GOCE 036822

SCENES
Water Scenarios for Europe and for Neighbouring States

Instrument: Integrated Project
Thematic priority: Global change and ecosystems

Deliverable 2.5 Analysis of first drafts of Conceptual Models and narrative storylines over all Pilot Areas

Due date of deliverable: 31.10.2008
Actual submission date: 27.10.2008

Start date of project: 1.11.2006 Duration: 48 months

Wageningen University

Final version

Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)		
Dissemination Level		
PU	Public	x
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Disclaimer

The information in this document is provided as is and no guarantee or warranty is given that the information is fit for any particular purpose. The user thereof uses the information at its sole risk and liability.

Legal Notice

Neither the European Commission nor any person acting on the behalf of the Commission is responsible for the use, which might be made of the following information.

SCENES
Water Scenarios for Europe and for Neighbouring States
-
Deliverable 2.5
(WorkPackage 2, scenarios)

Analysis of first drafts of Conceptual Models and narrative storylines over all Pilot Areas

Mathijs van Vliet[1]
-
With contributions from all Pilot Area organisers

[1] Department of Environmental Sciences, Wageningen University, Wageningen, the Netherlands

Vliet, M. van, 2008. Analysis of first drafts of Conceptual Models and narrative storylines over all Pilot Areas, SCENES Deliverable 2.5, Wageningen University, Wageningen

Introduction

This report contains the meta-analysis of the results from the first round of workshops held in the SCENES Pilot Areas. It does not contain all the results from the Pilot Areas, nor an analysis of the individual workshops; these can be found in Deliverable IA2.2 (Kämäri, 2008). The aim of this deliverable is to seek for similarities and differences between the Pilot Areas and draw first conclusions about the used methodology.
A first draft has been sent to the Pilot Areas for review, six Pilot Areas have responded which led to some small changes that have been incorporated in this report.

The set-up of this deliverable follows the set-up of the first round of workshops as it was described in Deliverable 2.1 (Vliet *et al.*, 2007). It starts with an overall comparison of the different workshops to see which methods have been used in which workshop. Then we take a look at the clusters created during the card-session, after which the results from the spidergrams are studied. In chapter 4 the Fuzzy Cognitive Maps are described and in chapter 5 we move to the future visions. In the last chapter some overall conclusions are drawn.

Figure 1.1; Stakeholders in Crimea workshop

1. Overview of workshops

Most Pilot Areas held their workshops between March and April 2008. The Candelaro was early (end of February). The Garonne workshop was late because of elections, and only an introduction workshop has been held. The Baltic regional panel[1] workshop was also late, because first the two Baltic Pilot Areas had to analyse their results. Therefore no concrete results of both the Garonne and Baltic regional workshop have been included in this report. The Turkish workshop has not taken place yet, as a new Pilot Area had to be chosen after comments from the EC. An overview of the used methods is given in table 1.1.

Table 1.1; Overview of methods used in the first round of workshops

Pilot Area	**date WS1**	**FCM**	**spidergrams**	**collages**	**storylines**	**scenarios used**			
						MF	SeF	SuF	PF
Baltic region	10/11-06	yes	yes	no [1)]	yes	x	x	x	x
Narew	21/22-04	yes	yes	yes	yes			x	
Peipsi	3/4-04	yes	yes	no [1)]	yes	x		x	x
Danube Delta	17/18-04	yes	yes	no	yes	x	x	x	x
Tisza	3/4-04	yes	yes	yes [2)]	yes	x	x	x	x
Crimea	26/28-03	yes	yes	yes	yes	x	x	x	x
Lower Don	11-04	yes	yes	yes	yes	x	x		x
Candelaro	21/22-02	yes	yes	yes	yes		x		x
Guadiana	6-05	yes	yes	no [2)]	yes	x		x	x
Seyhan	10-10	yes	yes	no	yes	*free scenarios[3)]*			
Garonne	05-6	*introduction workshop; different program*							

[1)] used timetrends
[2)] used FCMs
[3)]Scenarios in Seyhan were not connected to the fast-track scenarios
MF = Markets First, SeF = Security First, SuF = Sustainability First, PF = Policy First

In most Pilot Areas the methodology that was proposed in Deliverable 2.1 (Vliet *et al.*, 2007) was executed in a two-day workshop. Fuzzy Cognitive Maps were developed in every Pilot Area. At least two visions were developed everywhere, but in the Narew four visions were created on the basis of only one fast track scenario. Five Pilot Areas used collages to create the visions, other Pilot Areas developed time trends, Fuzzy Cognitive Maps and/or storylines. Some organisers felt the need to change the set-up to a limited extent in order to fit better to the local culture / customs or previous work.

For most of the following analysis data has been used of those workshops of which translated data was available in the beginning of June. More detailed information on the results of individual Pilot Areas can be found in Deliverable IA2.2 (Kämäri, 2008).

[1] Although the Baltic regional panel is not (as the name already suggest) a Pilot Area in this Deliverable it will be referred to as a Pilot Area to make the text more readable.

2. Creation of clusters

In all workshops one of the first sessions (after introductions etc.) was to map the current main issues in the Pilot Area. The result of this exercise was a number of clusters of main issues. The creation of the clusters was either done in a plenary session, or in the small groups. For instance in the Guadiana and the Candelaro this lead to a high overall number of clusters, although there is quite some overlap in the clusters defined by the different small groups in the workshops. An overview of all the clusters created in each Pilot Area can be found in Appendix 1.

Figure 2.1 Creation of clusters in the Candelaro

2.1. Comparison of cluster

In order to make a comparison between the different Pilot Areas we assigned each cluster to an overarching category. Nine categories have been used, see table 2.1:

Table 2.1; Categories used in the comparison of clusters

categories	
Water quality	includes f.i. pollution and sewage systems
Water quantity	includes aspects like flood protection, water demand, re-use of waste water
Management	includes infrastructure and planning aspects
Government	includes legislation, policies and governance aspects
Non-water sectors	sectors with a large influence on water, e.g. agriculture, tourism and industry
Social aspects	includes f.i. environmental education and training and awareness
Environmental aspects	includes f.i. role of forests and environmental degradation
Economical aspects	aspects that have a strong relation with economy
Other	all aspects that did not fit into the categories above, or that were hard to link to one specific category, such as: Alteration of the territory and globalisation and, due to it's specific nature climate change.

For a lot of clusters it was quite clear to which category they belonged, for others it was more difficult to link them to one category. Some clusters have therefore been placed in more than one category (indicated by a * in appendix 1).

There is a wide spread in the number of clusters that have been developed in the Pilot Areas (see also table 2.2). In the Guadiana 39 clusters were formed. This happened in

two separate groups, so there is overlap. Also the Candelaro and Danube delta identified a relative high number of clusters. In the Candelaro there were three groups that all separately identified clusters, here is overlap as well. In the Danube Delta some clusters were pre-defined and new ones were added during the workshop.

Table 2.2; Percentages of cluster under each category by Pilot Area

Pilot Area	water quality	water quantity	management	government	non-water sectors	social aspects	environmental aspects	economical aspects	other	n[1)]
Peipsi	13.3	6.7	6.7	20.0	20.0	13.3	6.7	6.7	6.7	15
Narew	18.8	18.8	18.8	12.5	12.5	0.0	12.5	0.0	6.3	16
Candelaro	4.2	25.0	12.5	8.3	4.2	16.7	8.3	8.3	12.5	24
Guadiana	2.4	19.5	12.2	9.8	17.1	12.2	4.9	9.8	12.2	**41**
Crimea	12.5	12.5	37.5	12.5	6.3	6.3	6.3	0.0	6.3	16
Lower Don	27.3	9.1	18.2	9.1	0.0	18.2	9.1	0.0	9.1	**11**
Danube delta	16.0	0.0	4.0	12.0	28.0	4.0	16.0	0.0	20.0	25

1) number of issues identified includes doubles (placed under two categories)

Some interesting differences could be seen between the different Pilot Areas. If we look at the percentages of the clusters belonging to a category we can compare the results of the Pilot Areas (table 2.2). Note however that some Pilot Areas have more clusters than others. If there are only as small number of clusters, one cluster represents a higher percentage. One cluster therefore ranges from 2.4 tot 9.1%. The number of clusters in each category can be found in Appendix 2.
Water quality is mentioned most in the Lower Don, and least in the Guadiana and Candelaro. It plays a relative important role in most of the other Pilot Areas as well.
For water quantity we see an opposite image; it is mentioned most often in the Candelaro, followed by the Crimea and Guadiana. Water quantity is not mentioned in the Danube Delta; it was perceived as not relevant, although floods do play a role now and then. There seems to be a division between the water poor countries among the Mediterranean (and to some extend the Black sea) and the more water rich countries in the Baltic (and to some extend the Lower Danube).

Not all categories are mentioned in all the Pilot Areas, often one or two categories are not represented. Management and water quality are the only categories that are mentioned in all the 7 PAs. Management is mentioned most in Crimea and the Lower Don. It is however a bit a tricky category, as the definition of management issues proofed difficult. Government is quite closely related to management. It is most often mentioned in the Baltic PAs. A reason for this in Peipsi is that decisions and agreements on governmental level are very important due to the cross-boundary nature of the basin (and the lake itself).

Non-water sectors include aspects such as tourism, industry and agriculture. It is mentioned the most in the Danube Delta and Peipsi.
The lowest scores were mainly in the social, environmental and economical aspects categories. This is even more the case in those Pilot Areas where there are only a limited number of clusters formed. The lack of socio-economic and environmental issues might be caused by the focus on the present, pressing water problems. This leaves the wider relations out of focus.

2.2. Conclusions clusters

All Pilot Areas identified what the main issues are within their river basin. A lot of issues play to some extend in all Pilot Areas. There is a difference in the focus of the stakeholders. A difference can be seen between the water rich and water poor countries. In water rich countries the focus lies more on water quality, and in water poor countries on water quantity.

3. Spidergrams

Spidergrams were created in seven Pilot Areas (see table 3.1). The creation of spidergrams was mainly done by asking the individual stakeholders to assign a value for the importance of the cluster on a scale of 1 to 10. To get a easier to compare output a standard spidergram showing which cluster was on which axis was presented, after which each stakeholder individually drew their spidergram on a paper. Spidergrams of the future were created after the visioning exercise. The results of the individual spidergrams were put together to get an average spidergram.

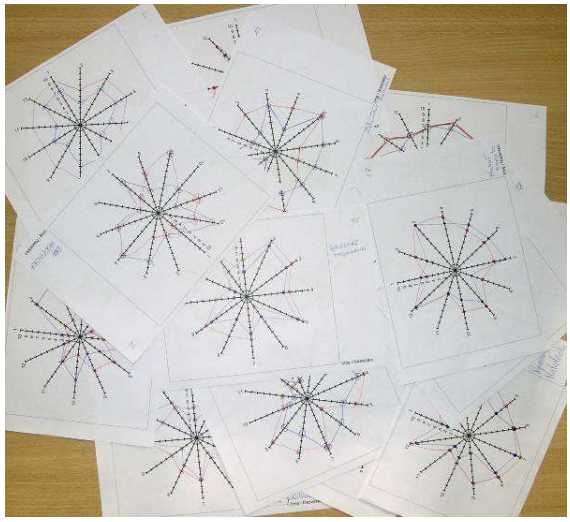

Figure 3.1; Spidergrams from the Narew

In the Candelaro a different process was followed; stakeholders were asked to give weights for the clusters as a small group, as a first action in the creation of the Fuzzy Cognitive Maps. This data has later been transferred to spidergrams.
In three Pilot Areas spidergrams were created for the present only, in four also for the future. The Crimea and Danube delta split the future spider grams up into the different scenarios.

Table 3.1; Use of spidergrams in the first round of workshops

PA	**spidergrams**
Baltic region	present
Narew	present and future
Peipsi	present and future
Tisza	present and future
Danube Delta	present and each scenario
Crimea	present and each scenario
Lower Don	present
Candelaro	present *
Guadiana	present *
Seyhan	present and future **
Garonne	no

** information for the spidergram was not created by the stakeholders in the form of a spidergram, but as part of the FCM exercise*
*** modified exercise*
(Tisza and Baltic not in analysis)

The results of the spidergrams give an extra idea of how the stakeholders (on average) perceive the main issues identified. These results can also be compared with the

results of the FCMs. It should be noted that there are sometimes large differences between the stakeholders' perceptions.

3.1. Examples

Peipsi

In Peipsi the differences between the future and the present are not very large. Most clusters gain importance, for most of the aspects this can be seen as a positive change towards the future. Cooperation (with other countries) is especially expected to increase. Pollution load is expected to decrease in importance, which is positive. The status of water quality/quantity in the lake however does not change, and especially water quality is perceived as a problem.

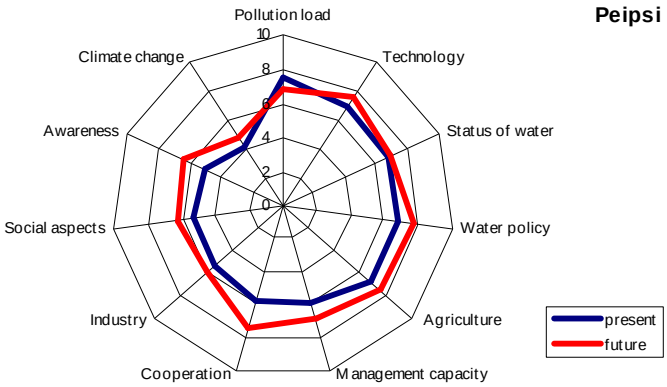

Figure 3.2; Spidergram Peipsi

Narew

In the Narew the stakeholders drew a spidergram for the present and future state. No particular scenario was added to the future. Overall the issues got a higher importance in the future compared to the present. The agricultural influence on the water status and melioration systems got lower values in the future, meaning that the influence of them will be lower. Aspects like water quality, natural valuable areas, tourism and spatial planning gained importance. Also the agriculture gained importance, but its influence on water status become lower. The stakeholders see a future where more agriculture is possible without damaging water quality, for instance via a transformation of the present agriculture practises towards more environmental practises and the development of eco-farming.

Candelaro

The Candelaro developed spidergrams from the values given to the clusters by the groups of stakeholders. So in this case it was not an individual exercise, but the group had to agree on the level of importance. This data was later put into a spider diagram by the SCENES researchers.

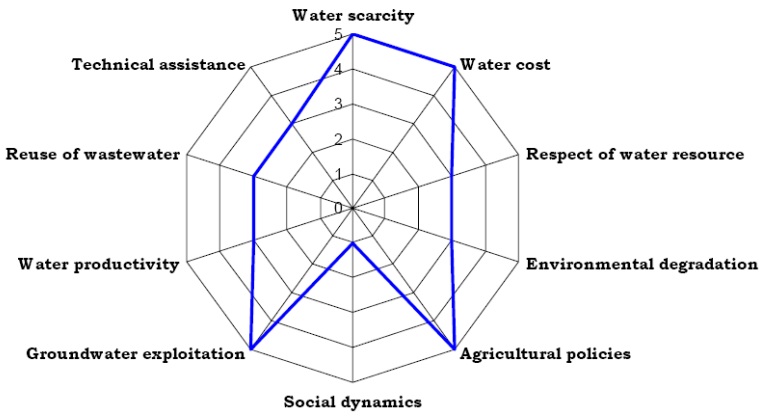

Figure 3.3; Spidergram Candelaro

Crimea

In the Crimea most factors are expected to be less important in the future (under all 4 scenarios) then the present. For instance water quality is lower then present. Interesting is the idea that state policy is lower in PF then at present. Also the protection water resources and ecosystems become less important in all scenarios than in the present.
SeF is clearly the least attractive scenario, although the negative impact of water is lowest in this scenario. MF is also not very positive, although it scores better then the others scenarios on state of water supply and sewerage system, and often has scores similar to PF.

1. State policy on water resources and institutional capacity
2. State of Infrastructure
3. Water quality
4. Negative impact of water
5. Monitoring
6. Legislation
7. State of water supply and sewerage system
8. Staff
9. Protection of water resources and ecosystems
10. Finances
11. Technology

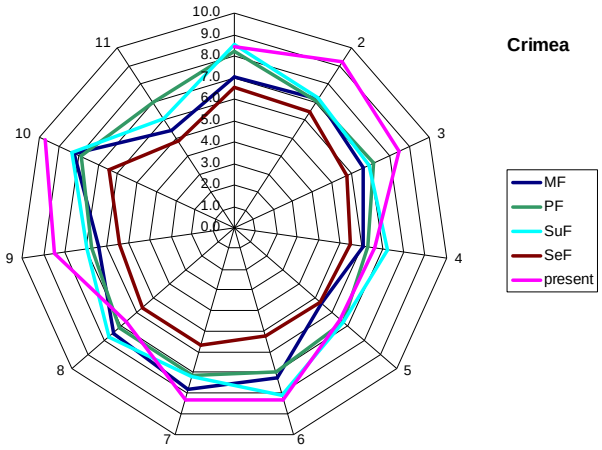

Figure 3.4; Spidergram Crimea

Lower Danube
In the Lower Danube a comparison has been made between 2010 and 2050. Some aspects were seen as 'not relevant in the present' namely: industry, best available techniques, population and best environmental practices (for 2010). Despite being not relevant they are rated in the spidergram, but they do get very low scores.
Security First and Market First in general score lower than present (except for navigation, agriculture, industry and socio-economic aspects, which are also already very low in present). Policy First scores higher then present on all issues, and scores better then Sustainability First. Sustainability First in general scores higher than present except for industry and best available techniques (BAT).

3.2. Conclusions spidergrams

Nine Pilot Areas used spidergrams, five of them used them for both the present and the future. Because of the wide variety of the issues on the axis it is hard to compare the Pilot Areas among each other. A combined spidergram has been made to facilitate the comparison (see figure 3.5). This has been done by placing each axis from the Pilot Areas spidergrams in the categories used for the clusters. The weight of each category has then been determined by the average of the values of the issues that fitted into that category. It should be noted that the values within one category did vary a lot. For instance for the Lower Don under the category social aspects the two issues were anthropogenic load on water bodies (value 8.3) and publicity factor (value 3.6).

The Crimea had the highes average scores, with an average of 7.7, while the Danube Delta had the lowest with an average of 5.2.
Not all categories were equally well covered. Especially the socio-economic and environmental categories were underrepresented. As could be expected water quantity was seen as most important in the Mediterranean Pilot Area (Candelaro) and Black see countries, while it scored lower in the Baltic Pilot Areas. For water quality the Candelaro scored the lowest. Surprisingly the two Baltic Pilot Areas did not score very much higher even though from the discussions it seemed that water quality seemed to be the biggest problem.
Another interesting observation is that the number of clusters under each category does not always correlate with the importance. For instance in the Candelaro government and non-water sectors had only two resp. one cluster, but both score a 10 on the importance.

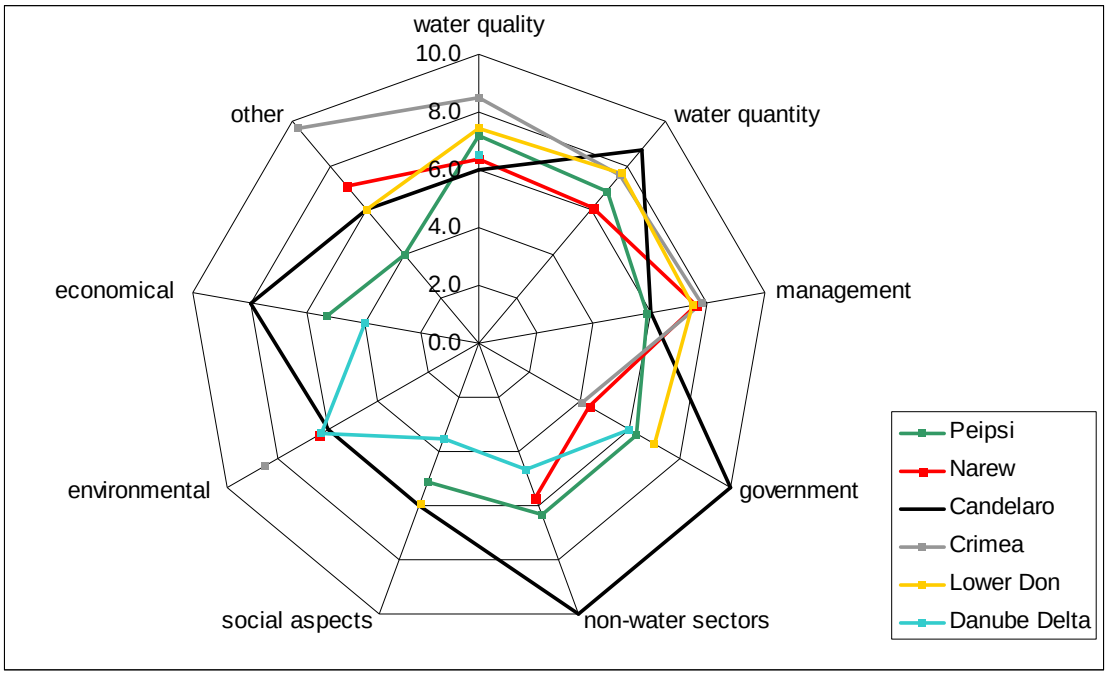

Figure 3.5; Spidergram of average values of the categories for six Pilot Areas

Four Pilot Areas also created spidergrams for the future. We did not study these results in detail but it is interesting to note that in some Pilot Areas the future the clusters gain more importance than the present, while in others they scored lower.
If we compare the two Pilot Areas that made separate spidergrams for each scenario it becomes clear that the Security First scenario is seen as the least positive scenario, while Policy First and Sustainability First are the more positive scenarios.

4. Fuzzy Cognitive Maps

All Pilot Areas included a Fuzzy Cognitive Maps (FCMs) exercise in their workshops (see table 4.1). Most of them were created from scratch by the stakeholders in small groups. In the Danube delta workshop a first draft was given as a starting point for stakeholders to create a full FCM. In the other workshops each small group (3 to 4 groups per workshop) created FCMs with the clusters that were defined in the card session. In some workshops every group used the same set of clusters, in other workshops each group came up with their own clusters. The latter made it harder to compare the FCM among the groups, but showed more the variety between the groups. In the Tisza workshops (3 workshops have been held in different places) and the Guadiana workshop FCMs have also been created for the future (see also chapter 5).

Table 4.1; Use of FCMs in the first round of workshops

PA	FCM	number and format	present/future
Baltic region	yes	4	present
Narew	yes	4, excel and graphical	present
Peipsi	yes	4, only excel	present
Tisza	yes	14 (3 WSs), only graphical	present and future
Danube Delta	yes	1, only graphical	present
Crimea	yes	3, only graphical	present
Lower Don	yes	3, excel and pictures	present
Candelaro	yes	3, excel and pictures	present
Guadiana	yes	4, present and future	present and future
Seyhan	yes	used matrix to create	present

The different workshops produced a wide variety of FCMs. Some groups created very dense FCMs with a lot of feedbacks, while other gave a relative simple system description, with only a low number of feedbacks. Within one workshop the different groups sometimes produced quite different system descriptions. Illustrative is the Candelaro workshop were two groups produced FCMs with little feedbacks while the third group did include several feedbacks.

A FCM can also be represented in a mathematical way (see Deliverable 2.1 for more information). The arrows between the clusters (boxes of the FCM) form a matrix. The starting values for each cluster form a vector. Multiplying the matrix times the vector gives a new vector, with the new value of the clusters. If iterated the system will (or not) reach a new balance. The weight of each concept in the end balance shows whether or not the concept will increase or decrease.

4.1. Examples of FCMs

Many of the FCMs created by the stakeholders reached a stable state. Most of the systems created were also relatively simple and relatively easy to stabilize when they were not stable. There were also some cases in which it cost considerable effort to stabilise the system. Not all results from the FCMs can be discussed here in detail because of lack of space and because there are too many differences within the

content and structure of the FCMs. Please check Deliverable IA2.2 (Kämäri, 2008) for the Pilot Area results. To give you some idea of the differences we will take a closer look at three FCMs. An example of a very dense and difficult to stabilise FCM is given by the Narew. An example of a relative easy system that exploded is given by a FCM from the Candelaro and an example of a system with more feedbacks that stabilised directly is given by another FCM from Candelaro.

We start with a simple system description with little feedbacks. Group 1 of the Candelaro workshop decided that water balance (water deficit) was the most important aspect (fig. 4.1). The water balance is affected by a lot of different issues. They therefore created an FCM with a lot of arrows coming into water balance. Originally there were no feedbacks at all included. After questions from the organizers if they could also identify feedback the group introduced one feedback from water balance to social dynamics. An increase in water deficit leads to more social dynamics, which in turn leads to an increase in water deficit. This system easily explodes as for instance the institutional latency keeps driving the water deficit and there is no regulating (negative) feedback. The system can be stabilised in several ways. One is to lower the relations between C0 and C1 to strong instead of very strong. The result is shown in figure 4.2. Depending on the definition of social dynamics and water balance the relation from C0 to C1 can also be negative. It then depicts a situation in which the public starts protesting if the water deficit gets to big and people do not have enough water. We therefore changed the relation between social dynamics and water deficit into a strong negative relation. Both C0 and C1 then stabilise on a lower value. Both are simple ways of portraying, as most likely social dynamics will influence other factors first, which than in turn might affect water deficit.

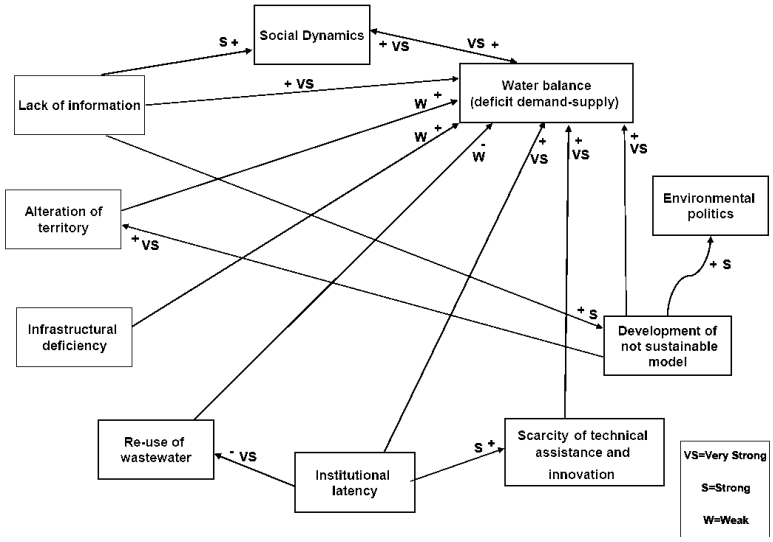

Figure 4.1; Original FCM of Candelaro workshop, group 1

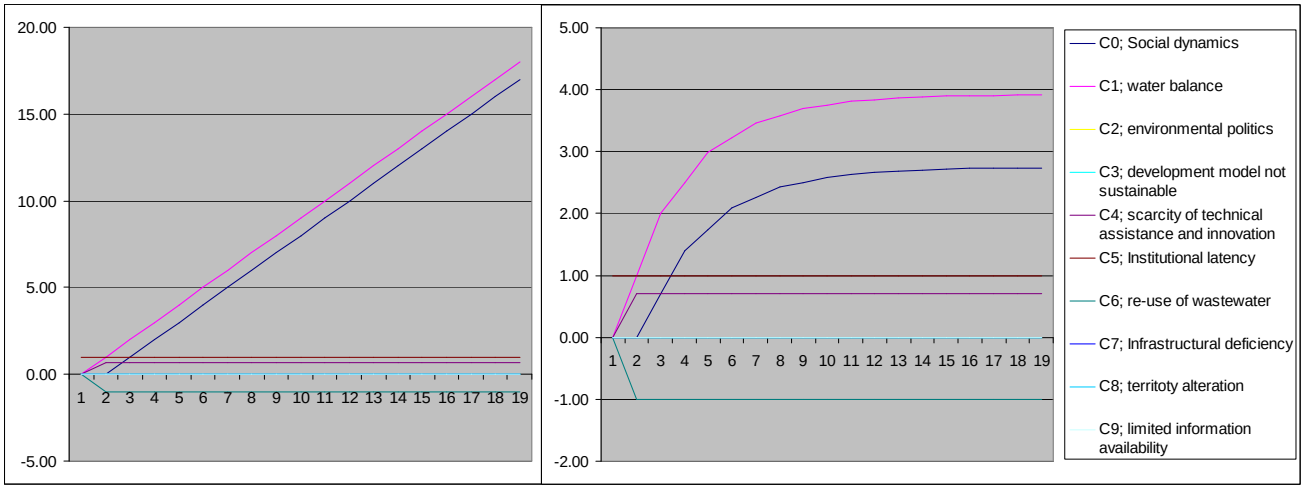

Figure 4.2; Graphs of iteration of the FCM of Candelaro group 1. On the left side the original version, on the left side the adapted version

Now we take a look at a more complicated system description created by group 3 of the Candelaro workshop (see figure 4.4). This group initially also had some problems in assigning feedbacks. They saw groundwater over-exploitation and water quality as the main problems. Later they started to see that a decline of water quality is a problem because it lowers the availability of water resources, which increases again the pressure on groundwater exploitation. The group also found relations between the main causes (blue boxes).

The output of the iteration stabilized after about 15 steps (figure 4.3). The stakeholders created a quite optimistic view of the current system in which groundwater exploitation is lowered and water quality will increase. This is driven by multi-sectional and global views. If we presume they are not there, the story will be completely opposite.

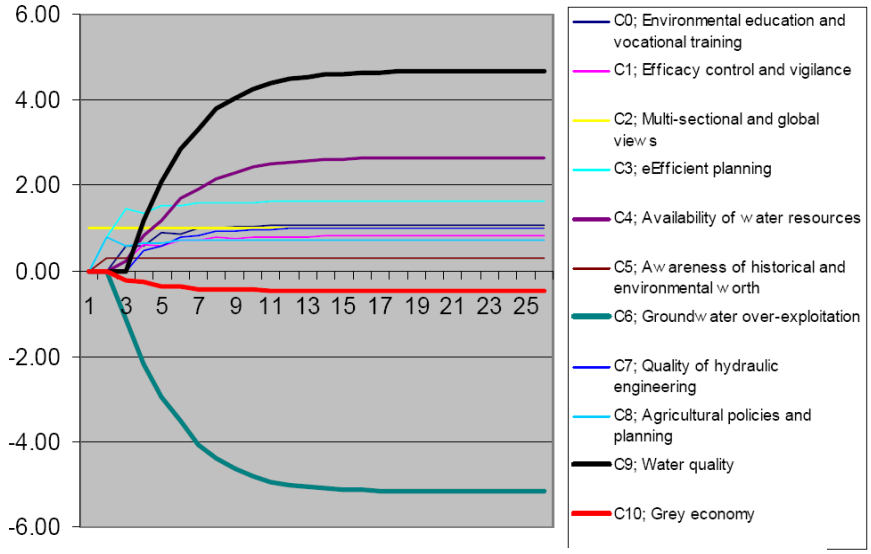

Figure 4.3; Results of iteration of FCM of Candelaro group 3

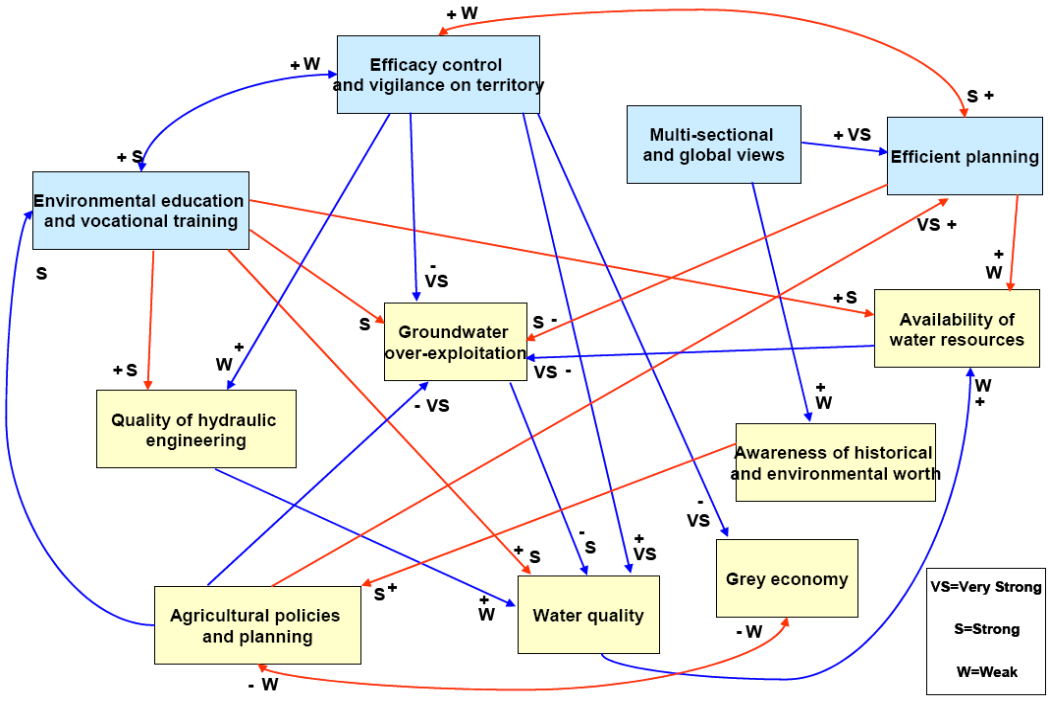

Figure 4.4; Original FCM Candelaro group 3

In the Narew workshop all groups identified a lot of feedbacks (see figure 4.6, next page). These stakeholders realised that on some level pretty much everything is connected to everything. In general those FCMs were also hardest to stabilize. This is for a part also caused by the fact that such complicated systems are much more difficult to understand and thus to purposefully manipulate. It is therefore important to realise that we can't get a complete system description and that the focus should be on those relations that influence the system most.

Group 2 of the Narew workshop created a system description that was very dense (see figure 4.6 next page); there were a lot of relations assigned between the clusters. It was a very interrelated system in the sense that all boxes were in the end connected to each other. Almost all boxes had both outgoing and incoming arrows.
Quite a lot of the relations between clusters were one on one relations. For instance if water retention increased, flood protection increased by 0.7, which directly increased water retention again by 0.6. In principle a lot of these relations exist, but they might not always be direct, or will act with a delay. These types of positive feedback loops caused the system to explode. By taking out some of the one on one relations and some other minor changes we finally managed to stabilise the system (see figure 4.5).

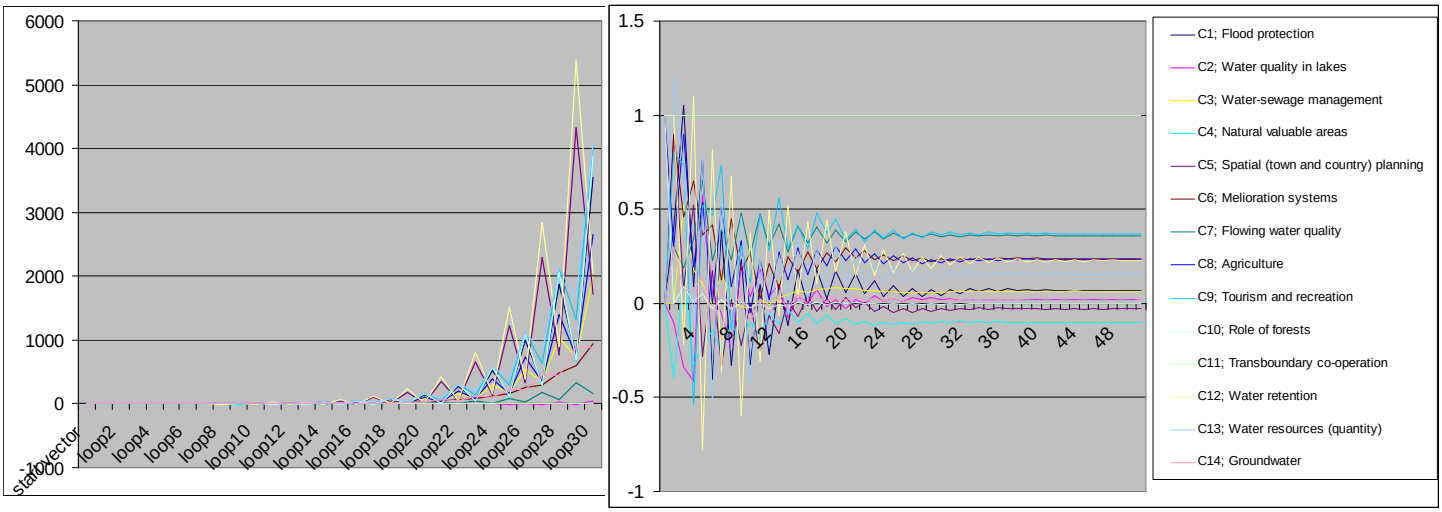

Figure 4.5; Results of the iteration of the FCM from Narew workshop group 2. On the left side the original version, on the left side the adapted version

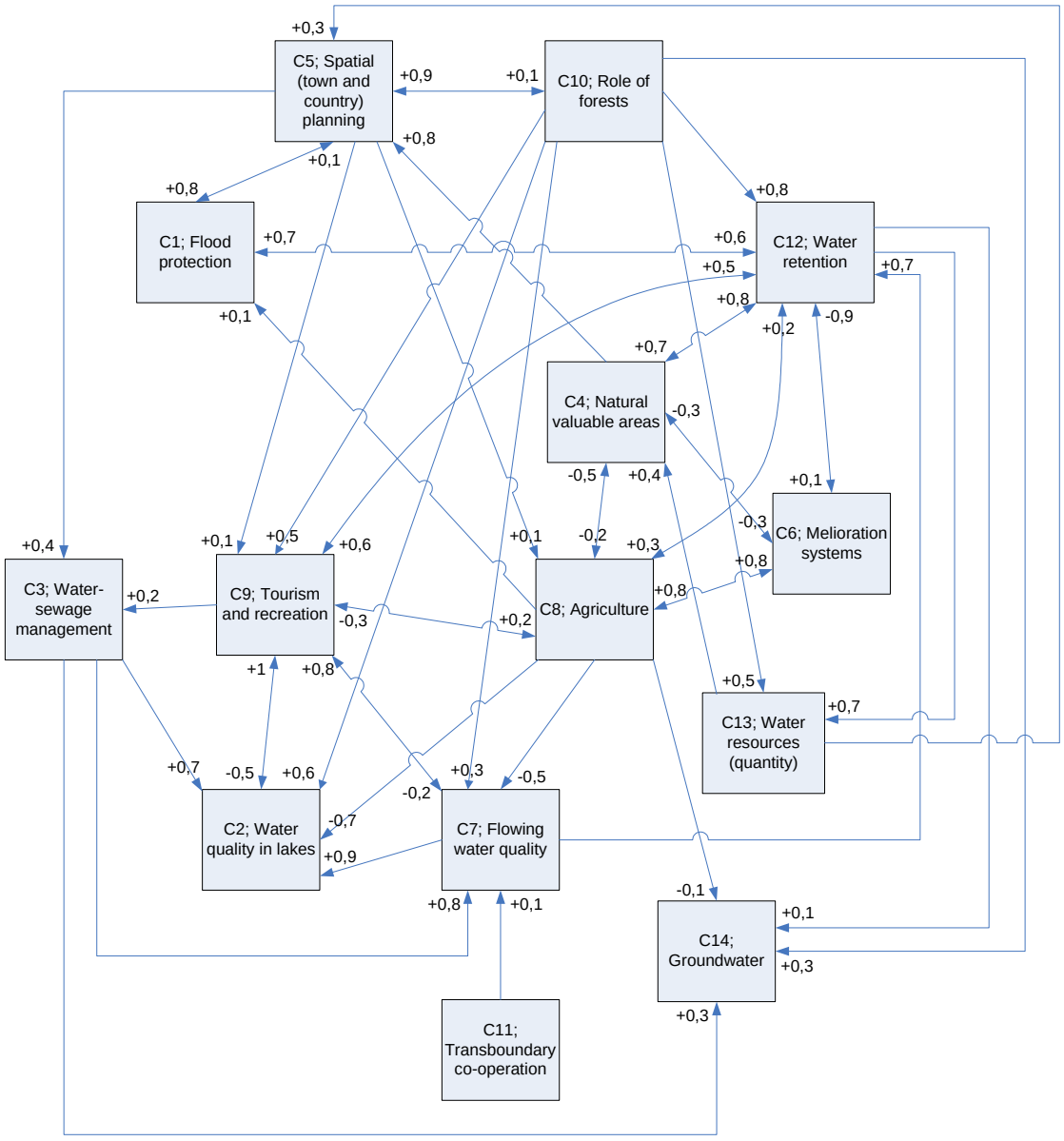

Figure 4.6; Original FCM from Narew workshop group 2

There are a number of indicators that are often used to study FCMs. We have used them to study twenty-two of the FCMs created in the Pilot Areas (table 4.2). Only those FCMs have been studied of which we had all data available in mid June 2008.

Table 4.2; Results analysis FCM parameters

Pilot Area (group name)	**number of boxes**	**number of arrows**	**pure receivers**	**pure transmitters**	**receiver/transmitter ratio**	**Density**	**hierarchy**	**highest centrality**		**average centrality**		**connections per variable**	**average value per arrow**	**stable**
								values	arrows	values	arrows			
Candelaro														
1	10	16	1	3	0.33	0.16	0.03	6.90	9	2.34	3.2	1.6	0.73	N
2	17	21	3	6	0.5	0.07	0.03	5.70	8	1.67	2.5	1.2	0.68	Y
3	11	27	0	1	0/1	0.22	0.09	4.50	7	2.60	4.9	2.5	0.53	Y
Lower Don														
yellow	10	29	1	1	1	0.29	0.32	6.50	9	3.62	5.8	2.9	0.62	Y
green	10	24	1	1	1	0.24	0.25	8.30	11	3.28	4.8	2.4	0.68	Y
pink	10	27	2	1	2	0.27	0.07	6.30	10	2.02	5.4	2.7	0.37	Y
Narew														
1	14	38	0	1	0/1	0.19	0.10	6.40	10	3.36	5.4	2.7	0.62	N
1 kk	14	40	0	2	0/2	0.20	0.08	5.50	10	2.50	5.7	2.9	0.44	Y
2	14	50	1	1	1	0.26	0.12	7.00	13	3.47	7.1	3.6	0.49	N
2 kk	14	52	1	1	1	0.27	0.12	6.70	14	3.30	7.4	3.7	0.44	Y
3	13	52	0	0	0/0	0.31	0.23	11.70	19	5.05	8.0	4.0	0.63	N
3 kk	13	52	0	1	0	0.31	0.12	8.20	18	3.74	8.0	4.0	0.47	Y
4	12	55	0	1	0	0.38	0.56	10.70	14	6.07	9.2	4.6	0.66	N
4 kk	12	56	0	2	0	0.39	0.13	6.80	14	3.78	9.3	4.7	0.41	Y
Peipsi														
1	11	26	1	3	0.33	0.21	0.01	4.70	8	1.98	4.7	2.4	0.42	N
1 mvv	11	26	1	3	0.33	0.21	0.01	4.30	8	1.89	4.7	2.4	0.40	Y
2	11	20	1	1	1	0.17	0.03	5.00	6	2.67	3.6	1.8	0.74	N
2 mvv	11	20	1	1	1	0.17	0.03	4.10	6	2.15	3.6	1.8	0.59	Y
3	11	29	0	4	0	0.24	0.00	4.4	10	2.05	5	2.6	0.39	Y
4	11	29	0	3	0	0.24	0.03	5.10	11	2.25	5.3	2.6	0.43	Y
4 mvv	11	30	0	3	0	0.25	0.02	5.10	11	2.25	5.5	2.7	0.41	Y
Baltic region														
3	13	28	0	4	0	0.17	0.03	4.50	10	1.58	4.3	2.2	0.37	Y

Adapted versions of a FCM are indicated by the initials of the person who adapted the FCM
For explanation of the indicators; see Appendix 3

Most of the FCMs had a limited number of clusters. Only group 2 of Candelaro had 17 clusters. In the Guadiana (not in table 4.2) there were also a high number of clusters in each FCM. A large amount of clusters makes it harder for the stakeholders to keep a good overview and can cause the FCM to be fragmented and with little feedbacks.

Tabel 4.3; Comparison of stable and non stable FCMs

	stable	n	boxes	arrows	receivers	transmitters	r/t ratio	Density	hierarchy	highest centrality		average centrality		connections / variable	value per arrow
										values	arrows	values	arrows		
all FCMs	Y	15	11.93	32.67	0.67	2.27	0.46	0.24	0.08	5.73	10.47	2.58	5.48	2.75	0.48
	N	7	12.14	36.71	0.57	1.43	0.38	0.24	0.18	7.49	11.29	3.56	5.89	2.96	0.61
changed FCMs:[1)]															
adapted	Y	6	12.50	41.00	0.50	1.67	0.39	0.26	0.09	5.93	11.67	2.89	6.45	3.25	0.46
original	N	6	12.50	40.17	0.50	1.17	0.39	0.25	0.15	7.58	11.67	3.77	6.33	3.18	0.59
total		22	12.00	33.95	0.64	2.00	0.43	0.24	0.11	6.29	10.73	2.89	5.61	2.82	0.52

1) six FCMs that originally were unstable and have been adapted by SCENES WP2 scientist in order to make them stable.

If we take a look at the FCMs that were not stable, one of the main problems seems to be the average value per arrow (see table 4.3). Non stable FCMs have a higher average value per arrow, and thus have lot of strong relations. When trying to stabilize a system one of the methods was to search for one on one feedback relations (C1 <-> C2). At least one of arrows was then given a lower value.
Another indicator that seemed important for stability was a high centrality. A high centrality means that one box has a lot of incoming and outgoing arrows with a high value. This makes that one box will easily reach a high value, and then spread this over the system. The system can then 'overshoot', and negative feedbacks can either not keep up, or push the system to overshoot to a negative state. Especially in the case of multiple boxes with a high centrality this causes problems.

In general comparing the stable FCMs with the original non-stable we can see that:
- the average value per arrow is lower
- number of arrows (and connections per variable) is the same or slightly higher, mainly because a internal drivers are added to clusters that push the system from outside the system (external drivers)
- the centrality is lowered, by lowering the values of arrows going into the central cluster
- hierarchy is lower or, when already low hierarchy often stays the same
- density is slightly increased (mainly due to extra external drivers) or remains the same
- r/t ratio does not change, but there are more transmitters (external drivers)

These indicators do not always give the right picture; for instance the FCM of the Lower Don green group has a high centrality, but is stable. So a high centrality does not necessarily mean instability. The stability of the system also depends on how the system is build up. Systems that have no feedbacks are by definition very stable. If there are no negative feedbacks and only positive feedbacks a system easily 'explodes'.

4.2. Conclusions Fuzzy Cognitive Maps

Overall we can conclude that all Pilot Areas used FCM as a method to map the present system and that the results were satisfactory. We are very pleased with results which provide a good first impression of the main issues in the Pilot Areas. Some system descriptions are very dense, others seem to miss some feedbacks. In the latter case extra attention should be given to missing feedbacks in the second round of workshops. This should lead to a better insight in the factors leading to the current problems. For the very dense FCMs the challenge lies in trying to 'simplify' the system description so that it still remains a good description but becomes easier to read and use.

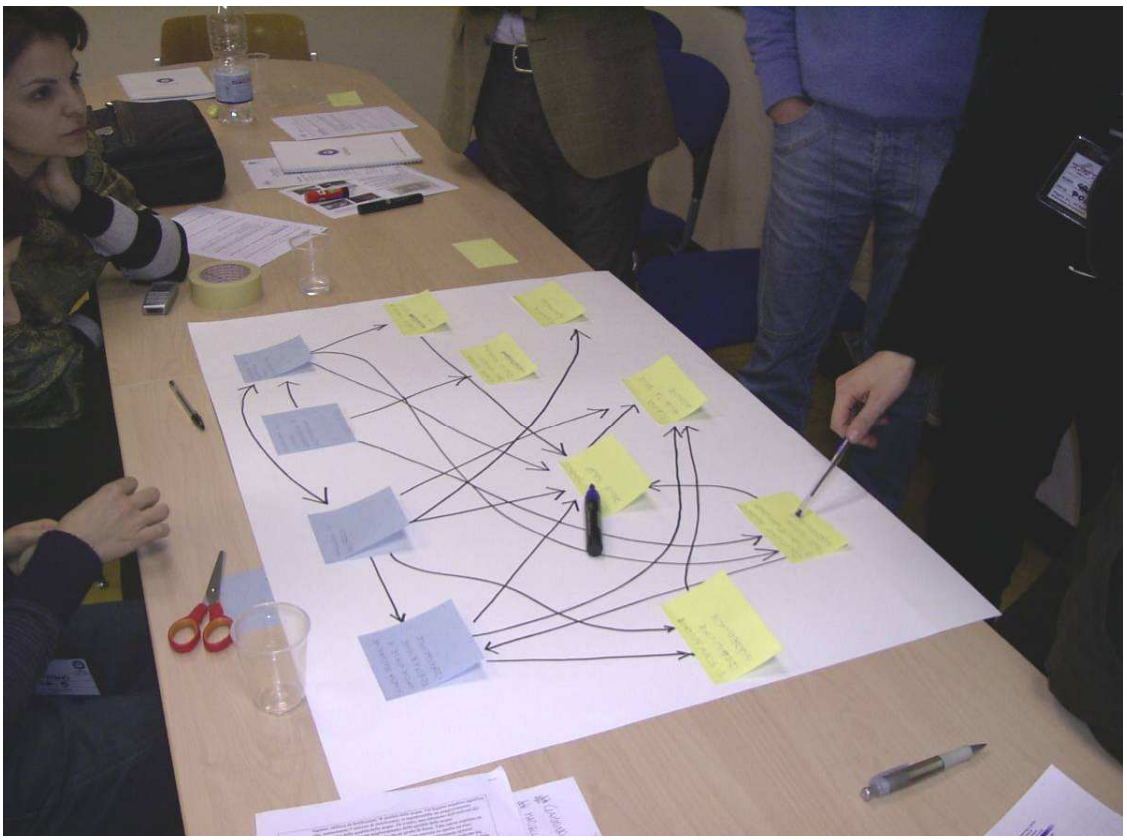

Figure 4.7; FCM creation in the Candelaro workshop, group 2

5. Visions

All workshops, except for the Garonne, created visions (see table 5.1). Five of the nine workshops studied developed collages, two workshops used timetrends to sketch the future, two used FCMs and one directly produced storylines. Most Pilot Areas converted these products created by the stakeholders into a storyline, using the products itself and notes from the discussions.

Table 5.1; Analysis of the visions after the first round of workshops

Pilot Area	**method used to create vision**	**scenarios used**				**length of storyline**
		MF	SeF	SuF	PF	
Baltic region	timetrends	x	x	x	x	¼ to ½ page
Narew	collages			4		ca. 1 page
Peipsi	timetrends	x		x	x	¼ to ½ page
Tisza	collages and FCM	x	x	x	x	no storyline?
Danube Delta	storyline	x	x	x	x	½ page
Crimea	collages	x	x	x	x	½ to 1 page
Lower Don	collages	x	x		x	ca. 1 page
Candelaro	collages		x		x	¼ to ½ page
Guadiana	FCM	x		x	x	¼ page
Seyhan	storyline	*free scenarios*[3)]				¼ page

MF = Market First SeF = Security First SuF = Sustainability First PF = Policy First
1) In the Tisza 3 workshops have been held in different places, FCMs have been created for an 'ideal' future and for one or two of the scenarios.
2) PF in combination with MF and SuF resp.
3) Scenarios in Seyhan were not connected to the fast-track scenarios

5.1. Use of fast-track scenarios

Because of limited group sizes most of the pilot areas could not cover all four scenarios presented in the fast-track. These fast-track scenarios sketched possible futures of how the world and Europe looks like in 2050 and were derived from GEO-4 storylines. Depending on the group size, and the number of small groups that could be made, two to four visions were created. In the Narew all four groups independently decided to use the Sustainability First scenario. This scenario was seen as the most favourable by the stakeholders and therefore they wanted to use it. Four variants of Sustainability First were created.
The Candelaro and Guadiana both had two groups that addressed two different scenarios. In the Guadiana stakeholders used a combination of scenarios. One group used a combination of Sustainability First and Policy First, while the other group used a combination of Market First and Policy first.
In the Tisza three workshops were held in different places. In each workshop FCMs have been created for an 'ideal' future and for one or two of the fast-track scenarios. The three workshops together covered all four fast-track scenarios. In the Lower Don and Peipsi three storylines were created. In the Lower Don Sustainability First was seen has highly unlikely.

In the Baltic region, Danube Delta and Crimea visions were created for all four scenarios. In the Crimea two versions were created for the Policy First scenario, one with the Ukraine joining the European Union and one without. In the Crimea two visions also got new names; Security First was renamed 'smile trough tears' and Market First was renamed 'from the bazaar to the market'.

On the whole there was no significant opposition against any of the fast-track scenarios. This does however not mean that there was no discussion about some of the underlying thoughts in the storylines. In the Candelaro there was for instance discussion if a long economic crises (and therefore poorer people) would lead to an increase in birth rates or not. In the Lower Don it was stated that the Sustainability First scenario was highly unlikely. During the Baltic regional panel meeting one group noticed that there might be a reaction of the public to the over emphasis on security, which might lead to a revolution.

5.2. Methods used

Five of the Pilot areas used collages as method to sketch the visions. Peipsi and the Baltic region used timetrends in stead of collages. No collages were used as there was a fear that stakeholders would see collage making as not scientific enough. In the Guadiana and Tisza FCMs were used. This method stayed close to methods used in previous workshops (Bayesian networks and Causal Loop Diagrams respectively). In the five Pilot Areas that used collages the method yielded little to no negative feedback from stakeholders. In the end most of the Pilot Areas also converted their output into storylines. These storylines are written after the workshops by SCENES scientist with the use of notes of the discussions and the end products. The length of the storylines differed from 10 lines to one page (see table 5.2).

Figure 5.1; Collage created in the Crimea workshop

5.3. Analysis of storylines

In order to get an indication of the richness of the storylines we can look at the length of the storylines, and the number of issues in them. Each storyline has been analyzed by the author to see how many of the issues identified for the present are in it and how many new issues are incorporated. We realise that this might not be the most accurate and objective method, but it does give some indication and lead to some interesting results. The results of this exercise are given in table 5.2.

Tabel 5.2; Analysis of issues in the storylines

Pilot Area	group	# clusters in FCM	issues from FCM in storyline			number of new issues	sum mentioned indirect & new
			mentioned	indirect	not		
Narew	1 SuF	14	6	2	6	9	17
	2 SuF	14	3	2	9	10	15
	3 SuF	13	4	3	6	11	18
	4 SuF	12	5	2	5	7	14
Peipsi	MF	11	4	4	3	5	13
	PF	11	10	1	0	3	14
	SuF	11	10	1	0	8	19
Danube Delta	SeF	23	8	0	15	7	15
	MF	23	8	0	15	4	12
	PF	23	3	0	20	6	9
	SuF	23	7	0	16	8	15
Candelaro	SeF	22	7	3	12	11	21
	PF	22	5	7	10	13	25
Guadiana	PF+SuF	17	6	1	10	12	19
	MF+PF	24	3	10	11	11	24
Crimea	SeF	13	3	3	7	12	18
	MF	13	1	2	10	7	10
	SuF	13	9	0	4	7	16
	PF	13	3	3	7	7	13
Lower Don	PF	10	7	1	2	9	17
	MF	10	3	3	4	9	15
	SeF	10	1	5	4	5	11

Storylines from the other Pilot Areas could not be analysed due to time constraints

As can be seen in table 5.2 the visioning exercise did bring up new issues. The use of collages was recommended as it was expected that it would be a creative process. The groups that used collages did get more new issues than the group that used timetrends. They also got more new issues than the group of the Danube Delta that used draft storylines. The Guadiana used FCMs and got more new issues than the collages groups on average. The Candelaro, however, added the most new issues. So on first sight it appears that the FCM creation of the future was a very creative process. New boxes are however relatively easily added to a FCM and each box was seen as one new issue. In a storyline several aspects might be easier put under one heading, leading to one new issue instead.

We should also take into account that there were also considerable time differences allocated to the visioning exercise. With more time allocated it can be expected that a

more detailed storyline can be created. Using the same method for the present and the future might also make it possible to dedicate more time to the actual process, instead of having to explain the method itself. This extra time can then lead to a more detailed description of the future.

When we take a closer look to the content of the new issues we can see that the new issues can mainly be placed in the categories non-water sectors and social aspects. Also the environmental and economical aspects are more represented than in the FCM exercise. It therefore seems that looking at the future makes people take a broader perspective, leading to the inclusion of more related aspects.

There are some remarkable differences between the group of Pilot Areas that used collages and the group that used other methods (timetrend, storyline and FCM) to create visions. In table 5.3 the averages for the two groups can be seen, in Appendix 4 the complete results can be found.

Table 5.3; Comparison of methods used for visioning exercise and the number of new issues in the storylines derived from it.

method	**number of new issues**	**sum mentioned, indirect and new**
collages	9.3	16.9
storyline	6.3	12.8
timetrend	5.3	15.3
FCM	11.5	21.5

Table 5.4; Percentages of issues mentioned under each cluster for the groups of Pilot Areas using collages and other methods

	method used	water quality	water quantity	management	government	non-water sectors	social aspects	environmental aspects	economical aspects	other
present	collages[1)]	15.7	16.8	20.7	8.6	6.1	10.5	6.1	3.7	11.8
	other [2)]	11.3	7.7	10.4	11.6	21.7	12.1	7.0	7.3	10.9
visions	collages	0.9	4.8	6.1	2.1	26.4	26.8	9.0	12.1	11.9
	other	3.6	3.6	15.9	12.3	16.3	6.8	13.9	15.6	11.9
present + visions	collages	6.0	9.7	11.5	4.8	18.3	21.0	7.8	9.4	11.4
	other	7.2	6.1	12.7	11.9	18.9	10.0	10.1	11.2	11.9

1) Narew, Candelaro, Crimea, Lower Don
2) Guadiana, Peipsi, Danube Delta

Of course it is important to remember that only a small number of case studies have been used. However it is interesting to note that in the Pilot Areas where collages were used social aspects are mentioned more (in FCM and visions combined, see table 5.4). In the Pilot Areas that used other methods governmental and management aspects were much more mentioned. Environmental and economical aspects are slightly more mentioned by the other methods group, but this was also already the case in the present (especially for economical aspects).

In general it looks like that with the collages participants looked more to the wider and social picture. The other Pilot Areas look more from a today perspective, looking

for solutions which needs governmental and management changes. This might be an indication that collages can help to create a wider perspective.
We have to be careful in our conclusions as also the Pilot Area setting and culture will influence the results. The two groups of Pilot Areas (with and without collages) where however quite equally spread over the regions.

Conclusions visions:

Most of the storylines only relate back to a part of the issues identified in the FCM of the present. Most groups came up with new, broader aspects, also things that are less water related.
It seems that the method used for the vision development does influence the results. The focus of the exercise with collages seems to be broader and include more new aspects. In the end the storylines were longer too.
It seemed that the timetrends led to the least developed storylines, with the least amount of new aspects. Of course this might also have been caused by other aspects than the method only. The FCMs were a bit different to analyse as no storylines are developed, therefore it was easier to pick new issues, which were all boxes that were not in the first FCM.
For the next workshop; the high number of new issues might make it more difficult to create a new FCM for the future. Maybe each PA should pick out the most important things that have changed that should be added.

6. General conclusions

Without exception, the results obtained from PA1 were more than satisfactory. All Pilot Areas developed Fuzzy Cognitive Maps. Because of the methods used a lot of the workshop results obtained were highly comparable, which was an excellent base for comparison. Differences between the main issues identified by the stakeholders in the different Pilot Areas were therefore easy to map. Also a comparison of spidergrams showed some differences. It was also interesting to see the differences in the way the FCMs were constructed. Here it was more difficult to see direct differences between Pilot Areas, but some differences within Pilot Areas between different stakeholders groups became apparent. For the visions a difference could be seen between the group of Pilot Areas that used visions and the group that did not.

A division can be seen between the water poor and water rich countries, this reveals itself most in the attention to water quality versus water quantity. Not surprisingly water poor Pilot Areas (mainly Candelaro and Guadiana) focus more on the water quantity aspects and the water rich (mainly Narew, Peipsi and Danube Delta) on water quality.

Acknowledgements

We want to thank all people from the Pilot Areas and regions who held the workshops. They dedicated a lot of time and energy to the organisation, which concluded in very good results. Thank you for sharing your results and ideas with us. Thank you also for taking a critical look at this deliverable and coming up with useful suggestions for change.

We further want to thank all the stakeholders that took part in the workshops, without their input this deliverable wouldn't be there.

References

Kämäri, J., Ed. 2008. *Results of first round of Pilot Area workshops, SCENES Deliveralbe IA2.2*. Helsinki, SYKE.

Özesmi, U. and S. L. Özesmi, 2003. A Participatory Approach to Ecosystem Conservation: Fuzzy Cognitive Maps and Stakeholder Group Analysis in Uluabat Lake, Turkey. *Environmental Management* 31(4),pp. 518-531.

Vliet, M. v., K. Kok, J. Sendzimir and A. Lasut, 2007. *Report describing methodology for scenario development at pan-European and pilot area scales, SCENES Deliverable 2.1*. Wageningen, Wageningen University, available from: http://www.environment.fi/default.asp?node=20749&lan=en

Appendix 1; Clusters identified in the Pilot Areas under each category

Pilot Area	water quality	water quantity	management	government	non-water sectors	social aspects	environmental aspects	economical aspects	other
Peipsi	pollution load Status of water quality and quantity *	Status of water quality and quantity *	capacity of institutions (implementation of policies) *	water policies cooperation (trans-boundary) capacity of institutions (implementation of policies) *	agriculture industry development* Technology	awareness/ education social aspect	capacity of institutions (implementation of environmental policies) *	industry development*	climate change
Narew	Water quality Sewerage systems and sewage treatment plants Agriculture influence on waters status *	Flood protection Water retention Agriculture influence on waters status *	Water-sewage management (amount of sewages) Spatial (town and country) planning Melioration systems * (management of)	Transboundary co-operation Legal and formal issues	Agriculture Tourism		Natural valuable areas Role of forests		Melioration systems *
Candelaro	Water quality	Gap between water demand and supply Re-use of wastewater Groundwater over-exploitation Water availability water balance Water scarcity	Scarcity of technical assistance and innovation Efficient planning Quality of hydraulic engineering	Environmental and agricultural policies Multi-sectional and global views	Agricultural planning	Awareness of historical and environmental worth Respect of water resource Environmental education and training Social dynamics	Environmental degradation environmental policies	Grey economy Water cost	Alteration of the territory Resources availability Water productivity

Pilot Area	water quality	water quantity	management	government	non-water sectors	social aspects	environmental aspects	economical aspects	other
Guadiana	Agricultural pollution*	Water scarcity Management of demands * Productivity of water use Fulfilment of demands Unmet demands Water use efficiency Water recharge Drought impact*	Effective control Management of demands * Capacity of regulation Planning Water allotment rights	Political will Coordination of policies / administrations Sufficient legislation SPUG	Encouragement of quality agriculture Infrastructures Irrigation surface Intensification agriculture Agricultural income* Agricultural pollution* Expansion energy industry	Rural development policies Rural population Culture of water use Social consciousness Sustainable development	Ecosystems conservation Wetlands conservation	Cap subsidies Price of water Regional economy Agricultural income*	(Options to irrigation) Control of the resource Diversification demands Globalization Drought impact*
Crimea	Protection of water resources and ecosystems* Quality of water	Protection of water resources and ecosystems* Reduction of injurious action of water	State of system of water use and sewerage Staff State of infrastructure of reclamation systems Management system of technological process* Management system of water resources Monitoring	Legislation Governance	Management system of technological process*	Problems of ownership	Protection of water resources and ecosystems*		Funding

Pilot Area	water quality	water quantity	management	government	non-water sectors	social aspects	environmental aspects	economical aspects	other
Lower Don	Water quality Anthropogenic load on water bodies * Bio-resources and water ecosystems *	Water resources availability	Water resource management system State of infrastructure and technologies	Legal base of water resource use		Anthropogenic load on water bodies * Publicity factor	Bio-resources and water ecosystems *		Watershed state Climate change
Danube delta	nutrients pollution organic pollution Water quality into Danube delta Hazardous substances		Dragging of the navigation channels	Policies infrastructure taxis/tariffs/penalties	Navigation Industrial fishing Population Industry Agriculture Fishing farms (Eco)-Tourism	Education	Illegal hunting tourism Biodiversity reduction Ecosystems modification Self purification capacity		hydromorphological alteration Solid waste disposal Associated sediments pollution Bastroe channel Raw materials (wood, fish)

* put into more then one category

Appendix 2; Number of clusters identified in the Pilot Areas under each category

Pilot Area	water quality	water quantity	management	government	non-water sectors	social aspects	environmental aspects	economical aspects	other	total including doubles	total excluding doubles
Peipsi	2	1	1	3	3	2	1	1	1	15	11
Narew	3	3	3	2	2	0	2	0	1	16	14
Candelaro	1	6	3	2	1	4	2	2	3	24	24
Guadiana	1	8	5	4	7	5	2	4	5	41	38
Crimea	2	2	6	2	1	1	1	0	1	16	13
Lower Don	3	1	2	1	0	2	1	0	1	11	9
Danube delta	4	0	1	3	7	1	4	0	5	25	25

Appendix 3; Explanation of indicators FCM

Number of Boxes (N) = total number of boxes in the FCM

Number of arrows (C) = total number of arrows in the FCM

Pure receivers = number of boxes with ingoing arrows only
Pure receivers are boxes that have no influence on the rest of the system, if there are many of them it is an indication of lack of feedbacks

Pure transmitters = number of boxes with outgoing arrows only
Pure transmitters can be seen as external drivers, if there are no external drivers the system is often very unstable

r/t ratio = number of pure transmitters / number of pure receivers

Density = C/N^2
A low density indicates a high chance of missing feedbacks

Hierarchy = $$h = \frac{12}{(N-1)N(N+1)} \sum_i \left[\frac{\mathrm{od}(v_i) - \left(\sum \mathrm{od}(v_i)\right)}{N} \right]^2$$

Where od (v_i) is the out degree of an box, the total of the absolute values of all outgoing arrows (Özesmi and Özesmi, 2003)

Centrality = *od (v_i) + id (v_i)*

Where od (v_i) is the out degree of an box, the total of the absolute values of all outgoing arrows (Özesmi and Özesmi, 2003)

And id (v_i) is the in degree of an box, the total of the absolute values of all incoming arrows (Özesmi and Özesmi, 2003)

Centrality (arrow) = number of incoming and outgoing arrows
A high centrality means that one aspect has a lot of influence on the system and/or is influenced heavily by the system

Connections per variable = C/N

Average value per arrow = total absolute value of all arrows/ total number of arrows
High average value means that there are a lot of strong relations, this can make the system unstable

Appendix 4; Comparison of categories in visions

percentages visions+clusters combined

Pilot Area	water quality	water quantity	management	government	non-water sectors	social aspects	environmental aspects	economical aspects	other
Narew	4.1	6.1	8.2	10.2	26.5	20.4	10.2	4.1	10.2
Candelaro	2.3	15.9	9.1	4.5	18.2	22.7	6.8	6.8	13.6
Crimea	8.7	10.9	19.6	4.3	19.6	19.6	2.2	8.7	6.5
Lower Don	9.1	6.1	9.1	0.0	9.1	21.2	12.1	18.2	15.2
collages	6.0	9.7	11.5	4.8	18.3	21.0	7.8	9.4	11.4
Peipsi	10.3	6.9	10.3	17.2	20.7	13.8	0.0	10.3	10.3
Guadiana	3.3	11.5	19.7	6.6	18.0	8.2	8.2	13.1	11.5
Danube delta	8.0	0.0	8.0	12.0	18.0	8.0	22.0	10.0	14.0
other	7.2	6.1	12.7	11.9	18.9	10.0	10.1	11.2	11.9
average	7.4	9.6	13.6	8.5	21.2	19.3	9.9	11.5	13.2
sd	3.2	5.1	5.3	5.7	5.2	6.2	7.2	4.5	2.9

percentages clusters

Pilot Area	water quality	water quantity	management	government	non-water sectors	social aspects	environmental aspects	economical aspects	other
Narew	14.3	14.3	14.3	14.3	14.3	0.0	14.3	0.0	14.3
Candelaro	4.5	27.3	13.6	9.1	4.5	18.2	4.5	9.1	9.1
Crimea	16.7	16.7	27.8	11.1	5.6	5.6	5.6	5.6	5.6
Lower Don	27.3	9.1	27.3	0.0	0.0	18.2	0.0	0.0	18.2
collages	15.7	16.8	20.7	8.6	6.1	10.5	6.1	3.7	11.8
Peipsi	15.4	7.7	7.7	23.1	23.1	15.4	0.0	7.7	0.0
Guadiana	2.6	15.4	15.4	7.7	17.9	12.8	5.1	10.3	12.8
Danube delta	16.0	0.0	8.0	4.0	24.0	8.0	16.0	4.0	20.0
other	11.3	7.7	10.4	11.6	21.7	12.1	7.0	7.3	10.9
average	16.1	15.3	19.3	11.1	13.6	12.7	7.4	5.8	13.1
sd	8.3	8.5	8.2	7.4	9.5	6.9	6.4	4.1	7.1

percentages visions

Pilot Area	water quality	water quantity	management	government	non-water sectors	social aspects	environmental aspects	economical aspects	other
Narew	0.0	2.9	5.7	8.6	31.4	28.6	8.6	5.7	8.6
Candelaro	0.0	4.5	4.5	0.0	31.8	27.3	9.1	4.5	18.2
Crimea	3.6	7.1	14.3	0.0	28.6	28.6	0.0	10.7	7.1
Lower Don	0.0	4.5	0.0	0.0	13.6	22.7	18.2	27.3	13.6
collages	0.9	4.8	6.1	2.1	26.4	26.8	9.0	12.1	11.9
Peipsi	6.3	6.3	12.5	12.5	18.8	12.5	0.0	12.5	18.8
Guadiana	4.5	4.5	27.3	4.5	18.2	0.0	13.6	18.2	9.1
Danube delta	0.0	0.0	8.0	20.0	12.0	8.0	28.0	16.0	8.0
other	3.6	3.6	15.9	12.3	16.3	6.8	13.9	15.6	11.9
average	2.2	5.0	11.2	6.8	25.8	22.1	12.3	15.3	13.6
sd	2.7	2.3	8.9	7.7	8.4	11.4	10.0	7.8	4.9