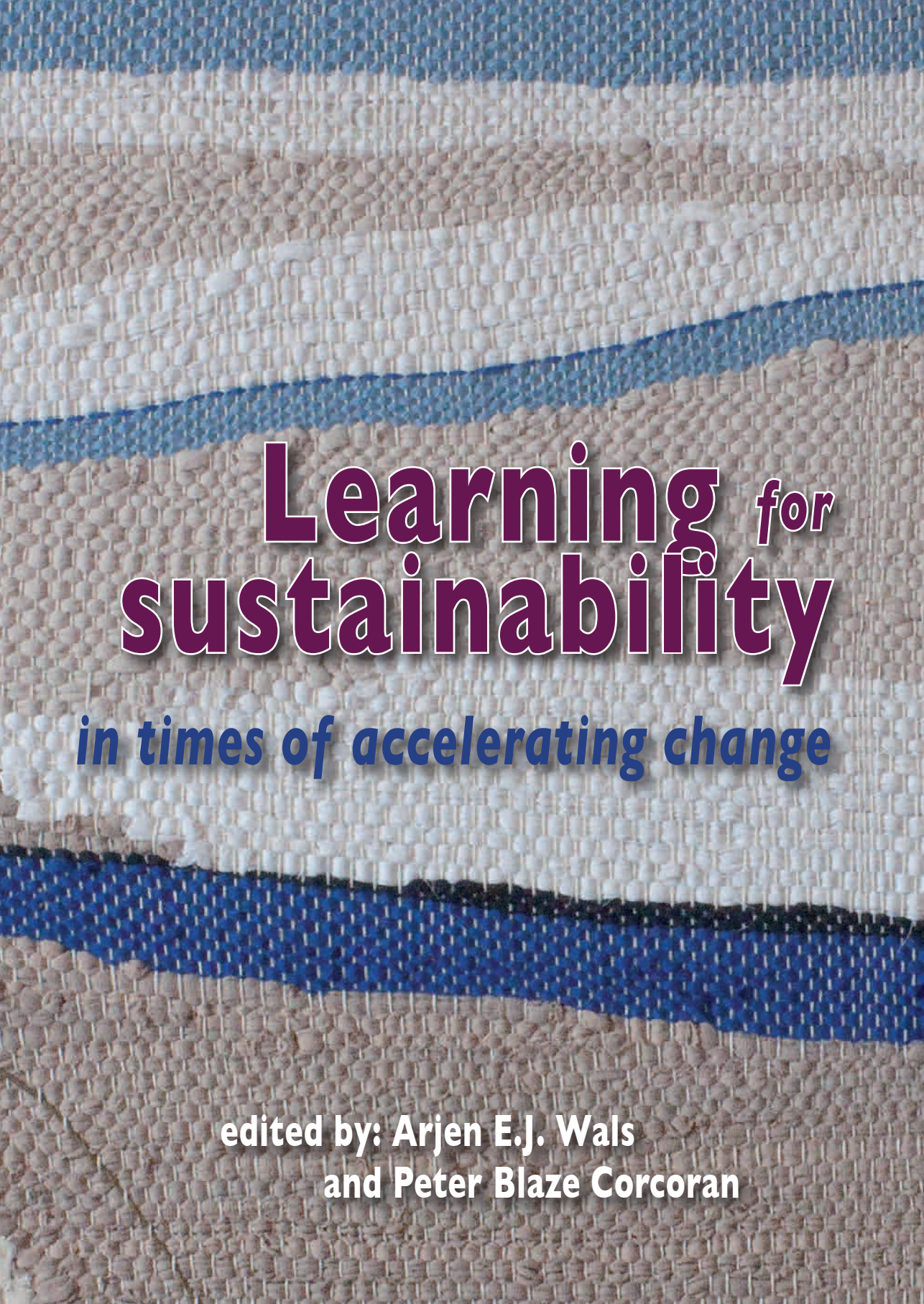
Learning for sustainability
in times of accelerating change
edited by: Arjen E.J. Wals
and Peter Blaze Corcoran

Learning for sustainability in times of accelerating change

edited by:

Arjen E.J. Wals

Peter Blaze Corcoran

Wageningen Academic
P u b l i s h e r s

ISBN: 978-90-8686-203-0
eISBN: 978-90-8686-757-8
DOI: 10.3920/978-90-8686-757-8

Cover art: "Handwoven Waddensea Landscape" by Marijke van der Maarel

First published, 2012

Table of contents

Acknowledgements 13

Foreword 15
Juliet Schor

INTRODUCTION 19

Re-orienting, re-connecting and re-imagining: learning-based responses to the challenge of (un)sustainability 21
Arjen E.J. Wals and Peter Blaze Corcoran

PART ONE – RE-ORIENTING SCIENCE AND SOCIETY 33

Chapter 1 Towards greater realism in learning for sustainability 35
John Huckle

Chapter 2 Participation and sustainable development: a matter of public concern 49
Joke Vandenabeele and Katrien Van Poeck

Chapter 3 Pedagogy for survival: an educational response to the ecological crisis 63
Thomas Nelson and John A. Cassell

Chapter 4 Weaving pedagogies of possibility 77
Marcus Bussey, Ase Eliason Bjurstrom, Miriam Sannum, Shambhushivananda Avadhuta, Bernard Nadhomi-Mukisa, Leonel Ceruto, Muwanguzi Denis, Ananta Kumar Giri, Asha Mukherjee, Gennady Pervyi and Maria Victoria Pineda

Chapter 5 Harnessing time travel narratives for environmental sustainability education 91
Eric C. Otto and Andrew Wilkinson

Chapter 6 Ethical deliberations in environmental education workplaces: a case story of contextualised and personalised reflexivity 105
Lausanne L. Olvitt

Chapter 7 Queering ecology: interrogating 'seductions to organic wholeness' in popular environmental rhetoric 121
Joseph P. Weakland

Chapter 8 Building resilient communities: where disaster management and facilitating innovation meet 133
Karen Elisabeth Engel and Paul Gerard Hendrik Engel

Chapter 9 Towards successful joint knowledge production for global change and sustainability: lessons from six Dutch adaptation projects 149
Dries Hegger, Annemarie van Zeijl-Rozema and Carel Dieperink

Chapter 10 Getting active at the interface: how can sustainability researchers stimulate social learning? 167
Jayne H. Glass, Alister Scott and Martin F. Price

PART TWO – RE-CONNECTING PEOPLE AND PLANET 185

Chapter 11 Finding hope in a world of environmental catastrophe 187
Elin Kelsey and Carly Armstrong

Chapter 12 Inviting the unforeseen: a dialogue about art, learning and sustainability 201
Natalia Eernstman, Jan van Boeckel, Shelley Sacks and Misha Myers

Chapter 13 Relationship-based experiential learning in practical outdoor tasks 213
Erling Krogh and Linda Jolly

Chapter 14 Transformative learning: towards the social imaginary of sustainability: learning from indigenous cultures of the American continent 225
Sylvia Catharina van Dijk and Eduardo Ernesto van Dijk

Chapter 15 Re-connecting with traditional knowledge: the experience of the Shangri-la institute for sustainable communities in China 241
Yunhua Liu and Alicia Constable

Chapter 16 Sustainability as meaningful relatedness: lessons from Grandmother Bear 255
Johanna M. Beyers

Chapter 17 Spirited practice of transformative education for sustainability 269
Alison Neilson, Doug Blomberg and Rosalina Gabriel

Chapter 18 How reflective practice can enhance learning for sustainability 283
Katherine Davies

PART THREE – RE-IMAGINING EDUCATION AND LEARNING 297

Chapter 19 How to handle knowledge uncertainty: learning and teaching in times of accelerating change 299
Rebekah L. Tauritz

Chapter 20 Enhancing environmental learning through controversy 317
David Zandvliet

Chapter 21 The role of knowledge, learning and mental models in public perceptions of climate change related risks 329
Jennifer Helgeson, Sander van der Linden and Ilan Chabay

Chapter 22 Designing and developing learning systems for managing systemic change in a climate change world 347
Chris Blackmore and Ray Ison

Chapter 23 Challenges for educators of building people's capacity for mitigating and adapting to climate change 365
Robert B. Stevenson, Jennifer Nicholls and Hilary Whitehouse

Chapter 24 Living systems, sustainability education, and institutional change 381
Michael K. Stone and Zenobia Barlow

Chapter 25 Balancing the whole: a dialogue around a frameworks-based education programme 395
Ken Webster and Paul Vare

Chapter 26 By their practice you will recognise them: a case study on a failed effort to implement education for sustainable development into the competence based Swiss curriculum 411
Johannes Tschapka

Chapter 27 Learning for sustainability in science education in Africa: 'learning as connection' an imperative for transformation 425
Overson Shumba

Chapter 28 Exploring possibilities of organisational learning-based change and transition towards sustainability 439
Abel Barasa Atiti

Chapter 29 We know how they feel: Global Storylines as transformative, ecological learning 457
Marie Jeanne McNaughton

Chapter 30 Engaging youth in developing urban plans using geographic information systems and computer visualization 477
Dennis J. DeBay, James Haley, Sheron Mark, Michael Barnett, Amy Anderson, Eric Strauss, Lindsey Cotter-Hayes, David Blustein and Catherine Wong

Chapter 31 Active learning about energy and sustainability: the SIEU experience 497
Lieke Dreijerink and Geja Roosjen

EPILOGUE 509

Afterword: let's face the music and dance? 511
Stephen Sterling

Biographies editorial team 517

Contributor biographies 519

DOI: 10.3920/978-90-8686-757-8_09

Chapter 9

Towards successful joint knowledge production for global change and sustainability: lessons from six Dutch adaptation projects

Dries Hegger, Annemarie van Zeijl-Rozema and Carel Dieperink

Abstract

In several Western European countries, scientists, policymakers and other actors collaborate in regional climate change adaptation projects. Such joint knowledge production is often assumed to lead to reconciliation of supply and demand for knowledge. Many conceptual analyses of joint knowledge production have been performed, yet systematic empirical assessments of the phenomenon are lacking. This chapter aims to address this gap by providing a retrospective analysis of six Dutch regional climate change adaptation projects, which were all part of two large programs, 'Climate Changes Spatial Planning' and 'Living with Water'. The analysis is based on desk research and 27 semi-structured interviews with researchers, policymakers and project funders. The chapter first explores how the success of joint knowledge production can be analyzed and, second, how differences in success can be explained. Based on the analysis, two variables are proposed clarifying the context in which a project takes place: (1) epistemological distance between participating actors; and (2) normative consensus. The chapter denominates some initial design principles for joint knowledge production. It is concluded that science-policy cooperation in regions seems to provide opportunities for transformative cross-boundary learning.

Introduction

Connecting science, policy and practice in the domains of global change and sustainability is a daunting task due to the value pluralities and uncertainties involved (Hisschemöller and Hoppe 2001, Kemp and Rotmans 2009). Also, connecting science and policy is inherently complex. Interactions are neither simple nor linear due to differences in time frames, reward structures, goals, process cycles and epistemologies (Edelenbos *et al.* 2011, Talwar *et al.* 2011, Van den Hove 2007, Weichselgartner and Kasperson 2010).

In literature (Pohl *et al.* 2010, Regeer and Bunders 2009; Van Buuren and Edelenbos 2004, Vogel *et al.* 2007) and in practice, joint knowledge production is endorsed as a potential way to deal with these challenges. Joint knowledge production is said to lead to 'better', 'more policy relevant', or 'more socially robust' knowledge. It could enhance mutual understanding through better communication; enable parties to learn each other's language; and do justice to different forms of knowledge including scientific-, practical-, local- and tacit knowledge (Van den Hove 2007). On the other hand, science can become tainted with politics. Joint knowledge production might become a merely strategic or symbolic process (Cash *et al.* 2003, Edelenbos *et al.* 2011).

Most existing analyses of joint knowledge production are conceptual in nature (Hoppe 2005, Van den Hove 2007, Van Kerkhoff and Lebel 2006). Existing empirical studies (e.g. Edelenbos *et al.* 2011, Kemp and Rotmans 2009, Roux *et al.* 2006, Steyaert *et al.* 2007, Talwar *et al.* 2011) are fragmented in their aims and scopes. Comparative empirical analyses clarifying how joint knowledge production could be done successfully and what would be suitable success conditions are lacking. Therefore, we first will explore how the success of joint knowledge production can be analyzed and, second, how the differences in success between projects can be explained. Based on this analysis, we will propose two variables clarifying the context in which a project takes place: (1) epistemological distance between participating actors; and (2) normative consensus. We will argue that successful joint knowledge production requires forms of co-production appropriate to the context specified by these two variables.

Our analysis is based on a retrospective analysis of six Dutch adaptation projects. These were part of two programs, titled 'Climate Changes Spatial Planning' (CCSP; http://climatechangesspatialplanning.climateresearchnetherlands.nl) and 'Living with Water' (LWW; http://www.levenmetwater.nl/home/). Both programs explicitly stated in documents that they endorsed joint knowledge production. We thoroughly assessed the projects' success, using Cash *et al.*'s (2003) criteria for the effectiveness of knowledge systems for sustainable development: credibility, salience and legitimacy. Next, we looked for factors explaining the differences.

Conceptual clarification and methodology

This section first introduces and operationalizes our two key notions 'joint knowledge production', and 'successful joint knowledge production'. Second, we will clarify our case selection and our data collection methods.

Joint knowledge production

Joint knowledge production in projects implies that scientists, policymakers and other societal actors cooperate directly in the exchange, production and application of knowledge (Cash *et al.* 2003, Van den Hove 2007, Van Kerkhoff and Lebel 2006). Such cooperation takes place at the 'science-policy interface' and involves 'a social process which encompasses relations between scientists and other actors in the policy process and which allows for exchanges, co-evolution and joint construction of knowledge with the aim of enriching decision making' (Van den Hove 2007). Joint knowledge production can be seen as a manifestation of both mode 2 knowledge production (Gibbons *et al.* 1994), post-normal science (Funtowicz and Ravetz 1993) as well as a broader deliberative turn in environmental governance (Bäckstrand *et al.* 2010).

Interaction between science and society always takes place to at least some extent. As literature from the STS field illustrates (e.g. Jasanoff 2004), knowledge and social order is always co-produced through various – often indirect, subtle and intractable – interaction mechanisms. Hence, joint knowledge production should be seen as a more direct and recognizable form of something that always takes place, namely co-evolution or co-production of science and society.

Bringing actors together in projects does not automatically lead to jointly produced knowledge. This is something that should be empirically assessed. To make a start with such empirical assessments, we have interviewed key actors, asking them for examples of knowledge which, according to them, could only be developed through cooperation. We expected to find examples of content-wise as well as process-related learning, both at the first-order level (means-end reasoning in case of a given policy problem and -context) as well as at the second-order level (on problem definitions and relevant policy arenas) (Van de Kerkhof and Wieczorek 2005). Of course, the outcomes of our endeavour cannot be more than a first exploration of the merits and limitations of joint knowledge production. Since we did not compare 'joint knowledge production' projects with 'normal-science projects', we cannot determine with certainty that cooperation was absolutely necessary to achieve the stated outcomes.

Conceptualising the success of joint knowledge production

Hegger *et al.* (2012) have defined successful joint knowledge production as 'a process in which the actors involved have managed to maximize synergy and minimize tradeoffs between the salience and credibility of the knowledge produced as well as the legitimacy of the process' (p. 54). The notions of credibility, salience and legitimacy were originally coined by Cash *et al.* (2003), who found

that exchanges between science and policy are likely to be effective if criteria for salience, credibility and legitimacy can be met simultaneously for all actors involved. Credibility refers to the perceived adequacy of the knowledge produced. Salience refers to the perceived relevance of this knowledge. Legitimacy refers to the extent to which knowledge production has been respectful of the divergent values and beliefs of stakeholders, unbiased in its conduct and fair in its treatment of opposing views and interests (*ibid.*).

Two assumptions underlie this definition. First, it is assumed that actors have different knowledge interests. Scientists may for instance be interested in knowledge that meets scientific standards and constitutes material fit for publication, while they feel free to report unwelcome findings to policymakers. Policymakers may be interested in plausible knowledge (credibility) that meets the demands of decision makers, while they hope that something is in it for them (legitimacy). Hence, actors will have different criteria and thresholds concerning credibility, salience and legitimacy (Cash *et al.* 2003). A second assumption is that given the value pluralities and uncertainties inherent in joint knowledge production, a constructivist evaluation of 'success' is in order. *De facto*, this presupposes a focus on process rather than outcome evaluation, although one can logically assume that a successful process forms a positive contribution to outcomes. The perceived quality of the process is of tremendous importance for assuring long-term commitment of parties, a precondition for social learning (Lee 1994).

Case studies and data collection

We used an embedded case study design (Yin 2008, Scholz and Tietje 2002) involving multiple levels (project and program). We aim to find differences attributable to knowledge production processes. We selected the research programs CCSP and LWW that both focus on water and climate and both aim at science-policy-practice collaboration. From the programs we only selected recently finalized projects in which at least scientists and public policymakers participated as partners. To ensure that all partners had a real stake, we did not select projects with a budget less than one hundred thousand Euros. In order to make a preliminary assessment of the projects' success we scanned available documents. We tried to identify different 'success rates' within comparable background conditions (program structure, financing schemes, empirical focus). Such a 'differentiating comparative analysis with plural causation' (Pickvance 2001) allowed us to gain insight into the diverse factors that may explain success. Table 1 provides an overview of the 6 projects selected for in-depth-analysis.

Data was collected through desk research and 27 semi-structured interviews. For each project, we interviewed actors from science, policy and program level

(4-7 interviews per project). Topics discussed included: outcomes (knowledge, policy measures, and network contacts); interviewees' interest and passion; the relationship between the project and interviewees' other activities; their original expectations (and the degree to which these were met); main lessons about science-policy collaboration; and finally, their opinion on whether the cooperation was fruitful. We tried to be mindful of the fact that what interviewees reported to us could be part of a (conscious or unconscious) process of 'strategic deployment of success/failure' (Van Assche *et al.* 2011) rather than their genuine opinion.

Characteristics of the six cases

Table 1 gives a characterization of the projects in terms of duration, budget, participants and stated goals. The first three projects received funding from the 'LWW' program (2005-2010), the last three from 'CCSP' (2004-2011). Both programmes were co-financed by the Dutch government (through the 'Economic Structure Enhancing or FES Fund') and by participating societal actors.

The FES covered € 22 million of the LWW program's budget, while the consortium partners co-financed another € 28 million. The CCSP program received € 40 million from the FES and € 50 million from participating organizations and stakeholders. The LWW projects aimed to (1) contribute to a transition from 'keeping down water' to 'accommodating water'; (2) intensify collaboration between technical and social scientists; and (3) strengthen knowledge infrastructures). The CCSP projects aimed to contribute to 'climate proofing'. This notion (Kabat *et al.* 2005) refers to developing and mainstreaming climate adaptation and mitigation measures; social innovation in risk management and coping strategies; and other technological, institutional and social innovations (Climate Changes Spatial Planning and Knowledge for Climate 2009). Apart from more fundamental research projects (on climate scenarios, mitigation, and adaption) and knowledge integration and communication activities, the CCSP program has introduced the so-called hotspots. In specific areas such as the Zuidplaspolder and Groningen, scientists, policymakers and practitioners collaborated in practice-oriented research on climate-proofing.

As Table 1 illustrates, in all projects actors from science and public policy are represented, albeit in different roles. All project goals have been formulated in terms of the projects' societal relevance. In accordance with our criteria, the projects seem to be substantial in terms of duration and budget, albeit with some differences between the projects. Other differences concern the individual participants, the project goals and the type of coordinating actor (once a research institute, twice a university, twice a provincial entity, and once a freelance coordinator).

Table 1. Characteristics of the selected projects.

Project	Duration	Budget in Euros	Participants (coordinator in italics)	Roles for scientific researchers	Goals stated in documents
What's the future of low-lying peat land?	2005-2009	3,250,000	Utrecht University; Research Institutes LEI and *Alterra*; Free University Amsterdam; three Ministries; three provinces; three Water Boards; various stakeholders, consultants; other actors	Two PhD researchers within broad consortium	Mapping out (ecological, economic, social) consequences of water management strategies in low-lying peat areas; developing new water management strategies
Co-valuation of water	2006-2009	925,000	*Erasmus University Rotterdam*; research institute TNO; Province of Zeeland; Municipality of Middelburg; regional Water Board; Inhabitants of Arnemuiden; TAUW consultancy	PhD researcher as main project executor	Development of two integrated regional visions, supported by inhabitants, on an area near Arnemuiden, in which water plays a profound role
Transitions Sustainable Urban Water manage-ment (SUW)	2005-2009	730,000	*Erasmus University Rotterdam*; research institutes for water and wastewater management (KWR/STOWA); municipalities of Heerhugowaard and Rotterdam; regional Water Boards; consultants	PhD researcher as main executor	Assessing the feasibility of concepts for more sustainable urban water management; analyzing the (potential for) socio-technical transitions needed to implement these concepts
Hotspot Zuidplas-polder (ZPP)	2007-2008	NA[1]	Wageningen University and Research Centre; VU University Amsterdam; *Province of Zuid-Holland*, regional Water Board; several consulting companies	Two PhD researchers involved; project was 'a case' for them	Assessing the climate resilience of development plans in Zuidplaspolder; developing climate proof designs; assessing the costs and benefits of adaptation options

Table 1. Continued.

Project	Duration	Budget in Euros	Participants (coordinator in italics)	Roles for scientific researchers	Goals stated in documents
Hotspot Groningen	2008-2009	NA	Experts from Water Board; universities, research institutes and other organizations; *Province of Groningen*	Workshops with many researchers	Providing input to make the regional plan 'climate proof'
Route-planner (co-executed by LWW and Habiforum)	2006-2007	NA	University researchers from three programs, Ministries of Economic Affairs; Housing, Spatial Planning and the Environment; Traffic and Water Management; *freelance coordinator*	Different researchers involved in various roles	Providing policymakers at the national level with state of the art insights from the three participating programs, getting input for a national adaptation strategy

[1] NA: not available.

What Table 1 does not show is that the projects also differ in the dynamics through which they have been initiated. The projects were more often initiated by the 'demand side' than by the 'supply side', contrary to the observation of Talwar *et al.* (2011), who found that, in Swiss sustainability research, virtually all transdisciplinary projects are science-driven. Nevertheless, issues were put on the agenda and projects were planned via various mutual interactions between scientists, policymakers and program managers. *Routeplanner* was the only 'purely policy-driven' project. The establishment of *What's the future of low-lying peat land?* by applied researchers was a reaction to knowledge needs articulated by national and regional policymakers. The *CCSP Hotspots* were set-up and coordinated by provinces but their participation was a reaction to the research program's funding opportunities. There were two more 'science-driven' projects. In *Transitions SUW*, scientists initiated research and sought collaboration with two municipalities (Rotterdam and Heerhugowaard) who provided the case studies. Both municipalities initially saw their role as 'facilitators of research'. At least in the case of Rotterdam, this changed when it was discovered that the researched concepts could provide economic opportunities. *Co-valuation of water* was initiated by the Dutch applied research organization TNO and Erasmus University Rotterdam. These institutes sought collaboration with the local stakeholders and applied for funding from LWW.

Comparing the success of the projects

This section discusses the relative success of the analysed projects. Table 2 provides a general impression of the projects' output and outcomes as reported by the interviewees. We will discuss whether these reported output and outcomes meet actors' perceived credibility, salience and legitimacy criteria.

Credibility

In most projects, credibility did not seem to be an issue of great concern (*Hotspot ZPP*, *What's the future of low-lying peat land?*, *Transitions SUW* and *Routeplanner*). Actors' remarks on credibility were general in nature. For instance, it was frequently mentioned 'that practical knowledge enables researchers to do more credible research'. In *Co-valuation of water* and *Hotspot Groningen*, however, serious criticisms were raised which can be interpreted as a lack of credibility. In *Co-valuation of water*, an interviewee mentioned 'that the developed visions were unrealistic and not well-supported'. In *Hotspot Groningen*, some interviewees criticized the project leader, describing him as a visionary person who – although he was officially a policy officer – was seen as a 'representative of science'. Two general observations can be made on the basis of this comparison. First, credibility only became an issue in cases in which there were 'dissidents' in the projects (value

Table 2. Some reported results of the analyzed projects.

Project	Documents produced	Other output/outcomes	Illustrative interview quote
What's the future of low-lying peat land?	Two PhD theses (ecology; public administration, both in progress), several articles (some in progress); many project reports	Platform for ongoing debate, development of COP; knowledge exchange via broad consortium meetings during project	'People within the agricultural sector started to see that the problems in peat land areas are real ... One of the farmers is still saying: 'you want to deprive us of the best soil'. My answer is always: '[that is the best soil] because the speed of soil subsidence is highest there' (hydrologist).
Co-valuation of water	Two regional visions (not executed) based on participatory process with inhabitants; a PhD thesis; several reports and articles	Knowledge on the merits and limitations of participatory processes	'There were questions posed to the experts by people who did not understand what they were asking. A public administration scholar does not know what 'cubic meter per second' means ... if you do not know that, you cannot talk to techies' (scientific project supervisor)
Transi-tions SUW	PhD thesis (boundary of civil engineering, transition management, water management); several articles	Knowledge on feasibility of new concepts; application of some of them (floating pavilion in Rotterdam harbour)	'You have to make sure that all stakeholders, including your professor, are a bit satisfied ... that's your scope for action ... the stakeholders put a lot of pressure on you and are not always satisfied. On the other hand, it can be functional to get critical feedback at the start (PhD researcher)
Hotspot ZPP	Reports on climate effects, climate resilient designs and societal cost-benefit analyses	Bypass to the ongoing policy process; knowledge exchange via key persons; contribution to two PhD projects	'You may have read a book ... but that does not automatically imply that you can use the knowledge in the book ... this only happens once you put people together and almost force them to start thinking beyond the short-term interest of their own organization (project leader)

Table 2. Continued.

Project	Documents produced	Other output/outcomes	Illustrative interview quote
Hotspot Groning-en	Various thematic reports (e.g. energy, agriculture, water supply, etc.)	Advice for provincial government on regional climate resilience; agenda setting function for regional actors	'Some space was left in the provincial plan to allow for using some of the project results. At a certain moment, however, the timing of the Hotspot lagged behind that of the regional planning process, making it more complicated to actually influence the plan' (project supervisor)
Route-planner	Various reports (a.o. on climate resilience, climate effects, knowledge gaps, evaluation of adaptation options); some journal articles and book chapters	Providing insight to policymakers in consequences of climate change; introduction of concepts (e.g. robustness, resilience) to policymakers	'Routeplanner and ARK [national adaptation program] were conducted in parallel. Sometimes knowledge exchange took place. You saw a clear distinction between those demanding and those supplying knowledge. [the two coordinators] often had to act as a knowledge broker, explaining things in a specific way, or act as spokesperson' (researchers)

pluralities). Second, actors sometimes coupled (lack of) credibility of knowledge to the credibility of persons.

Salience

Actors had different criteria for the salience of knowledge. As we will show in this section, the projects differ widely in terms of the type of knowledge produced. What mattered, however, were not these differences as such, but the extent to which actors succeeded in reconciling their diverging knowledge interests. The interviewed researchers liked being involved in a practice-oriented project and deemed the implementation of sustainable concepts and visions important.

However, they unanimously indicated that their main interest was to be able to publish. This interest was met in most cases. The only exceptions were one PhD in *Hotspot ZPP* (no publications on the project) and one researcher in *Routeplanner* (who had wanted to publish more). For the researcher interviewed in *Hotspot Groningen*, the project's relative importance (in terms of time investment) was small, so it could only provide a small contribution to one publication. Most researchers were young and untenured and hence they were looking for job opportunities. We came across two examples in which job opportunities were generated. A researcher in *What's the future of low-lying peat land?* found a new job through the project network. *Transitions SUW* resulted in a spin-off company, Deltasync, specialized in floating urbanization. Researchers in several projects (*What's the future of low-lying peat land?*; *Hotspot ZPP*; *Routeplanner*) indicated that they valued the acquisition of practical knowledge. They learned about terminologies and about how policymaking works. One interviewee (*Routeplanner*) – with a natural science background – also learned 'to think in terms of actors rather than processes'.

Policymakers and program managers deemed the applicability of the knowledge most important. The projects differed widely in the types of knowledge produced and its perceived applicability. A first type of knowledge production observed is agenda setting knowledge. Policymakers in *Hotspot ZPP* became more aware of the importance of desiccation for the area. Various policymakers in Groningen started to think about the consequences of climate change for the province. An interviewee in *What's the future of low-lying peat land?* reported 'that it is no longer possible to deny the existence of soil subsidence'. Second, some projects focused on the development of concepts for practical use. A policymaker indicated that *Routeplanner* familiarized her and her colleagues with such concepts as 'robustness', 'resilience' and 'adaptive capacity'. The project also provided policymakers with state-of-the-art climate change knowledge. Third, some policymakers referred to the generation of insights and ideas. A policymaker in *Transitions SUW* claimed

to have learned most from the project's 'transitions part' which made him familiar with the role of actors in transitions, long-term thinking and thinking in terms of opportunities. According to several interviewees, *What's the future of low-lying peat land?* contributed to the development of a nuanced and pragmatic vision on the merits and limitations of a new policy concept *'Function follows water level'* (in which land-use functions depend upon the water level in certain areas rather than the other way round). Knowledge was developed, amongst other things, on the strengths and weaknesses of underwater-drainage, a mitigation technology. Fourth, several projects provided arguments supporting and legitimizing ongoing planning processes. In *Hotspot ZPP*, scientific underpinning of existing plans and approaches – a.o. the so-called 'layer approach', a relatively new Dutch spatial planning principle – was generated. The project also legitimized the plans for building in Zuidplaspolder. Fifth, policymakers referred to the identification of economic opportunities (e.g. *Transitions SUW*). Sixth, especially actors at program level deemed the development of process-related knowledge important (e.g. in *Hotspot ZPP*, *CCSP*'s first hotspot).

Two projects differ negatively from the others: *Co-valuation of water* and *Hotspot Groningen*. Actors involved perceived the quantity of 'relevant knowledge' produced to be relatively low. Worse, actors did not manage to reconcile their different views on 'relevance'. Actors in *Co-valuation of water* had different views on whether implementing the developed visions was desirable, and whether this was a goal of the project. In *Hotspot Groningen* we see a distinction between people who found that input should be given to the provincial plan, including the board of CCSP (which was initially dissatisfied about the project outcomes) and others who emphasized 'awareness raising' and 'having scenarios available for future use'. Clearly, in these two projects some actors' thresholds for 'salience' were not met.

Legitimacy

In the *Co-valuation of water* and *Hotspot Groningen* projects actors seemed to perceive a 'lack of legitimacy'. In the former project, a civil servant believes 'that the local population was fooled'. Inhabitants were asked to participate in the development of plans, while 'it was clear from the outset that these would not be executed'. Also, several interviewees claimed that the position of experts in the project was problematic. They were not familiar with the 'subordinate' role they were expected to play, providing feedback on, rather than making plans. A PhD researcher in *Co-valuation of water* learned that commitment of organizations is largely dependent on individuals. After a civil servant and the responsible alderman left, the municipality turned out to be no longer committed. The same researcher mentions 'that scientists are wrong in assuming that practitioners know everything about 'integrated water management', 'stakeholder involvement'

and 'making room for water'. The fact that the project leader of *Hotspot Groningen*, a policy officer, was seen by some as 'a representative of science' was claimed to be a crucial factor complicating the internal acceptance of his work within the province. An employee of one of the participating water authorities explained that he believes that he was 'merely facilitating science'. This employee indicated that 'if the local water authority had been the principal, the current project results would not have been sufficient'.

In some of the other projects, statements were made which can be linked to a lack of legitimacy; although the issues addressed seem to be less serious ones. The PhD researcher within *Transitions SUW* found working at the intersection of science, policy and practice exciting and instructive, but it resulted in a high workload since policymakers were interested in easily accessible reports, while his supervisors were mainly interested in submitting journal articles. Drafting reports could therefore be interpreted as an illegitimate activity in the eyes of this researcher, in the sense of leading to a too high workload (although he himself did not use this term).

Some interviewees in *What's the future of low-lying peat land?* referred to the – according to them theoretical – possibility that actors would prematurely use intermediary products. Farmers could have an interest in claiming 'that underwater drainage is a solution for continuing agricultural activities in low-lying peat areas'. Claiming more than science justifies can be interpreted as a lack of legitimacy. However, at the time of writing, such premature use had not taken place.

Explanations for differences in success rates

Co-valuation of water and *Hotspot Groningen* score lower than the other projects in terms of the perceived credibility, salience and legitimacy (actors' thresholds for all three criteria were not met). These projects can be considered as having 'failed' in the sense that no shared commitment was created (although we do not want to play down the fact that also in these projects actors have gained some knowledge). A crucial difference between 'failed' and 'successful' projects seems to be whether actors found context-specific forms of collaboration appropriate to the epistemological and normative situation at hand. Table 3 shows how the six researched projects 'score' on epistemological distance and underlying normative consensus.

First, the more successful projects managed to link-up with the epistemological distance between participating actors. The projects differed in this respect, with on the one extreme *Hotspot ZPP*, in which co-creation took place in the sense of discussing, thinking and writing together, or being physically present in the same

Table 3. Knowledge production dynamics in the six adaptation projects.

	Short epistemological distance	Long epistemological distance
Relative normative consensus	Hotspot ZPP What's the future of low-lying peat land?	Transitions SUW Routeplanner
Value pluralities present	No projects	Hotspot Groningen Co-valuation of water

venue. The project's short epistemological distance was promoted by physical proximity combined with the involvement of knowledge-driven policymakers and practically-oriented scientists. We found long epistemological distances in *Routeplanner*. In this project, scientists had to translate much knowledge which was 'basic' for them to policymakers, including knowledge on concepts such as resilience, adaptation and vulnerability. Epistemological gaps were bridged through knowledge brokering. In *Hotspot Groningen* and *Co-valuation of water,* epistemological distances were also long. Actors had diverging views as to what knowledge had to be derived from the project and what would constitute credible knowledge. Co-creation seems to be better feasible in cases with relatively short epistemological distance between the actors involved. Actors should have some initial knowledge and experience with a subject and some understanding of each other's language. Otherwise, less intensive forms of collaboration seem more appropriate.

Second, we see a distinction in the normative consensus within the project. Normative consensus is lacking in cases in which the project team includes many 'dissidents' or actors providing contra-expertise. The latter did not occur in the researched projects, but the former situation was manifest in *Co-valuation of water*. Normative consensus was also low in Hotspot Groningen, in which actors disagreed as to how important the realization of 'a climate neutral provincial plan' actually was. According to Hoppe (2005) such advocacy projects are likely to be more difficult to execute. Normative consensus in the other projects was much higher. These projects can be characterised as 'learning cases' in which participants will be more 'automatically' inclined to engage in communicative action.

As the researched projects took place within a more or less comparable background situation (e.g. the participation of multiple actors, the presence of facilities and financing arrangements, type of steering through the research program) differences in success rates cannot be attributed to such factors. However personal factors did

differ between the projects. Interviewees often referred to the role of persons in key positions (e.g. project leaders) – positively and negatively – when discussing a project. The scope of this chapter does not allow us to discuss these factors in great detail (but see Hegger *et al.* 2012).

Lessons

Epistemological distances and the degree of underlying normative consensus are relevant factors in explaining the success of knowledge co-production projects. However, other factors might mitigate their impact. Also in cases characterised by long epistemological distances between the actors and value dissent, successful co-production can be possible. One may expect that it would be helpful ensuring – before and during the execution of projects – that knowledge interests are made explicit. The big challenge is to create a communicative context. Based on our research, we can provide the following considerations as to how to achieve this.

First our research indicates that bridge-builders with experience in several worlds (science and policy) are necessary. They are needed in crucial project positions (e.g. project leaders).

Second, co-production seems to be feasible only if actors have some initial knowledge and experience with a subject and some understanding of each other's language.

Third, as joint knowledge production involves a large degree of task uncertainty and unpredictability (Whitley 1984); it can be 'steered' only to a limited extent. It is important for actors to be aware that the success of co-production is not always in their own hands. For instance, scientific findings may be unwelcome in the eyes of policymakers; or set-backs may occur (as in the case of *Co-valuation of water*).

Fourth, the previous sections brought to light the importance of shared commitment in the sense of actors being satisfied with the knowledge production process. Moreover, we deem it important that actors feel invited to denominate 'success' as such. This can be the start of a virtuous circle of long-term productive science-policy-practice collaboration.

Fifth, in the researched projects, we observed positive correlations rather than trade-offs between the criteria of credibility, salience and legitimacy. This is an addition to existing research stressing the importance of trade-offs between the concepts (Vogel *et al.* 2007, White *et al.* 2010).

Concluding remarks

The six adaptation projects have resulted in several examples of knowledge which, according to the actors involved, could only be developed through cooperation. Although we cannot 'prove' the latter in an absolute sense, our findings provide some indication that direct science-policy cooperation in regions provides opportunities for transformative cross-boundary learning. It seems that – at least in the context of regional climate change adaptation projects – joint knowledge production enables policy to be more informed by scientists and, on the other hand, enables scientists to conduct more socially relevant research.

The dominant message to be derived from our analysis is that there is no panacea in developing joint knowledge production processes. Different potentially fruitful forms of joint knowledge production (more or less intensive; aiming at concepts, arguments or ideas) can be found. These forms of collaboration, however, have to be appropriate to the epistemological closeness or distance of actors (the degree to which they can be expected to be able to cooperate closely) as well as the degree of agreement in values of the participants. A classification scheme including these two variables may have both analytical and practical value. Further research could use the scheme as an analytical tool to detail the relationship between types of projects and their success. Such a scheme would also enable actors to make knowledge production processes more reflexive by inviting participants to purposefully choose for forms of cooperation.

In any case, the analysis has shown that actors should not only learn at a substantive level, but also at the level of processes: what are the knowledge interests of other actors, and how can these interests be met? In current post-normal times, it is therefore required that people are enabled to perform at the top of their abilities. We hope to have shown interesting examples of the latter.

References

Bäckstrand, K., Khan, J., Kronsell, A. and Lövbrand, E. (2010) *Environmental Politics and Deliberative Democracy –Examining the Promise of New Modes of Governance.* Cheltenham: Edward Elgar.

Cash, D.W., Clark, W.C., Alcock, F., Dickinson, N., Eckley, Guston, D., Jäger, J. and Mitchell, R. (2003) 'Knowledge systems for sustainable development'. *Proceedings of the National Academy of Sciences of the United States of America,* 100(14): 8086-8091.

Climate Changes Spatial Planning and Knowledge for Climate (2009) *Climate Research Netherlands – Research Highlights*.

Edelenbos, J., Van Buuren, A. and Van Schie, N. (2011) 'Co-producing knowledge: joint knowledge production between experts, bureaucrats and stakeholders in Dutch water management projects'. *Environmental Science & Policy,* 14: 675-684.

Funtowicz, S.O. and Ravetz, J.R., (1993) 'Science for the post-normal age'. *Futures* 25(7): 739-755.

Gibbons, M., Limoges, C., Nowotny, H., Schwartzmann, S., Scott, P. and Martin, T. (1994) *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies.* London: Sage Publications.

Hegger, D.L.T., Lamers, M., Van Zeijl-Rozema, A. and Dieperink, C. (2012) 'Conceptualising joint knowledge production in regional climate change adaptation projects: success conditions and levers for action'. *Environmental Science & Policy,* 18: 52-65.

Hisschemöller, M. and Hoppe, R. (2001) 'Coping with intractable controversies, the case for problem structuring in policy design and analysis'. In Hisschemöller, M., Hoppe, R., Dunn, W.N. and Ravetz, J.R. (eds.), *Knowledge, Power and Participation in Environmental Policy Analysis and Risk Management.* New Brunswick, NJ, USA: Transaction Publishers, pp. 47-72.

Hoppe, R. (2005) 'Rethinking the science-policy nexus: From knowledge utilization and science technology studies to types of boundary arrangements'. *Poiesis and Praxis,* 3(3): 199-215.

Jasanoff, S. (ed.) (2004) *States of knowledge – The co-production of science and social order.* New York, NY, USA: Routledge.

Kabat, P., Van Vierssen, W., Veraart, J., Vellinga, P. and Aerts, J. (2005) 'Climate Proofing The Netherlands'. *Nature,* 438: 283-284.

Kemp, R. and Rotmans, J. (2009) 'Transitioning policy: Co-production of a new strategic framework for energy innovation policy in the Netherlands'. *Policy Sciences,* 42(4): 303-322.

Lee, K.N. (1994) *Compass and Gyroscope: Integrating Science and Politics for the Environment.* Washington D.C. and Covelo, CA, USA: Island Press.

Pickvance, C.G. (2001) 'Four varieties of comparative analysis'. *Journal of Housing and the Built Environment,* 16(1): 7-28.

Pohl, C., Rist, S., Zimmermann, A., Fry, P., Gurung, G.S., Schneider, F., Speranza, C.I. and Urs, W. (2010) 'Researchers' roles in knowledge co-production: experiences from sustainability research in Kenya, Switzerland, Bolivia and Nepal'. *Science and Public Policy,* 37(4): 267-281.

Regeer, B.J. and Bunders, J.F.G. (2009) *Knowledge co-creation: Interaction between science and society – A transdisciplinary approach to complex societal issues.* Amsterdam, the Netherlands: VU University Amsterdam, Athena Institute.

Roux, D.J., Rogers, K.H., Biggs, H., Ashton, P.J. and Sergeant, A. (2006) 'Bridging the science-management divide: moving from unidirectional knowledge transfer to knowledge interfacing and sharing'. *Ecology and Society,* 11(1): 4-23.

Scholz, R.W. and Tietje, O. (2002) *Embedded Case Study Methods – Integrating quantitative and qualitative knowledge.* Thousand Oaks, CA, USA: Sage.

Steyaert, P., Barzman, M., Billaud, J.P., Brives, H., Hubert, B., Ollivier, G. and Roche, B. (2007) 'The role of knowledge and research in facilitating social learning among stakeholders in the French Atlantic coastal wetlands'. *Environmental Science & Policy,* 10(6): 537-550.

Talwar, S., Wiek, A. and Robinson, J. (2011) 'User engagement in sustainability research'. *Science and Public Policy,* 38(5): 379-390.

Van Assche, K., Beunen, R., Duineveld, M. (2011) 'Performing success and failure in governance: Dutch planning experiences' *Public Administration*, first published online.

Van Buuren, A. and Edelenbos, J. (2004) 'Why is joint knowledge production such a problem?'. *Science and Public Policy,* 31(4): 289-299.

Van De Kerkhof, M. and Wieczorek, A. (2005) 'Learning and stakeholder participation in transition processes towards sustainability: Methodological considerations'. *Technological Forecasting and Social Change,* 72(6): 733-747.

Van den Hove, S. (2007) 'A rationale for science-policy interfaces'. *Futures,* 39(7): 807-826.

Van Kerkhoff, L. and Lebel, L. (2006) 'Linking knowledge and action for sustainable development' *Annual Review of Environment and Resources* 31: 445-477.

Vogel, C., Moser, S.C., Kasperson, R.E. and Dabelko, G.D. (2007) 'Linking vulnerability, adaptation, and resilience science to practice: Pathways, players and partnerhips'. *Global Environmental Change,* 17(3-4): 349-364.

Weichselgartner, J. and Kasperson, R. (2010) 'Barriers in the science-policy-practice interface: Towards a knowledge-action-system in global environmental change research'. *Global Environmental Change,* 20(2): 266-277.

White, D.D., Wutich, A., Larson, K.L., Gober, P., Lant, T. and Senneville, C. (2010) 'Credibility, salience, and legitimacy of boundary objects: water managers' assessment of a simulation model in an immersive decision theater'. *Science and Public Policy,* 37(3): 219-232.

Whitley, R. (1984) *The Intellectual and Social Organization of the Sciences.* Oxford: Clarendon Press.

Yin, R.K. (2008) *Case Study Research: Design and Methods, Third Edition, Applied Social Science Research Methods Series, Volume 5.* Thousand Oaks, CA, USA: Sage.