



River basin game

Introduction

Maarten Krol / Arjen Hoekstra

University of Twente, the Netherlands





The setting

- 9-15 farmers per river basin, competing for water
- groundwater is the limiting factor in crop growing
- three compartments: upstream, midstream, downstream
- we play 4 rounds (years); 10 minutes per round



The aim

Make money with farming!

cost: pumping water

gross benefit: market price for crops produced

net benefit = gross benefit – cost



Benefits of water abstraction

Gross benefit = Units of water abstracted x Benefit per unit

Benefit achieved per unit of water 50 euro / unit



Costs of water abstraction

Total cost = Number of water units x Average unit cost

Average cost per unit of water

- increases as you and other members of your group consume more water, due to dropping groundwater levels

- base cost of **first water unit**

1 euro in first round

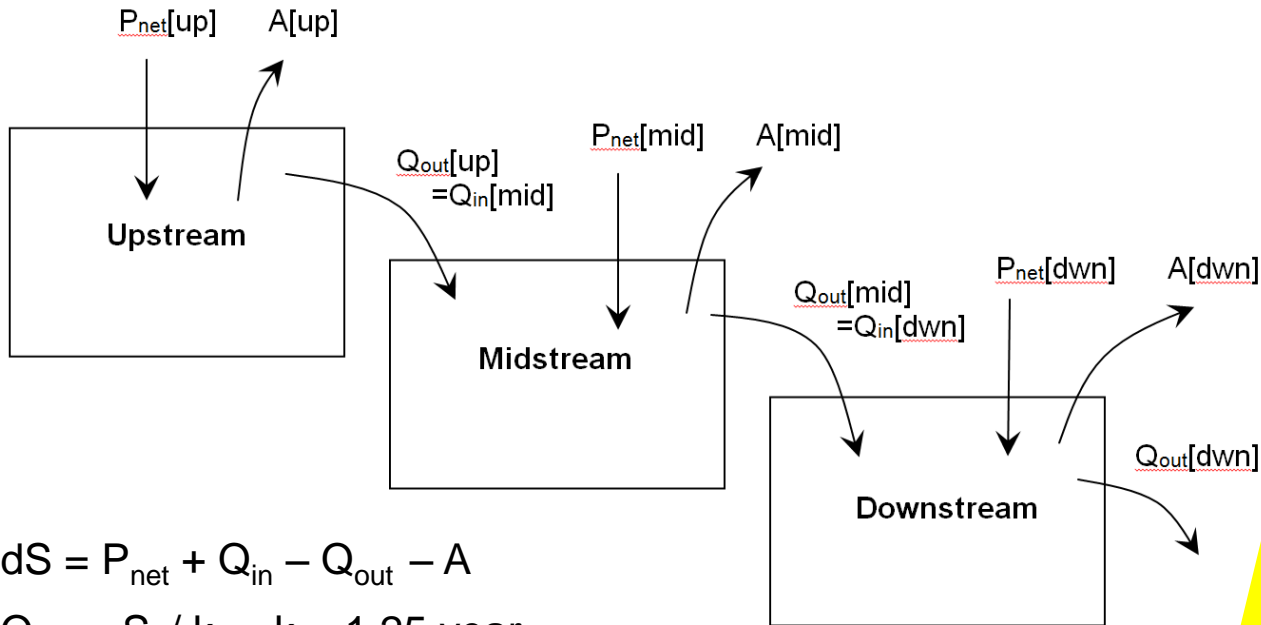
1 + n euro in later rounds, whereby

n = depletion of groundwater storage from previous rounds

- each **additional water unit** increases unit cost with **1 additional euro**



Hydrology of the river basin



$$dS = P_{net} + Q_{in} - Q_{out} - A$$

$$Q_{out} = S_i / k, \quad k = 1.25 \text{ year}$$

*this is constant
the rest is not*

Variables in the game with their value for year 1:

	Symbol	Unit	Values for year 1		
			Upstream	Midstream	Downstream
Initial water storage	S_i	water units	50	75	100
Outflow	Q_{out}	water units / year	40	60	60
Net precipitation	P_{net}	water units / year	40	20	20
Inflow from upstream	Q_{in}	water units / year	-	40	60
Water abstraction	A	water units / year	?	?	?



Procedure per round

Choose your water abstraction

- groups may discuss / negotiate
- you decide individually

Fill in on Individual record sheet

Decision sheet

Bring Decision sheet to Game leader

At end of round: Game leader returns

average unit cost (per compartment)

cost first unit next round (per compartment)

net benefit (river basin)

Complete your individual record sheet

Game starts now !

Individual record sheet

Your name: _____
 Name of your river basin: _____
 Your location: _____
 Your farmer number: _____

upstream / midstream / downstream
 1 / 2 / 3 / 4 / 5

Round 1				
No. of units abstracted	Gross benefit	Cost of the first unit	Average unit cost	Total cost
		1		
				Net benefit

Round 2				
No. of units abstracted	Gross benefit	Cost of the first unit	Average unit cost	Total cost
				Net benefit

Round 3				
No. of units abstracted	Gross benefit	Cost of the first unit	Average unit cost	Total cost
				Net benefit

Round 4				
No. of units abstracted	Gross benefit	Cost of the first unit	Average unit cost	Total cost
				Net benefit

Round 5				
No. of units abstracted	Gross benefit	Cost of the first unit	Average unit cost	Total cost
				Net benefit

DECISION SHEET
 round 1

Your river basin: _____
 Your location: _____
 Your farmer no.: _____

upstream / midstream / downstream
 1 / 2 / 3 / 4 / 5

Your abstraction in this round: _____ water units

No. of units abstracted	Gross benefit	Cost of the first unit	Average unit cost	Total cost	Net benefit