Upscaling scenarios using Fuzzy Cognitive Maps

Pre-conference day

SCENES water scenarios – final results

Budapest, 23 March 2011

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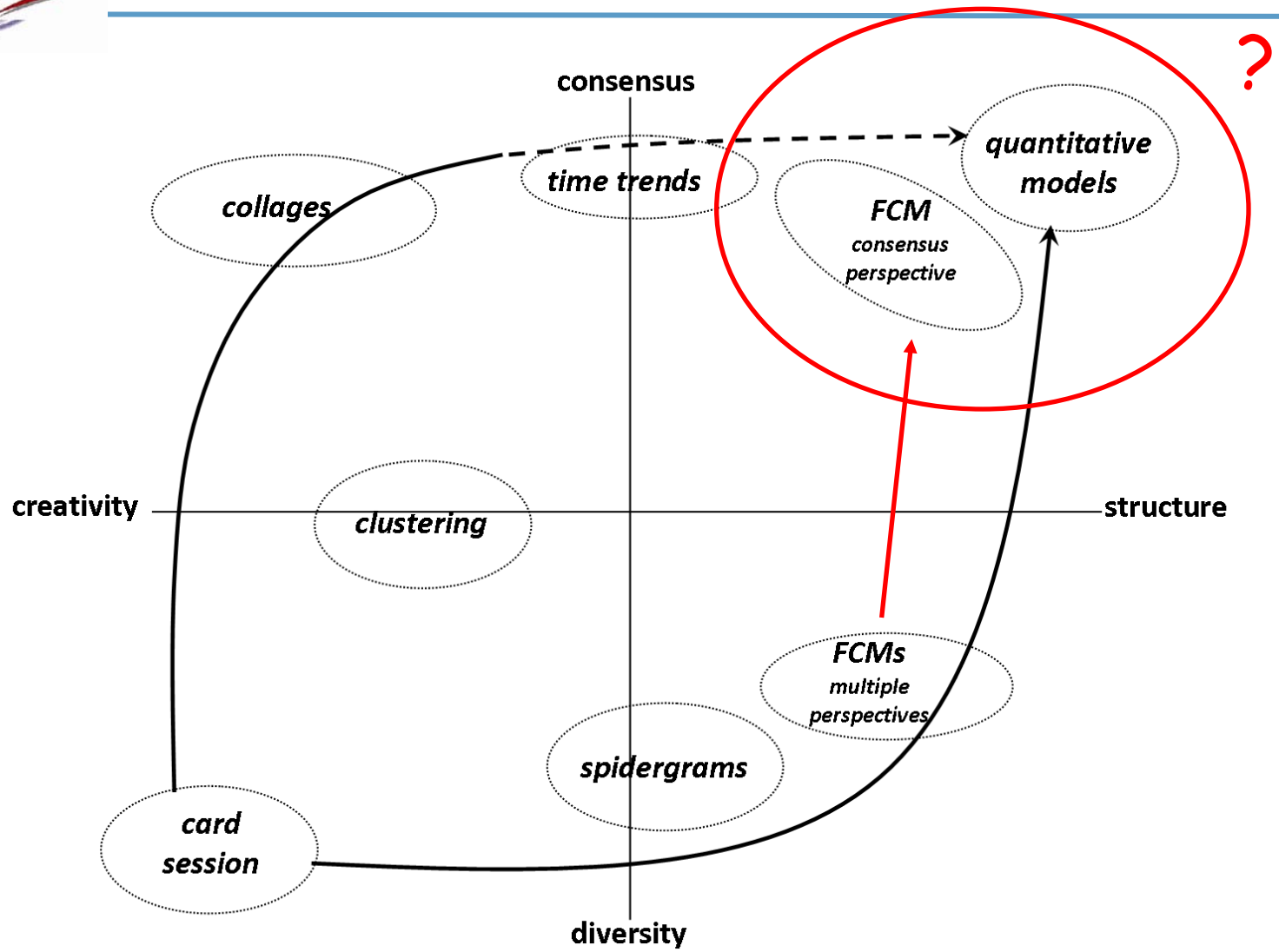
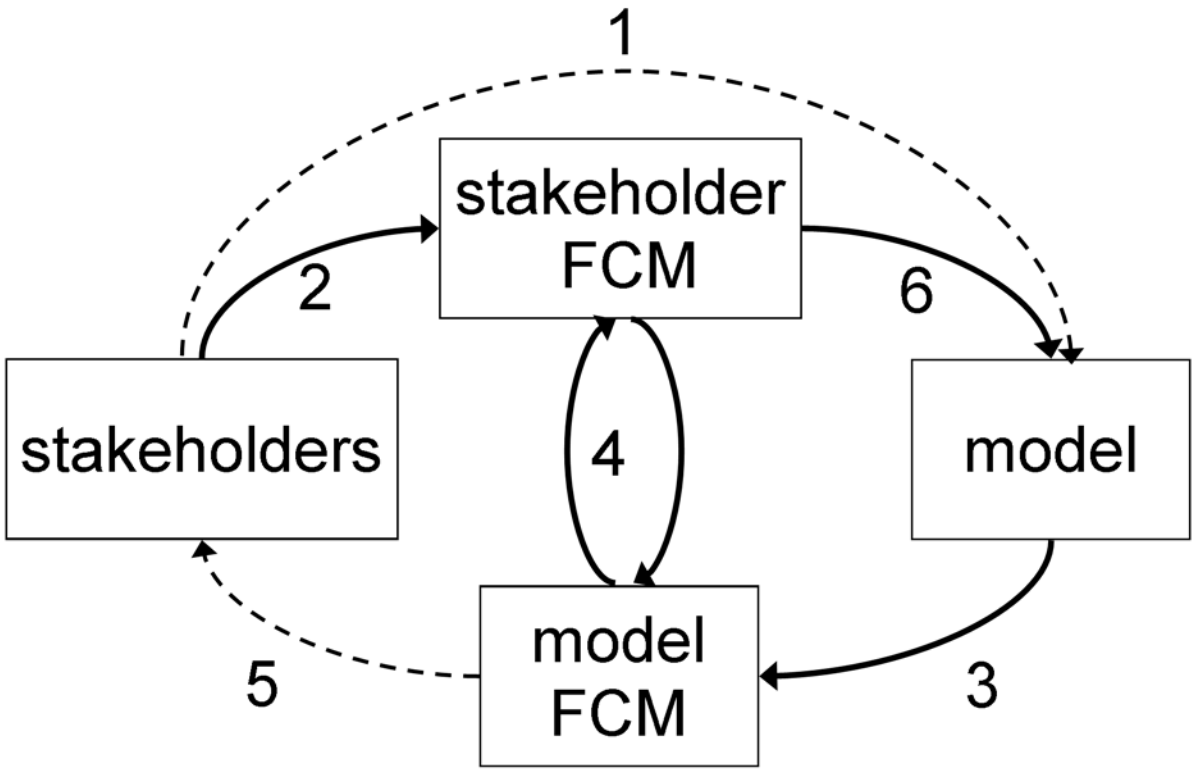
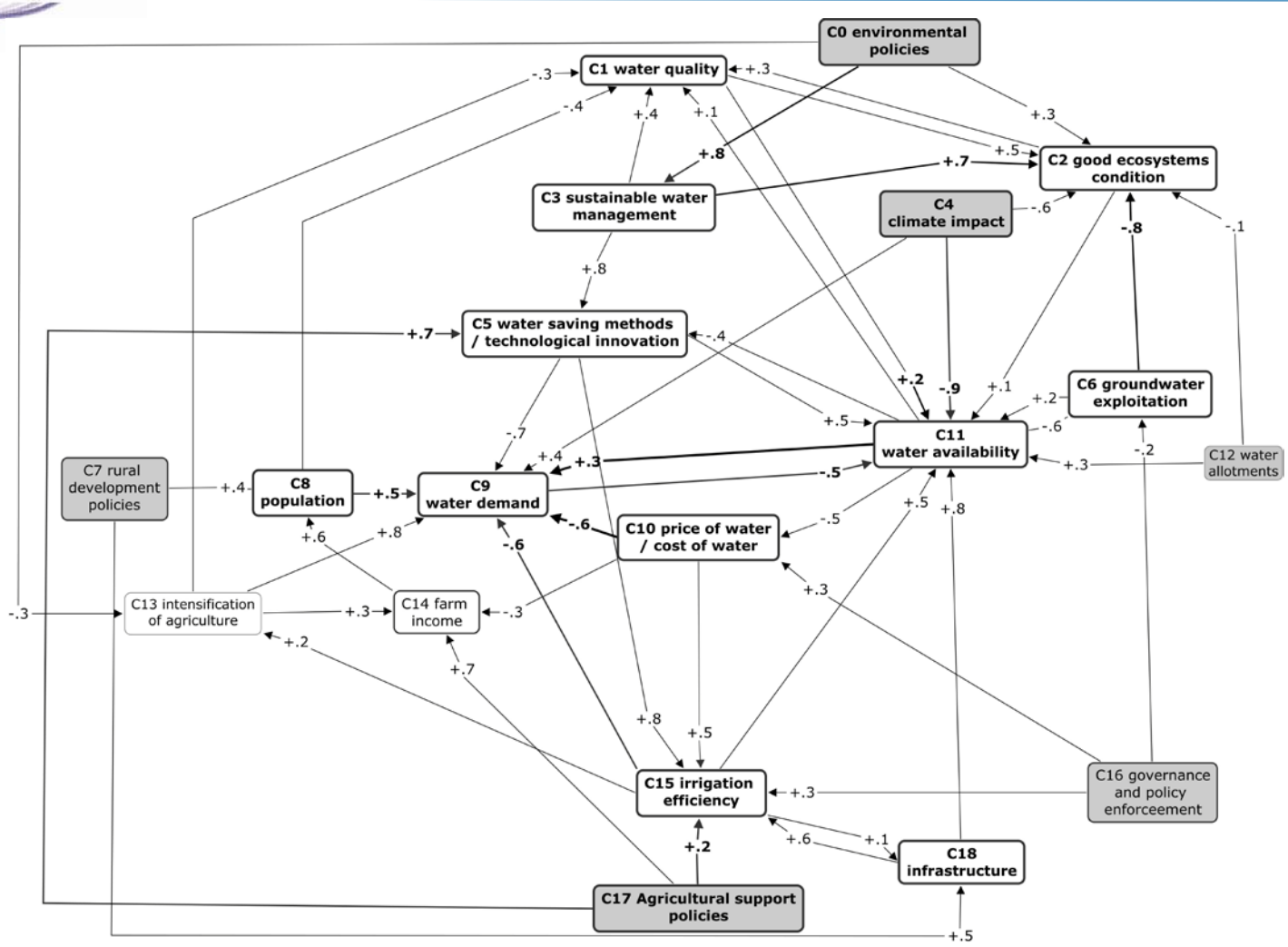
Conceptual idea



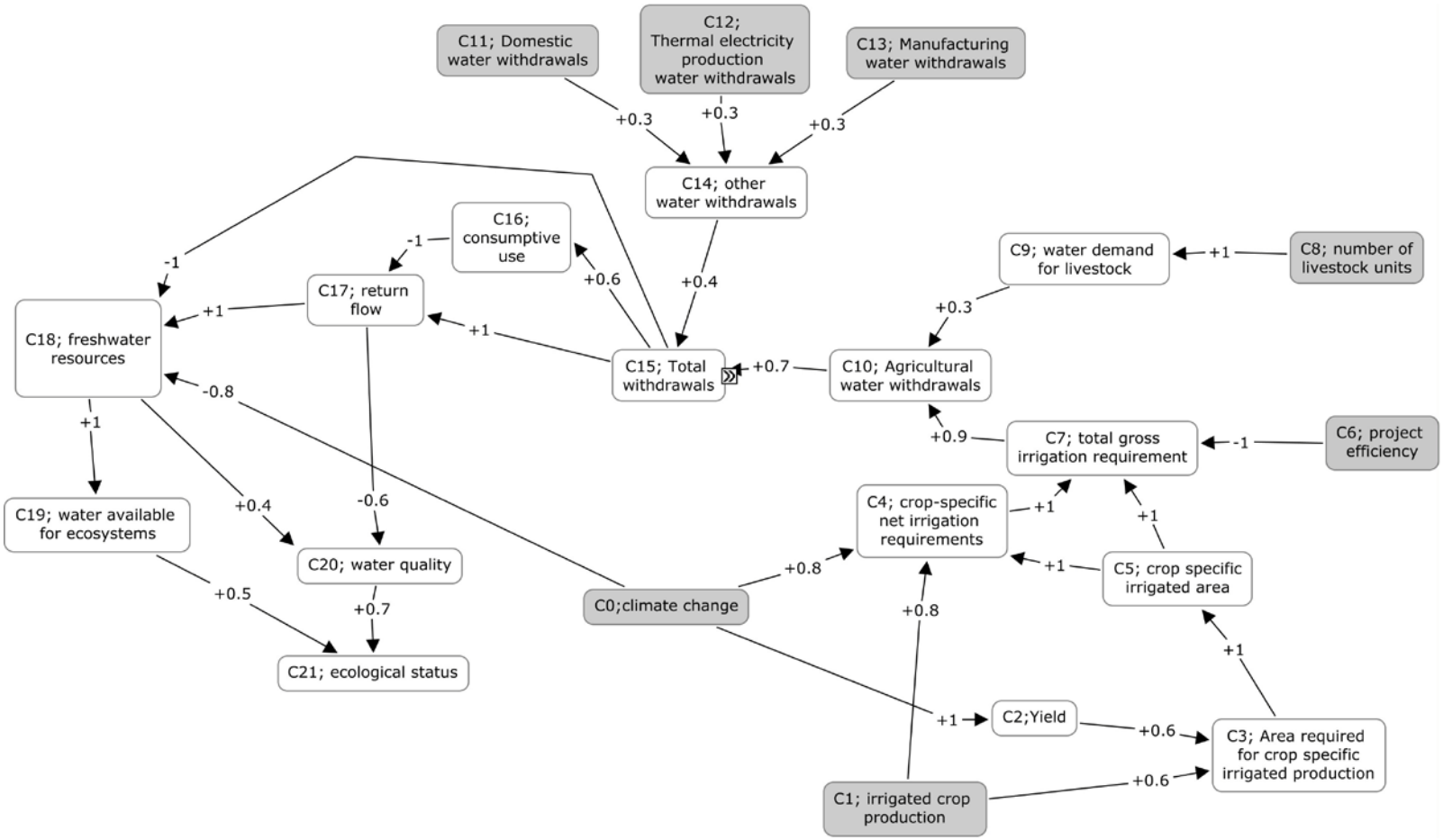
Conceptual idea



SH - Fuzzy Cognitive Map



WaterGAP - Fuzzy Cognitive Map



Comparison of graphs

	stakeholder based FCM	WaterGAP based FCM
variables present in both FCMs	- water quality - irrigation efficiency - water availability - ecosystems condition - climate impact - water demand - population - intensification of agriculture	- water quality - project efficiency - fresh water resources - ecological status - climate change - total withdrawals - domestic water withdrawals - crop specific irrigated area
variables present in only one FCM	- environmental policies - agricultural support policies - governance and policy enforcement - rural development policies - ground water exploitation - water price / cost of water - sustainable water management - effectiveness of control - water saving methods - water allotments - farm income	- number of livestock - water demand for livestock - agricultural water withdrawals - other water withdrawals - irrigated crop production - area required for crop specific irrigated production - crop specific net irrigation requirement - total gross irrigation requirement - manufacturing water withdrawals - thermal electricity production water withdrawals - return flow - consumptive use - water available for ecosystems - yield
number of variables	19	22
number of connections	49	29
Density (C/V^2)	0.14	0.06
average value per connection	*0.46*	*0.74*
# pure transmitters	6	7
# pure receivers	0	1 (ecological status)
highest centrality (#connections and absolute value of connections)	water availability *14 connections (abs value 5.9)*	fresh water resources *5 connections (abs value 4.2)*
average centrality (out + ingoing connections)	*5.16 connections (abs value 2.37)*	*2.64 connections (abs value 1.96)*
most receiving connections (# of connections)	water availability *(9 connections)* Water demand *(7 connections)*	crop specific net irrigation requirements, total gross irrigation requirement, other water withdrawals, fresh water resources *(all 3 connections)*
most transmitting connections	water availability *(5 connections)*	climate change, total water withdrawals *(both 3 connections)*

- 8 factors in both
- > 10 in only one
- no. variables equal
- SH-FCM more dense
- SH-FCM higher centrality
- etc.

From visual

- WaterGAP FCM no feedbacks
- SH-FCM more complex

Comparison of dynamic output

	average of Pilot Area data			average of country data		
	WG [1]	FCM-SH [2]	FCM-WG [2]	WG [1]	FCM-SH [2]	FCM-WG [2]
crop specific irrigated area / intensification of agriculture	-52%	-52%	-52%	-31%	-31%	-31%
project efficiency / irrigation efficiency	12%	12%	12%	12%	12%	12%
water demand for livestock	-9%		-9%	-8%		-8%
domestic water withdrawals / population	-33%	-1% [3]	-33%	-36%	0% [3]	-36%
thermal electricity production water withdrawals	-8%		-8%	-28%		-28%
manufacturing water withdrawals	-12%		-12%	-24%		-24%
other water withdrawals	-21%		-18%	-29%		-29%
total water withdrawals / water demand	**-45%**	**-35%**	**-38%**	**-32%**	**-36%**	**-27%**
freshwater resources		14%	25%		14%	17%
water quality		9%	30%		8%	21%
ecological status		8%	27%		8%	19%

- Numbers are highly comparable
- WG-FCM can handle information that the WaterGAP model cannot
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Conclusions

1. Fuzzy Cognitive Mapping has a high potential as a tool for **upscaling**
   - Technically easy to combine graphs
   - Straightforward to compare dynamic output
2. Fuzzy Cognitive Mapping has potential to **link stories and models**
   - Products are in the same 'language'
   - Dynamic output can be compared directly to model output
   - Graphs can highlight differences in perception

And thus:

3. Fuzzy Cognitive Maps can play an important role in developing cross-scale scenarios using the Story-And-Simulation approach

But:

4. More research is needed to translate 'comparing outputs' to 'dynamically linking Fuzzy Cognitive Maps and/or models'

Questions?