

Sustaining urban ecosystem services : The multiple benefits of urban green spaces

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Presentation outline

1. Climate change and urban areas : heat waves
2. Relevance of green infrastructure, role of urban commons in adaptation to Climate Change
3. Experimenting with urban commons

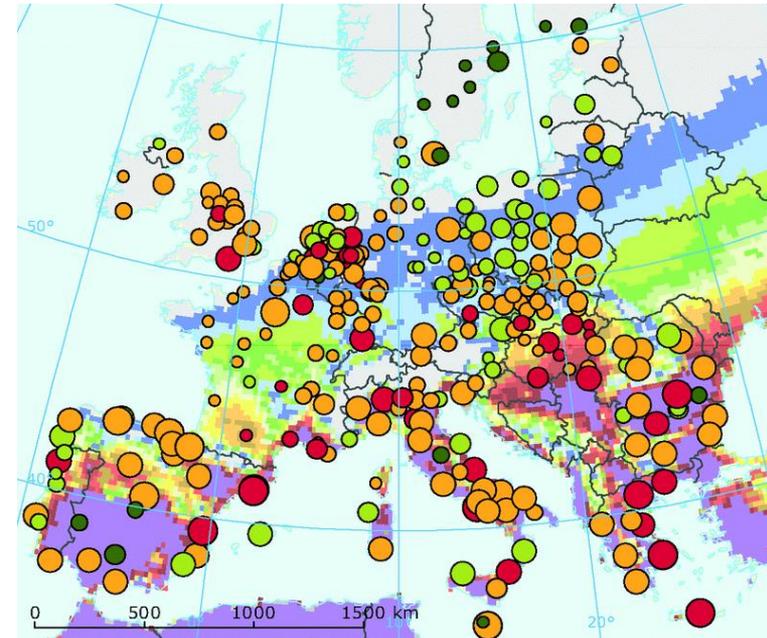
Climate change and vulnerability of cities

Urbanisation in Europe:

- today 72% , by 2020 80 % , 2100 90 % or more
- aging population,
- economic capital ↔ production of greenhouse gases,

Urbanization + CC + socio-economic trends → *risks for urban population:*

**UHI (urban heat island),
water scarcity,
floods,
droughts and heat waves
extreme weather events**



Heat waves — both a low share of green and blue urban areas and high population densities contribute potentially to the urban heat island in cities

Population density per city (UMZ), 2004 (inh./km²)

- < 3 000
- 3 000–4 000
- 4 000–5 000
- 5 000–10 000
- > 10 000

Green/blue areas per city (UMZ), 2006 (%)

- ≥ 40
- 30–39
- 20–29
- < 20

Number of combined tropical nights (> 20 °C) and hot day (> 35 °C), 2070–2100

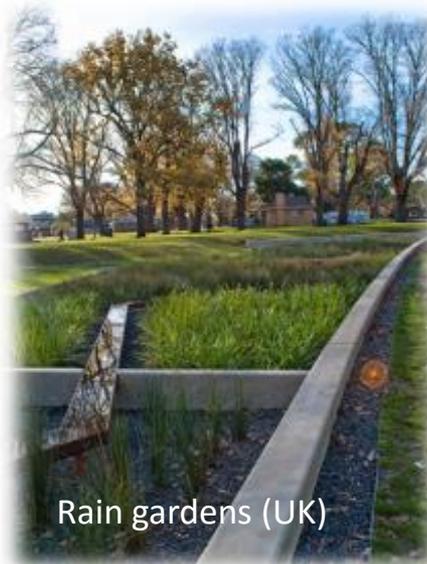


Relevance of green infrastructure in adaptation to CC

Fulfils the needs of a variety of stakeholder groups and policy aims (DG Environment, 2012):

- biodiversity conservation (ecological networks)
- **ecosystem services** - mitigation of climate change related impacts (and also many other benefits and goods)

Sustainable drainage
Systems
(Sweden)



Rain gardens (UK)



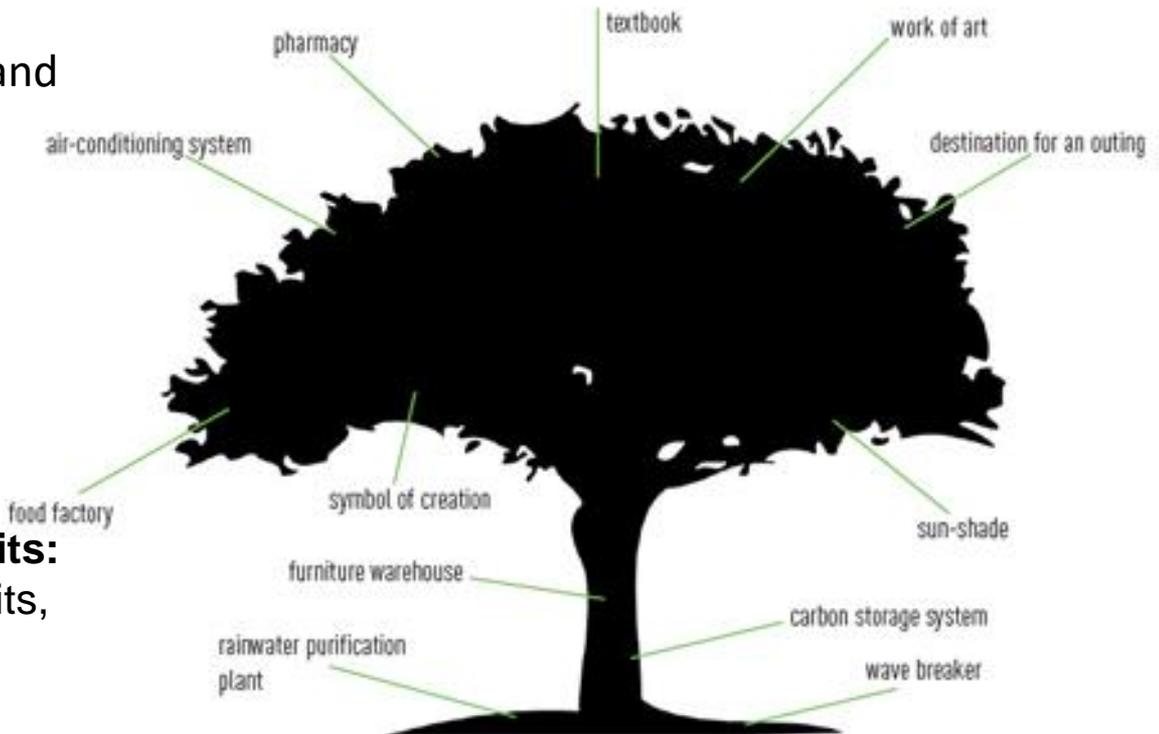
Green roofs and walls
(Japan, France)

Urban Green Infrastructure & Ecosystem service provision ***(Demuzere et al., 2014)***

Physical benefits:

- CO2 sequestration,
- flood protection,
- improved water abundance and quality,
- air quality and temperature regulation,
- food production
- reduced energy use,

The tree – a service station for human beings



Psychological and social benefits:

- Health and restorative benefits,
- Aesthetic appreciation
- Inspiration
- Education
- Recreation & leisure

What is green infrastructure:

- „Network of green spaces in which and through which natural functions and processes are sustained.“ (EC, 2013)
- In **urban** environment: „A hybrid infrastructure of green spaces (and blue spaces) and build systems.“ (Demuzzere et al., 2014)



Urban gardening (Slovakia),



Street trees



Court-yards (Slovakia)



Green Bike paths (Slovakia),



River revitalisation, Parks and ponds



Management effectiveness of urban green spaces – urban commons

- (new) Urban commons are **publicly shared resources** that have been reconceptualized as commons, mostly human-constructed, parts of urban environment (Hess 2008, Maco, Kluvánková, *in review*).

Court yards (Maco, 2015)



Parks and multipurpose public spaces (Kassa, 2008 , Poklembová, 2013)



Street trees (Steed, Fischer, 2011),



Community gardens (Maco, 2015)



Gated-communities (Herrod, 2011)

Motivation by heat waves

- A heat wave is generally defined as a period of several days to weeks of abnormally hot weather
- In the past 3-4 decades, there has been an increasing trend in high-humidity heat waves, which are characterized by the persistence of extremely high night-time temperature.
- The combination of high humidity and high night-time temperature can make for a deadly pairing, offering no relief and posing a particular threat for the elderly
- Extreme heat events are responsible for more deaths annually than hurricanes, lightning, tornadoes, floods, and earthquakes combined

Motivation by heat waves

- An urban heat island is a man-made area that's significantly warmer than the surrounding countryside — especially at night. The term stemmed from the analogy of an urban heat island as a 'warm island' in a 'cool sea' of the surrounding natural environment
- Heat islands exist because the land surface in towns and cities, which is made of materials like Tarmac and stone, absorbs and stores heat. That, coupled with concentrated energy use and less ventilation than in rural areas, creates a heating effect.

Behavioural experiments– role and agent based models - increased participation in decision making

- Policy formulation and implementation is shaped by the interaction between multiple actors (national, regional, local governments, non-governmental organizations, scientists, private companies, citizens, etc.)
- Demands for increased participation in policy-making - strengthens citizens' role in the governance of their society, building capacity, awareness and social cohesion among the public
- The game theory is a concept often used in economy and political sciences, while the format can largely limit or enhance the potential of these games (which can be designed as agent based models) in facilitating participatory processes (Hermans et al, 2012),
- Agent based models as a form of behavioural experiments help explain under which conditions agents (actors) are most likely to either cooperate or decide to follow their own strategies.

Behavioural experiments – role and agent based models (cont.)

- can be used as a participatory method for addressing the complex and uncertain societal problems,
- serve as an analytical tool for studying the strategic interactions among these actors (Walz et al. 2007, Reed et al., 2013).
- We attempt to use such a model in the form of a role board game to analyse and predict individual and group behaviour of different actors in controlled settings where we simulate a social dilemma related to the provision and consumption of ecosystem services.
- Based on the Janssen Cardenas and Bousquet's (2013) new generation of field experiments with the commons, we present our strategy to of using participatory games for:
 - i) supporting participation in addressing complex issues in urban and marginalised areas facing risks of climate change
 - ii) making a better understanding of the choices actors make under conditions of uncertainty.

Role Board Games

- Interactive agent based models (field experiment + role game)
- **Repeatability under the controlled conditions & time frame** to increase validity of experiments in real situation (Barretau, 2001, Janssen et al., 2010)
- **Learning aspect:** Experience gained in playing roles foreign to one's own interest may provide insights hard to obtain in any other manner" (Shubik, 1975)
- **Dynamic modelling:** Feedback loops – player feedback – adjusting the simulation model & game rules
- **Test the sensitivity** of the consequences of given set of collective rules for management of an ecosystem, with respect to individual behaviours" (Barreteau, 2001).



The „Green city“ role board game

general introduction

- The local residents are becoming increasingly threatened by heat waves during summers. Since in the city there is a lot of concrete and paved roads, dense streets and high population density, the negative impacts of heat waves are felt even more.
- The players make decision each round on whether to support more built up areas (for housing or amenitie) or more green areas (parks, trees, gardens, etc). By supporting construction of new green areas you enhance the capacity of the city to adapt to climate change. The ideal ratio is to have twice as much green areas as there are grey areas.

The „Green city“ role board game

- Designed on Cardenas, Janssen and Bousquet (2008) new generation of field experiments with the commons
- Communication and resource dynamics
- ***Developed further at VEEL at CE SPECTRA***
- **Player roles** / 5 players: 2 politicians, developer, 2 citizens
- **Social dilemma:** grey/ green infrastructure - private, public or commercial investment
- **Resource degradation:** the fewer green spaces, the greater the urban heat island (achieve minimum of green to grey ratio - 2:1)
- **Game treatments:** non-cooperative, cooperative with communication (crafting own rules), each for 10 rounds



The „Green city“ role board game – exchange channels

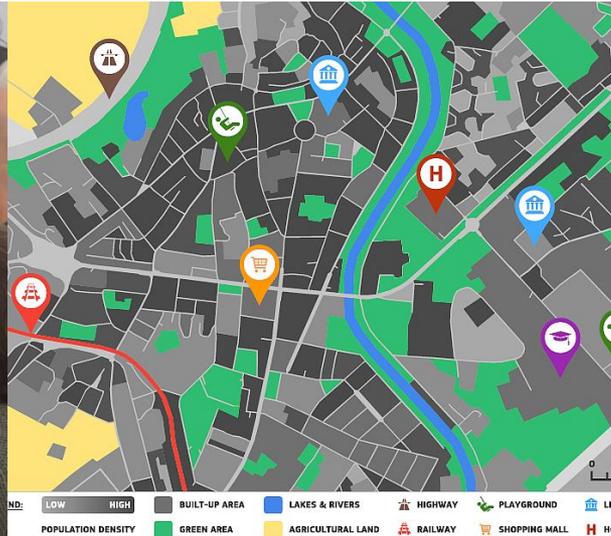
- As players make these decisions by investing their initial endowments into different exchanges : **public exchange or commercial** and the endowment they decide not to invest remains in **private exchange.**
- The endowment varies from role to role as well as the pay offs. The initial endowment is restored before the beginning of each round

The „Green city“ role board game – treatments

- The game has 2 treatments: 2x 10 rounds,
- The first treatment no communication is allowed,
- the second treatment communication is allowed
- On the board there are 100 blank areas, which can be converted either to green or on to grey areas.
- after each round is calculated : player payoff, and green and grey (commercial or housing) areas has been build

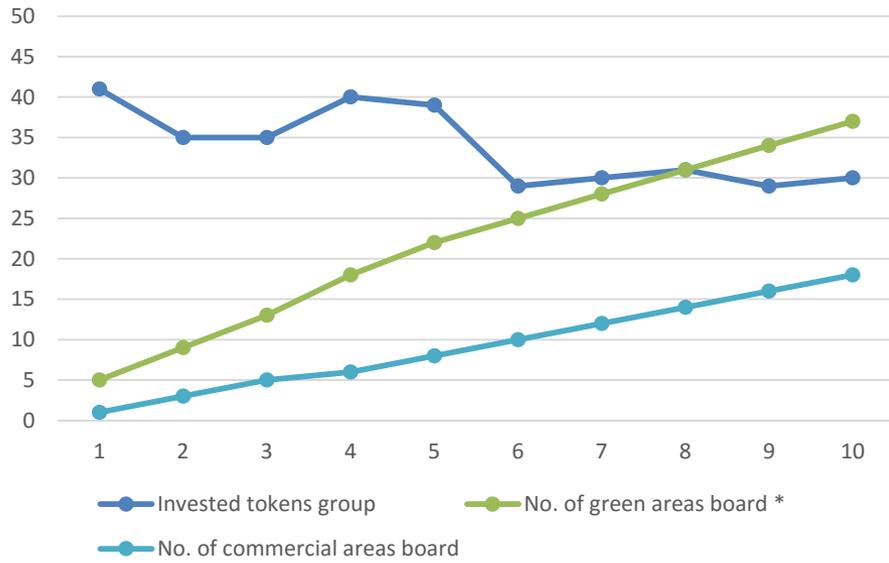
The „Green city“ role board game

- Further steps:
- Stakeholder involvement & follow up survey
- Player (stakeholder) feedback - whether the model's assumptions match the stakeholders' own representation of the system dynamics and provide stakeholders with a large enough range of possible actions/competencies

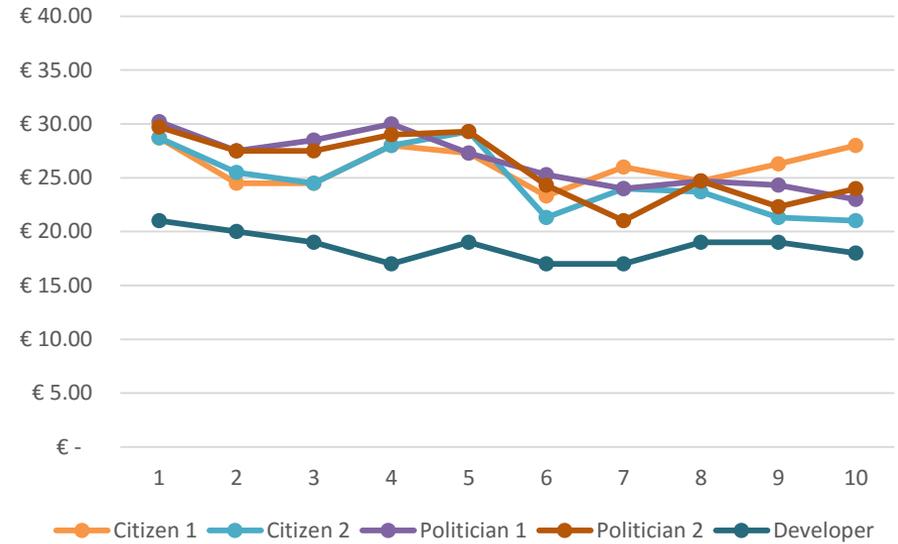


Examples of preliminary results

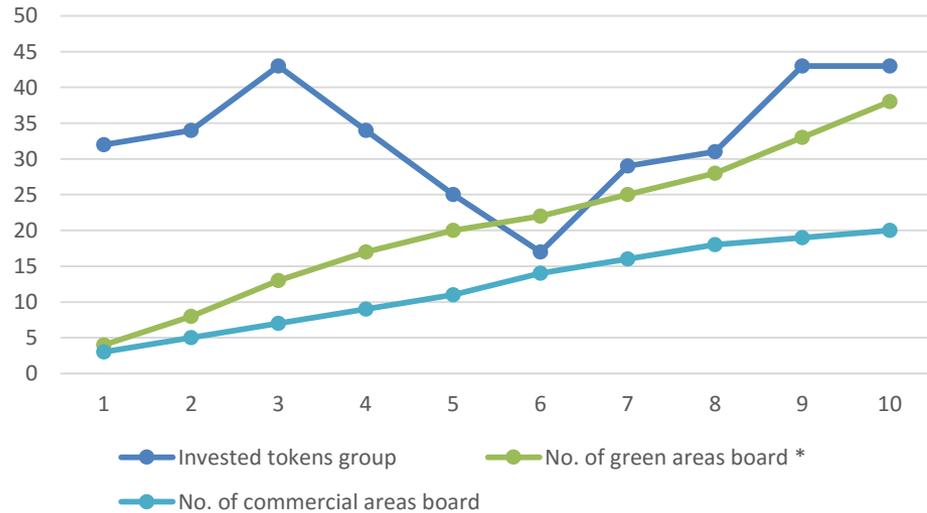
Treatment 1: without communication



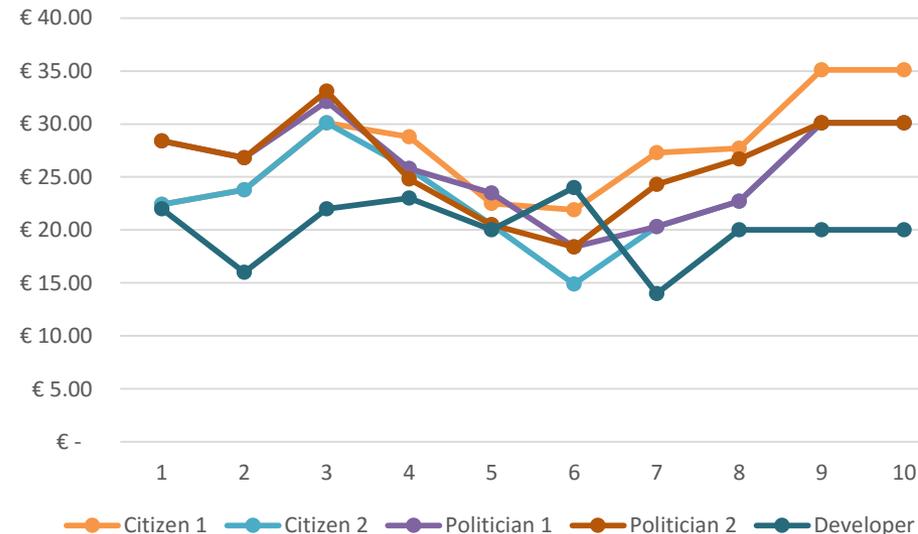
Treatment 1: without communication



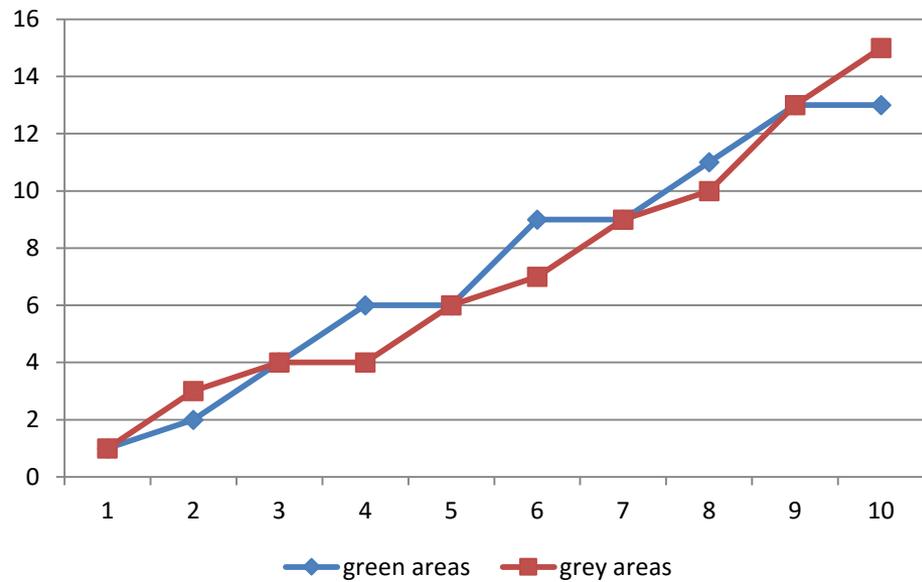
Treatment 2: with communication



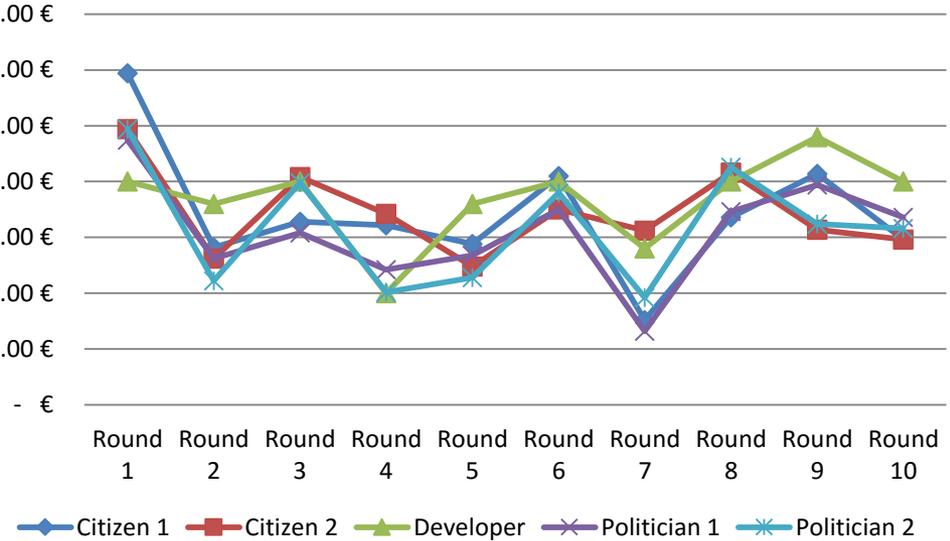
Treatment 2: with communication



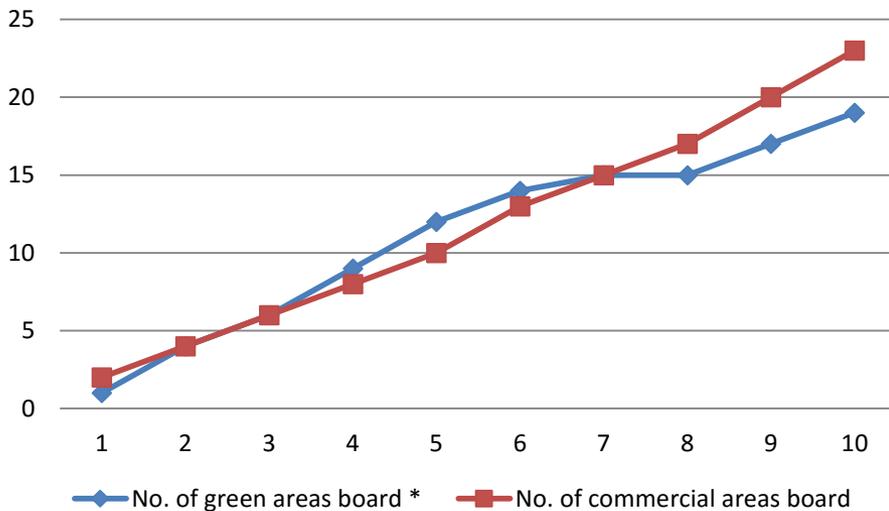
Students 2yr Msc, 5 rounds without a 5 rounds with com.



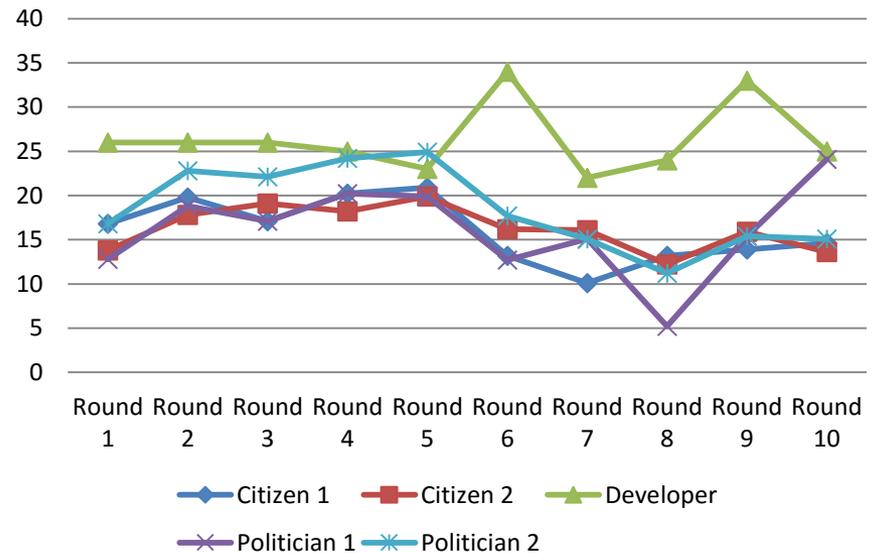
Individual payoffs per round (students 2yr Msc)



Students 1yr Msc, 5 rounds without a 5 rounds with com.



Individual payoffs per round (students 1yr Msc)



Conclusions

- To study how communication between stakeholders helps developing better green infrastructure in cities that decreasing influence of heat waves on our city life
- What can be impediments in communication between roles

Thank you for your attention