herd size, housing practices, manure/slurry production and fertilizing.

• in one situation, compare a cropping system and the needs of the animals, explain why it can be necessary to buy feeds.

#### Effects of AEPs

• within a category of AEPs, summarize (explain in your own words) the effect of various individual AEPs on direct indicators of the farm.

• explain, on an example, how these direct effects contribute to the sustainability indicators (dashboard)

• choose an AEP (option within a category) in order to obtain an effect on a direct indicator

• predict the short-time effects of this AEP on other indicators and on sustainability gauges

• observe the long-time effects of a choice of AEP

• observe the long-time effects of a combined set of AEPs

• describe in detail different pathways (combinations and sequences of AEPs) to achieve a specific goal

#### Complex interactions between parts of the farming system

• describe how a set of options require changes in other parts of the system

• analyze “crashes” of your farming system, i.e. how do you get negative outcomes as a consequence of the choices that you have made, or of random incidents like a drought.

• assess the overall sustainability of your farming system and identify major levers that you would need to act on to improve it.

#### Strategic planning and adaptive management

• when given a management goal, e.g. greater protein autonomy, identify the indicators that are relevant to measure achievement and assess your system’s position towards that goal, at the beginning of the game, and after several rounds.

• during a game, assess the coherence between parts of the system, e.g. if there is enough grassland to backup feeding rations based on grass and hay.

• discuss the impact of limited resources (natural resources, land, money, housing and farming equipment, workforce) on the choices that you are able to make.

• design a strategy to reach a management goal. First, list the resources, the time-frame and the indicators of achievement of the goal. Then decide on the principal AEP practices and anticipate which other AEPs might be affected. Choose a set of indicators to follow for staying on track during annual choices and continually assess the overall sustainability.

• practice adaptive management: analyze your own results, compare with other strategies, and make a proposal of new choices.

## Annex2: Vocabulary

|  |  |
| --- | --- |
| **English** | **DEF\_EN** |
| alfalfa | legume used as feed for animals, major protein source |
| area | the Total Cultivated Area is the sum of the total arable area and the total area of permanent crops |
| barley | Cereal, the grains and straw areused as animal feed, the straw is used as bedding |
| bedding | Straw, wood shavings, sawdust, rubber mats used to provide comfort for animals on the floor of their housing |
| bull, young bull | Adult or young male bovine, uncastrated |
| calf (calves) | young male or female bovine, from birth to 6 months of age |
| calving | Give birth to a calf |
| cash crop | plants that are cultivated to be sold and not used on the farm |
| concentrate | feedstuff of high nutritional density like (grains, pulses, beetroot pulp etc.), that is given to animals as a supplement to herbaceous fodder. |
| cow | female adult bovine |
| crop | cultivated plants ( sown, harvested) |
| crop protection | Actions that aim at protecting crops from viral or fungal diseases, pests and weeds |
| cropping | the act of cultivating plants |
| cubicles | Separated spaces inside a housing, where animals can stand to feed, or lie down |
| culled animals | animals sent to slaughter |
| cultivar | selected plant variety |
| dry period | period of ca. 2 months between lactations, where the adult cow does not produce milk, after 10 months of lactating period and before her next calving, which starts the new lactation period (see “lactating cow”) |
| faba bean | legume used as feed for animals, source of protein |
| fertilisation, fertilization | act of spreading organic matter or chemicals on a land area, in order to enhance the fertility of the soil. |
| field margin | strip of a width of a few meters that marks the transition between a field and its immediate environment |
| fodder, forage | feed that is given to cattle |
| Free-stall | A housing where all animals roam in the same space, without separations |
| grazing | for a herbivore, eat grass on a pasture |
| Hay | dried grass as animal feed |
| hedgerow | linear element in the landscape made of trees, shrubs and herbaceous plants. A hedgerow often marks the limit between agricultural plots, either fields or meadows |
| heifer | female bovine before the first calving |
| herd | group of animals |
| Insemination (artificial) | Fertilising a cow with semen collected from a bull |
| Lactating dairy cow | adult cow that produces milk, generally for 10 months out of 12, in a yearly cycle. |
| legume | family of plants whose roots are able to incorporate atmospheric nitrogen, by symbiosis with root-associated bacteria (rhizobium) |
| litter, bedding | plants or other materials that are used for covering the floor of animal housing, to improve the comfort of the animals |
| maize, corn | Cereal, the grains, leaves and stems are used as animal feed, stems and leaves are used as bedding |
| manure | mix of urine, feces and bedding cleared from animal housing, generally compact and stored in heaps before it is spread on the fields for fertilization |
| mastitis | inflammation of the udder due to bacterial infection |
| meal | transformed state of certain grains (cereals or legumes - pulses) used as feed for animals |
| Milk replacer | Mix of dehydrated milk and water, used to feed young calves that don’t feed from their mother. |
| organic farming | type of agriculture that excludes the use of synthetic biocides, genetically engineered organisms or products obtained from GEOs |
| pasture | meadow, field with grass where animal graze |
| rapeseed | Cruciferous plant. The grain is used for oil productions, the residue (meal) is rich in protein. The plant as a whole can also be given as fodder. Other uses are green manure and agro-fuel.  |
| residue | parts of the plant that are left on the field after the harvest |
| silage | stored feedstuff that is preserved by fermentation |
| Slatted floor | Concrete floor of animal housing, with gaps that let animal feces and urine fall through into a reservoir. |
| slurry | mix of urine and feces, cleared from animal housing, stored in reservoirs or basins |
| sorghum | Cereal whose (leaves, stems and grains) are used to feed animals, as fresh feed, as straw or as supplement |
| sound approach | is said of an agricultural practice that is adjusted to the needs, in a particular context, e.g. an exact dosis of pesticide applied only if their is a signifacant hazard, not systematically |
| soybean | Legume whose grains are used to feed animals, in form of meal (residue obtained after oil extraction) that is rich in protein |
| steer | castrated male bovine, adult or growing |
| tillage | act of preparing the soil of a field for cultivation by inverting it with a plow |
| weed | herbaceous plants or shrubs that are present in an agroecosystem without having been planted. The word weed is in itself neutral, but is often used to refer to undesirable plants against which herbicide treatments or machine weeding are used. |
| wheat | Straw cereal, whose grains and stems are used for feeding animals. The straw is also used as bedding in animal housing. |