The strategic flood master plan

Topic: management, floods, disaster, ecology, sustainability, nature based solutions, buildings

Introduction

Already half of the world population lives in urban areas. One of the main challenges related to water is the increasing number of the water-related disasters such as floods and droughts. Unsustainable urbanization and climate change leads to drought and flooding because in cities there is much less opportunity for rainwater to filtrate naturally into the ground because of the amount of hard surfaces, such as roofs, roads, driveways, etc. This results in large volumes of surface water during heavy rainfall which puts pressure on existing drains and sewers and leads to flooding and pollution. Thus, there is a need to identify and implement ways to rehabilitate urban ecosystems. Urban water planning, development, and management are in urgent need of new strategies. Usage of ecosystem services through nature-based solutions has proved to be a cost-effective measure for adapting cities to climate change, and for reducing the risk of current and future extreme weather events with the added advantage of bringing multiple co-benefits, for example, increased biodiversity and more green spaces for leisure.

Context

It is widely recognized that dealing with large amounts of water and avoiding floods is impossible and too expensive through enlarging the sewage system or building dams and concrete channels for redirecting the natural flow paths of the water. There are several uncertainties in climate projections but the overall pattern indicates the growing risks for extreme events. Extreme weather events cannot be managed by conventional pipe systems and their occurrence becomes more difficult to predict. Eliminating all flooding is not a realistic objective; however, the consequences may be reduced and the risks lowered for property damage and public health.

Government policy has a strong role to play in increasing the amount and pace of eco-innovation in urban water delivery that is critical to the improved management of urban water. Strict environmental and economic regulations, constantly growing cities, and the general need for adaptation to climate change put pressure on utilities to find new ways to optimize the water and sewer systems. Integrated urban water management is the key element to reduce adverse impacts on surface waters and minimize future investment costs. Cities can contribute to water resources management and ecosystems and biodiversity conservation, through their design and making their infrastructure more ecological with the help of nature-based solutions.

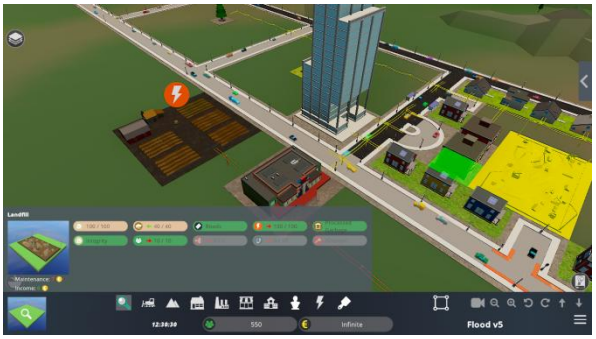

Figure 1. The scenario introduces concepts on flood management in a city.

The following roles may be used for exposing students to the scenario:

Role 1: City manager

The city manager ensures that the city has proper infrastructure and it is capable of managing flash floods. The manager also needs to administer the city's budget and generate income in order to expand the city. The manager is also responsible for the happiness of the citizens. This role can build and bulldoze everything besides housing.

Figure 2. The city includes features such as housing, a landfill, farms, and movie theaters.

Role 2: CEO of the water company

The CEO of the water company designs the city fortifications against flooding. This may include implementing projects that alter the landscape to allow water to flow through the city without causing damage or use already existing landscape for smart design. The CEO also needs to monitor the

pollution levels of water and ground. This role can terraform, build, and bulldoze infrastructure, industries, and public services.

Role 3: Safety inspector

The safety inspector ensures that the infrastructure follows safety measures and needs. The inspector has the capability of destroying dangerous or falsely built infrastructure. They will also need to provide citizens with housing and ensure their health. The inspector can build housing, public services, and culture and bulldoze everything.

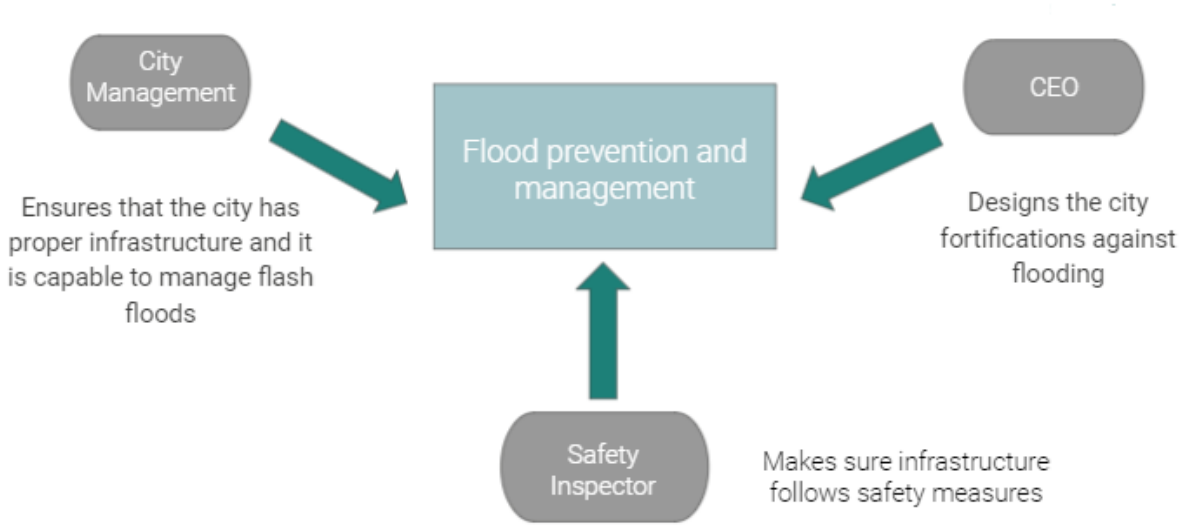

Figure 3. Roles and activities.

Learning goals

Upon completion of the activity students will:

- Understand the connections between environmental, social, and economic aspects of everyday life.
- Have experienced how to achieve cooperation between different parties with different goals and needs.
- Built competence in taking an integrative approach in researching city management and related environmental issues.

- Create conditions necessary for navigating the challenges modern society and environmental changes pose for the public and private sector.

Prerequisites

Understanding the concept of flooding and water absorption.

Audience

The screnario is relevant to both engineering and economics students as any solution for the management of natural disasters, such as flooding, needs to take into account both technological advances and economics principles for implementing a solution within realistic boundaries.

Figure 4. Office buildings provide working space for city economic activities.

Core concepts

- **Sustainability:** Encouraging decision making in terms of environmental protection and the impact of human activities on their surroundings both short- and long-term.
- **Nature-based solutions:** Solutions to real-life challenges that are based on processes the functioning of nature.
- **Ecosystem services:** Services and systems that directly or indirectly benefit communities.
- **Urban water management:** Managing and/or conserving freshwater, wastewater, and storm water of an area through sustainable methods.
- **City management:** Managing the services, revenues, and expenses of a city.
- **Water treatment systems:** Systems that control the quality of drinkable water at homes or in businesses.

- **Transversal skills:** Collaboration, critical thinking.

Description of the scenario

The overall objective is to ensure the water supply and wastewater treatment for the population and help the city to deal with extreme rain events and flash floods.

Flooding cannot be managed effectively by the city government acting alone; all parties have to work together in order to manage flood risks sustainably.

This can be achieved through planning for a sustainable drainage system. The choice of solution will be determined by the local characteristics of the site including its size, topography, soil, land-cover flood risk, and the available discharge points, such as rivers, drains, or sewers. A combination of measures can be employed in real life: green roofs, permeable paving, bioswales, soak-aways, basins, ponds, wetlands, storm water attenuation tanks, and rainwater recycling.

Students must understand that the key is to reduce the amount of rainwater entering into combined sewerage systems from road and land drainage. In most urban areas sewage and rainwater are still collected in combined sewers. This way rainwater can overload the sewers causing flooding and pollution and costing billions every year to collect, pump and treat.

Figure 5. The city is built next to a river and mountainous area.

One solution is to replenish the drainage systems on large commercial sites, such as shopping centers and industrial estates, and the government estate, including schools, hospitals, and other service buildings. Replace the regular pavement in strategically located parking lots with natural or cultivated grassland and create nature-based surface water drainage systems such as ponds, wetlands, and wet woodland to meet the future drainage needs. This water can also provide environmental and recreational value like for walking, hiking or just relaxing with a family and friends.

Suggested class activity

1. The teacher presents the problem to the class and introduces the scenario and game. The teacher has pre-designed a town that students need to fortify and re-design against flooding.
2. The students have to understand the problem and define possible solutions.
3. Teacher forms groups and gives students their roles in the game.
4. The students are encouraged to come up with as many ideas as possible through brainstorming. Techniques of design thinking may be used.
5. Team members evaluate ideas, combine them, and prioritize them towards designing the best possible solutions.
6. The students validate their ideas by playing the game according to the role assigned to each.
7. The students discuss game results, their experiences, and the knowledge they developed and the teacher provides feedback.

Assessment methods

This is a collaborative, open ended activity that aims to raise awareness among students on emerging risks related to flood protection as a result of climate change as well as effective urban water management. Students design their cities and enhance them in terms of smart design that allows water to flow through the city without flooding. Students present their solutions for a specific town and discuss alternatives in the classroom. This allows students to build on each other's ideas and to understand issues related to optimization of potential flood management approaches.

Supplementary materials

UN Water and cities: https://www.un.org/waterforlifedecade/water_cities.shtml

Sustainable Water: https://www.aquatechtrade.com/news/water-treatment/sustainable-water-essential-guide/

Cloudburst Management Plan: https://oppla.eu/casestudy/18017

Urban Green-Blue Grids: https://www.urbangreenbluegrids.com/measures/bioswales/