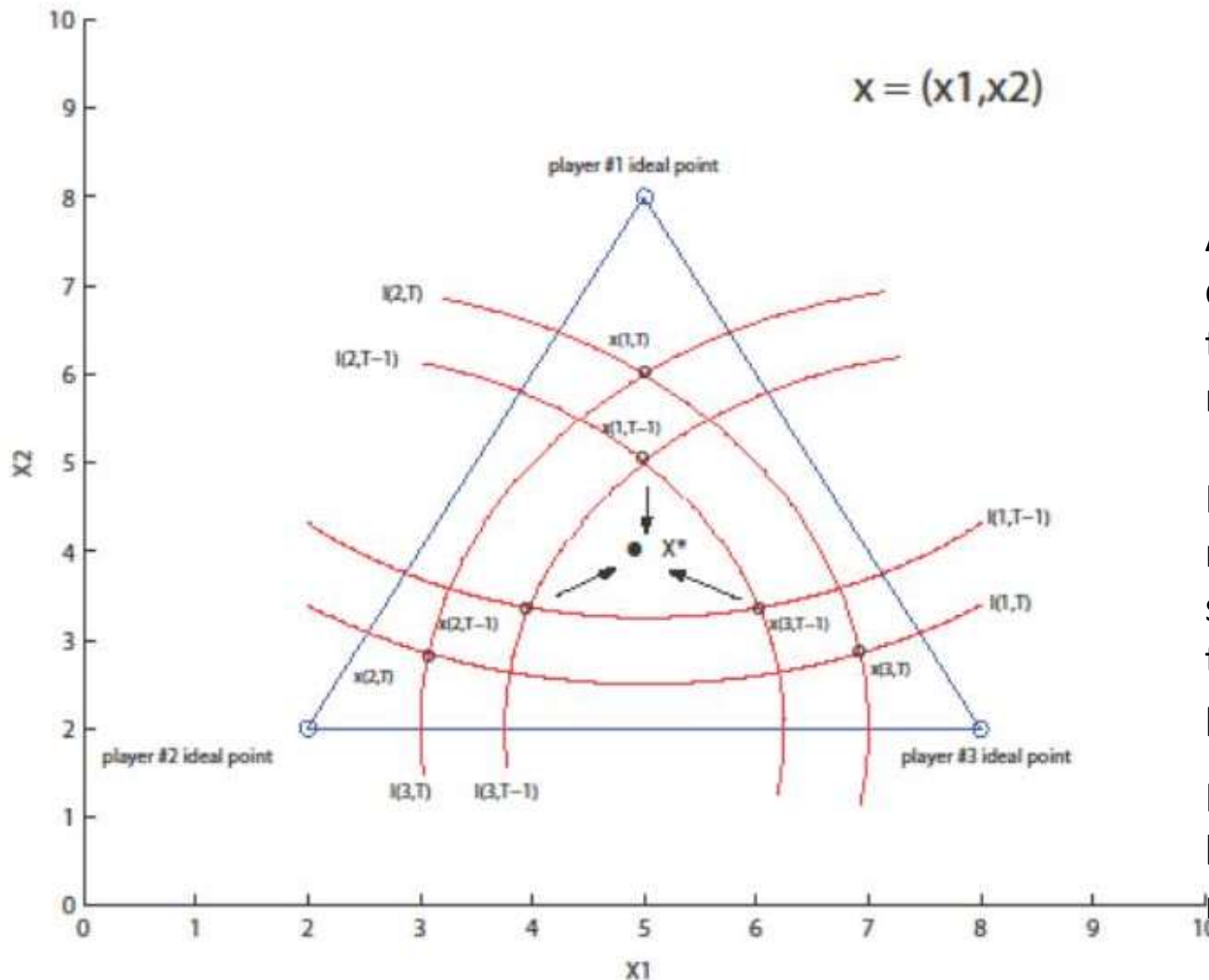


# **Consensus building in coupled human-water systems under uncertainty**

Saket Pande

# A consensus based water policy negotiation



All stakeholders (players) can equally exert influence the outcome of the negotiation process

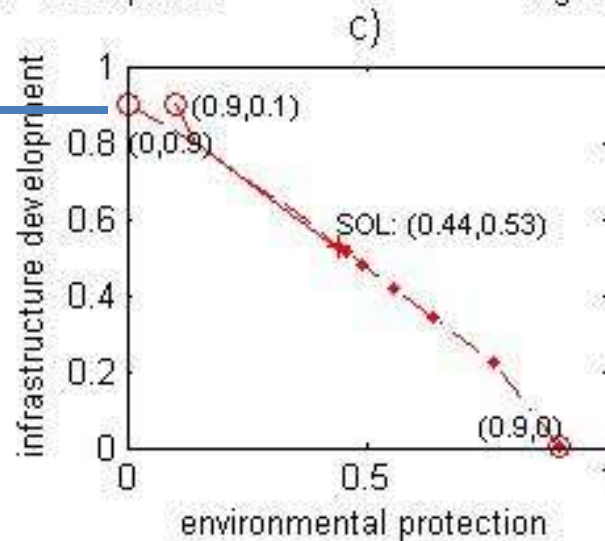
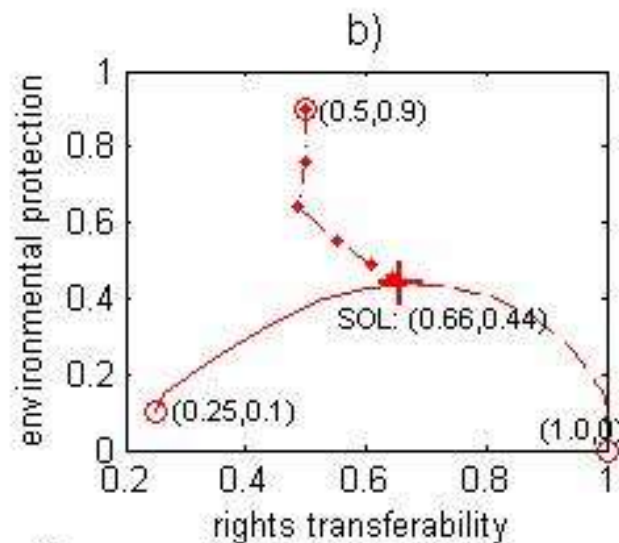
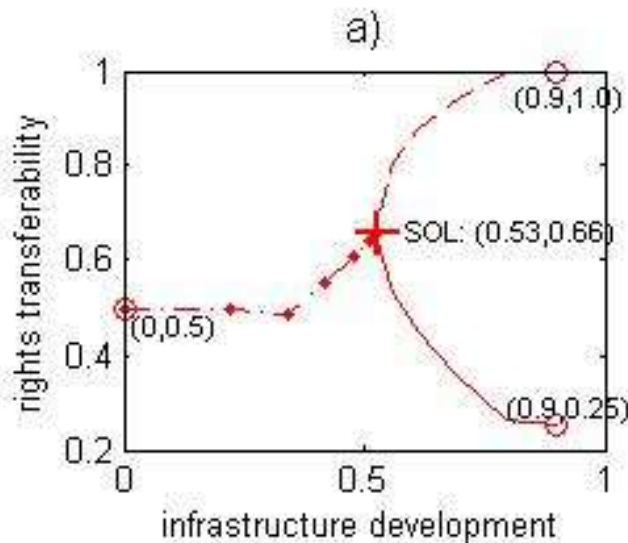
Each stakeholder must respect the desires of other stakeholders, with regards to policy  $x_1$  and  $x_2$ , in the process

Here  $I(j, T)$  represents the least that player  $i$  expect in round  $T$ .

# Toy example

- 3 stakeholders
  - farmer group, urban group and environmentalists group
- 3 policy variables
  - infrastructure development, water rights transferability, environmental protection
- Farmer and urban group have similar preference for infrastructure development and environmental protection
- Stakeholders attempt to build a consensus on water policy under uncertainty in water rights.

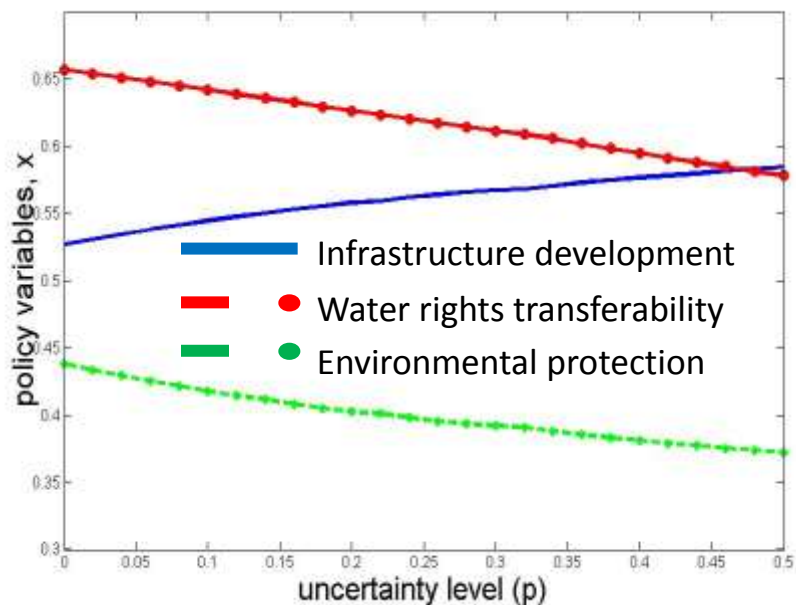
# Evolution of the negotiations



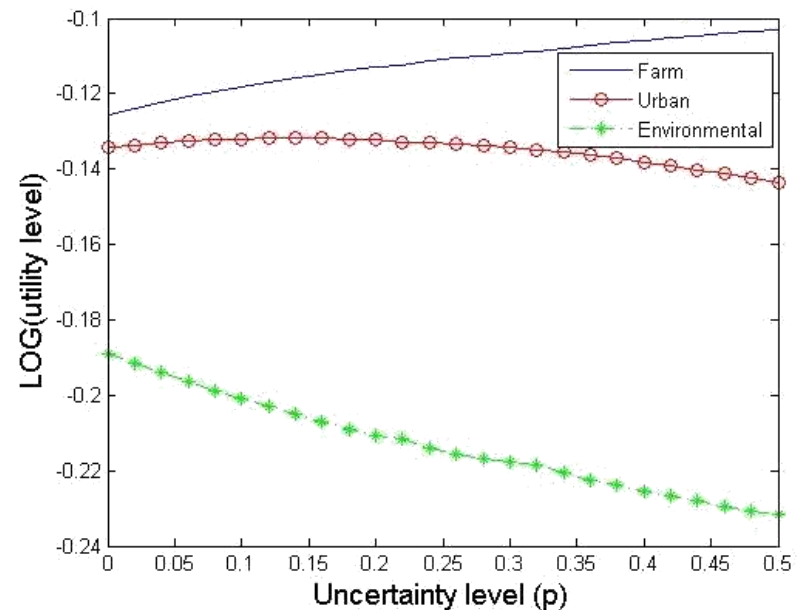
Farmer and urban groups are aligned on infrastructure development and environment protection: both desire more of infrastructure and less of environment protection

- Farmer group
- - Urban group
- • Environmentalists group
- Desired policy for each group

# With increasing uncertainty in water rights transferability:



Why is there more of infrastructure development & less of environmental protection, especially when there is uncertainty in water rights transferability?

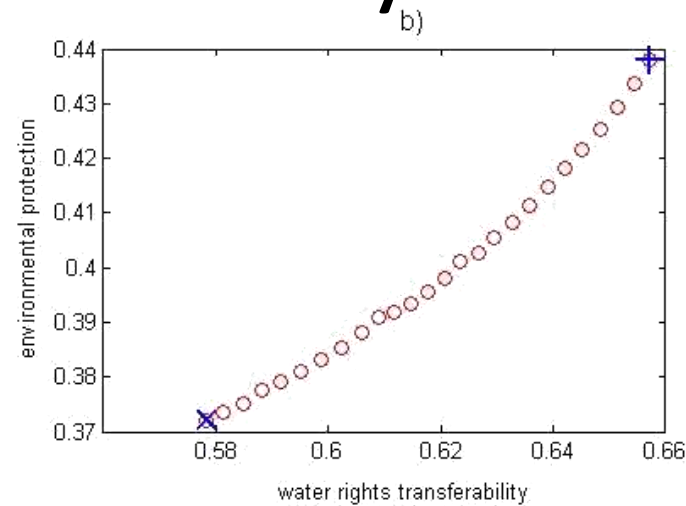
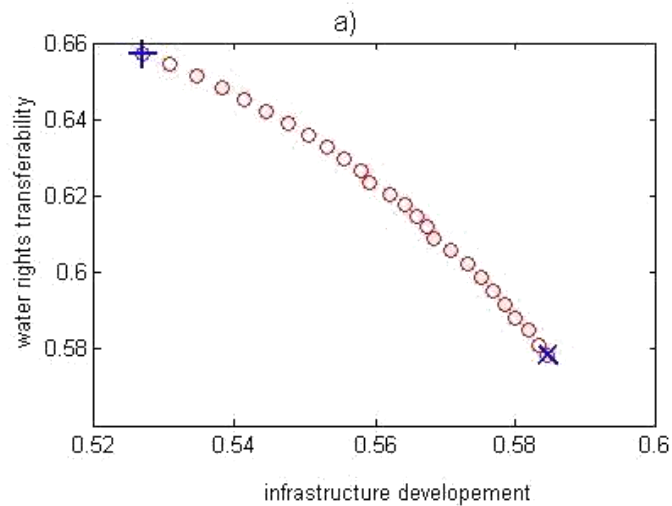


Why farmers gain the most and environmentalist loose the most?

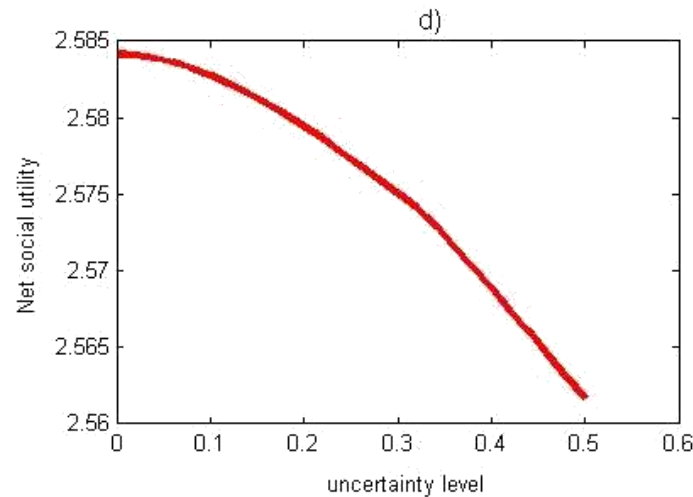
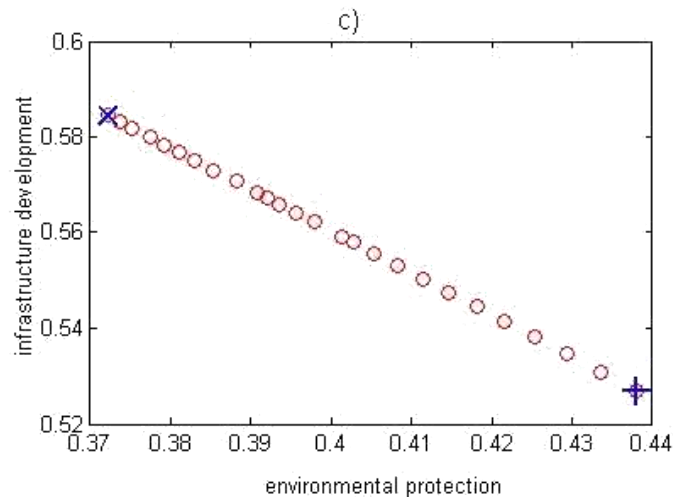
# A tale of aligned interests and hidden power

- Farmers and urbanites are more aligned on policy not affected by uncertainty, i.e.
  - they both want more of infrastructure development and less of environmental protection
- Environmentalists suffer the most from uncertainty in water rights transferability because they do not agree with farmers and urbanites on the other issues
- Farmers and urbanites, though not intentionally, strategize against the environmentalists under uncertainty because they think more alike than the environmentalists

# Co-evolution of policy variables and decline of social welfare under uncertainty



+ No uncertainty  
x high uncertainty



# Possible role of government

- Support the environmentalists if urbanites, farmers and other stakeholders think more alike.
  - Thinking alike implies implicit bargaining power over other stakeholders
- Invest in reducing uncertainty
  - Better institutions, for eg resulting in lower uncertainty in water rights transferability
  - Better monitoring
- Improve understanding of coupled human-water systems



# Panta Rhei – A new IAHS scientific decade 2013-2022



Understanding, predicting and  
managing water - society interactions