

Title of the special session:

## Serious games for sustainable water management in low-income countries

Set up of the session:

Activity	Name	Details
<b>Opening / presentation</b>	Joske Houtkamp	Introduction to the session and short presentation about recent developments in serious game research
<b>Presentation: Throw a dice to improve sanitation in schools in Ethiopia ? <i>-Serious gaming for sustainable water management -</i></b>	Darja Kragić Kok	Interactive presentation on games for behavior change and awareness raising, for communities in Ethiopia
<b>Presentation: Gamifying Decision Support System for resource recovery from sanitation</b>	Lila Paschalidou	Interactive presentation of the ongoing research on inclusion of games in decision support systems on sanitation technologies for resource recovery
<b>Game session</b>	Joske Houtkamp Darja Kragić Kok	Participants play board games to tackle complex water & wastewater management issues in small groups
<b>De-briefing/ Wrapping up/ Interactive session</b>	Joske Houtkamp Darja Kragić Kok	Discussion of players' experiences. Opportunities and benefits of serious games in sustainable water management.

## Organizers:

Joske Houtkamp – Wageningen University and Research / Utrecht University

Darja Kragić Kok - LeAF

Joske Houtkamp (PhD) is researcher at Wageningen Environmental Research (WUR), in the team Spatial Knowledge Systems. She is also assistant professor serious gaming and human-computer interaction at the department of Information and Computing Sciences, Utrecht University.



Dr Houtkamp initiated and participated in scientific and applied research projects on interactive visualization tools, citizen science, crowd sourcing, public participation, stakeholder engagement, persuasive technology, and serious games. These projects are a.o. the FP7 Volante (Visions of land use transitions in Europe) project, the FP7 ToPDAd (Tool supported policy development for regional adaptation) project; and the AgMIP (Agricultural model intercomparison and improvement) project. She conducts studies to determine validity and usefulness of different data and information sources for environmental policy making, including citizen science and citizen sensing.

Her research is on methods and techniques for user centered design; stakeholder engagement processes in research projects; serious game development and evaluation; visualization and communication of (geo-) information.

### Selected publications:

Metzger, M. J., Murray-Rust, D., Houtkamp, J., Jensen, A., La Riviere, I., Paterson, J. S., ... & Valluri-Nitsch, C. (2017). How do Europeans want to live in 2040? Citizen visions and their consequences for European land use. *Regional Environmental Change*, 1-14.

Houtkamp, J.M. ; Rivire, I.J. la; Groot, H.L.E. de; Janssen, S.J.C. ; Jong, A. de (2016). From Research Data To Web-Based Policy Tools: User-Centered Design Techniques in the Development of the AgMIP Impacts Explorer. 8th International Congress on Environmental Modelling and Software in Toulouse, France, on July 10-14, 2016.

Bozzon, A. ; Houtkamp, J.M. ; Kresin, Frank ; Holz Amorim de Sena, N.H. ; Weerdt, M. de (2016). From Needs to Knowledge. A reference framework for smart citizens initiatives. Amsterdam Institute for Advanced Metropolitan Solutions, - 58 p.

Toet, A., Houtkamp, J. M., & Vreugdenhil, P. E. (2016). Effects of personal relevance and simulated darkness on the affective appraisal of a virtual environment. *PeerJ*, 4, e1743.

Darja Kragić Kok is an environmental engineer with a drive for improving sanitation worldwide by implementing sustainable and innovative solutions in the sector. She holds MSc degree in Environmental Science from Wageningen University and MSc in Biochemical Engineering and Biotechnology of University of Belgrade. She works for LeAF, a spin-off organization of the Environmental Technology Sub-department of Wageningen University, as a senior resource recovery and WASH adviser. Ms Kragić Kok has experience on working on interdisciplinary projects in Sub-Saharan Africa, South-East Asia, Middle East and Balkan, related to sustainable sanitation, gaming and simulation, resource recovery from waste streams, hygiene and capacity building.



### Selected publications:

Rienks, W., Belete, H., Kragić Kok, D., Meijer, C., Hammenga, A. (2016) Resource Oriented Sanitation Services in Adama (Ethiopië). H2O-Online / 29 december 2016.

Kragić Kok, D., Bisschops, I. et al. (2013) Energy and nutrient recovery potential from agricultural residues and organic waste in Vojvodina province, Serbia. Paper presented at the WASTES conference, Braga Portugal, 11-13 September 2013 and published in the conference proceedings.

Natale, O.E., Bisschops, I., Caso, P., Nanninga, T., Essel, L., Kragić Kok, D., Starkl, M., (2012) Criterios para la evaluación del impacto ambiental de las tecnologías de abastecimiento de agua y saneamiento para zonas periurbanas. El caso del Delta de Tigre. Revista Ingeniería Sanitaria y Ambiental-AIDIS Argentina.

Kragić Kok, D., Spanjers, H. and Starkl, M. (2011) Global knowledge based technologies for water supply and sanitation in rural and peri-urban areas - An integrated approach for various stakeholders and decision makers. Plurimondi 8, 157-186.

## Main idea of the session:

Our planet is developing rapidly – but some regions faster than the others. While in industrialized countries cutting edge technologies are applied for water and wastewater treatment, in developing countries about two billion people lack safe drinking water at home, and more than twice as many lack safe sanitation.

This special session will present serious games developed to tackle complex environmental problems, such as sustainable water and wastewater management in low-income countries. After presenting recent research of students (from Wageningen University and Utrecht University), participants will play several games in small groups. The games address different water related problems and were developed for different purposes, different target groups and different scales – community, city and region. After the game session, de-briefing and discussion will take place. What were experiences of the players?

We expect a range of stakeholders in the audience – NGO sector, policy makers, scientists, and industry.

## Brief descriptions of the games to be played:

The Game “Clean & Green School” deals with challenges of improving WASH at schools, while promoting water recycling. The original concept was co-developed by LeAF and Adama Town Health Office in Ethiopia and redesigned by the Department of Information and Computing Sciences, Utrecht University.

The game “Sh.. happens” is a contextualized role-playing game where players try to manage the wastewater and organic waste from the non-sewered city, while protecting the environment and improving livelihood of the people. The game was co-developed by WUR and LeAF.

Provisionally - the game “Upstream-Downstream” shows relations and effects of actions of communities living upstream and downstream from each other and risks related to climate variability and change. The original concept was developed by Red Cross Climate Center and redesigned by Antidote Games.

## Abstract 1:

### Throw a dice to improve sanitation in schools in Ethiopia ?

#### *-Serious gaming for sustainable water management -*

Authors:

1. Darja Kragić Kok\* (LeAF, Wageningen), E-mail: darja.kragic@wur.nl
2. Fabienne Heijn (Utrecht University), E-mail: f.heijn@students.uu.nl
3. Lemma Tulu Ali (Adama Town Health Office), E-mail: lematulu@gmail.com
4. Joske Houtkamp (Utrecht University and Wageningen University and Research), E-mail: J.M.Houtkamp@uu.nl

\*-corresponding author

Inadequate water, sanitation and hygiene (WASH) services in schools negatively impact health and educational outcomes of students and cause gender disparities<sup>1</sup>. In our innovative approach for improving WASH in schools in Adama, Ethiopia, we address both “hardware” and “software” aspects.

A constructed wetland is implemented for the treatment of handwashing wastewater (grey water) in schools, where effluent can be reused for irrigation and toilet flushing (Figure 1). For the sustainability of the intervention, a complete understanding of the socio-technical system around it is needed. This was done by following a Companion Modelling methodology for the development of the contextualized game about the water recycling in schools. Gaming and simulation is used to assist stakeholders in managing complex resource dilemmas in socio-ecological systems<sup>2,3,4</sup>, however their application in socio-technical systems for resource recovery at the community scale is novel.

With P-ARDI analysis<sup>5,6</sup>, a model with socio-technical interactions was elaborated for constructing a simulation of the system in the form of a computer-assisted board game. The first version of the game was tested with students and teachers in Ethiopia in the autumn of 2017. Test results provided indications for improvement and objectives for redesign of the game – better understanding of the system and triggering behaviour change.

To increase understanding of the importance of sanitation and specifically hand washing, and to affect the students’ behaviour, the game should engage and motivate the students to play repeatedly. The redesign offers more elaborated and varied game play, enhancing the effect on behaviour and relating the game mechanics with the desired behaviour in real life. Persuasive techniques are included in the gameplay for resulting change in attitude<sup>7</sup>. The prototype of the redesigned game was tested in Ethiopia in June 2018.

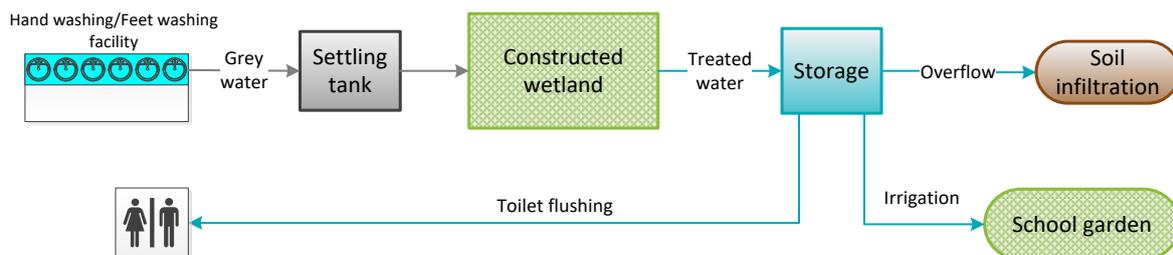


Figure 1. Grey water treatment concept to be developed and implemented in school

## References:

1. Morgan, C., Bowling, M., Bartram, J., Kayser, G.L. (2017) Water, sanitation, and hygiene in schools: Status and implications of low coverage in Ethiopia, Kenya, Mozambique, Rwanda, Uganda, and Zambia. *International Journal of Hygiene and Environmental Health* 220 (2017) 950–959
2. Bousquet F, Trébuil G, Hardy B, editors. (2005) *Companion modelling and multi-agent systems for integrated natural resource management in Asia*. Los Baños (Philippines): International Rice Research Institute. 360 p.
3. Speelman, Erika N. (2014) *Gaming and simulation to explore resilience of contested agricultural landscapes*. PhD thesis. Wageningen University and Research. ISBN: 978-90-6173-904-9
4. Savic, D.A., Morley, M.S. Khoury, M. (2016) Serious gaming for water systems planning and management. *Water*, 8, 456; doi:10.3390/w8100456
5. Étienne, Michel, Editor (2014) *Companion Modelling: A Participatory Approach to Support Sustainable Development*. Springer. ISBN: 978-94-017-8556-3
6. Simon, C., and Etienne, M. (2010) A companion modelling approach applied to forest management planning with the Société Civile des Terres du Larzac. *Environmental Modelling & Software*. doi:10.1016/j.envsoft.2009.09.004
7. Kors, M., Van der Spek, E. D., & Schouten, B.A. (2015) A foundation for the persuasive gameplay experience. *Proceedings of the 10th Annual Foundations of Digital Games Conference*.

## Abstract 2:

### **Gamifying Decision Support System for resource recovery from sanitation**

#### Authors:

1. Lila Paschalidou\*, Wageningen University and Research, Sub-Department of Environmental Technology, E: lila.paschalidou@wur.nl
2. Darja Kragić Kok, LeAF, E: darja.kragic@wur.nl
3. Katarzyna Kujawa-Roeleveld, Wageningen University and Research, Sub-Department of Environmental Technology and LeAF; E: katarzyna.kujawa@wur.nl

\*-corresponding author

#### **Abstract**

During the last decades various Decision Support Systems (DSSs) have been developed to assist stakeholders in selecting appropriate sanitation technology. Nevertheless, in densely populated urban areas in Sub-Saharan Africa sanitation and sustainable wastewater management remain a big challenge<sup>1</sup>. Where access to water is restricted due to climatic stresses and growing population's needs, informing stakeholders about the benefits of resource recovery from sanitation could catalyze increase of the agricultural yields, creation of new market opportunities, while safeguarding environmental stewardship.

The aims of our research were to gain insights into existing DSSs and to develop a sanitation DSS conceptual model that includes data on resource recovery possibilities from different sanitation technologies. The concept of gamification<sup>2,3</sup> was used for increasing the engagement of the model.

Our research started with a literature review of DSSs for sanitation developed during the last decades. An online survey was carried out amongst the developers, for investigating the applicability and usage of the developed DSSs, and a.o. for identification of their strengths and challenges. In addition, local sanitation experts from Ethiopia and Ghana were contacted for providing feedback during the research. The MDA framework<sup>4</sup> (referring to Mechanics, Dynamics, Aesthetics) was applied for integration of gamification into the design of the new DSS conceptual model.

A literature review of the developed DSSs in sanitation and wastewater domain during the last two decades (n=27), revealed that sanitation for urban areas was strongly addressed (>50%). The trend of including resource recovery was significantly increased over the past decade. The results of our study identified possible improvements of DSSs: better interface, better dissemination of technical knowledge, and improved access to information.

Gamification can be used as tool for increasing engagement and for simplifying the information. The application of a framework based on iteration (such as MDA) allows addressing of the identified challenges. Keeping information up-to-date is crucial for the adaptability of the DSS, therefore a digital format seems the most favorable for the full DSS development.

## References

- 1 World Health Organization, & UNICEF. (2017). Progress on drinking water, sanitation and hygiene: 2017 update and SDG baselines. World Health Organization.
- 2 Brigham, T. (2005) An Introduction to Gamification: Adding Game Elements for Engagement, Medical Reference Services Quarterly. Volume 34, Issue 4, p 471 -480.
- 3 Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011, September). From game design elements to gamefulness: defining gamification. In Proceedings of the 15th international academic MindTrek conference: Envisioning future media environments (pp. 9-15). ACM.
- 4 Hunicke, R., LeBlanc, M. and Zubek, R., (2004) MDA: A formal approach to game design and game research. In Proceedings of the AAAI Workshop on Challenges in Game AI.