



D 1.7 Workshop 4 Report

February 2023 WP1: Farming Community Engagement



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Work Package	1			
Delivery Date (DoA)	30 th April 2023			
Actual Delivery Date	17 th April 2023			
Abstract:	The WATERAGRI Workshop 4 was organized in Month 34 of the project to present the final prototype of the serious game AgriLemma and organize play sessions with internal and external WATERAGRI. This document presents the planning, execution, and results of the workshop.			

Document Revision History					
Date	Version	Author/Contributor/ Reviewer	Summary of main changes		
03/02/2023	1.0	Aashna Mittal, Zoran Kapelan	Report outline		
27/03/2023	1.1	Aashna Mittal	The first draft of the WS4 report		
28/03/2023	1.2	Zoran Kapelan	Revision and minor edit		
30/03/2023	1.3	Aashna Mittal	Revision and finalization of V1		
12/04/2023	1.4	Sebastian Puculek (ULUND)	Quality revision		
17/04/2023	1.5	Rolf Larsson (ULUND)	Final revision		
17/04/2023	2.0	Aashna Mittal	Revision and finalization of V2		

Dissemination Level			
PU	Public	\checkmark	

WATERAGRI Consortium					
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Funding Scheme: Research and Innovation Action (RIA)

Theme: SFS-23-2019
Start date of project: 01 May 2020
Duration: 48 months

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List of Abbreviations and Acronyms			
WS	Workshop		
GA	General Assembly		

Executive Summary

To enable sustainable food production, various water retention and nutrient retention solutions are being developed as part of the WATERAGRI project. Given the wide range of solutions, an engagement tool is needed to make relevant stakeholders aware of the solutions and communicate their pros and cons. Serious games are a fitting means to achieve this. A serious game is a game developed to enable learning about a complex problem in fun and engaging way. A multi-player board game, AgriLemma, has been developed to engage WATERAGRI stakeholders and increase their awareness about the technologies and solutions.

The design and concept of the final prototype of AgriLemma were presented at the 4th WATERAGRI stakeholder consultation workshop (i.e., WS4), conducted on 24th February 2023. Three gameplay sessions were organized along with pre-game and post-game questionnaires to test the game's impact on players' awareness and perception of the WATERAGRI solutions and obtain feedback on the gameplay experience. WS4 was a physical meeting at the Delft University of Technology, The Netherlands. In preparation for the workshop, invitations were sent to the entire WATERAGRI consortium and the 101 people in the stakeholder register. 13 participants, including the workshop organizers, attended the workshop.

The workshop started with registering participants and filling out the pre-game survey. This survey was designed to capture participants' awareness and perception of the WATERAGRI solutions before playing the game. After that, a short presentation was given introducing the game concept, rules and mechanisms, followed by dividing participants into 3 gameplay sessions. Each game was led by a facilitator responsible for guiding the participants throughout the game. The gameplay sessions lasted 1.5 hours, after which participants were asked to complete a post-game survey. This survey was designed to capture participants' awareness and perception of the WATERAGRI solutions after playing the game and provide feedback on the gameplay experience. The workshop concluded with a short plenary session where participants could share their learnings, gameplay experience, and suggestions for improving the game.

The WATERAGRI WS4 was successfully conducted. The final prototype of the serious game AgriLemma was presented and tested with 10 participants across 3 game setups. On comparing the results of the post-game and pre-game surveys, slight improvements were seen in the awareness levels of participants. After playing the game, participants also felt that they were less prepared to deal with the uncertainties in farming, implying that the game could portray the complexity of water and nutrient management and the trade-offs involved. The game was rated highly on fun, engagement, and suitability as an engagement tool.

Since members of the WATERAGRI project mostly attended the workshop, the game should be tested with external stakeholders to validate the findings from WS4. The game can be used as an engagement tool in future WATERAGRI activities and can be translated into local languages to make it more accessible to stakeholders. The game can be further improved beyond the project. Some aspects that could be taken up include improving and updating information on the technologies and solutions, adding solutions beyond those developed in the WATERAGRI project, and adapting the game to incorporate local soil and weather conditions.

1. Introduction

The WATERAGRI project aims to enable agricultural production that can sustain growing populations amid climate change in the long term. As part of the project, innovative technical drainage and irrigation solutions are being developed along with nature-based solutions, such as constructed wetlands and bio-inspired drainage systems that will be introduced in the agricultural landscape to improve the *retention* of both water and nutrients.

The serious game AgriLemma is a board game developed to engage WATERAGRI stakeholders and help them improve their understanding of solutions and technologies developed in the project. The game targets farmers or farm managers, agricultural chambers, farmer associations, water management organizations, media, researchers, and policymakers. By playing the game, stakeholders can explore the trade-offs regarding the costs and benefits of different solutions. More broadly, players will be challenged to handle various aspects of farming, such as managing water, nutrients and workers while keeping their farm profitable and socially and environmentally sustainable. All this, in turn, will ensure their continuous engagement with the WATERAGRI project and its solutions and technologies.



Figure 1: Options to explore WATERAGRI technologies and solutions

AgriLemma is one of the multiple ways stakeholders can explore the WATERAGRI technologies and solutions. Any stakeholder visiting the WATERAGRI website (<u>https://wateragri.eu/</u>), can choose from the following four options, as shown in Figure 1:

- 1. Play AgriLemma: Stakeholders can download Agrilemma materials, print them, and organize a session to play the game;
- 2. Explore the WATERAGRI framework: They can explore the WATERAGRI framework that will recommend a specific solution based on parameters such as location, the role of the stakeholder, the problem they are dealing with (dry soil, less water, too much nitrogen, etc.);

- 3. Go through case studies: Stakeholders can go through the ten WATERAGRI case studies/pilots spread among different climatic zones and check the results of the solutions that were implemented there;
- 4. Browse all solutions: Stakeholders can also explore all different solutions on their own by reading through the factsheets, which contain details about the design concept, technical information and results from case studies where the solutions were applied, costs and benefits of each solution, challenges and opportunities in implementing them, and contact details of the researchers and companies that developed these solutions.

The 4th WATERAGRI stakeholder consultation workshop (WS4) was held at the Delft University of Technology in the Netherlands on 24th February 2023. The main aim of this consultation workshop was to present the serious game - AgriLemma and test the game with WATERAGRI stakeholders. The game concept (including aspects such as game objectives, design methodology, rules, and other elements) was presented in the workshop, and game sessions were organized.

This report presents the results from WS4. In section 2, we discuss the key features of the serious game AgriLemma. In section 3, the agenda and organization of the workshop are presented in detail. Section 4 presents the workshop's results, and Section 5 summarizes the key messages of the workshop, along with lessons learned and the next steps.

2. AgriLemma

AgriLemma is a 2-4 player competitive serious board game. In the game, players step into the shoes of a farmer. They have their own farm with six fields, and they can grow different crops on these - potatoes, sugar beets, rapeseed, maize, wheat, and chickpeas. Players need water, nutrients, workers, and crop seeds to grow these crops. In addition, they can invest in WATERAGRI solutions and other developments such as crop insurance, pesticides, and farm machinery to boost production on their farm. While growing crops and running their farm, players have to deal with the uncertainties of weather, government policies, consumer preferences, sustainability assessments/audits and many more.

The game aims to maximize the farm's total sustainability score, which has environmental, financial and social aspects/scores. Players can achieve more environmental points by investing in sustainable technologies and/or diversifying their crops. They can achieve more social points by generating livelihoods, i.e., employing and paying workers. Lastly, they can make their farm economically sustainable by keeping the profits high and ensuring the money doesn't run out. The players need to strategize and balance the environmental, social, and financial goals. Players play a total of 8 rounds (each representing a farming season) during which they have to run, invest in and improve their farms. Ultimately, the player with the maximum total sustainability score for their farm is declared a winner.

The game board is divided into 4 player zones on the four sides of the game board, each represented by a different colour – red, green, yellow and blue (see Figure 2). On the edge of the board, there are 3 scoring meters to track the score for social, financial and environmental sustainability. On the top left and right corners is a deck of event cards and a deck of weather cards, which players have to draw

in each round. At the centre of the board, the number of rounds and the steps within each round are listed. As players progress through the game, they must progress the trackers for the rounds and the round-steps accordingly.



Figure 2: AgriLemma game board

Each player starts with 6 fields, 40 money tokens, 5 water tokens and 5 nutrient tokens and an initial score of 10, 10, and 40 for social, environmental and financial sustainability. Players gradually progress through 8 rounds in the game, where each round is further divided into 5 steps:

- 1. *Invest*: In this step, players can make investments in their farms. They can hire workers, buy development cards (max 2), crops, and technology cards.
- 2. Uncertainties: In this step, players have to draw one weather card and one event card.
- 3. *Trade and Cultivate*: In this step, players must provide nutrients and water to crops sown in their field. They can trade them with other players if they do not have sufficient resources.
- 4. *Harvest*: After cultivation, players can harvest their fields in this round and get the yield in terms of money tokens.
- 5. *Payments and Scoring*: In the last step of a round, players must make payments they need to pay the workers deployed on the field and pay the maintenance costs of tech cards. Once the payments are made, players can adjust their social, environmental and financial scores.

At the beginning of rounds 3 and round 6, there is an assessment of the social and environmental sustainability score of all players. Players have to pay a penalty if the score is not above a certain limit.

This encourages them to not only chase the goal of financial sustainability but also consider options to make their farm socially and environmentally sustainable. At the end of the game, the scores are tallied, and the remaining resources are monetized and converted into financial points. The player with the maximum score is declared the winner.

For more detailed information about game mechanics, paraphernalia and game cards, please refer to Deliverable 1.3: Serious game design document.

3. Workshop Methodology

3.1. Preparatory activities

The design and development of the AgriLemma serious game was done iteratively for about 3 years, from May 2020 to January 2023. The timeline of the game development and testing is shown in Figure 3. The game's first prototype was tested with 15 MSc students at TU Delft (see Figure 4-a,b). The major feedback received during the test sessions was to simplify the game rules, balance the numbers in the game, and make technologies more intriguing and informative. This feedback was used to further improve the game mechanics. The improved version of the game was tested with internal consortium members in April 2022 in Vienna during the general assembly meeting of the WATERAGRI project (see Figure 4-c). Three game sessions were conducted with internal WATERAGRI stakeholders, with each session lasting about 2 hours. The game was well received, as well as many useful suggestions for further improvement – simplifying the farming cycle and removing crop trackers for different seasons, further balancing the game numbers, and adding social and environmental objectives to the game in addition to economic profitability.



Figure 3: Timeline of game development and testing



Figure 4: (In clockwise order) (a) The first prototype of AgriLemma (b) Game session with MSc. students at TU Delft (c) Game session with internal WATERAGRI stakeholders in Vienna, Austria (d) Game session with farmers in Gleisdorf, Austria

The 2nd prototype was also tested with two farmers in Gleisdorf (Austria) during a project workshop organized on 30th November 2022 to get further feedback on the game experience of the intended audience (see Figure 4-d). The players enjoyed playing the game and were interested in using the game for further engagement activities. They felt that while playing the game, they concentrated more on what they earned from different WATERAGRI solutions (just for winning the game) and did not learn enough about the technical aspects of the solutions and their performance. This feedback was further used to improve the game between November 2022 and January 2023 in preparation for creating the final prototype that was presented in WS4.

3.2. Workshop structure and game play sessions

The preparation of the WS4 started in October 2022. The steering group organizing WS4 was composed of Aashna Mittal (TU Delft, Organizer), Lisa Scholten (TU Delft, Organizer) and Zoran Kapelan (TU Delft, WP1 Leader) with inputs from Tamara Avéllan (UOULU), Jovana Bondzic (INOSENS), and Sebastian Puculek (ULUND). Firstly, email invitations were sent out to 101 stakeholders in December 2022. These stakeholders are part of the WATERAGRI stakeholder register and have consented to be informed about project activities and updates (see Appendix 7.1). These stakeholders include internal consortium members and external stakeholders covering different groups – farmers, decision/policymakers, researchers and the general public. Invitations were also sent out to the WATERAGRI consortium mailing list to ensure that all project members were informed

and invited to WS4. Interested people were asked to complete a registration form indicating their contact details and dietary preferences (see Appendix 7.2). The partner INOSENS further helped disseminate and communicate the WS4 through posts on LinkedIn, Twitter and Facebook. A total of 17 registrations were received, out of which 13 participants (including 3 workshop organizers) attended the workshop. Of the people who attended, 12 participants were internal consortium members, while 1 participant was external to the WATERAGRI project.

The WS4 was organized as a one-day workshop in Delft with 3 major phases – briefing, gameplay, and debriefing (see Table 1). The workshop started with registration and distribution of the pre-game survey. Participants were given 15-20 minutes to fill in the survey. After players had filled in the pre-game survey, a short presentation was given explaining the aim of the workshop and introducing participants to the AgriLemma (see Appendix 7.3 for the introductory presentation). The presentation covered topics such as roles, game objectives, scoring, round actions, rules, and winning and losing conditions.

Timings		Activity	
9:00 - 9:30		Registration and pre-game survey	
9:30 - 9:40	Driofing	Project introduction and WS4 objectives	
9:40 - 10:00	ынејшу	Introduction to AgriLemma	
10:00 - 10:30		Coffee break and division across game setups	
10:30 - 12:15	Gameplay	Gameplay	
12:15 - 12:30		Post-game survey	
12:30 - 14:00		Lunch	
14:00 - 14:20	Debriefing	Plenary discussion of game experience. Any	
		other business?	
14:20 - 14:30		Closing remarks and deliverables	

Table	1:	WS4	agenda
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After the briefing phase, players started the gameplay, which lasted about 2 hours (see Figure 5). Players were separated into 3 groups, and each group was assigned a gameplay table. Each game table was led by a facilitator. The facilitators guided the players through the first round of the game, and as the players became more comfortable with the game rules, the role of the facilitator became more passive. Players played 8 rounds of the game, and at the end, scores were tallied, and a winner was declared.



Figure 5: Pictures from the WS4. Row 1: Briefing and debriefing phase. Row 2: Gameplay session

After the gameplay concluded, the debriefing phase started with the filling of the post-game survey. The survey was scheduled just after the gameplay session so that the gameplay experience would still be fresh in the players' memory and richer responses could be obtained. After the post-game survey, the workshop participants went for lunch and came back for a short plenary session. Participants were encouraged to share their learnings and game experience in the session. The workshop was concluded with closing remarks from the organizers.

3.3. Game surveys

Whenever games are used as an intervention, it is critical to test their impact, i.e., understand what difference the game makes and whether the game achieved the goals it was developed for (Mayer, 2012). To test the impact of AgriLemma, pre-game and post-game questionnaires were used (Hauge et al., 2013). These surveys were conducted on paper, and participants were provided 15-20 minutes to complete them. In addition, a plenary debriefing session was conducted after gameplay completion to understand players' gameplay experience and obtain feedback on future improvements.

Pre-game survey

The pre-game survey was conducted to record participants' perceptions about WATERAGRI solutions before the game (see Appendix 7.4). This survey consists of three parts. The first part, "demographics", was used to collect background information about the participants – level of education, whether they are part of the WATERAGRI consortium or not. This data was collected to better understand the results, assuming that higher education levels and association with the WATERAGRI project would lead to a lower % change in outcomes. Since AgriLemma aims to increase awareness of WATERAGRI solutions, the next part of the survey was focused on collecting data about the awareness levels of WATERAGRI solutions.

A total of 10 WATERAGRI solutions were presented in the game and included in the pre-game survey. These were:

- 1. Farm-constructed wetlands for nutrient retention;
- 2. Farm-constructed wetlands for water retention;
- 3. Remotely sensed data for water and nutrient resources management;
- 4. Irrigation management platform;
- 5. Enhanced water retainer concept;
- 6. Filter system for subsurface drainage water treatment using biochar;
- 7. Bio-inspired multi-layer filter system using biochar adsorbents for water and nutrient uptake;
- 8. Nano-cellulose membranes for nutrient recovery;
- 9. Microfluidic system for nutrient recovery;
- 10. Data assimilation system;

Players were asked to select one out of 4 options about these solutions:

- I have not heard of this, and I don't know what it is;
- I have heard of it, and I don't know what it is;
- I have heard of it, and I know what it is;
- I have heard of it, and I would like to try/buy one;

The last part of the survey consisted of a few statements on farming, the impending climate change, and the role of water retention and nutrient retention technologies, and players were asked to enter their responses on a 5-option Likert scale (Nemoto & Beglar, 2014) – strongly disagree, somewhat disagree, I don't know, somewhat agree, and strongly agree.

Post-game survey

The post-game survey was conducted with the aim of investigating participants' perceptions of WATERAGRI solutions after the game (see Appendix 7.5). As part of this survey, the awareness and assertion section of the pre-game survey was repeated along with two additional sections on gameplay experience and open questions. For the gameplay experience, players were asked to provide feedback on 9 statements that covered aspects of fun, engagement, realism, learnings, difficulty levels and the suitability of the game to its learning objectives on a 5-point Likert scale (Nemoto & Beglar, 2014).

Players were further asked to fill in their responses to three open questions:

- 1. Please describe shortly one of the solutions you encountered in the game and its main tradeoffs.
- 2. What did you learn from the game? Did any information surprise you?
- 3. Do you have suggestions on how the game could be improved? (please describe).

Plenary session

Towards the end of the workshop, a short plenary discussion was initiated to conclude the game sessions. Players were asked to share their thoughts and opinions about the following (but not restricted to) three questions.

- 1. What did you learn?
- 2. How realistic is the game? Does it represent the complexities of farming?
- 3. Did you miss something in the game? What needs improvement?

Analysis of collected data

Several methods were deployed to analyse the data collected through the pre-game and post-game, as shown in Table 2. To understand the change in awareness levels before and after the game, the average score for each WATERAGRI solution presented in the game was compared before and after the game, and a %change was calculated. The same method was also deployed to understand the percentage change in responses towards the assertions presented to the participants. Since the game experience section of the post-game survey was only deployed after the game was played, there was no basis for comparison. Hence, we simply visualize the ratings given by participants. Lastly, the responses to open questions were analysed by calculating the frequency of similar responses and grouping them into similar themes.

Evaluation aspect	Method	
Solution awareness	Percentage change in average score after playing the	
	game	
Assertions	Percentage change in average score after playing the	
	game	
Game experience	Visualization of post-game scores	
Open questions	Frequency and collation of similar responses	

Table 2: Methods deployed to analyze survey data

4. Results

This chapter presents the results of the surveys deployed to measure the impact of AgriLemma on change in awareness levels and perceptions. In Section 4.1, we briefly present the demographics of the participants who played the game. The comparison of results from the post-game and pre-game survey highlights the change in awareness of WATERAGRI solutions and the change in perception about assertions related to farming and water/nutrient management. These results are presented in Section 4.2 and Section 4.3. In Section 4.4, we present the results from the post-game survey where participants rated the game on different aspects. Lastly, Section 4.5 presents the responses to open questions on learning and feedback.

4.1. Demographics

The workshop was attended by 13 participants, out of which 3 were involved in organizing and facilitating the workshop. The organizers did not fill in the pre-game and post-game survey. Of the 10 participants, 3 were female, and 7 were male. The workshop was attended mostly by the consortium members, representing project partners from Sweden, Serbia, Germany, Poland, France, Italy and Finland. Nine out of 10 players were already familiar with the WATERAGRI project and the solutions being developed. The remaining 1 player was also from a similar background, working on a project on nature-based solutions in farming.

4.2. Change in awareness of solutions

The game performed only marginally well in changing participants' awareness about the WATERAGRI solutions, as shown in Figure 6. There was a 13% and 14% increase in the awareness levels of 2 solutions, bio-inspired multi-layer filter systems using biochar and microfluidic systems for nutrient recovery. For the remaining solutions, the % change was less than 10%. The low values can be attributed to the demographics of the participants who played the game. Since the workshop was attended mostly by WATERAGRI project members who are already familiar with the solutions, it explains the relatively low level of change in awareness of these solutions.





4.3. Change in assertions

In the pre-game and post-game survey, we asked participants to rate their agreement to eight statements about farming, the urgency to do something about water and nutrient scarcity, and adapting to climate change. Two statements stood out for which the % change was high. There was

a 22% decrease in favour of the statement "I am prepared to deal with the uncertainties in farming" after playing the game. This indicates that the game demonstrated the complexity of farming and managing water and nutrients and made the players re-think their preparedness to deal with the uncertainties of weather, government policies, and diseases. Similarly, there was a 14% increase in favour of the statement, "I am aware of the benefits and impacts of the nutrient retention solutions". This indicates that the game could partially communicate and improve player's understanding of the benefits of nutrient retention solutions.



Figure 7: Pre- and post-game average score of 10 participants on self-reported perception on statements about farming, urgency to act and role of water and nutrient retention solutions (the percentages indicate % change in the average score)

4.4. Game experience

Following the game, participants provided feedback on the gameplay experience. They rated their level of agreement on the Likert scale -1 (strongly disagree), 2 (somewhat disagree), 3 (neutral), 4 (somewhat agree), 5 (strongly agree), as shown in Figure 8. Overall, the participants strongly agreed that the game was fun and engaging. The group somewhat agreed that the game was realistic, the rules were clear, it is suitable to engage stakeholders to increase the awareness of water retention and nutrient retention solutions, and the game supports the learning of complex tradeoffs that exist with regard to solutions. Players somewhat disagreed with the statements that the game was difficult to follow and that it was easy to win the game.



Figure 8: Post-game average rating of 10 participants on the game experience

4.5. Responses to open questions

In the post-game survey, participants responded to three open questions. The detailed responses to open questions can be found in Appendix 7.6.

Solutions and their trade-offs

When asked to shortly name and describe one solution players encountered in the game and its corresponding trade-offs, nine out of 10 players named "farm constructed wetlands". More specifically, 4 participants mentioned constructed wetlands for water retention, 1 for nutrient retention, and the rest did not specify the type of wetlands. Players mentioned the trade-offs as high costs versus benefits of water retention, nutrient retention, sustainable impact, ecosystem services, and prevention of water pollution. The remaining 1 participant described the irrigation management platform. The high frequency of naming farm-constructed wetlands hints at skewed attention towards the specific solution. Owing to other feedback provided by the players, it seems that the farm-constructed wetlands had too many benefits compared to the other technology cards, which made it attractive (and almost necessary) for players to pick it up to have an advantage in the game.

Learnings

In terms of learnings from the game, players mentioned that the game introduced them to the complexity of farming. In the plenary session, some participants even said that the game is "depressing" in the sense that it makes you feel hopeless about the reality of farming. A few quotes from the post-game survey where players shared their learnings from the game are provided below:

How to combine trade-offs of different factors affecting farming. It (the game) supports systematic thinking.

It's very hard to plan your work regarding uncertainties in the game (I guess it is the same in real life).

I learned that technologies in farming are useful but expensive.

Suggestions for improvement

Players further shared suggestions and feedback for improving the game. Some of the key suggestions mentioned frequently were:

- Introducing WATERAGRI technologies/solutions at the beginning of the game and adding more information about these in the game manual or on the technology cards (for instance, a barcode that can be scanned and leads the player to the webpage of the solution on the WATERAGRI website);
- Adding more event cards and weather cards to the game to make the game more dynamic when played multiple times;
- Diversifying technology cards beyond the ones developed in the WATERAGRI project. Some potential solutions/farming approaches that could be added are cover-crop technologies, agroforestry, conventional agriculture with high use of fertiliser and pesticides;
- Adding more realism in the game by differentiating between crops based on their ability to withstand weather changes, incorporating soil types, and allowing technology cards and the parameters of the crops to be adapted for local and or regional contexts;
- Increasing collaboration among the players by allowing them to share investment costs or resources;
- Improve the balance of benefits gained from technologies in the game. Currently, the benefits seem skewed towards constructed wetlands as it is difficult to earn similar social and environmental points from other technologies.

5. Conclusion

WATERAGRI WS4 was organized to present the final prototype of the serious game AgriLemma. The game was designed with the aim to engage WATERAGRI stakeholders, increase their awareness about the solutions being developed as part of the project and introduce them to the trade-offs involved in selecting the solutions. The workshop was conducted as an in-person meeting for one day. 13 participants, including the workshop organizers, attended the meeting. 10 participants played the game. The workshop started with presenting the game concept and its rules, followed by three gameplay sessions. The workshop concluded with a plenary session where participants shared their game experience and feedback for improving the game.

To measure the game's impact on awareness levels and perception of WATERAGRI solutions, a pregame and post-game questionnaire was deployed, and the responses were compared to measure the change. Slight improvements were seen in the awareness levels before and after the game. Similarly, the performance on statements related to farming and related uncertainties also changed only marginally. Improvements were noticed for two statements which indicated that the game made players reconsider their preparedness to deal with the uncertainties of weather, government policies, and diseases. Furthermore, players also felt that they are more aware of the benefits and impacts of the nutrient retention solutions. The game's performance on aspects of engagement, fun, and suitability to engage stakeholders to increase awareness of solutions and communicate their tradeoffs was scored well. Furthermore, aspects of realism and clarity of rules can be further improved, for which ample suggestions were provided.

Although the organization and execution of the workshop corresponded well with the goals outlined in the project proposal, there are several limitations that were encountered which could be improved upon. The turnout of the workshop was relatively low. Since the game is a physical board game, participants were expected to attend the workshop in person, which added overheads of travelling, leading to only 1 person external to the project attending the workshop. Another limitation was that there were no farming community representatives in the workshop, despite previous advertising. The game will be further played (but without extensive evaluation) at future project GAs and other project events where hopefully, some of these stakeholders will be available.

Based on the feedback provided by players and the discussions that ensued in the plenary session, multiple opportunities for future work after the project arise, which are listed below:

- There is scope for communicating the information on WATERAGRI solutions in a better way. This involves improving the design of the solution cards to make them more engaging and attractive. QR codes can be added to the technology cards leading the players to the webpage of each solution. Furthermore, as solutions are still being developed and their results are being finalized, further work needs to be done to update the technology cards and align the results with the information presented in the game.
- The game can be made accessible to relevant stakeholders by translating it into more languages. Furthermore, we recommend adapting the game to better represent the local conditions where the game will be played. For instance, the type of crops used in the game can be changed to match the local context. Furthermore, aspects of soil conditions, local weather patterns, and government policies can be introduced by adapting the weather cards and event cards. The set of solutions introduced in the game can also be expanded beyond WATERAGRI solutions to make it more realistic with local practices and farming approaches being used.
- AgriLemma has the potential to be used in other contexts, for example, teaching. Students can be introduced to the complexity of farming, water management, and sustainability in general. To do so, the questionnaires can be adapted based on the learning goal.
- We recommend testing the game with the target audience, i.e., real-world stakeholders that are external to the project, to draw more concrete conclusions on the effectiveness and impact of the game and get more nuanced feedback on aspects of play, meaning and realism. It will also be interesting to explore how repeated play changes the perception and acceptability of the game as players become more familiar with the rules and whether the game still stays dynamic and interesting enough to be played multiple times.

6. References

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Mayer, I. (2012). Towards a comprehensive methodology for the research and evaluation of serious games. *Procedia Computer Science*, *15*, 233–247. <u>https://doi.org/10.1016/j.procs.2012.10.075</u>

Nemoto, T., & Beglar, D. (2014). Developing Likert-Scale Questionnaires Campus Reference Data. In N. Sonda & A. Krause (Eds.), *JALT2013 Conference Proceedings*.

7. Appendix

7.1. WS4 invitation and agenda



6th December 2022

Invitation to the 4th WATERAGRI Stakeholder Consulation Workshop – Serious Gaming

24th February 2023

TU Delft, The Netherlands

Dear WATERAGRI stakeholder,

We herewith cordially invite you to the 4th WATERAGRI Stakeholder Consultation Workshop on Serious Gaming on 24th February 2023. This workshop will be conducted as a in-person meeting at the Technical University of Delft, The Netherlands. WATERAGRI aims to re-introduce and enhance sustainable solutions for water retention and nutrient recycling to enable agricultural production that can sustain growing populations and cope with present and future climate change challenges. WATERAGRI is re-developing traditional drainage and irrigation solutions and re-introducing nature-based solutions such as integrated constructed wetlands, bio-inspired drainage systems and sustainable flood retention basins in the agricultural landscape, leading to better retention of both water and nutrients. WATERAGRI is testing these solutions in ten case studies distributed across three climatic zones in Europe.

The main aim of this consultation workshop is to present the serious game - AgriLemma and test the game with WATERAGRI stakeholders. A serious game is a game designed not just to entertain but also educate, motivate, increase awareness about a complex problem or change behaviors. AgriLemma is a board game designed to engage farmers and stakeholders involved in the project and make them aware of the WATERAGRI solutions alongwith their pros and cons. By playing the game, farmers and other stakeholders will learn to appreciate more complex trade-offs that exist when using different solutions thus increasing the acceptance of overall WATERAGRI approach. In the workshop, the game concept (which includes aspects such as game objectives, design methodology, rules, and other elements) will be presented and sessions will be organized where participants can play the game.

Registration:

We kindly ask you to sign up and fill in the information required in the following form until the end of this month: https://forms.gle/yeTuL36V1GvUh8Mq8



This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 858735.



Venue:

The workshop will be held at the Delft University of Technology (address: Building 23, Stevinweg 1, 2628 CN Delft)

Map location: <u>https://goo.gl/maps/RoZJNDfbeeN1K1gz5</u>



We are looking forward to meet you.

With kind regards,

Aashna Mittal (PhD candidate, Faculty of Civil Engineering and GeoSciences, TU Delft)

Dr. Lisa Scholten (Associate Professor, Faculty of Technology Management and Policy, TU Delft)

Prof. dr. Zoran Kapelan (Professor and Chair of Urban Water Infrastructure, Faculty of Civil Engineering and GeoSciences, TU Delft)

(on behalf of the WATERAGRI team)



This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 858735.



Agenda

When	What	Location	Presenter	Notes
9:00 - 9:30	Registration	Room 2.02		Registration, handing out of nametags, filling
				pre-game workshop survey
9:30 - 9:40	Welcome	Faculty of Civil	Zoran Kapelan	WS4 objectives and agenda of the day
9:40 - 10:00	Introduction	Engineering and	Aashna Mittal	Game objectives, design, introduction to game
	to AgriLemma	Geosciences,		board, rules, and setup of game sessions
10:00 - 10:30	Coffee break	Building 23,		Short coffee break, dividing participants across
		Stevinweg 1,		different game board setups, and filling pre-
		2628 CN, Delft		game survey
10:30 - 12:30	AgriLemma	https://goo.gl/	Facilitated by	1.5 hour game session, followed by individual
	sessions	maps/RoZJNDfb	Zoran Kapelan,	post-game survey
		eeN1K1gz5	Lisa Scholten,	
			Aashna Mittal	
12:30 - 14:00	Lunch	Café X, TU Delft		
		Sportcentrum,		
		2628 CD Delft		
		https://goo.gl/		
		maps/JiwdNAg		
		d6CBWtnFj7		
14:00 - 14:20	Plenary	Room 2.02	Aashna Mittal	Plenary discussion of game experience.
	discussion			Any other business?
14:20 - 14:30	Summary	Faculty of Civil	Zoran Kapelan	Closing remarks, workshop summary and next
		Engineering and		steps (deliverables)
		Geosciences,		
		Building 23,		
		Stevinweg 1,		
		2628 CN, Delft		
		https://goo.gl/		
		maps/RoZJNDfb		
		eeN1K1gz5		

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 858735.



Accomodation

Below you will find a list of recommended hotels in Delft:

- Hotel Johannes Vermeer: <u>https://www.hotelvermeer.nl/</u> (Address: Molslaan 18-22, 2611 RM Delft)
- 2. Bridges House Hotel: https://www.bridgeshouse.nl/ (Address: Oude Delft 74, 2611 CD Delft)
- Hampshire Hotel Delft Center: <u>https://hoteldelftcentre.nl/en/home-en/</u> (Address: Koepoortplaats 3, 2612 RR Delft)
- Best Western Museum Hotels: <u>https://www.bestwestern.nl/nl_NL/book/hotel-</u> <u>rooms.92579.html?aff=BNL&iata=00171880&ssob=BLBWI0004G&cid=BLBWI0004G:google:gmb:9</u> <u>2579</u> (Address: Phoenixstraat 50A, 2611 AM Delft)

Getting there (see further https://www.delft.com/planning-your-trip/getting-there):

From Schiphol Airport to Delft

- By train: Schiphol Train Station is located directly below the airport. The direct trains from Schiphol to
 Delft depart every half an hour and take about 40 minutes. You could buy an e-ticket <u>online</u> or buy a
 single-use smart card from the NS (Netherlands railway) service counter or a NS ticket machine, both
 located in the arrival hall. An <u>anonymous OV-chipkaart</u> is a convenient option for multiple travel with
 the public transportation (train, bus, tram, metro, etc). <u>Time table and travel fee by NS</u>.
- **By taxi**: A taxi stand is located directly outside the arrival hall at Schiphol Airport. A one-way trip to Delft costs about €60.

From Delft train station to the conference venue

The workshop venue is located at Stevinweg 1, 2628 CN Delft.

- By taxi: The taxicab stand is next to the bus terminal.
- By Bus: The bus terminal is just outside the train station. You can take bus 69, 174 or 40 and get off at
 the stop 'Mekelpark', which is in walking distance (2 min) from the workshop venue. You can also take
 bus 455 and get off at the stop 'TU-Aula', which is about 5 minutes walk from the workshop venue.
 Tickets can be bought from the bus driver. A one-way ticket costs €4. For the latest bus time table,
 please use this link.
- On foot: It is a 20-minute walk from the train station to the workshop venue.

Public transportation in the Netherlands

The whole country is well connected with public transportation. It is very convenient to travel by train from Delft to other cities such as Amsterdam, Rotterdam, Den Haag, Utrecht. You can plan your trip from A to B via public transportation on this <u>site</u>. Information for the trains can also be found <u>here</u>. An <u>anonymous OV-chipkaart</u> is a convenient option for multiple travel with public transportation (train, bus, tram, metro, etc.). You can buy the card at the information desk at any train station (the card costs 7 euros) and you will have to load travel credit onto such a card at a vending machine or ticket office. Delft is also well connected with Paris, Brussels, and some other European cities with <u>international trains</u>.



This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 858735.

7.2. Registration form

Registration form

4th WATERAGRI Stakeholder Engagement Workshop

9:00 AM - 3:00 PM on 24th February 2023

Faculty of Civil Engineering and GeoSciences, TU Delft, The Netherlands

'All data and information will be collected, stored and processed according to the European General Data Protection Regulation (GDPR). If you have any questions or queries please contact the WATERAGRI project team through <u>https://wateragri.eu/</u>. We thank you for your kind collaboration.'

* Required

- 1. 1. Name *
- 2. 2. Organization name and place (e.g. TU Delft, The Netherlands) *
- 3. 3. Do you have any food allergies/preferences? *

Check all that apply.

No	
Yes:	
Gluten	
Dairy	
Lactose	
Nuts	
Vegeterian Vegeterian	
Vegan	
Other:	

7.3. Game introduction presentation

Pre-game survey





Workshop (WS) 4 – Serious gaming to engage stakeholders



Aashna Mittal Lisa Scholten Zoran Kapelan





The **WATERAGRI** vision is to solve agricultural water management and soil fertilisation challenges in a sustainable manner to secure affordable food production in Europe for the 21st century.

09/03/2023

WATERAGRI water retention and nutrient recovery solutions





WS4 objectives

• • •

- Present the final prototype of the serious game AgriLemma
- Introduce WATERAGRI technologies and solutions to farmers and other stakeholders.
- Test the game and its impact with WATERAGRI stakeholders

Workshop agenda

Timings	Activity
9:00 - 9:30	Registration and pre-game survey
9:30 - 9:40	Project introduction and WS4 objectives
9:40 - 10:00	Introduction to AgriLemma
10:00 - 10:30	Coffee break and division across game setups
10:30 - 12:15	Gameplay
12:15 - 12:30	Post-game survey
12:30 - 14:00	Lunch
14:00 - 14:20	Plenary discussion of game experience. AOB?
14:20 - 14:30	Closing remarks and deliverables





Game specifications

 $\bullet \bullet \bullet$

Target audience: farmers or farm managers, agricultural chambers, farmer associations, water management organizations, media, researchers, policymakers

Players: 2-4 Facilitator: 1 Number of rounds: 8 Time: ~90 minutes Type: Competitive

09/03/2023











Permission for clicking pictures?





Assigning players across game tables

• • •

Table 1 (Facilitator: Aashna)	Table 2 (Facilitator: Lisa)	Table 3 (Facilitator: Zoran)
Richard Hoffmann	Wieslaw Fialkiewicz	Eriona Canga
Mona Arnold	Arkadiusz	Attilio Toscano
Agossou Gadedjisso-Tossou	Seth Nathaniel Linga	Ana Nordberg
Raymod Reau	Jovana Bondzic	Vincent Bellinkx
Tamara Avellan	Harrie Jan Hendricks-Franssen	Sebastian Puculek
Salvatore Gentile		

09/03/2023

Post-game survey





Lunch





Plenary questions



What did you learn?



How realistic is the game? Does it represent the complexities of farming?



Did you miss something in the game? What needs improvement?







7.4. Pre-game survey

Pre-game questionnaire

1. Demographics

Gender:

Age:

Country of residence:

Profession:

Are you a researcher who is part of the WATERAGRI consortium? Yes: No:

Highest achieved scholarly qualification:

- \Box Vocational degree / apprenticeship
- □ High school degree
- □ Bachelor degree
- □ Master degree
- 🗆 PhD
- \Box Other (please specify):

2. Have you heard of these solutions before?

	I have not heard of this and I don't know what it is	I have heard of it and I don't know what it is	I have heard of it and I know what it is	I have heard of it and I would like to try/buy one
Farm constructed wetlands for nutrient retention	0	0	0	0
Farm constructed wetlands for water retention	0	0	0	0
Remotely sensed data for water and nutrient resources management	0	0	0	0
Irrigation management platform	0	0	0	0
Enhanced water retainer concept	0	0	0	0
A filter system for subsurface drainage water treatment using biochar	0	0	0	0
A bio-inspired multi-layer filter system using biochar adsorbents for water and nutrient uptake	0	0	0	0
Nano-cellulose membranes for nutrient recovery	0	0	0	0
Microfluidic system for nutrient recovery	0	0	0	0
Data assimilation system	0	0	0	0

3. Assertions

		Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	l don't know
S.1	Current farming practices are sustainable and can withstand the impact of climate change	0	0	0	0	0
S.2	Availability of water for farming is uncertain	0	0	0	0	0
S.3	Availability of nutrients for farming is uncertain	0	0	0	0	0
S.4	It is urgent to protect farmlands against water scarcity/flooding	0	0	0	0	0
S.5	It is urgent to protect farmlands against nutrient scarcity	0	0	0	0	0
S.6	I am prepared to deal with the uncertainties in farming	0	0	0	0	0
S.7	I am aware of the benefits and impacts of water retention technologies	0	0	0	0	0
S.8	I am aware of the benefits and impacts of nutrient retention technologies	0	0	0	0	0

7.5. Post-game survey

Post-game questionnaire

1. Have you heard of these solutions before?

	I have never heard of this and I don't know what it is	I have heard of it and I don't know what it is	I have heard of it and I know what it is	I have heard of it and I would like to try/buy one
Farm constructed wetlands for nutrient retention	0	0	0	0
Farm constructed wetlands for water retention	0	0	0	0
Remotely sensed data for water and nutrient resources management	0	0	0	0
Irrigation management platform	0	0	0	0
Enhanced water retainer concept	0	0	0	0
A filter system for subsurface drainage water treatment using biochar	0	0	0	0
A bio-inspired multi-layer filter system using biochar adsorbents for water and nutrient uptake	0	0	0	0
Nano-cellulose membranes for nutrient recovery	0	0	0	0
Microfluidic system for nutrient recovery	0	0	0	0
Data assimilation system	0	0	0	0

2. Assertions

		Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	I don't know
S.1	Current farming practices are sustainable and can withstand the impact of climate change	0	0	0	0	0
S.2	Availability of water for farming is uncertain	0	0	0	0	0
S.3	Availability of nutrients for farming is uncertain	0	0	0	0	0
S.4	It is urgent to protect farmlands against water scarcity/flooding	0	0	0	0	0
S .5	It is urgent to protect farmlands against nutrient scarcity	0	0	0	0	0
S.6	I am prepared to deal with the uncertainties in farming	0	0	0	0	0
S.7	I am aware of the benefits and impacts of water retention technologies	0	0	0	0	0
S.8	I am aware of the benefits and impacts of nutrient retention technologies	0	0	0	0	0



3. Game experience

Please provide feedback on the serious game experience in this section. Please mark on the scale below how well you agree/disagree with each statement.

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
S.1 The game was fun	0	0	0	0	0
S.2 The game was engaging	0	0	0	0	0
S.3 The game was difficult to follow	0	0	0	0	0
S.4 The game was realistic	0	0	0	0	0
S.5 I learnt a lot in this game	0	0	0	0	0
S.6 It was easy to win the game	0	0	0	0	0
S.7 The game rules were clear	0	0	0	0	0
S.8 The game is suitable to engage stakeholders to increase awareness of WATERAGRI solutions	0	0	0	0	0
S.9 The game supports learning about complex trade-offs that exist with regard to these solutions	0	0	0	0	0



4. Open questions

1. Please describe shortly one of the solutions you encountered in the game and its main trade-offs.

2. What did you learn from the game? Did any information surprise you?

3. Do you have suggestions on how the game could be improved? (please describe)



7.6. Responses to open questions

Respon dents	Please describe shortly one of the solutions you encountered in the game	What did you learn from the game? Did any information surprise you?	Do you have suggestions on how the game could be improved? (please describe)
	and its main trade-offs.		
1	Constructed wetlands can help the farm have more water. The benefits also concern the ecosystems	The game has been improved from the last time	The game could be implemented with the addition of community costs to add any subsidies. The costs could be managed by a farmer, or each farm have event cards and weather cards
2	Wetlands for nutrient retention, a solution for preventing water pollution	Water and nutrients - are considered resources. Lack of realism of crops, solutions and crop sequences: important, for example, for nutrient recovery Nothing about fertilizers and the environment (impacts air and water) Technology cards are limited to "hard" technologies" for WATERAGRI	Need to add crops like wheat and barley to make the game realistic for farmers (from France) Need to diversify the technology cards with soft technologies as well, such as cover-crop technologies, to deal with nitrate losses and erosion Other hard technologies such as conservation agriculture with high use of fertiliser and pesticides or agroforestry or farming agriculture Need to give the opportunity to adapt the technology cards and the parameters of the crops for local and or regional solutions
3	the most useful ones were the constructed wetlands for water retention. Most of the technologies were not used or not deemed useful as the return on investment (actual costs) was not there.	In this game, we made lots of progress in env and social sustainability but were not financially secure. There isn't enough money.	Maybe introduce payments for cultivation or something of the sort at the end of each round CW for nutrients should fit nutrients as a reward We never got to the place of using more than 1 or 2 fields because we never had enough resources (water, nutrients or money). That probably needs to be adapted It would be good to really introduce the technologies at the beginning of the game. I have not learned much about them after the game
4	Farm-constructed wetlands for water retention Pros: continuous water supply (also in dry seasons) and positive environmental and social impact Cons: costly	Find the right balance between 1) the number of technologies, 2) crop types and the number of fields per person and 3) good sense for interactions between uncertainties, technologies and crops. Great game! I enjoyed it!	The farm should have a value at the end of the game; for example, every nutrient and water should count for 0.25 or 0.5 coins The constructed wetlands are powerful as they give every round extra points: I had the sense that if you don't have CW, then it is impossible to earn similar social and environmental points
5	Constructed wetlands give relative profits	Pesticides were more beneficial than some technologies	 More event cards (less predictable outcomes) Differential cost trade with a bank Nutrient technology is expensive and doesn't solve the problem of nutrients Selling and buying technologies, as well as loans, should have some costs Bigger scoreline for all 4 players Maintenance is not equal to payments Some crops can be more resilient to weather Bigger font on explanation cards or book of indexes
6	Farm-constructed wetlands for water retention. Pros: Env impact, sustainable impact, water retention	I learned that technologies in farming are useful but expensive	Farmers can collaborate more
7	Farm-constructed wetlands provide env and social points during the whole game, which is good	Not to buy too many technologies at the beginning, to sell everything in the final round. Insurance is important. It's good to take a loan for investment with zero interest rate	The initial amount of money should be about 40 coins. Event cards should be increased to more scenarios

8	Wetlands are mature technology which has much potential, and others are still immature. As part of the project consortium, the tech solution was somewhat familiar	How to combine trade-offs of different factors affecting farming. It supports systematic thinking	The social aspects were not that prominent or clear. Collaboration could be included as a factor, or getting extra points for hiring disabled workers (costs more but gives sustainability points). Biodiversity aspects of being included in wetlands?
9	Farm-constructed wetlands - I was expecting it to have a bigger impact on water retention. However, its benefits were useful only several times. It was quite costly, and as it occurs, investing early in other technologies at the beginning of the game is more profitable	It's very hard to plan your work regarding uncertainties in the game (I guess it is the same in real life)	 (1) Solution cards should repeat the steps you are taking in the game, so we know exactly where to look for the information In each step (2) Information about the cost/benefits of each tech should be better visible/explained (3) I don't understand what is the different between "maintenance" and recurrent on a few of the cards as you need to pay it recurrent anyway, so it's either maintenance that you pay recurrently (4) On the irrigation management platform card, there is a mistake. The social score says -1, but the graphics show -2
10	The irrigation management platform in the game gains a lot of water per field but also has a high maintenance cost per field	Capital gap - you need a basis of investment capital to start running the farm	Clearer rules about which action yields at which step - also on the card Have different scenarios - play the game without investments, with higher accessibility to loans (with interests), and add agro-ecological measures in the game (Nature-based solutions)

