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Integration of knowledge in river restoration

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ABSTRACT: New EU regulations and expected changes in climate are translated into river restoration projects in ways that require knowledge from science and policies to be integrated with local and experiential knowledge in the design and development of hydro-morphological structures, with the aim to improve ecological conditions. This raises the following questions: what forms of knowledge integration underlie current planning, design and execution of hydro-morphological interventions? Are these adequate? This paper presents research conducted from 2009 to 2010 in the Rhine river basin taking a case study from the Netherlands as an example. The research is transdisciplinary; it studies processes of integration of the social and natural sciences (like hydraulic engineering) and, by engaging with professional practice, also of experiential knowledge. It does not deal with technical aspects of river engineering. The case study examines the integration of knowledge in the design of the 'Doorbraak', a 13 km river engineering project in the east of the Netherlands. The analysis of the integration processes was performed by a group of scientists, water management professionals and policy makers in a two day interactive event; the group itself is experimenting with co-creation of new knowledge. The case study is part of a research program called: "Knowledge in action in river restoration in the Rhine river basin".

Keywords: River engineering, Planning and decision making, Knowledge arrangements, Co-creation, Community of practice

1 INTRODUCTION

In planning river engineering projects, water management meets competing land and water users and usually this leads to complex negotiations. The interests of many must be translated into a concrete project with a workable design. These translation processes are interesting because not only local interests and expert knowledge are at issue but also the legitimacy of sciences, public policies, and technocratic strategies.

Researchers (Funtowicz & Ravetz 1993, Gallopin et al. 2001, Stirling 2006) have highlighted the changing roles of scientists, policy makers and water management professionals in planning. Gaps are recognized between scientific knowledge, practical experience of water management, experience of policy makers and knowledge of stakeholders. Knowledge integration in river basin management is seen as one of the crucial elements of river basin regime formation (Lindemann, 2008) and is considered essential for translating policies like the European Water Framework Directive (WFD) and climate adaptation into river projects. Also the WFD takes international river basins as unit of planning, and the importance of closing cross boundary gaps in knowledge is essential.

In river engineering water managers have to cope with different perspectives on the importance of ecological objectives and standards, on priorities and investments, on evaluations of the impacts of measures and last but not least with land-use issues. Science in all countries abutting the Rhine is contributing to the improvement of understanding, for example by developing Decision Support Systems and models to facilitate planning. But the use of these scientific tools in practice is problematic. The same is true for stakeholder involvement. Stakeholder consultation has been institutionalised in regulations. The WFD for example sets a frame for stakeholder involvement and participation (Kaika and Page (2003)).

In the last decades considerable research has been dedicated to the integration of knowledge in water and river basin management c.f. EU programmes like SLIM (Blackmore et. al. 2007), Harmonicop (2005), and Newater (Pahl-Wostl et al. 2008). These studies build on the understanding that new forms of collaboration emerge as a result of social learning as an organised form of knowledge integration (Blackmore et al. 2007).

This paper describes a research programme that takes knowledge integration in planning and decision taking in river engineering projects as the object of study. The three country studies are ongoing. The results reported here thus are preliminary. The case study presented provides an example of the conceptual framing, the research approach, and the initial results.

2 THE KNAC RESEARCH

Before entering into the case study, this section presents the KNAC research[1]. KNAC is part of the IWRM-net research programme[2] funded by the EU FP6 programme, with additional German and Dutch research funding.

2.1 *Introduction*

"Knowledge in Action in the Rhine river basin hydro-morphological restructuring" (KNAC) is about knowledge integration in modern river engineering projects on a local scale. Our assumption is that improvements in knowledge integration, by joint learning among scientists, professionals and policy makers, is possible. The main elements are:

1. Assessment of knowledge integration in planning and decision making in river engineering activities in sub-basins of the Rhine river basin, based on literature studies and interviews with key stakeholders.
2. Joint testing with stakeholders of approaches to knowledge integration by means of transdisciplinary field study events, each of two days. The first field study is presented in section 3;. The second was held in April 2010 along the river Kyll in Germany; and the third in May 2010 along the Kander in Switzerland.
3. Formulating general principles, relevant to all European river basins, for improving knowledge integration.

The research is executed by a 'community of practice' (CoP) (Wenger 2000, Wenger & McDermott 2002). Representatives from each of the participating countries, with knowledge in a range of sciences, practical and policy experience, and who have stakes in actual river engineering projects, form the CoP membership.

Our research is positioned in the context of the following policy landscape:

1. Implementation of the Water Framework Directive (European Commission 2000) and the General European ambition to improve the environment and the ecological quality of water systems, expressed for instance in the Natura 2000 legislation (European Commission 1992).
2. Climate change. The need for adaptation to probable hydrological impacts of climate change is being translated into projects to enhance the resilience of water systems in order to cope with greater volatility in weather patterns and resultant (more extreme and more frequent) floods and droughts.

2.2 *Theoretical Framework*

In river engineering projects, knowledge from science and policies mixes with local knowledge and experiential knowledge, flowing into the design and development of hydro-morphological structures. During the design process new knowledge may be formed and old practices and routines may become unnecessary or become an obstacle to a smooth execution. Regeer and Bunders (2009) propose two modes of knowledge integration. Mode 1 corresponds with the view that knowledge can be 'transferred' between people. The underlying metaphor of transfer here implies that 'knowledge' has become stabilized and packaged in some formal way as information and that packages of information about knowledge are sent by researchers to receivers (policy makers and practitioners). The process of knowledge creation typically is experienced as (and designed to be) a step by step process, starting with research and ending in its integration in practice. Every step asks for the translation of knowledge into a form thought to be relevant, usable and understandable by the next user. In translation elements usually get lost or re-interpreted.

Payne[3] distinguishes between:

1. Lost before translation: Researchers are producing answers but the questions are not the ones practitioners are interested in.
2. Lost in translation: Researchers are producing the answers that practitioners need, but the

[1] More information on KNAC: http://www.knac-iwrm.eu/knac/knac_de/index.html (30-Jan. 2010)

[2] http://www.iwrm-net.eu/ (30-Jan. 2010)

[3] Presentation at the IWRM-net conference Febr. 2009 in Brussels, see: http://www.iwrm-net.eu/spip.php?article191 (30 Jan. 2010)

practitioners are not aware of the answers (or do not understand them).
3. Lost after translation: Relevant, accessible research results are available to practitioners, but they do not use them.

In mode 2, 'co-creation' (Regeer and Bunders 2009), new knowledge emerges from interaction. In this emergence process 'knowledge' still has a transient form as participants' jointly co-create knowledge. The assumption is that no losses before, in or after translation are made, because of the intensive interactions.

Following this theoretical argument our key research questions are: What forms of knowledge integration underlying current planning, design and execution practice of hydro-morphological interventions exist? Are these adequate?

In discussions on theory in the CoP the metaphor of baking a cake has been used. Integrating knowledge following mode 1 is like 'dividing a cake'. Every stakeholder has his own piece and maintains the integrity of that piece. In mode 2 a new cake is baked. Boundaries of knowledge lose significance in the newly baked cake. Co-creation is compared with 'baking a new cake'.

2.3 *Assumptions*

The basic normative assumptions we make are that:

- In water management practice losses before, in and after translation do occur.
- Knowledge integration needs to evolve (given the overall contextual landscape already noted) so as to enable 'co-researching' among stakeholders.
- A qualitative analysis of knowledge integration, drawing on the three CoP-based field experiments with co-creation, and additional researcher-based assessments, yields relevant lessons of general applicability.

We are interested in understanding how, in each of our sites, the interactions between research and practices are organized, at three levels:
1. local,
2. regional (or national),
3. trans-national (river basin) levels.

The local level is understood as the level where realization of projects such as river restoration, construction of retention measures, flood protection, urban water system improvement, take place. The regional level is where policies, strategies and plans are formulated, such as sub catchment river basin plans for WFD implementation. The third level is where states or nations coordinate their policies and strategies, as in the Rhine commission or the international Rhine WFD implementation project group.

3 FIELD STUDY 'DE DOORBRAAK'

On 30th of November and 1st of December 2009 a CoP meeting took place in the area of the Water Board Regge and Dinkel (Fig.1). The objective was to conduct a field study of a river engineering project, called 'The Doorbraak'. The Water Board is responsible for the project management of the Doorbraak.

During the field study key stakeholders from the region were invited to join in interview-based investigations 'in the field'. Together with water managers, local stakeholders, policy makers and CoP members they engaged in a systematic analysis of and reflection on the project (see section 3.1). The field study involved fourteen CoP members and eleven local stakeholders in two activities;

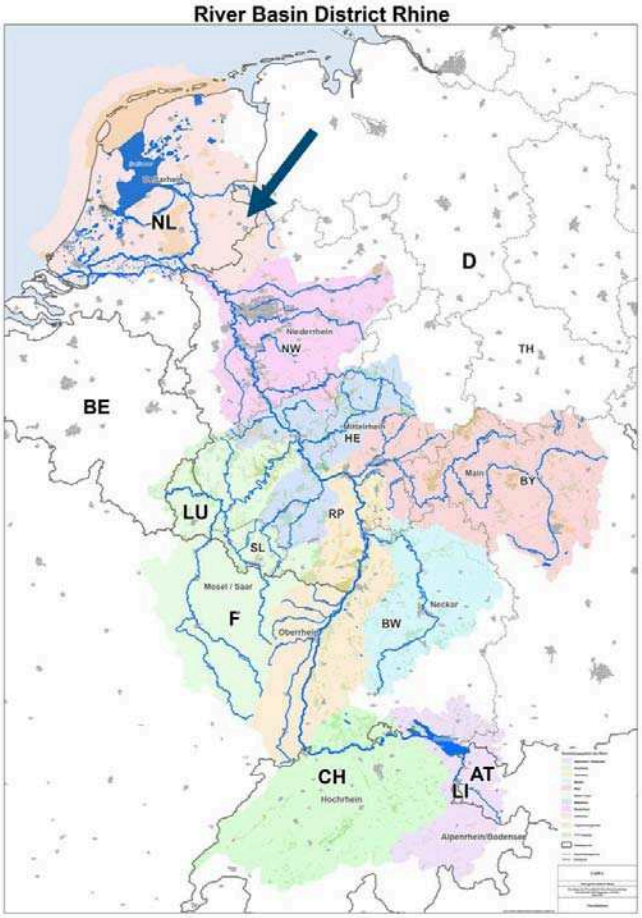

Figure 1: Map of the Rhine River Basin with location of the Doorbraak

1. Studying the actual knowledge integration in this river engineering project, together with local stakeholders and governmental parties.
2. Monitoring the methods of knowledge creation used during the field study experiment, in

order to analyse and assess the added value of these methods.

A crucial element in the field experiments is that the hosting party must benefit from the results. Therefore attention was been paid to preparing the study together with the Water Board of Regge and Dinkel officials. Their expressed need was to be able to formulate explicit learning points and lessons for planning and decision taking, drawing on the 'knowledge integration' among CoP members.

3.1 *The Doorbraak*

De Doorbraak (The Breakthrough) is a newly constructed 13-km long brook through Twente to the South of Almelo (see Fig. 1 and 2) in the Regge river basin. The Regge is a tributary of the Vecht, which flows into the IJsselmeer.

Figure 2: The Doorbraak, south of the city of Almelo, crossing rural areas and infrastructure.

The project was initiated by the Water Board Regge & Dinkel and the province of Overijssel. The preparations first started about twenty years ago and are planned to be finished in 2014, after which the water will stream through the new brook, following the trajectory of existing smaller brooks and new cuts about two metres deep through a hydrological boundary (this is why it is called the 'Breakthrough'). The Water Board estimated the total cost at forty million euro. The stakeholders are three ministries, two water management and land use agencies, three municipalities, farmers, citizen organizations, nature conservation organizations, land consolidation commissions, recreational organizations, businesses, engineering consultants, universities, utility companies, and private investors.

De Doorbraak serves three major goals (Fig.3):

1. Separation of urban and rural watercourses. The cities of Enschede, Almelo and Hengelo (about 700.000 inhabitants) produce polluted water that flows into a branch of the Regge river. The Doorbraak connects two rural branches while making it possible to separate the 'urban' branch, thus improving the water quality in an important part of the Regge river basin and contributing to WFD objectives.
2. Prevention of floods in the city of Almelo. The new brook serves as a detour canal for water flowing in the direction of the city of Almelo. The brook (being 75 meters wide) also contributes to enhancement of the resilience of the water system to extreme climatic events by creating more space for water.
3. Establishment of an ecological connection zone between two rural areas by crossing areas of housing, railways and highways. Over time, the Doorbraak also will enhance landscape values and incorporate recreational and educational functions.

Figure 3: areal view on the Doorbraak. Picture: Water Board Regge and Dinkel

3.2 *Conceptual Framework*

In discussion with the CoP a conceptual frame has been formulated which makes comparison of knowledge integration of the field studies in KNAC possible. This frame was adapted from theories of knowledge systems and cognition. Research (Röling, 2002) shows that competent decision making in networks of interdependent actors is a result of continuous interaction between different elements (or kinds) of knowledge.

Bawden & Röling (Röling, 2002) have developed a model (Fig.4) of cognitive systems based on research on cognition and learning. The model connects four elements that are present in any cognitive entity. It shows that the values and emotions of the actors with a stake in the planning and decision taking, perceptions of the environment in which the entity exists, the actors' theories about this world, and the action taken in it, are connected with each other. The assumption is that integration of knowledge in planning and design takes place when sufficient attention is paid to all the elements and when there is a measure of coherence among them. Further, stakeholders' insights about each others' 'knowledge elements'

helps to improve the integration of diverse knowledge into planning and decision taking.

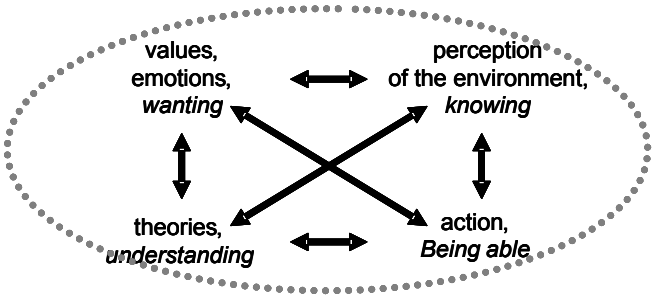

Figure 4: Model of a cognitive entity

3.3 *Data collection and methods used*

The research was executed by members of the CoP as well as the policy makers and practitioners engaged in the research process. The following methods for data collection were used:

- Study of project reports and maps.
- Presentations from officials of the Water Board and round table discussion of questions.
- Field visit with officials of the Water Board.
- Interviewing of invited stakeholders. As most members of the CoP did not have any interview experience these were prepared carefully. A semi structured question list was distributed (based on the four elements of the conceptual framework shown in figure 4) to teams of two interviewers. Eleven interviews were conducted with: farmers, officials from local, regional and national governments, nature organization and house owners living along the Doorbraak.
- Analysis of interview reports in a plenary session, using the conceptual framework.
- Plenary discussion of the findings of the Doorbraak analysis.
- Plenary self evaluation of the co-creation process during the research.

The field study was prepared by a team from the Water Board of Regge and Dinkel and the University of Wageningen.

3.4 *Presentation and discussion of findings on integration of knowledge in the Doorbraak project.*

Three issues were highlighted in the discussions among CoP members on the findings and analysis. These three issues are presented in this section.

1. Communication and knowledge interaction.

During the life cycle of the Doorbraak project communication practices have evolved. In the 1990s communication between government and the public was understood as 'informing or consulting the public'. New forms of communication, involving interaction and stakeholder participation, have come into practice since 2000, confronting project managers with new knowledge perspectives

The interviewed stakeholders expressed different views on the communication processes in and about the Doorbraak. Some praised the 'interactive information' meetings on the plans and the designs that have been held throughout, at which participants were invited to contribute to the design of the Doorbraak. The detailed design of the brook was left flexible on purpose by the Water Board designers in order to create space for adaptation of the designs and plans by local inhabitants and house owners. This emphatically 'open' and flexible attitude of the Water Board was recognized and respected. Also much attention has been paid to transparent information sharing (website, newsletter, meetings, drawing media attention etc.).

But there was also criticism. Some farmers complained about the project's multiple objectives (see point 2). They claimed they did not understand the rational of the project anymore. They particularly expressed their problems with the inclusion of nature goals. They agree with the water drainage objective, but disagree about the nature development side of the project. And they complained about the lack of personal contact ("I have good coffee at home")[4].

The nature – agriculture tension was not only expressed by the farmers. Water Board experts and officials mentioned it too. The experts did not have professional ecological expertise and all of them mentioned their 'good learning experience' relating to how to match ecology with civil engineering, hydrology and supervision by learning from the implementation process. Still, it was clear that ecology lies outside the professional routine of Water Board experts.

The Ministry representative expressed the view that knowledge interaction among political, technical and management levels was not flowing smoothly. People were talking "*different languages*".

[4] The interviewed farmers were still in negotiation with the water board. Of a total of 160 involved farmers, 10 are still negotiating transfer of land ownership to the project. These negotiations are connected to the construction of a new industrial site. A complicating factor is that land prices are rising because of the 'speculation value' of the new industrial site.

Figure 5: View on the Doorbraak. Picture: Water Board Regge and Dinkel.

2. Goals

During the project life cycle, new objectives were added to the initial goal (flood management, and separating urban and rural water flows in order to improve the water quality). The project has all the characteristics of a masterful adaptive implementation strategy or a '*learning by doing*' strategy. New policy priorities were translated into the planning (like the ecological main structure and the European Water Framework Directive) and unexpected windows of opportunity were used (like the flooding of the city of Almelo in 1998 and the sense of urgency thereafter, and the construction of a new industrial site south of Almelo). This impacted on the design. For instance the initial mean width of the required zone was 25 metres, but after ecological goals were added this became 75 metres.

New policies and windows of opportunity presented also new financial opportunities. The Water Board could finance only part of the project investment costs and other funding was needed. Therefore subsidies (from Europe) and contributions from other parties (province, municipality Almelo, ministry) have had to be sought and integrated. The art of searching for additional sources of finance and integrating these in the project is called by Water Board experts "*financial engineering*". The definition of the goals of the project has been heavily influenced by this dependency on (or, integration of) external funds. "*Everything of this project is about money*" (project manager)

3. Monitoring Success

Because of the adaptive nature of the project and the flexible goal setting the monitoring of success became very important but it also became more complicated. An integrated project like the Doorbraak is framed as improving the sustainability of the region. But how to monitor and measure progress toward sustainability? Also, the project is presented as an improvement of the Twente landscape and of course as an ecological zone. But how can the success be effectively monitored in these terms? Two issues arose during discussion:

- Engineering a new 'natural' brook is in essence unnatural. And therefore much attention is being paid to landscaping, design of infrastructure, ecological design etc. The question becomes: what criteria exist to measure the degree to which an engineered construction is sustainable?
- The mean width of 75 meters is justified as 'being necessary to create enough habitat for a functional ecological zone' and as 'the area needed to have enough space for water in order to safeguard the protection of Almelo against floods'. But on what criteria are these statements built? The point was made that here scientific evidence or knowledge should play a role, but often certain knowledge is lacking at the time decisions have to be taken. And what knowledge might be used to monitor such claims?

3.5 *Analysis of co-creation in the CoP*

The CoP members conducted a self evaluation of the 'cake baking' (co-creation of knowledge) during the field study.

During the field study knowledge and experiences were shared between the Water Board and the other CoP members. The awareness increased that the KNAC participating countries face common problems and have similar approaches to finding solutions. The members' practical knowledge, based on experience, was used to form suggestions to the Water Board and included improving the communication strategy and recognising the importance of mobilising scientific evidence to support project objectives.

At the final evaluation there was a positive feedback from CoP members. The working atmosphere was perceived to be constructive and, between the CoP members themselves, a 'friendly professional relationship' began to evolve. The cultural differences between the Dutch and German participants were not as important as expected beforehand.

4 DISCUSSION

One field study does not produce enough empirical material to be able to execute a profound analysis of knowledge integration. But going back to the research question: "*what forms of knowledge integration underlying current planning, design and execution practice of modern river engineering exist?*" preliminary answers may be formulated. A 'red thread' in the CoP's findings (sec-

tion 3.4) is the observation that 'different languages' are spoken. In the field study interviews the following discourses were recognized:

- The need to increase the safety of the city of Almelo against floods. After severe flood damages in 1998 the Doorbaak project was framed as an effective detour channel for water flow around Almelo.
- The need to enhance ecological values. First the Doorbraak was framed as an interesting ecological connection zone between two nature areas, divided by the urbanized areas. Later European legislation (Natura 2000; European Commission 1992 and WFD; European Commission 2000) heightened the perception of the need for ecological improvements (but also thereby increasing the potential for conflict with farmers' perceptions of their interests).
- Farmers' need to keep space for entrepreneurial growth . Farmers argue that any change of function in agricultural land and water decreases the potential to develop their business in the future.
- Regional governments and developers of industrial sites frame the Doorbraak project as an improvement of the traditional Twente landscape, that is today considered to be of 'high cultural value'.
- Scientists and specialists question the scientific underpinning of design choices (why 75 metres?) and the problems with monitoring of success. On what grounds can cost benefit analysis be made?

The question is how were these discourses integrated in the Doorbraak project?

As the Water Board is responsible for project management their role must be considered first. The CoP observed that the Water Board shows an impressive capacity to engineer and realise a complete new infrastructure of 13 km in a context of constrained funding, continuous re-negotiations on the objectives and (until now) land acquisition only on a voluntary basis. The Water Board officials who were interviewed showed a remarkable motivation for the project '*I take my grandchildren here to show them'*, '*This project is my baby*'. Engineering of an integrated design clearly resonates with their professional interest.

The strategy was one of going slow and benefitting from opportunities when they appeared. New policies (flood control, WFD, Natura 2000) were integrated into the planning when they came into force, and provided legitimacy for decision-making, and local opportunities (new industrial site, connection with a nature area) were seized whenever possible. The planning may be characterized as an adaptive process; although the decision to construct the Doorbraak itself was non-negotiable, the design procedures were flexible and responsive to a range of stakeholder concerns. In this regard, the co-financing imperative proved a strength in terms of knowledge integration, enabling the project to push toward greater multi-functionality over time. Indeed, the Water Board professionals see the 'financial engineering' experience as a crucial factor in project success. Land acquisition provided other opportunities for knowledge integration. Farmers and inhabitants were invited to translate their local interests into the design, on the condition that the overall design criteria were honoured. Many seized the opportunity (although a few farmers still refuse to negotiate).

The second research question of KNAC is '*Are actual forms of knowledge integration in river engineering adequate?*'

The CoP found that the Water Board is strong on the action and explicit strategy side. It is quick and pragmatic in seeking and integrating new knowledge when needed. But on the other side, their discourse on the deeper values and emotions stirred up by a complete new waterway remained superficial and 'distant'. A question here is whether the project management not only should involve stakeholders in planning and execution issues (as they did), but also should initiate a broad regional dialogue on the transformation of an old agricultural landscape into a new ecological waterway and, if so, at what stage(s) of the planning and decision making process. The CoP experienced co-creation of knowledge itself during the two day field study event. This experience was evaluated as rich and powerful. But how widely applicable is this kind of interactive meeting among different knowledge fields in the planning and decision-making processes involved in river restoration? The findings and analysis from the completed KNAC project will be reported at end-2010.

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REFERENCES

Blackmore, C., R. Ison, J. Jiggins. (2007). "Social Learning: an alternative policy instrument for managing in the context of Europe's water." Environmental Science & Policy 10(6): 493 -586.

European Commission (1992) Council Directive 92/43/CEE, of 21 May 1992, on the conservation of natural habitats and of wild fauna and flora. European Commission. Brussels.

European Commission (2000). Directive 2000/60/EC of the European Parliament and the Council of 23rd October 2000 establishing a framework for Community action in the field of water policy. Official Journal 22 December L 327/1. European Commission. Brussels.

Funtowicz, S., Ravetz, J. (1993) Science in the Post-Normal Age. Futures 25 (7): 735-755

Gallopin, G. C., Funtowicz, S., O'Connor, M., Ravetz J. (2001). Science for the twenty-first century: from social contract to the scientific core. International Journal Social Science 168: 219-229

HarmoniCOP (2005). Learning Together To Manage Together; Improving Participation in Water Management. D. Bergmann. Osnabruck.

Kaika, M. and B. Page (2003). "The EU Water Framework Directive: Part 2. Policy Innovation and the Shifting Choreography of Governance." European Environment(13): 328-343.

Lindemann, S. (2008). Understanding Water Regime Formation – A Research Framework with Lessons from Europe. Global Environment Politics 8:4, November 2008.

Pahl-Wostl, C., Kabat, P., Möltgen, J. (eds) (2008). Adaptive and Integrated Water Management. Coping with Complexity and Uncertainty. Springer: Berlin Heidelberg.

Regeer, B. J., Bunders, J.F.G. (2009). Knowledge co-creation: interaction between science and society. A transdisciplinary approach to complex societal issues. RMNO. Den Haag

Röling, N. (2002): Beyond the Aggregation of Individual Preferences. Moving from multiple to distributed cognition in resource dilemmas. Wheelbarrows Full of Frogs. Social Learning in Natural Resource Management. C. Leeuwis and R. Pyburn. Assen, Koninklijke Van Gorcum: 25-28.

Slim (2004). Social learning as a policy approach for sustainable use of water. A field tested-framework for observing, reflecting and enabling slim (social learning for the integrated management and sustainable use of water at catchment scale). Milton Keynes, Open University.

Stirling. A. (2006) From Science and Society to Science in Society: Towards a Framework for Co-Operative Research. Report of a European Commission Workshop. Governance and Scientific Advice Unit of DG RTD, Directorate C2. Directorate Gerenral Research and Technology Developments. Brussels. 24th-25th Nov. 2005

Wenger, E. (2000). Communities of Practice and Social Learning Systems. London, Sage Publications.

Wenger, E., McDermott, R. & W. M. Snyder (2002): Cultivating communities of practice, Boston: Harvard Business School Press.