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Publication date

2017

Document Version

Final published version

Citation (APA)

Onencan, A. (Author). (2017). TU Delft serious game elevates Nzoia. Web publication/site, Flows.

Important note

To cite this publication, please use the final published version (if applicable).
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TU Delft serious game elevates Nzoia

As a leading thinker on water management in East Africa, [Abby Onencan](#) became a proponent of serious gaming. She is now a research fellow at Delft University, working on a third-generation game for water distribution policymaking. Pilot projects in the Nzoia watershed show that gaming enhances cooperation – it can do the same for Kenya, the Nile basin, and, perhaps, the entire continent.

March 2017

Water in Kenya

Kenya's rivers and groundwater tables are severely stressed due to disturbances of their natural flow; the impact of dams, irrigation schemes and the rising demand for drinking water. This has led to loss of native biodiversity, and risk to ecosystems and humans from increased flooding or water shortages. Recent [reports](#) from the International Union for the Conservation of Nature record a steep decline in the Kenyan wetland landmass from 12,8% to 6.4% of the total landmass. Currently, 41% of Kenyans lack access to safe water supplies and 68% [cannot access improved sanitation](#), despite clear evidence that the current water resources are sufficient: the problem is distribution. As a result, some parts of Kenya have too much water, while others are extremely dry. Cities like Kisumu, Nairobi and Mombasa can barely meet their inhabitants' daily needs, which has led to water rationing.

Climate change is expected to increase water stress in Kenya and managing the stressed and vulnerable water resources will require proactive or reactive management interventions. Long-term pro-active planning though is hard when current problems dominate the agenda of water policy makers. Especially as Kenya's rivers provide many – sometimes competing – goods and services: food, medicine, energy, fiber, forage, fertilizer, construction and craft material, and services: tourism, recreation, erosion control, home for wildlife, cultural and religious sites, climate regulation and water cycling. They are a source of livelihood for over 70% of the Kenyan population.

Serious games can help water policy-makers to explore different allocation and cooperation strategies and experiment with policies and can create a basis for trust and cooperation, which is needed for an integrated approach to river basin management. The WeShareIt game was developed for and played with stakeholders and policymakers in the Nzoia river basin in Kenya to explore whether serious games can indeed be game changers and may lead the way to cooperation between water managers.

The WeShareIt project

To address water distribution improvement issues in Kenya, Delft University of Technology started the [WeShareIt project](#) three years ago. WeShareIt focuses on a selected smaller study area known as the Nzoia catchment as illustrated in the map. The area is home to more than 3.5 million inhabitants and is approximately 10,156 km² (approximately a quarter of Netherlands). The Nzoia River, which drains into Lake Victoria in the West is highly seasonal, at times the water in the river is too little to sustain the people currently using it and at times

the river has too much water leading to flooding. The high regions of the river are the Mount Elgon and Cherangani hills and the lower regions where flooding is a main problem are Budalangi plains and Yala swamp. The middle and lower reaches of the river are densely populated because of economic activities along the river bank (fishing, crop farming and livestock rearing). Part of the upper reaches of the river are protected forests.

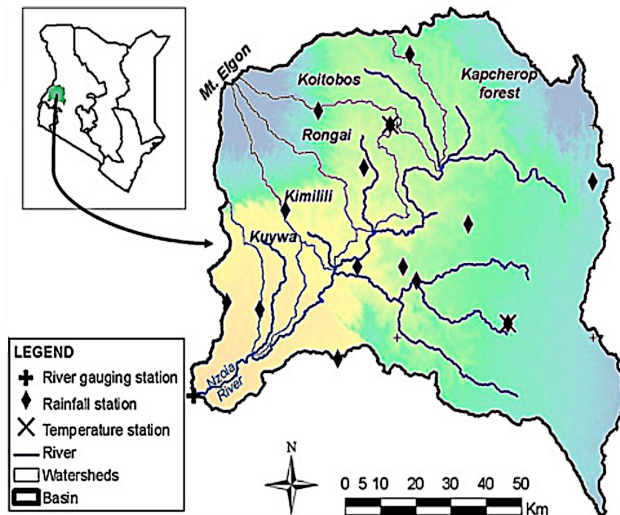


Fig. 1. The Nzoia River Catchment

The goal of the WeShareIt project is to enhance the capacity of Nzoia River Catchment policy makers in building water partnerships that would enable them to address the water accessibility problem and to balance the investments in and demands for environmental services, food, energy and drinking water provision. Moreover, cooperation and coordination between upstream and downstream counties would make them more resilient especially in case of climate change and extreme (weather) events. This paper answers the question whether serious gaming can enhance learning on the value of building strong cross-county water partnerships, in the current Nzoia Catchment. Therefore, we will first explore the current water partnerships, introduce the game, and present the results of the games played in the Nzoia catchment.

Nzoia catchment water partnerships

According to the Kenyan constitution, the obligation to ensure *access of water for all* lies with the national government. Since the passing of this new constitution, there has been lack of clarity on the functional water management responsibilities between the old institutions and the newly established 47 County Governments. The Water Act (2002) was not aligned with the new Constitution, thereby resulting in three uncertainties that have contributed to the current water sector fragmentation. First, new institutions were created with overlapping roles and responsibilities to existing institutions, leading to disputes. The existing institutions were many and they were operating under the leadership of the Water Resources Management Authority (WRMA) and the Water Services Boards (WSBs). Second, some counties are under the impression that they can charge for the export of water from their counties to other counties. This false perception has stifled water partnerships and led to unsustainable unilateral actions. Third, it was not clear whether Water Services Boards (WSBs) should be merged into one single national body or devolved to county governments. This led to disputes between the WSBs and the county governments, thereby weakening water partnerships. During the 2016

Devolution Conference, county governments expressed concerns of delays in the devolution of water services. In response, the WSBs stated that water cannot be fully devolved because it is trans-boundary and not equally distributed.

To address these challenges, a new Water Act was passed in 2016 which requires the national government, to develop within one year a strategy that clarifies the functional responsibility for national and county governments in relation to water resources management. Currently, water service provision is undertaken by county and cross-county water service providers. In Nzoia Basin, these companies operate under the authority of both the county governments and the Lake Victoria Water Services Board.

Researchers from Moi and Delft Universities visited ten water services companies in the Nzoia catchment area, with a focus of establishing the source of energy that the different county governments use to extract, treat and distribute their water and the challenges they face. During the visit to Kakamega and Trans-Nzoia counties, we witnessed an example of a strong water partnership aimed at saving on the costs of extracting, treating and distributing water, that we wanted to replicate in the entire basin (as illustrated in the figure 2). The figure illustrates how Nzoia Catchment has great opportunity for cross-county partnerships in the extraction and distribution of the water resource, if they decide to jointly manage the resource. The upper reaches of the river are on a very highly elevated region and the water flows naturally downstream that there is no need to use energy to move the water from one place to another. Unfortunately, only two of the six counties have initiated cross-county partnerships (as indicated in the yellow box). The other four counties manage their water resources independently. The details of the cross-county partnership established between Kakamega and Trans-Nzoia county is explained in detail in the next paragraph.

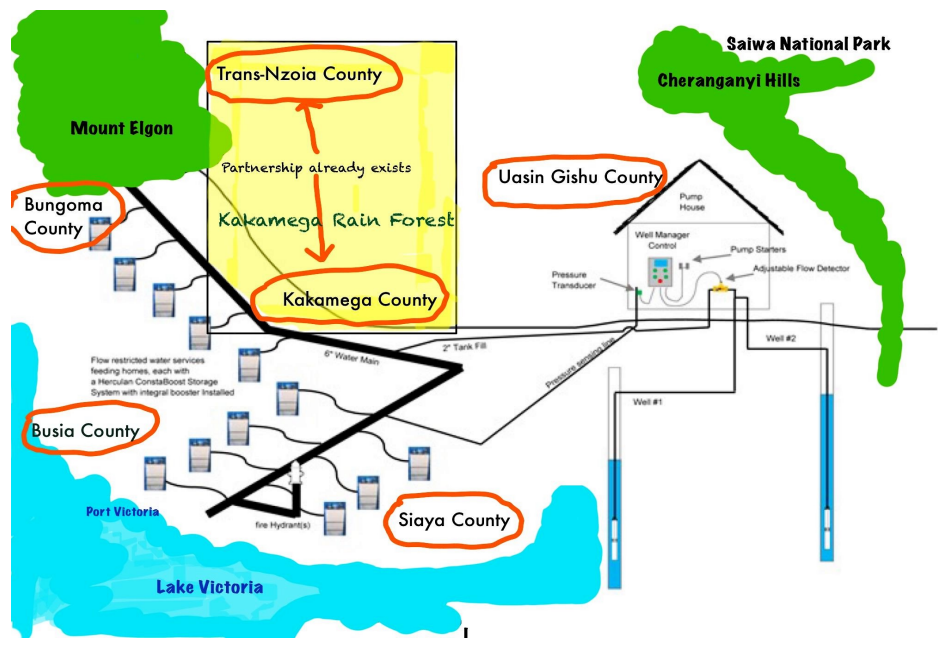


Fig. 2. The proposed plan for strengthening water partnerships within the Nzoia river catchment through joint extraction, treatment and distribution of water. The upper reaches of the river are found in the Trans Nzoia and Uasin Gishu county where the water can be extracted, treated and distributed downstream through gravity. The yellow rectangular area indicates an already existing water partnership that can be replicated to the other counties downstream.

In the recent past, Kakamega County spent too much money on hydro-electric power to extract water directly from the Nzoia River and distribute to its inhabitants. The money spent to pay for electricity costs was higher than the money received from the water users for water use. This mode of extracting, treating and distributing water using electricity was not sustainable. To change this, they reached an agreement with Trans-Nzoia county so that Trans-Nzoia county would extract water from Mount Elgon, on their behalf, treat it and release it to flow naturally through the water pipes without the use of hydro-electric energy or any other form of energy, as is shown in the Figure above. This is what we refer to as the gravity method. This change led to large savings for Kakamega County because it cut down significantly on its energy costs. It was also beneficial to Trans-Nzoia county because they were able to increase their water revenue.

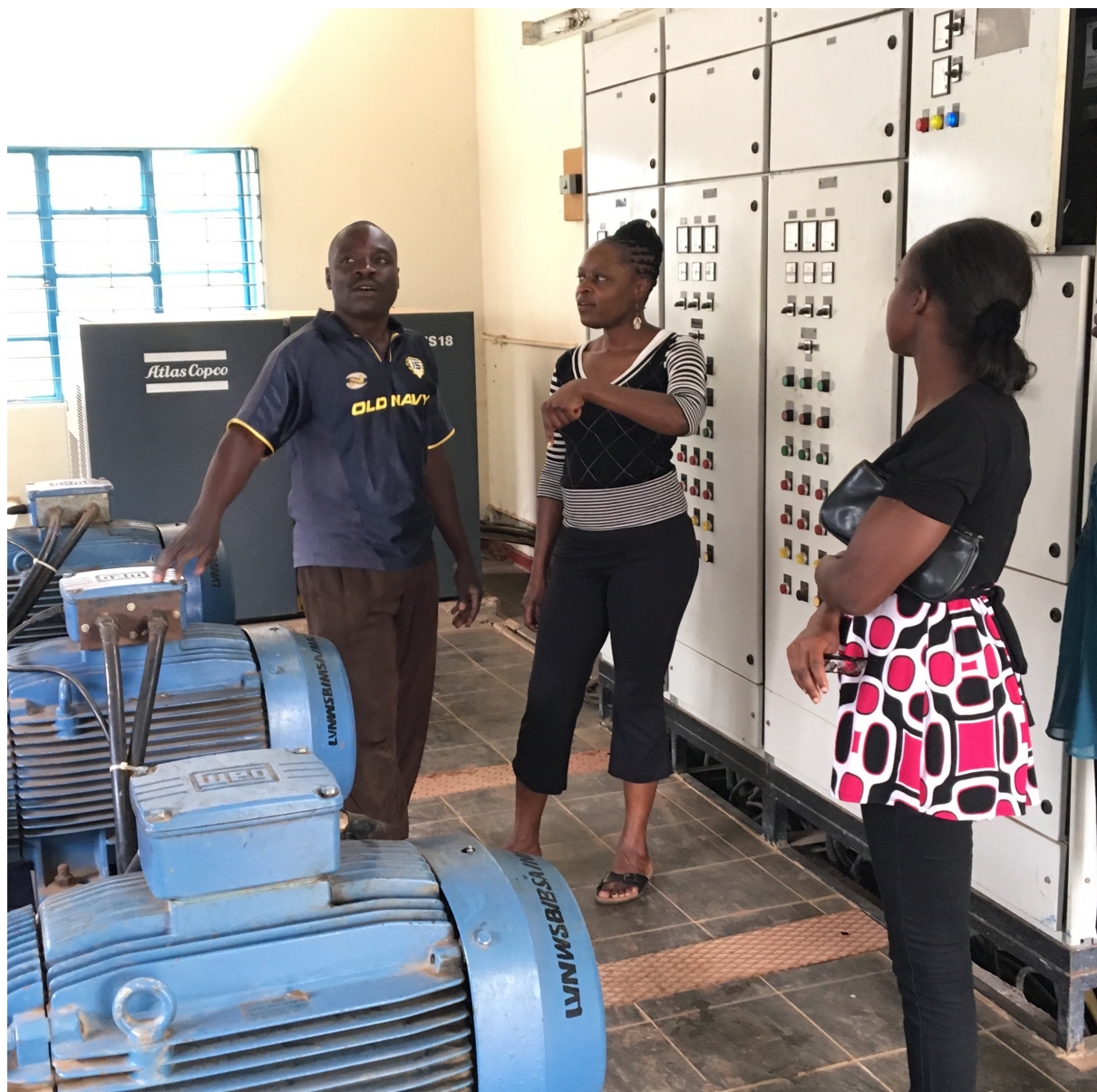


Fig. 3. Visit to one of the water companies in Nzoia River catchment. This county relies heavily on hydro-electric power to extract and distribute water with pumps.

As a result of the visits, three areas of fragmentation emerged. First, weak partnerships were discovered across critical sectors, especially energy and water. This has led to the adoption of expensive energy options to extract and distribute water. For example, to reduce the high electricity costs incurred when distributing water, Bungoma county was considering starting its own hydro-electric generation plant at the water extraction point. This idea has not been implemented for a long period of time due to the weak partnerships between the county and the Kenya Electricity Generation Company. Second, weak cross-county water partnerships lead to adoption of high energy options: electric pumping, rather than joint extraction of water from upstream counties and use of gravity method to distribute water. Third, weak public-private partnerships lead to purchase of poor quality equipment and adoption of weak water saving and treatment technologies. Clearly better cooperation could have prevented these problems.



Fig. 4. Visit to one of the water treatment centres. In this centre, a representative explains water delivery to the treatment centre, the treatment process and the final distribution. All the water companies we visited treat water using chlorine. Some have advanced dozers that automatically measure the levels of chroline while others use less refined methods to dose the water.

Nzoia WeShareIt game

Nzoia WeShareIt is a web-supported board game for the Nzoia catchment policy, and is played with iPads. The game aims at strengthening water partnerships in the following areas: water, energy, food/agriculture and nature. It is a cross-county water partnership game between five county governments, who depending on their physical location and geography (upstream/midstream/downstream), level of urbanization, agricultural production and energy proficiency, face different challenges. An important element in the game is public-private cooperation, especially with the water services companies. The game is designed around the following objectives:

1. Demonstrate the struggle that the five county governments face in meeting the water, food, energy and environmental needs within their geographical boundaries.
2. Increase their understanding on the benefits of managing the water resources jointly (as a catchment area).
3. Use the game as a rehearsal space to test possible trade-offs between the different county governments in food, energy and environment and their effect on the water resources. Through the game the policy makers test effects of entering into certain coalitions with other county governments in a safe learning environment.
4. Improve Water Partnerships between the county governments in the Nzoia catchment and the food, energy and environment sectors.

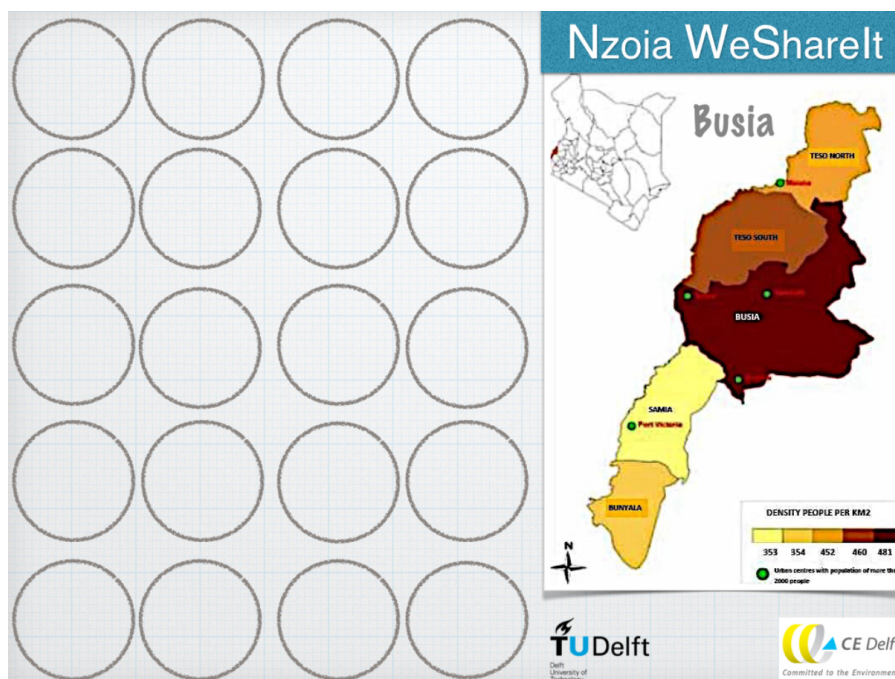


Fig. 5. The Nzoia WeShareIt Game-Board for Busia county. There are five boards in total for five counties. The twenty (20) circles on the right of the Board represent water which can be allocated for energy, food and nature purposes. Water allocation decisions are made at the end of every round during the game.

WeShareIt is a collaborative game designed to encourage policy makers to come out of their comfort zones and seek strategic partnerships with other counties. These partnerships are based on their respective comparative advantages (food or hydro-electric energy production). The

policy makers' objective in the game is to get happy faces; the happier faces, the happier and healthier their population.

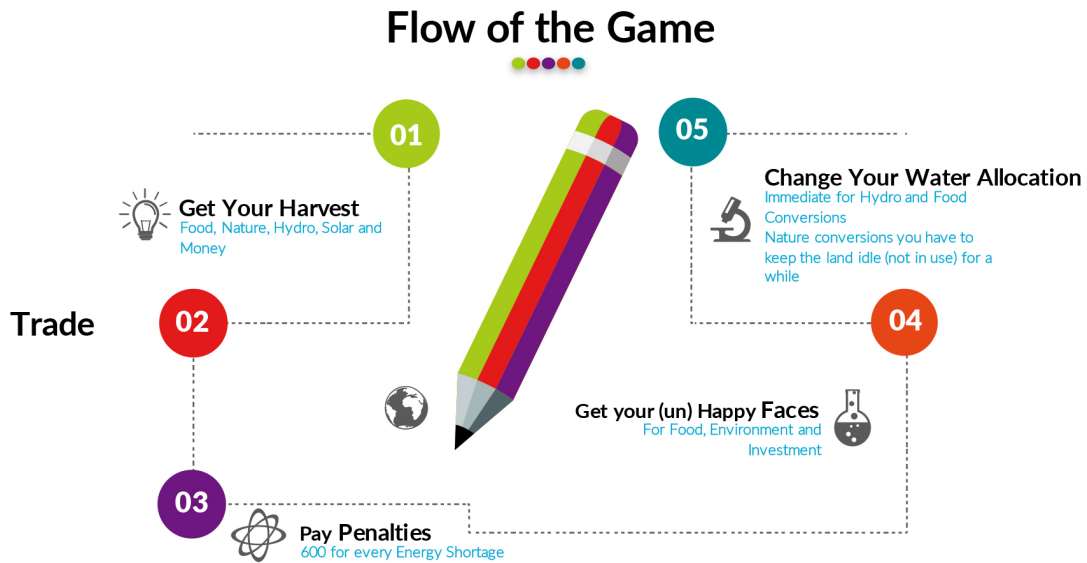


Fig. 6. The game flow is explained in five (5) stages per round. Once the fifth stage is complete, the players assess their peers and then start a new round.

The game is played in a series of rounds (maximum 10) and each round consists of six steps. First step: get your land allocation in terms of food, energy, nature, solar energy and income. Second: trade in food, wood fuel and hydroelectric energy so as to fulfil the basic requirement, which is to make your population happy. Third: pay your eventual penalties. Fourth: get your (un) happy face scores. Fifth: invest and/or change your water allocation squares and buy solar panels (optional). Finally move to the next round.

Computation of Happy Faces

| HAPPINESS FACTOR | 😊😊😊 | 😊😊 | 😊 | 😐 | 😞 | 😞😞 | 😞😞😞 |
|-------------------------------|------|------|---------|---------|---------|---------|-----|
| Food | | > 24 | 22 – 23 | 19 – 21 | 16 – 18 | 12 – 15 | |
| Environment | | | 0 | -6 – -1 | < -7 | | |
| Investment in Public Services | 3600 | 3000 | 2400 | 1800 | 1200 | 600 | 0 |

Fig. 7. The (un)happy faces for each county government are calculated as the sum total of faces gained based on the amount of food, energy (excess or shortage) and how much has been invested in public services.

If a county is unable to meet the minimum food requirements for its citizens, their inhabitants die and they are removed from the game. If a county goes below the minimum energy needs, they pay a penalty. After three successive rounds, there is a drought round where all the county resources are reduced to half. To survive the drought round and make high gains, all the counties need to collaborate early and pull all their resources to strengthen their positions.



Fig. 8. Each county government is given a certain amount of resources in form of food, energy and nature. In addition, a county government can purchase solar panels to be able to increase energy supply.

The gaming method applied

Nzoia WeShareIt was developed by Delft University of Technology in 2015 and 2016 with the close collaboration of the [CE Delft](#), the Ministry of Water and Irrigation and the Moi University.



Fig. 9. Game session with the Ministry of Water and Irrigation, Maji House, Nairobi.

After development, there were a series of test sessions leading to further refinement of the game. The final prototype was tested in TU Delft by the Policy Analysis Section and the TU Delft GameLab, and later in Eldoret, Kenya by the Moi University staff and students. After the testing was complete, Nzoia WeShareIt was applied with the support of Moi University students, in five county governments: Uasin Gishu, Trans Nzoia, Kakamega, Bungoma and Busia. In total, there were 13 game sessions played with 167 players.

The data was collected through pre, in and post-game questionnaires together with a debriefing session at the end of the game. The in-game questionnaire was in the form of a peer review form that enabled the players to assess their peers' partnership building skills, after the conclusion of every round. The peer review results were aggregated in a leader board, displaying overall scores. The results of the game and the peer review session for that particular round were projected on the screen on real-time basis so as to support decision making and improve strategies for the forthcoming rounds.

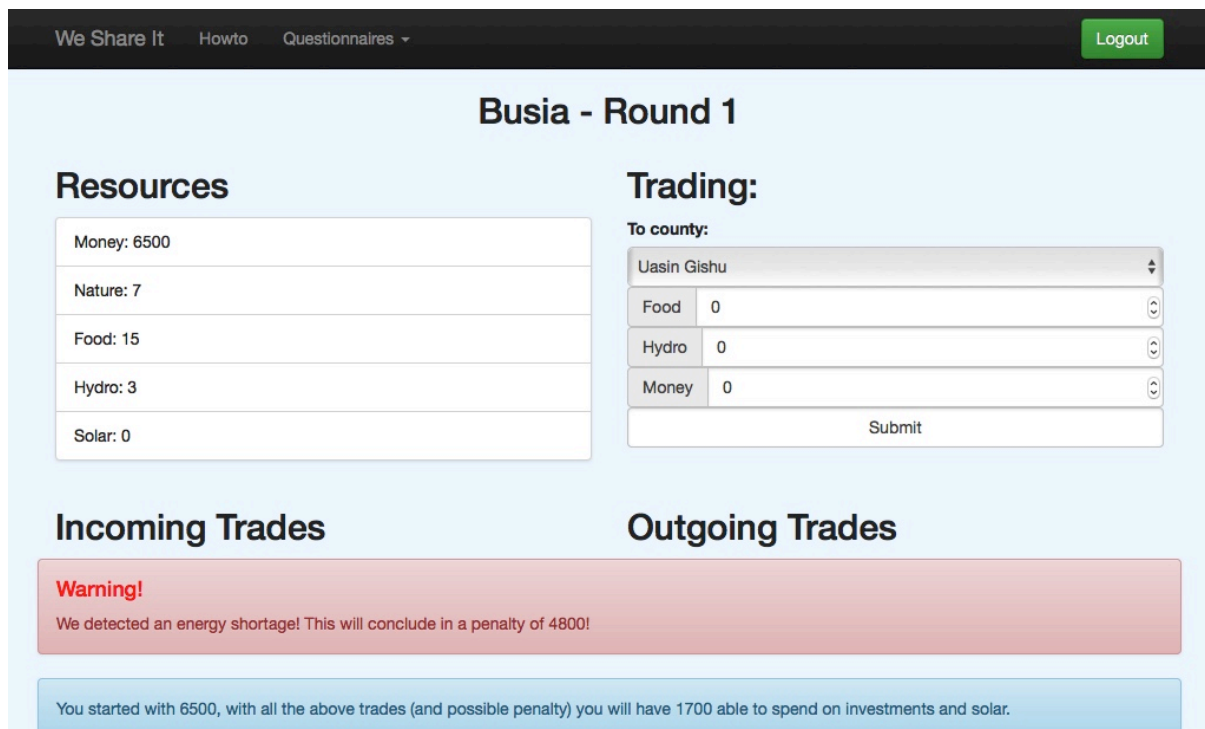


Fig. 10. Initial screenshot of the Nzoia WeShareIt game on the iPad. After the players log in to their respective counties, this screen appears to inform them of their starting food, energy, nature and income. If their energy is below the demand by its citizens, they receive a warning.

At the end of the game, the players rated their overall satisfaction with the game as follows: not or somewhat satisfied: 0%, satisfied: 11%, very satisfied: 66%, extremely satisfied 23%.



Fig. 11. Game session with Trans Nzoia county government in Kitale, Kenya. Each county government was given an iPad and had to work closely with the other county governments before making a gaming decision. On this picture, some of the players can be observed to have left their seats to come closer to their neighbour governments for joint strategy, planning and decision-making.

The players were also requested to make specific comments and recommendations, and below are some of the specific select recommendations they made:

- “The game has improved my decision making in the county level.”
- “The game was an eye opener on how different interests compete.”
- “The game enabled policy makers to make clear and correct decisions when allocating resources for sustainability of present and future generations.
- “The game has opened and enlarged my thinking capacity. The game also transformed me to another being. So thanks to the game organizers.”

- “The game was really awesome and provides knowledge for future planning and decision making for people in the society as a leader.”
- “Very interesting concept. It would be more interesting to have it at sub catchment level where Water Resources Users Association (WRUAs) are engaged in catchment protection and conservation issues alongside other stakeholders. To see how this tool can be used for local water resources and land use planning decisions and resource sharing among local communities.”
- “Cascade the game to the lowest group in society to help them make decisions too.”
- “The organizers should involve all sectors for proper planning.”

Conclusions

From the observations and evaluations, it is clear that game participants are enthusiastic about the opportunity to participate in the game and they are expressing their satisfaction with the learning outcomes. Especially the experience of going through the rounds with little cooperation to be confronted with the drought in round four, which could have been overcome if they had cooperated in the past is an eye-opener and important learning moment. Playing the game is a first step to realization that cooperation is required to survive and is a first step in trust building. The preliminary results indicate that serious games can be game changers.

Based on the player’s recommendations, future work in this field may entail improving the user interface of the game and the time allocated to play the game. Also the game could be customized for a wider audience to bring more stakeholders on board, like Water Resources Users Associations (WRUAs) and other sectors like energy and environment. Finally, it would be a great idea to redesign the policy makers game so that it specifically deals with an emerging challenge within the Nzoia River Basin (or Kenya as a whole) and apply it at the basin level, as a policy planning tool. This would involve choosing a policy area that needs further considerations like the draft National Water Strategy (as provided in the Water Act 2016), aimed at clarifying the functional responsibility for national and county governments. The draft strategy can be gamified and the game can be designed as a practice ring for the different actors to check the viability of the proposed policies, before the National Strategy is approved.

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