The Indeterminacy of Technical Effects: The Case of the 2nd. Generation Water Conservation Project, the Netherlands

Janice Jiggins* and Niels Röling**

Abstract

This paper reports stakeholder perceptions of the technical effects of on-farm weirs in an area of sloping, free-draining, sandy soils, in the context of water conservation by the agrarian sector. The effect variables desired by the stakeholders are related to the target variables of the intervention, and to the differences in the mix of policy mechanisms that frame action in two Dutch provinces. The study reveals a wide range of views, variable certainty about being able to establish 'the truth' about the effects, and the extent to which this matters. The core of the issue is that technical effects are irreducibly indeterminate in the context of dynamic inter-active relationships. In North Brabant the approach is seen by stakeholders to have a bias toward building trust and multi-stakeholder learning processes, anchored in experience; in Limburg, the perception is of a bias toward creating binding obligations, anchored in rules.. In terms of the cognitive basis of social learning, one can say that only in North Brabant is there emergence of **coherence** among stakeholders. However, it cannot be shown in either case that there is greater **correspondence** between actions and desired effects.

1. Introduction

This paper deals with a case study in a country in which all surface and groundwater water, and all land use, is managed (albeit under different laws, which severely constrain integrated planning). The case presents a 'moment in time' in the flux of multi-year experimentation with 'agrarian water management'[1]. While groundwater is the responsibility of the provinces, river and surface water management over historical time has been handed to expert institutions, the water boards, and to a powerful national coordinating agency. The water boards have their own tax powers and elected governing boards. Historically, farmers dominated the boards but a reconstruction of the basis of representation has led in recent years to a growing 'democratisation' and the intrusion of non-farming interests. The project, coordinated by a farmers' union, thus represents in part an attempt by farmers' organisations to re-gain the initiative and safeguard their entrepreneurial flexibility.

This paper focuses on part of a much larger study, the relation between 'target' and 'effect' variables with reference to stakeholders' perceptions of the technical impacts of the placement of small weirs on-

* Dept. of Communication and Innovation Studies, Wageningen University Research.

** Professor Emeritus, Dept. of Communication and Innovation Studies, Wageningen University Research.

1. The experiments began with a number of small scale actions that led to *Beregenen op Maat* (metered use of overhead sprinkler irrigation) In North Brabant, the BoM today covers some two thirds of the irrigated area, and over one third of irrigators; based on a 2000 study, non-participants on average use 26 cum and participants 21 cum groundwater (Provincie Noord-Brabant, 2000).. BoM was followed by a range of crop-water management efficiency experiments and on-farm trial of various physical measures for holding winter rains in farm ditches (known as the 1st. Generation Water Conservation project, this phase also included the Belgium provinces of Antwerp and Brabant) (Jiggins, 2002; 2003). The 2nd. Generation project reported on here, will be followed from Jan .2004 by a new project, again including Antwerp and Brabant.

farm, in the two Dutch provinces of Limburg and North Brabant[2]. The 2nd Generation Water Conservation project coordinates and extends previous multi-stakeholder actions around the spread and management of on-farm weirs and more permanent physical measures in an extensive area of sloping, free-draining sandy soils subject to summer drought. The *direct technical purpose* of the weirs is to hold winter rainfall in field ditches, in order to raise soil water levels in the immediately surrounding land. The purpose is linked in turn to three strong technical effects that stakeholders wish to realise. The technical effect at *farm level* is to 'save' the first mid-season irrigation (mostly taken from shallow ground water). The technical effect the *provincial level* wishes to slow the draw down of shallow ground water. The third technical effect, of the protection of 'wet' Nature areas by raising soil water levels in Nature areas and the buffer zones around them, is related to the construction and conservation of the Ecological Core Structure[3], a *landscape effect.* All three are critically related to how the measures impact the overall hydrological system

The background motivations that led to the convergence of interest in on-farm water management include the increasing recognition by the national and provincial governments, and water boards, of the de-stabilisation of hydrological systems in the delta. The origins of instability include less predictable and more extreme weather events, faster and heavier snow melt in the spring in the upper catchments, swifter run off as more of the catchment area is paved over, a sinking and tilting coastal land mass, and higher sea levels. Engineering solutions to water safety in the delta are no longer sufficient. Space must be found for spreading floodwater and for increasing the absorptive capacity of the land (the sponge effect). At the same time, EU and domestic Nature directives are pushing rural land use away from a single-minded focus on farming, giving rise to a more complex mosaic of soil water requirements as the Ecological Core Structure is created and the mosaic of rural livelihoods changes. The Water Framework Directive in turn is encouraging renewed attention to river system functioning, and water quality, in a context in which competing claims for water by different sectors are intense. A long-running reconstruction of farming in the sandy areas (under the Reconstruction Law - *Reconstructie Wet*), which involves closure or re-location of intensive animal husbandry in order to avoid the pollution effects of excess manure, further complicates the hydrological aspects of spatial planning, as farmers shift out of grassland and into irrigation-demanding crops such as fodder maize, or into high value crops such as asparagus, which require a much lower soil water profile in early spring than grassland.

The deep background relates to the post-WWII decision to set the standard soil water norm in rural areas at a level that erred generously on the side of caution. The reason for this were farmers' fears, based on historical and family experience, of surface water damage, with memories of entire potato crops being lost after 24 hours in the standing water resulting from heavy rainfall or flooding. Water boards are required to drain water from farmers' fields on demand and up to now, farmers have had a free choice as to what crops to grow, where. The major programme in the 1950s and 1960s of land re-adjudication and rationalisation, with re-alignment and deepening of drainage ditches, won the farming sector almost a month of cultivation time in early spring, giving a huge boost to the profitability of the farming sector, and great flexibility in crop choice. The consequences for Nature were not so positive, since the soil water levels preferred for farming almost always lie below the level needed to maintain 'wet' Nature. The decision also increased the demand for groundwater for overhead sprinkler irrigation in dry summer

---

2 Jiggins, J. & N. Röling. 2003. Final Report. Key Informant Study. 2nd. Generation Water Conservation Project. North Brabant and Limburg.

3 The ECS (EHS - ecologisch hoog structuur) attempts to link isolated nature areas, hydrological systems and land use in ways that strengthen the ecological value and integrity of the Dutch landscape, in conformity with both EU and domestic nature and environmental legislation. In addition to the spatial aspects, related actions include providing, for example, space for water' to spread into Nature areas during peak flooding, the restoration of 'natural' or half natural' river flows and bank-side vegetation, and experimentation with the provision and reward of 'blue' and 'green' services.

spells, especially in the sandy areas, and the need to transport water (of a different quality) from the main river (the Maas) to the primaries in the summer months.

2. Methodology: the relationship between 'target variables' and 'effect variables'

The study is based on archive material, secondary literature, and 50 stakeholder interviews, typically lasting up to two hours in focussed dialogue, with stakeholders in the two provinces, in the categories: policy-makers; *bestuurders*[4]; implementers; subsidy givers; researchers; Nature and environmental agencies. The methodology thus captures *stakeholders' perceptions* rather than 'objective' data, and stakeholders' *interpretations* of the objective data generated by specialist studies and monitoring records.

The authors have constructed an analytic framework that asserts a relationship between the 'given' political, policy, historical (etc.) conditions, the context-specific factors that might lead to 'success' or 'failure', the 'target' and the 'effect' variables (Fig. 1). The study in particular examines the mix of policy mechanisms that have been deployed to produce perceived effects. Policy mechanisms are seen as ways of coordinating action to produce desired effects at societal scales. Where effects appear dependent on coordinating complex inter-actions among stakeholder interests, that are potentially or actually in conflict, it has been proposed that *social learning* is a necessary, but relatively unfamiliar element in the policy mix (Röling, 2000).

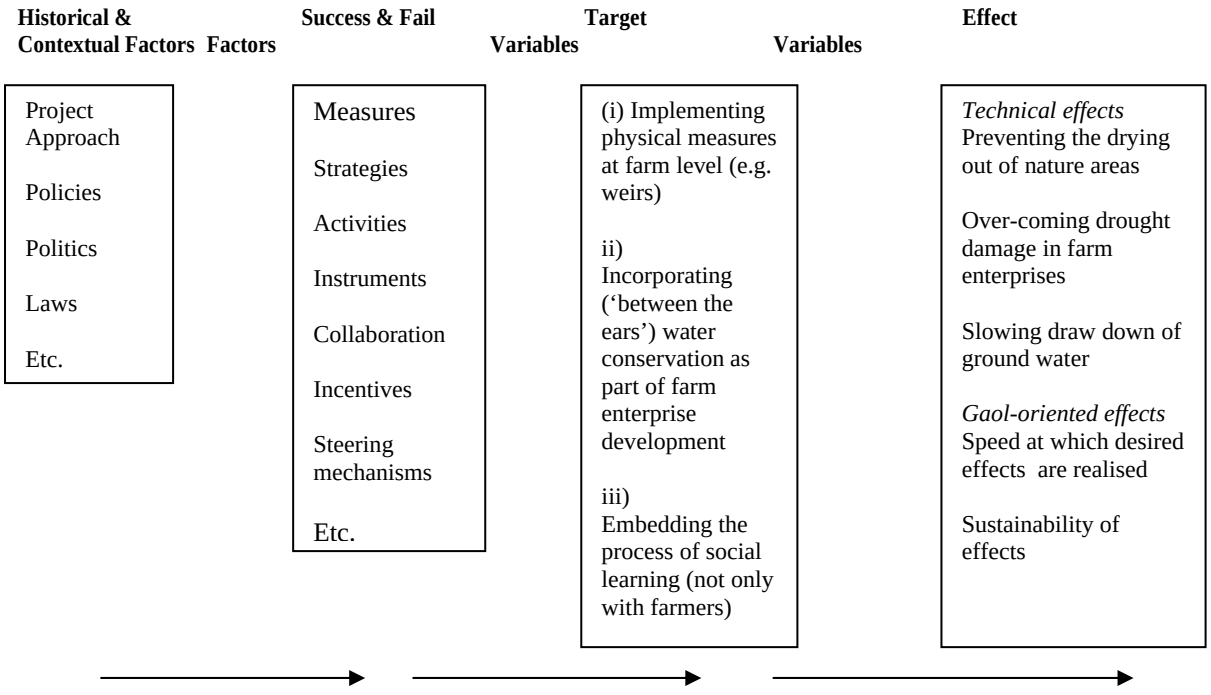

Figure 1: Analytic Framework Used in 2nd. Generation Water Conservation Study

[4] In Dutch, *bestuurders*: literally translated, unhelpfully, in dictionaries as managers, directors or administrators, the word has the implication of a senior person, such as a chairman of a water board, or a senior official in the provincial administration, with experience of a range of higher level management functions and responsibilities, who guides or steers relationships and actions towards desired goals through inter-active dialogue. Because of the ambiguity of the English translation, it is preferred to keep the Dutch original.

The relevant literatures suggest that each policy mechanism is associated with a set of internally consistent features (Fig.2). The salient question for the study is which mix most effectively creates *coherence* among actions, and *correspondence* between the actors and their environment (Röling, 2000) ? The well-known policy mechanisms are 'regulation' and 'compensation': both have acknowledged limitations in coordinating actions in the situation of high complexity that constitutes the highly inter-dependent physical and social space of the Netherlands. 'Stimulation' thus often is deployed to lead in a smooth and gradual way (*geleidelijk*) to change mandated by regulation or to smooth the more brutal or abrupt effects of market-based change. However, stimulation assumes that someone knows the direction in which others should go, and that sufficient consensus can be created that this is indeed necessary. This was not the case at the start of the on-farm water management initiatives: Nature and farming interests were in direct confrontation and the provinces had met a hostile reaction from farmers to attempts to impose hard regulation of access to and use of groundwater. The 'water conservation' projects thus have tried explicitly, in varying degrees over time and between the two provinces, to deploy also 'social learning' as a conscious policy mechanism.

The target variables discussed in this paper focus on (i) the physical measures and (ii), changes 'between the ears' that lead to different water management practices. The effect variables covered are those at farm level, in groundwater, and on Nature areas. The main focus of discussion in this paper, however, is on stakeholder perceptions of the *relationship* between the 'target' and 'effect' variables with respect to the technical effects – effects that one might suppose would be unambiguously determinable by objective relationships and data. This turns out to be far from the case, as we report in the next two sections.

Distinguished on basis of	**Regulation**	**Compensation**	**Stimulation**	**Social learning**
Rationale	Instrumental	Strategic	Communicative	Collective action
Basis for individual behaviour change	Involuntary	Identification	Internalisation	Socialisation
Preferred management approach	Hierarchy	Individualism	Egalitarianism	Creation of many-sided relations
Coordination mechanism for organisation of action	Hierarchy	Payment of compensations & subsidies	Applied management	Networking
Presumed origins of welfare	Access to resources and/or power	The invisible hand of the market	Social capital, trust, community	Relational capital
Rules base	Dominance, legitimacy	Exhange relations	Giving meaning; communication	Inter-action
Risks	Non-compliance	Market distortions, market failures	Dependent on availability of financing	Dependent on funding of the facilitation of process

Figure 2: Analytic Framework for Policy Coordination Mechanisms

3. The target and effect variables

The 1st Generation project expressed targets in terms of effort, such as 'number of weirs placed'– the so-called 'effort obligation', which is well established in Dutch administrative and management practice, and signals a commitment to ambition while allowing room for lower level creativity in finding ways to secure the desired results. The 2nd. Generation project includes targets expressed also in terms of 'cubic metres of water saved', and in the case of Limburg, also in terms of the participation of '80 per cent of irrigators' – a so-called 'results obligation' which introduces a harder, more directive line and that assumes a higher degree of confidence in the assumed relationship between the intervention and the

outcome. The 80 % figure was based on a provincial estimate of the 'area coverage' required to have an effect that was sufficient in terms of Nature stakes and raising the overall ground water level.

Approx. 3500 out of a total of some 4500 irrigators in the two provinces by Dec. 2003 had installed on-farm weirs[5]. Approx. 310 physical measures (including weirs) in addition have been placed in or around the Nature areas. The rate of installation has slowed as the project has moved into the more challenging areas, and out to the margins of experience. In part the slower rate of installation relates to technical uncertainty in specific areas concerning surface water effects, leading water board field workers (who are obliged to drain surface water on demand) in some areas to insist on all local farmers signing an agreement concerning where the weirs should be placed (the 'area accord'). It is also perceived that the most suitable locations are now filled. However, it is by far from certain that all those who have registered as adopters of BoM, and/or who have weirs, are managing them optimally. Though the indications are positive (Baecke and van Huylenbroeck, 2001), at present there are essentially no means to check 'compliance' with best practice; nor is there agreement that such controls would be productive (see further 5.4 below).

4. The technical effects perceived

In the eyes of project stakeholders the single most important question is: are the project's measures achieving the desired technical outcomes? The 'water world' in the Netherlands is data rich and well modelled, so the answer, one might assume, is easy to deliver. There are various kinds of 'hard and soft data' available on the technical effects of the proejct:

1. provincial groundwater data, obtained from automatic site monitoring networks;
2. water board surface water data, obtained from monitoring networks;
3. specialist hydrological and other studies of impacts at field and higher levels, statistical analyses of groundwater data over time, and simulation models;
4. water boards' field staffs' routine observations and experience; institutional memories of water management;
5. farmers' daily and inter-generational observations related to crop choices, farm management experience, and observation and management of the on-farm weirs. Although farmers were supposed under the 1st. Generation project to use manual water gauges to monitor the effects on their own land of raising or lowering the height of the weirs, most did not do so (Baecke and van Huylenbroeck, 2001). Under the 2nd. Generation project, 14 of the more enthusiastic users of the weirs, spread across the two provinces, have carried out systematic registration of their actions and observations, in conjunction with data registered by automatic water gauges located at various points in their fields (CLM et al., 2002; Bos et al. 2003). The provinces also have encouraged the water board field staff to use simplified modelling of impacts at the field level, to help them determine, together with farmers, the optimal placement of the weirs and other physical measures.

There is some early indication that run-off peaks are levelling off (although it will take a longer time-series data to establish if this is the case), suggesting that the measures collectively might be contributing to restoration of groundwater levels, and that impacts at the field level, while small, are positive.. However, the 'hard' data available are susceptible to various interpretations, not least because the period over which measurements have been made is quite short, there have been two wet winters followed by

[5] The total number of irrigators includes those drawing from deep groundwater, as well as hobby farmers and others (such as those with a riding pony), who are individually using too little water to be charged user fees or included in the water conservation projects.

an abnormally dry summer, and various other major changes have occurred in land and water use independently of the project. The interviews with 50 stakeholders indeed demonstrated a marked lack of consensus: some 72 statements about the technical effects of the weirs and other physical measures, can be summarised as revealing that:

- There is no agreement among stakeholders on what the technical effects are, or what their impact is.
- The different categories of stakeholder have different perceptions of technically 'what is at stake'
- These differences are perceived as related to stakeholders' positions in a hierarchy of ecological inter-dependence i.e. that each stakeholder is concerned with effects and impacts that manifest themselves at difference scales of system integration and management.
- The Brabant project experience reveals a bias toward tolerance for uncertainty, and the Limburg experience, reveals a bias toward searching for the truth.
- By opening up technocratic management and knowledge development to wider participation, the project is blurring the boundaries between 'expertise' and 'interests', as stakeholders become more expert, and experts become stakeholders.

5. Discussion

In this section we use four lenses to examine the results summarised above: differences in perceptions of what is at stake; differences in stakeholders' positions and experience of inter-dependence; the 'search for certainty' versus 'tolerance of uncertainty'; and differences in the policy mix that guides the implementation process in each province.

5.1. Different perceptions of what is at stake

In part, we understand that the lack of consensus reflects differences in stakeholders' perceptions of 'what is at stake':

For farmers: it is the preservation of a 'licence to irrigate'; defence of their continuing capacity to exercise entrepreneurial flexibility in response to changing market and climatic conditions; and an opportunity to take a pro-active role in improving their image in society by demonstrating that farming is 'doing its share' to conserve water and reduce the rate of groundwater draw down. Additional perceptions of 'what is at stake' include the opportunity to learn more about the role of water in farming and Nature management, and the expectation of deriving benefit for the farm business from on-farm water conservation.

For water system managers: it is an opportunity to continue to move water users' understanding, and river system performance, in the direction of integrated functions in ways that give greater priority to water in spatial planning at micro (field level) and area levels.

For nature managers: it is the protection of 'wet' Nature areas, and an opportunity to develop other stakeholders' understanding of hydrological systems and the implications for the Ecological Core Structure.

For provincial policy makers: it is an opportunity to avoid the difficulties associated with heavy regulation by establishing the ground for smoother inter-action among interests with competing claims on the same resource, while maintaining the pressure to achieve, through others' actions, their own groundwater goals.

For elected political managers (bestuurders in provincial and local government, farmers' organisations and the water boards): it is an opportunity to translate into local action various European and national political commitments to moving societal behaviour and understanding toward acceptance of the growing importance of Nature interests in land and water use, the changing role of the agricultural sector, the need to find 'space for flood water', conserve groundwater, combat drought, and improve the overall water balance.

5.2. Differences in stakeholders' position and experience of inter-dependence

These differences in turn can be related to differences in stakeholders' position in a hierarchy of ecological inter-dependence. That is, each stakeholder category is concerned with technical effects and impacts of different kinds, at different scales of water system management:

The farm sector: must deliver a positive pay-off at the enterprise level in terms of saving the cost of (at least) one irrigation per season, while avoiding surface water damage; the measures must be sufficiently flexible to allow farmers to manipulate soil water levels according to local weather and crop choices

The water system:, must help to move understanding from 'water' as a factor input to farming, to understanding of water functions; must help make visible the impact of agricultural use of water on the hydrological cycle and on Nature areas; must achieve a new 'water balance' in the whole land-and-water system.

Nature areas and establishment of the Ecological Core Structure: must conserve soil water in the buffer zones at a level sufficient to maintain 'wet' Nature; must help to make the problem of managing seepage water more visible.

Provinces: must reduce the rate of draw down of groundwater; must help move understanding and action from managing soil water levels to meet crop needs, to making crop choices on the basis of soil water levels managed independently of cultivation *('van peil volgt teelt tot teelt volgt peil').*

5.3. The search for certainty vs. the acceptance of uncertainty

Our third lens uses a more abstract framework of interpretation, in terms of a polarity: *the search for certainty vs. the acceptance of uncertainty*. It is proposed that the 'search for certainty' is related to the understanding that 'true knowledge' is based on 'what can be measured', and that true knowledge is necessary if 'right action' is to follow. An 'acceptance of uncertainty' is related to the understanding that 'what can be measured' does not necessarily yield complete knowledge, yet 'right action' none the less can be taken, in so far as actions are seen to lead over time to progress in the desired direction of change. We begin to explore these propositions by introducing a simple heuristic model[6]. It is based on one of the foundation assumptions, dating back at least to Pythagoras, which continues to inform western science and public policy. The assumption might be stated as a simple and unambiguous relation between the True and the Good (Fig. 1)

[6] Presented by Dr. Silvio Funtowicz, at a seminar on The Influence of Complexity on Ecological Economics, Dept. of Communication and Innovation Studies, WUR, Wageningen, 22.10.03. We are deeply grateful for drawing our attention to this line of reasoning.

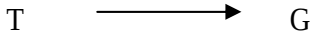

Figure 1: The Pythagorean relationship between the True and the Good

The relation, it might be noted, can be read also as establishing a relation between the epistemological (how we know things), and the normative (what we desire). It also can be read as carrying the ethical implication that right knowledge leads to right action. At the Rio Conference in 1992, an additional normative principle was proposed, the so-called pre-cautionary principle. The relevant text in Agenda 21 states that, *in the absence of scientific certainty*, but with the suspicion of great and irreversible harm, action should err on the side of caution. Since 1992, the growing weight of the evidence that things badly need fixing has tended to push policy makers toward a presumption that establishing the True and determining the Good should be kept separate, with scientists doing the risk assessment and politicians determining the public good (Fig. 2).

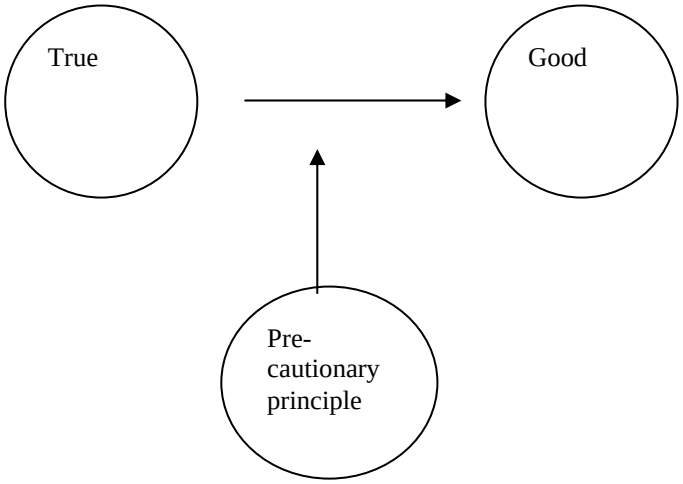

Figure 2: The Precautionary Principle disturbs the Pythagorean relationship

Over the years since Rio, the difficulties have grown of establishing what is happening to the environment by the normal measures of scientific certainty. In the face of a lack of scientific consensus on what is True in terms of the risks, politicians have shown willingness to invite wider citizen and stakeholder participation in the determination of the public response to the uncertainty. One consequence of these participatory processes has been to draw attention to the pre-analytic assumptions made by scientists in their assessments of the risks (What is counted as a risk? for whom ? what burden of risk is considered tolerable ? etc.). This in turn has led to wider citizen and stakeholder participation in determining the issues that frame risk assessment. Within the traditions of science itself, there also has been a growing realisation that the True with respect to man-made environmental risks is complex and ambiguous. There is a beginning of an acceptance within the scientific community that, here also, wider citizen and public participation in creating and interpreting knowledge, can be useful (Fig.3).

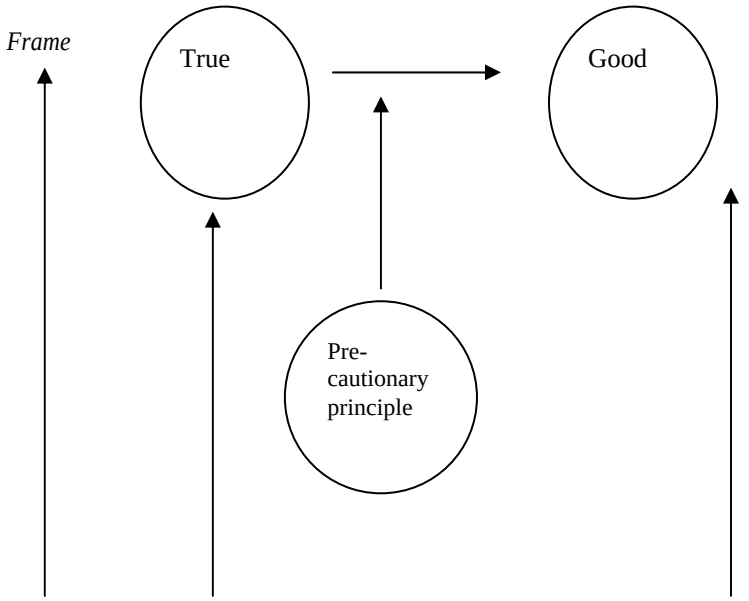

Figure 3: The Pythagorean relationship disturbed by democratic participation

One of the consequences of these steps away from Pythagorean purity, simplicity and certainty, is that *the boundaries between expertise and interest begin to blur*, as a wider set of stakeholders provide knowledge, and as experts become stakeholders. A second implication is that inter-action among stakeholders concerning the framing of the issues, the determination of the True, and the shaping of the Good, implies an acceptance of *irreducible uncertainty*. As the pool expands of those contributing to the co-creation of knowledge, there can be convergence of understanding but not final closure around a single 'truth'.

This framework, we believe, is useful in distinguishing the Limburg and the North Brabant situation. When stakeholders' statements about technical effects and their impacts are sorted by province, it becomes clear that *there is a bias in Brabant toward a 'tolerance of uncertainty'*. Brabanters see themselves as having chosen to follow a *zoekende pad*, a 'searching pathway', that opens up to a range of social actors the opportunity to participate in framing of what constitutes technical risk and risk management, in co-creating knowledge and understanding of the effects, and in defining the public good that results from concerted management of the technical options. It is a renewal process that is clear as to intentions but uncertain as to outcomes. The same analysis reveals that, *in Limburg, there is a bias toward the 'search for certainty'*. The technical issues have been defined by the project partners, as well as how they shall be resolved, and what is a fair allocation of public and private benefits (and costs). Limburgers have chosen a defined pathway, which steers participants toward a pre-chosen target, and assumes certainty in the relation between action and outcome.

The model in addition helps us to understand the comments made by technical researchers, that their understanding of what is 'true' has deepened as a result of interacting with farmers, whom they have come to recognise as having a special position with respect to determining what is 'good' in terms of action. It also provides a frame for placing stakeholders' perceptions that the project has contributed to a much more widely shared understanding that:

- 'Béta-Gamma'[7] knowledge is necessary in order to inform actions with understanding,
- multi-stakeholder inter-action implies a shift from 'thinking for' to 'thinking with',
- anecdotal knowledge, anchored in experience, has value.

5.4. Differences in the policy mix guiding the implementation process

The stakeholder interviews make clear that the differences in perception also relate more or less directly to the different mix of policy mechanisms applied in the two provinces.

North Brabant: The idea of the weirs, and early experimentation with their functioning, originated with farmers in North Brabant, and the idea of water management in the agrarian sector grew from the ground up on the basis of these initiatives. The board of the southern farmers' and glasshouse growers' organisation (ZLTO), together with a number of leading farmers, after a period of feeling 'under attack' by the province, nature organisations and the public, deeply hostile to a threatened ban on overhead irrigation on grassland, and unhappy with a variety of rules (for example, to control nitrate pollution), which were seen as further unwarranted restrictions on their entrepreneurial freedom, committed themselves by the mid 1990s to a pro-active stance. Beginning with BoM, they negotiated their way into a relationship with other key stakeholders, i.e. the water boards and the province of North-Brabant, which led to the 1st Generation project, and subsequently to the 2nd Generation project, based on voluntary adoption of measures for the more efficient use of water in the farm enterprise and water conservation. Agreements between the province, the ZLTO, the water boards and the Brabant Milieu Federation were laid down in Declarations of Intent.

It is important to understand that this orientation has arisen out of an earlier history of conflict and hard regulation with respect to water extraction facilities with a capacity of more than 10 m³ per hour. Table 1 below gives an overview[8].

[7] A term used in the Netherlands to signify respectively the natural sciences and the human/social sciences.

[8] We are grateful to Jeroen Kessels of the Ground Water Division of the Province of North Brabant for this table.

Table 1: Time Line of Initiatives Taken in North Brabant

Plan period	Regulation	Declarations of Intent	Stimulation projects
1991-1998	• 1991: introduction of compulsory licence. • 1992 Prohibition of over-head irrigation grassland: Total ban from January through May. Ban between 11:00 and 17:00 in June and July. • 1992: No new licences for overhead irrigation of grassland. • Intention to eventually totally ban overhead irrigation of grassland.	Conflict arise because of the hard regulation of overhead irrigation, especially on grassland. The pro-active role of ZLTO lead to agreements lay down in declaration of Intent: • Water conservation 1 to increase groundwater level (1996): First ideas of water conservation; Start of Measured Overhead Irrigation.	• 1996-1999: Project Measured Overhead Irrigation (BoM = Beregenen op Maat).
1998-2002	• No new licences (i.e. including arable land). • 1998-2002: Moving of licences accepted under conditions. • 2000: introduction of general obligation to register and pay levies for all licensees. Everyone has to register quantities extracted. Province has to be informed of total extraction. Province imposes levy (in 2003 and 2004: Euro cent 19 per m^3 and max. Euro 68.00 (only if groundwater is extracted, no fee if no extraction).	• Water conservation 2, Measured Overhead Irrigation 1998 with: Further building of Water Conservation Project (Project Water Management). Agreements about scaling up of Measured Overhead Irrigation. • Measured Overhead Irrigation and Water conservation 1999 with: Introduction of regulation: registration and levy; Start of Project Agrarian Water Management per January 1, 2000 (important agreement: participants receive compensation equal to the imposed levy). Further impulses for Water Conservation.	• 1998-2001: Project Water Management Benelux Middle Area: Water Conservation. • 2000-?: Project Agrarian Water Management: compensation equal the levy. • 2001-2004: Project Water Conservation II.
2003-2006	• 2003: moving individual licenses no longer permitted, unless within the framework of implementation of Government plans. • 2003: introduction of licences that allow registration of annual changes in bore holes. No overhead irrigation of grassland		• 2001-2004: Project Water Conservation II; • 2004-2007: Project Sustainable Water Systems Benelux Middle Area.

The degree of voluntarism continues to be influenced by the occasional reminder that there remains a 'stick behind the door' in the form of the power to re-impose the ban on sprinkler irrigation in whole or part, and activation of the power to levy a water use fee (that industrial users are already paying). In the particular case of the buffer zones around the Nature areas, the stronger powers available under the Reconstruction Law, and the Nature Protection Law (that allows private interest organisations to prosecute individual farmers for drawing ground water down to levels that threaten Nature), also come into play. At the same time, the provincial and local government authorities have shown considerable finesse and creativity in creating space for new action. The coincidental timing of a new plan period that began in 1996 helped to open the door to dialogue with new stakeholder groups.

The province, for example, has set the levy on ground water extraction at zero, for licensed extractors who are using BoM and who participate in the water conservation project. Participants pay a small fee, which provides them access to a Help desk, a newsletter, other information materials and courses. Local

authorities are proving flexible in matters such as private arrangements among farmers who wish to temporarily swap fields, in higher or lower parts of the hydrological profile, in order to grow a particular crop in any one year (including grass), and in the granting of a license to construct a new barn if a farmer agrees to sell out a piece of low-lying land.

The province and water boards also have taken a somewhat relaxed attitude to legal complexities, such as who exactly owns the on-farm weirs and is responsible for their maintenance, on the grounds that if they truly deliver benefits to the farm enterprise, farmers will begin to maintain them anyway. They made during the 1st Generation project a very considerable effort in a shared learning-based approach to developing the understanding, data and skills necessary to manage the weirs optimally in specific contexts. This process has been continued in the 2nd Generation project, and formalised at the request of participating farmers, in a Knowledge Circle, made up of 15 farmers spread through representative sites in North Brabant and Limburg. The farmers, together with technical experts and water board staff, and supported by specialists in facilitated learning, are experimenting with weir management, micro-drainage, and simple data registration using manual water gauges. A monitoring network, of automatic water gauges, complements their efforts.

Neither the province nor the water boards are attempting on a routine basis to 'control and check' farmers' actual use of the weirs and BoM – an attempt that would be strongly resisted by farmers. The 'control and check' approach is viewed as something that could only be destructive of the trust and mutual understanding that has grown up. However, this position leaves open the question of whether the measures are located and operated to optimal effect. It does seem to be the case, at least in the view of the stakeholders we interviewed, that on the basis of the voluntary approach and the 'doing together' culture, relationships have been created that have carried the 'water' message to stakeholders who previously gave no thought to water functioning, and that the weirs (or plans for the weirs, as well as farmers' agreement to other measures), are now in place more or less everywhere they would serve a purpose within the designated areas. As we shall see, however, in the next chapter, the 'last percentage' of participation is proving quite hard to achieve, and the nature organisations and land managers are not so sure that enough emphasis has been placed on strict implementation, sufficient to achieve desired outcomes.

Limburg: elements of water conservation specific to the two Water Conservation projects (and the funding available for these), over time have been folded into a larger programme known as Optimal Water Management Limburg (OWL) (Box 1). The policy mix guiding the programme has had a strong regulatory character:

- Compulsory registration of irrigators; licence to irrigate given on basis of an Enterprise Water Plan
- Enterprise Water Plans, drawn up for each farm (first by the Limburg farmers' and market gardeners' organization -LLTB, subsequently by water boards), covering BoM, weirs, and rainwater management, at an initial cost of Euro 800 to the farmer
- Water boards, in discussion with farmers, took the lead in the placement of the weirs
- The cost of the weirs 100 % subsidised
- The LLTB promised to 'deliver' 80 % participation under a covenant signed with the Limburg Environment Federation (LMF), the province, and the water boards.

The Enterprise Water Plans were the vehicle chosen to integrate, at the farm level, the rights, responsibilities and obligations of the various stakeholders under the two separate pieces of legislation governing surface and ground water. They swiftly ran into trouble (Box 1). The cost to the farmers of the plans was reduced to Euro 200, and the rainfall water management elements were dropped., but by early 2003, it was clear that the LLTB was not going to be able to deliver the 80 % participation across the whole province as promised, and that effort had either to shift toward a more voluntary, more explicitly social learning basis or toward simpler but stronger regulation.

Box 1: Optimal Water Management Limburg and the Enterprise Water Plans

The Enterprise Water Plan was an instrument signed by the province and the farmer concerning water use within the farm, and included, among other things, the regulation of overhead sprinkler irrigation, placement of weirs in the secondary channels, the location of irrigation wells, land use patterns (in time and space), economical use of rinsing water in barns etc., and the modification of drainage. While the individual farmer, as entrepreneur, was responsible for volunteering to participate, in practice the stimulation came from the LLTB. At the same time, effort was made to ensure that physical measures in the primary system supported the efficiency and effectiveness of the Enterprise Water Plan.. There were just two points that checked the enthusiasm of all parties: who was to pay, in addition to the farmers, for the one-time cost of making the plan, installing the weirs etc., and what was the legal status of the plans and, in terms of ownership, of the physical measures installed ?

It was argued that the plans must be in accord with the law (e.g. the groundwater law), as well as with the provincial planning rules, while according equal treatment to all eligible farmers, and between farmers and other stakeholders. And here in practice things began to go wrong. There were so many fine details (technical, scientific, managerial, administrative…etc), that needed to be sorted out for each farm, involving so many exhaustive enquiries and discussions, that the plan-making process became ever more complex, more time-consuming, and less satisfactory for all concerned. In the end, in October 2000, a way forward was found by negotiating a covenant between the province, the LLTB, the Water Boards, and the LMF, the so-called Optimal Water Management in Agriculture (OWL). The LLTB undertook to 'deliver' 80 per cent participation. A Steering Group. Project Group and Working Group were set up to oversee the implementation of the covenant. LLTB also established a special office, staffed by water board and project technicians, to smooth the administration of the subsidy, provide advice to farmers, and guide the development of the activities on the ground.

The covenant served to clarify roles and responsibilities but, after several costly small pilot schemes to test the implementation process and build up the experience of the project teams, it was found that the participation of farmers was rather low. Farmers perceived the plans as primarily a 'licence to irrigate'. The area-based planning process did little to develop a more comprehensive understanding among farmers of the effects of their actions on the overall productivity of their farm enterprises nor of the contribution of farming to water system management. Although participants were required to sign an 'area covenant', interest in the wider issues remained low and peer pressure failed to deliver the number of participants required. And although on-farm weirs were installed in the context of the plans, farmers showed little enthusiasm for their active management. The other measures were rarely adopted.

It became evident by the spring of 2001 that the target participation had not been achieved in a single area. Participation rates varied between 10 and 75 per cent. In response, the procedures were simplified, water board staff assumed responsibility for coordination, and more effort was put into giving individual advice to farmers on the active management of their weirs. Subsequently, further simplifications were made, and toward the end of 2002 the water boards became fully responsible for the development of the plans. A study during this period revealed some of the reasons why so many farmers had not participated, including: the special irrigation needs of particular crops; the enterprise characteristics of particular farming systems; and the fact that many of the older farmers (and even younger ones, following two serious outbreaks, in quick succession, of pig diseases), had stopped farming. Twenty five per cent said they had no interest in the plans, or had no trust in the government (i.e. that further restrictions would not in any case be introduced), or gave no particular reason.

Source: StaatsBosBeheer 2003, a & b

In the event, Limburg has chosen for simple, clear juridical framework for regulation for access to and use of groundwater, accompanied by individual coaching of farmers in water management, and with ownership and responsibility for on-farm weir management passing to the water boards.

The way that the target and effect variables have been linked in Limburg is perceived as increasing the mistrust of 'the government' by farmers, dividing the members of the LLTB among themselves, and increasing the mistrust of the LLTB among non-members. The break down of the covenant between the water boards, LLTB, the province, and Nature organisations over the failure to deliver the target participation also has soured stakeholder willingness to engage in further shared action. However, Limburgers also perceive their approach as more capable of delivering the desired technical effects.

A final comment: the interviews in both provinces make clear that there remain strong disincentives to effective *cross-scale* sharing of the various interpretations of data, field observations and local experiences. The key points, from different stakeholders' points of view, have been widely publicised by the project in both the professional and popular media. Considerable effort has been made to share and

discuss the information and experiences in a variety of multi-stakeholder fora, and stakeholders have cited these discussions as among the most valuable and stimulating occasions for mutual learning that the projects have offered. However, different attitudes toward what constitutes valid data and information, and the hierarchical distance of senior policy makers and *bestuurders* from locally situated knowledge, appear to continue to offer strong barriers to the development of convergent understanding.

6. Conclusions

The main lessons learned are:

- It is unrealistic to expect unanimity concerning technical effects and impacts in large scale multi-stakeholder projects that seek to bring about change in individual and institutional behaviours; there is an irreducible indeterminancy in people's perceptions of the dynamic inter-play of bio-physical and human inter-actions.
- It follows that monitoring, and evaluation of success and failure, must be open to the richness of shared and divergent meanings rather than confined to objective standards only.
- Success and failure are as much anchored in implementation processes that belong to particular traditions of governance and specific choices in the mix of policy coordination mechanisms, as they are in technical measures.
- Comparable technical effects and impacts can be achieved on the basis of different implementation pathways.
- Investment in shared learning processes are a necessary complement to regulation and stimulation if the desired results include institutionalisation of behavioural change, among individuals and within institutions.

References

Baecke, E. And G. van Huylenbroeck. 2001. Watermanagement in her Benelux Middengebied. Gedragsonderzoek ten aanzien van Waterconservering en Peilbeheer in Agrarische Gebieden. Gent. Unviersity of Gent., with Streekwijzer.

Bos, L., de Leeuw, P., de Bruin, R., Bleumink, H. 2003. Tussenrapportage Kenniscirkel agrarisch waterbeheer 2002. Utrecht. Centrum voor Landbouw en Milieu, with Streekwijzer and TNO. January.

CLM, Streekwijzer, TNO. 2002. Projectvoorstel Kenniscirkel Agrarisch Waterbeheer. Utrecht. Centrum voor Landbouw en Milieu, with Streekwijzer and TNO. January.

Jiggins, J. 2002. Interim Report. Literatuurstudie en Interviews met Sleutelinformanten. Interregproject Watermanagement in het Benelux Middengebied. June 18. Wageningen. WUR.

Jiggins, J. 2003. Key Informant Study. Final Report. Interreg Project Watermanagement in het Benelux Middengebied. Water management in the Central Benelux Area. March. Wageningen. WUR.

Jiggins, J. and N. Röling. 2003. Final Report. Key Informant Study. 2nd. Generation Water Conservation Project. North Brabant and Limburg. Wagenignen. WUR. December..

Provincie Noord-Brabant. 2000. Evaluatie intentieverklaringen Waterconservering en Beregenen op Maat 1996-1999. Evaluatie intentieverklaringen 'Waterconservering op peil' van 1996, 'Waterconservering op peil 2: Beregenen op Maat 1998' en 'Beregenen op maat en watercosnervering 1999'. 's-Hertogenbosch. Provincie Noord-Brabant, with ZLTO, Brabantse Milieufederatie, en Noord-Brabantse Waterschapsbond. April.

Röling, N. 2000. Gateway to the Global Garden: *Beta/Gamma* Science for dealing with Ecological Rationality. Eighth Annual Hopper Lecture. October 24. Guelph. University of Guelph.

StaatsBosBeheer. 2003a. Het project OWL geëvalueerd – visie vanuit natuur en milieu.Roermond. Typescript. January.

StaatsBosBeheer. 2003b. Evaluatie OWL 2002. Roermond. Typescript. January.