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Publication date
2025

Document Version
Final published version

Published in
Crossing boundaries

Citation (APA)

Magherini, A., Piccoli, C., Dunne, K., De Smit, M., & Bekebrede, G. (2025). Facing Floods: a stakeholder river management game. In V. Chavarrias, & A. M. Van den Hoek (Eds.), *Crossing boundaries: NCR DAYS 2025 Proceedings, Book of Abstracts* (pp. 106-107). NCR (Netherlands Centre for River Studies).

Important note

To cite this publication, please use the final published version (if applicable).
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Facing Floods: a stakeholder river management game

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Keywords — Serious game, stakeholder management, river engineering

Introduction

River management projects involve multiple stakeholders with different interests, priorities, and constraints. As these stakeholders could have conflicting perspectives, river management entails complex decision-making processes. While technical expertise is essential, students in higher education should also develop an understanding of the societal impacts of engineering interventions. Integrating such skills into engineering curricula is crucial. One effective method is the use of serious games, which simulate and simplify the real-world complexities (Kriz, 2003). These games provide a safe space for students to explore practical challenges without facing real-world consequences (Freese et al., 2020). Serious games are also proven to enhance the learning outcomes and increase motivation, even in professional contexts (Bekebrede and Champlin, 2022).

We developed *Facing Floods*, a game designed for students in higher education to simulate the challenges of river management projects. Players take on the roles of stakeholders, each with specific goals, needs, and budgets. Through discussion and negotiation, they must balance individual objectives with the shared responsibility of effective river management.

Setting

Facing Floods takes place in Bendegom, an idealized town in the Dutch countryside, through which the Tulla River flows. The town is protected by dikes, but a recent alarming report shows the flood water level has risen by 10 cm. Hence, the current dike height no longer meets the required safety standards. Rijkswaterstaat hires a consultant to develop a plan for decreasing this risk, while aiming to balance the interests of multiple local stakeholders. These stakeholders will collaborate in drafting the plan through negotiation, working toward a solution that addresses their individual goals and needs.

Stakeholders, criteria, and playing

The game features five stakeholders: Rijkswaterstaat, concerned on reducing the risk of flooding; the Municipality, aiming to increase housing; the navigation sector, interested on improving the river navigability; farmers, seeking for more more agricultural land; nature conservationists, fighting to enhance the ecological status of that region. The game is set on the floodplains (Fig. 1). Two-thirds of the floodplains are occupied by agricultural (brown) and natural areas (pink). Farmers and nature conservationists use these areas for their goals and no intervention can be placed there without their consent. The green area has no owner and is open for all stakeholders to implement their measures. The area behind the dikes (black lines) is split between the town (gray) and the farmers (brown).

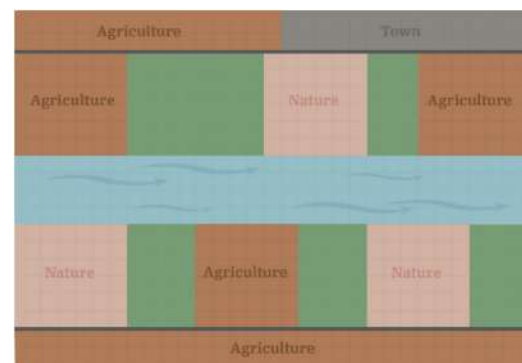


Figure 1: Map of Bendegom.

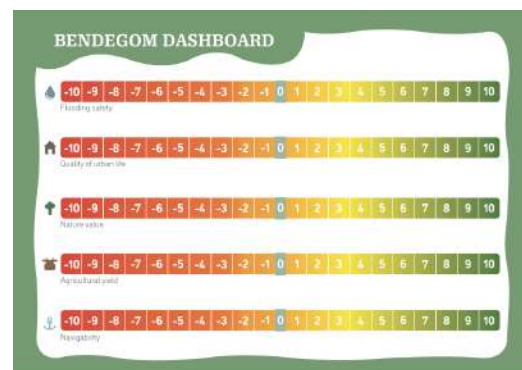


Figure 2: Bendegom dashboard of all criteria.

Five criteria are used to assess the performance of the river and the floodplains: flood-

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ing safety, quality of urban life, nature value, agricultural yield, and navigability. Each criterion has a score ranging from -10 to 10, which changes based on the measures implemented. These scores are tracked and displayed on the Bendegom dashboard (Fig. 2). Each stakeholder has a budget to propose one or more measures (Fig. 3).

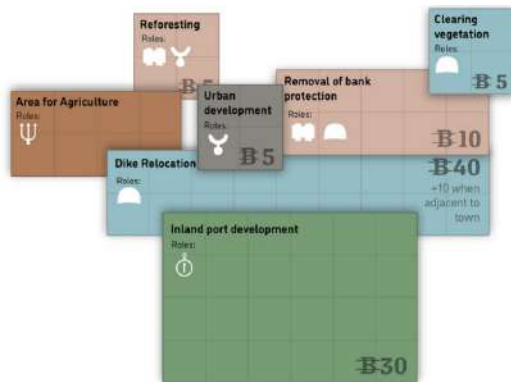


Figure 3: Examples of possible river measures.

A facilitator is needed to introduce the story, explain the game and the rules, and lead the debriefing at the end of it.

The game begins with each stakeholder presenting their proposal to the consultant, who reviews them and facilitates discussion and negotiation. Once a shared plan is agreed upon, the consultant implements it by placing the selected measures on the map and updating the criteria scores. This concludes the first round. The game is designed to be played in two or three rounds. At the end of every round, a "News event" is introduced to highlight specific societal issues or emphasize a particular criterion, adding new challenges to the decision-making process. Four events are proposed: a sudden increase in citizens, underscoring the housing shortages; a governmental law to promote self-sufficiency in food production, addressing the need for more agricultural yield; an increased demand for inland navigation, pushing for improved shipping connections; a governmental law to promote nature-based solutions for increasing the safety against flooding. The event card can be chosen at random or selected to guide the game towards a specific direction. Each event introduces requirements for certain criteria scores. If stakeholders fail to meet these requirements, they face penalty fines (Fig. 4).

Debriefing and discussion

At the end of the final round, players reflect on their experiences and draw connections between the game and real-world challenges. It



Figure 4: Example of a "News event" card.

is important to analyze the emotions, strategies, and interactions with other players. They should consider how they communicated, why they made certain decisions, and whether the game is representative of real-life negotiations. Test sessions of the game showed that students understood the relevance of stakeholder management in river engineering and that negotiation is required when taking multiple objectives into account.

Acknowledgements

The game material is available on [Edusources](#). This project has benefited from the Education Innovation project *STREAMS* of the Faculty of Civil Engineering and Geosciences of TU Delft and the collaboration with [TU Delft Gamelab](#). The authors thank Laura Maria Stancanelli for funding acquisition and project initiation; Erik Mosselman for designing the original workshop that laid the foundation for the development of the serious game, and for valuable reviews, feedback, and suggestions; Ralph Schielen for valuable reviews, feedback, and suggestions; Michelle Rudolph for conceiving and outlining the first draft of the game, and for the useful conversations and suggestions provided during the course of action.

References

- Kriz, W. C. (2003). Creating effective learning environments and learning organizations through gaming simulation design, *Simulation & Gaming*.
- Freese, M., Lukosch, H., Wegener, J., & König, A. (2020). Serious games as research instruments – Do's and don'ts from a cross-case-analysis in transportation, *European Journal of Transport and Infrastructure Research*.
- Bekebrede, G., & Champlin, C. (2022). Frame game as teaching methodology in higher Education: The case of RElastiCity, *Gaming, Simulation and Innovations: Challenges and Opportunities - 52nd International Simulation and Gaming Association Conference*, edited by U. Dhar, J. Dubey, V. Dumblekar, S. Meijer, & H. Lukosch.