EPI WATER

Evaluating Economic Policy Instruments for Sustainable Water Management in Europe

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Water Abstraction Charges and Compensation Payments in Baden-Württemberg (Germany)

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Executive Summary

This case study analyses the policy mix of economic and regulatory instruments introduced in the Land of Baden-Württemberg to address two key water management problems of excessive nitrate concentrations in groundwater and unsustainable water abstraction.

The policy mix consists of the following instruments:

- Regulation on Protected Areas and Compensatory Payments (SchALVO)[1]
- Water Abstraction Charges
- Market Relief and Cultural Landscape Compensation (MEKA)

The introduction of the SchALVO in 1988 in Baden-Württemberg was then and still is today unique in Germany and within the European Union and receives a high level of attention. The same year, Baden-Württemberg became the first German *Land* to establish an abstraction charge on water. The *Land* has the longest experience with abstraction charges in Germany, and its regulatory framework has been copied by many other German *Länder.*

Four years later, in 1992, the innovative MEKA program was introduced as a pilot project from the European Union and has proven to be successful. It provides an incentive for farmers, via compensation payments, to implement voluntary environmentally sound agricultural practices

As the objectives of the SchALVO and the MEKA complement one another, they are analyzed conjointly in this paper. The water abstraction charge, on the other hand, relates with these instruments mainly via the implementation and institutional process leading to their design.

Definition of the analysed EPI and purpose

The SchALVO is both a regulatory and economic instrument; hence its purpose is twofold. On the one hand it curtails standard agricultural practices in water protection areas to reduce nitrates and pesticides leaking into water bodies (regulatory instrument), and on the other hand it introduces a compensatory payment scheme for farmers that are affected by the aforementioned curtailment in order to increase the acceptance and enforcement (economic instrument).

[1] Verordnung des Umweltministeriums über Schutzbestimmungen und die Gewährung von Ausgleichszahlungen in Wasser- und Quellschutzgebieten (Schutzgebiets- und Ausgleichs-Verordnung – SchALVO)

Conversely, participation in the MEKA program is voluntary and payments are only made for farmers outside water protection areas, with the exception of farmers in low-risk areas of water protection areas who do not receive SchALVO compensations (since 2001). By financing measures which promote environmentally sound agricultural practices, it changes the market incentives for farmers. Farmers can chose from a toolbox of measures which enables a high degree of regional customisation.

Water abstraction charges are levied for the actual water abstracted with the objective of improving the sustainability of abstractions, particularly with respect to pressures from flow regulation, and to internalise the environmental and resource costs of abstracted water.

Introduction

Two legislative changes can be said to have initiated discussions on SchALVO and water abstraction charges. First, the thresholds of acceptable nitrate concentrations in the Drinking Water Ordinance were tightened from 90mg N/l to 50mg N/l in 1986. Second, compensation payments to farmers that were restricted in their agricultural practices by constraints in water protection areas were made compulsory with the amendment of the Federal Water Law in 1986 (§19(4)).

The *Länder* could decide whether they wanted to implement §19(4) via a centralized model, i.e., the *Land* is responsible for compensation payments to farmers, or via a decentralised model, i.e. the compensation has to be paid by the water suppliers to the farmers directly.

In Baden-Württemberg, at the time, around 1,000 water companies were responsible for water supply and agricultural activities took place in some 2,400 water protected areas. In addition, Baden-Württemberg's history and geography led to very small average farm sizes (in 1987: 13.1 ha) which would have increased the transaction costs of negotiating compensations. Under these conditions, the centralised version was deemed the more suitable option.

An array of options was considered to finance the compensation scheme, among which water abstraction charges crystallized as the most promising. However, earmarking the revenues of the water abstraction charge for SchALVO payments raised serious legal concerns. Thus, the focus of the water abstraction charge was changed to reflect the objectives of increasing sustainable abstractions and to internalize the environmental and resource costs of water abstracted. While the compensation payments and the water abstraction charge are legally unconnected, the budgetary importance and the relevance of this link for the implementation of the water abstraction charge cannot be denied.

Legislative setting and economic background

Instruments discussed in this policy mix had to adhere to the wider framework laws provided by federal legislation such as the Federal Water Act (WHG, 1957), with which the Water Framework Directive (WFD) was transposed. Given the federal system in Germany, however, and the nature of the instruments, only changes to legislation at *Länder* level were required.

As the Federal Water Act does not provide for abstraction charges, the *Länder* are neither obligated to introduce these charges, nor are they limited in their design if they decided to introduce these. The introduction in Baden-Württemberg thus only required amendments in Baden-Württemberg's Water Act *(Wassergesetz).*

The SchALVO and MEKA, while introduced before the transposition of the WFD to federal law, are categorized as "supplementary measures" within the WFD and are framed by federal legislation on agricultural practices. The SchALVO, for example, curtails standard agricultural practises (*ogL)* in water protection areas. These standard agricultural practises are defined by, among other legislations, the Fertilizer Ordinance (transposition of the EU Nitrate Directive) which is now included in the WFD. The Regulation on Protected Areas and Compensatory Payments (SchALVO) was introduced in 1988 into the *Land* legislation of Baden-Württemberg. The MEKA program is co-financed by the Pillar II payments from the European Common Agricultural Policy (CAP), which are implemented via the "Action and Development Plan for the Rural Area of Baden-Württemberg (MEPL)".

Brief description of results and impacts of the proposed EPI

The change in behaviour of the economic agents, as a result of the SchALVO and MEKA, resulted in a decrease of nitrate concentrations. From 1994 to 2010, nitrate concentrations decreased by 5.7 mg N/l, a reduction of 19.5%, outside water protected areas and by 4.3 mg N/l, a reduction of 15.9%, within water protected areas. When contrasting the nitrate concentrations in 2010 to the baselines, the MEKA measures led to an additional 1.4 mg N/l improvement when compared to the SchALVO measures.

In 2001, the SchALVO was amended to focus measures on areas with high nitrate concentrations classifying them into 'problem' and 'decontamination' areas - thus linking the immissions and emissions of nitrate. By 2010 the average concentration of nitrates in decontamination zones had decreased from 52.1 mg N/l to 46.5 mg N/l (-10.7%) – a reduction which can be seen as a step towards the achievement of the goal of 'no measuring station exceeding concentrations of 50mg N/l by 2015'. However, the overall reduction of nitrate concentrations in water protected areas only decreased by 1.3 mg N/l between 2001 and 2010, while it had decreased by 3 mg N/l before the amendment between 1994 and2001. Thus, while the focus on areas with high nitrate concentrations led to a reduction of concentrations below the

thresholds (50 mg N/l), overall the reduction of nitrate concentrations in water protected areas slowed down. This could be explained by the fact that only 38% of the water protection area was targeted after the amendment and by the low levels of monitoring in low risk areas However, the impact of other factors on nitrate concentrations over time, such as differing hydrogeologies, climatic conditions or the impact of other direct regulation, e.g. Fertiliser Ordinance, cannot be attributed with certainty.

Following the implementation of the water abstraction charge in 1988, total water abstraction has decreased from 7,619 mil m^3 in 1987 to 5,015 mil m^3 in 2007 (-34%). This can be attributed to changes in production processes that increased water productivity by 61.3% between 1991 and 2007. The energy sector, for example, decreased the litres needed to produce energy by 39% over this period. As the energy sector was the main driving force behind the increased water abstraction between 1975 and 1987, these changes led to a 37% reduction in water abstraction between 1987 and 2007. However, the impact of other factors, such as increasing water and wastewater prices, on these changes in behaviour cannot be identified with certainty.

Conclusions and lessons learnt

The MEKA and SchALVO measures have been considerably successful in reducing groundwater nitrate concentrations in Baden-Württemberg. However, it can be assumed that the success would have been higher if monitoring activities had been expanded and enforcement measures, such as fines for non-compliance with constraints, had been imposed. Monitoring the impact of agricultural practices, e.g. via nitrate levels in soil, are aggravated by the impact of climatic conditions on these values and thus pose a challenge to a strict enforcement.

While the water abstraction charge internalises the environmental and resource costs, the compensation payments for farmers arguably contradict the "polluter pays principle", both of which are set out in Article 9 of the Water Framework Directive.

Experience with these measures in Baden-Württemberg has shown that transaction costs can be reduced by introducing joint applications for compensatory measures (e.g., for MEKA and SchALVO) and by harmonizing administrative procedures to already existing economic or regulatory instruments (e.g., the water abstraction charge was linked to existing procedures of the effluent tax).

Legal certainty and clarity regarding reduction schedules for the water abstraction charge appeared to be crucial for increasing acceptability among industries (e.g. energy, chemical and paper) and decreasing transaction costs, particularly legal costs, for all stakeholders. Furthermore, the option to offset investment costs for ecologically friendly measures against the abstraction charge further increased acceptance among the industry and was perceived as compensation for any competitive disadvantage the charge might have caused. The perception that revenues are being used to finance measures which improve water quality (i.e.

MEKA and SchALVO) increased the acceptability of water supply companies which depend on water sources endangered by agriculture.

Close cooperation between water suppliers and the government enabled the shared use of the water suppliers' water quality monitoring data. This reduced annual transaction costs by EUR 500,000 and enabled the control and assessment of compensation payment measures.

The fragmented structure of the water supply industry and the small average size of farms essentially prohibited voluntary agreements between farmers and water suppliers to improve water quality programs. This, however, led to the introduction of a regulation covering all water protection areas (SchALVO) that resulted in coherent efforts to reduce nitrate concentrations and decreased the potential for moral hazard. However, voluntary measures that offer a high degree of flexibility to adjust to regional particularities, such as MEKA, enjoy high levels of acceptance among farmers.

The WFD, the Nitrates Directive and the Natura 2000 sites create synergies with the implementation of the MEKA, SchALVO and water abstraction charges. Contrary, the combination of the Atomic Energy Act and the Renewable Energy Directive pose barriers to the effective implementation of the MEKA, SchALVO and water abstraction charges. The CAP (Pillar I) creates a further barrier to MEKA and SchALVO programs

Market incentives, such as increasing food prices and increased demand for biofuels accelerated by e.g. the Renewable Energy Directive and the Atomic Energy Act, exceed the incentives which can be provided by compensation payments, such as the MEKA, thus disabling their full environmental protection potential. Future developments will have to find the means to compete with these market forces to ensure that the prospect of short term profit does not outmatch sustainability.

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Acronyms

BW	Baden-Württemberg
CAP	Common Agricultural Policy
DM	Deutsche Mark
EEA	European Environment Agency
EMAS	European Eco-Management and Audit Scheme
EnBW	Energie Baden-Württemberg AG
EPI	Economic Policy Instrument
GPD	Gross Domestic Product
GWD-WV	Grundwasserdatenbank Wasserversorgung
ISO	International Organization for Standardization
KWh	Kilowatt hour
LVI	Regional Association for Industries in Baden-Württemberg
LWV	Landeswasserversorgung
MEKA	Market Relief and Cultural Landscape Compensation
MEPL	Maßnahmen- und Entwicklungsplan Ländlicher Raum
MLR	Ministry of Rural Affairs and Consumer Protection, Baden-Württemberg
MU	Ministry of Environment, Climate and Energy, Baden-Württemberg
N	Nitrate
NABU	Naturschutzbund Deutschland
RBMP	River Basin Management Plan
SchALVO	Regulation on Protected Areas and Compensatory Payments
WFD	Water framework directive

1. EPI Background

This case study analyses the policy mix of economic and regulatory instruments introduced in the Land of Baden-Württemberg to address water management problems, such as high nitrate levels in groundwater.

The policy mix consists of the following instruments:

- Regulation on Protected Areas and Compensatory Payments (SchALVO)[2]
- Market Relief and Cultural Landscape Compensation (MEKA)
- Water Abstraction Charges

The SchALVO has a twofold purpose. One the one hand, it curtails standard agricultural practices in water protection zones in order to reduce the leakage of nitrates and pesticides into water bodies, and, on the other hand, it introduces a compensatory payment scheme for famers affected by the aforementioned curtailment.
MEKA was introduced in 1992 as a pilot project to compensate, among other things, voluntary measures that support environmental services undertaken by farmers in areas outside of water protection zones. MEKA is co-financed by the European Common Agricultural Policy- Pillar II (MEPL) and has been seen three periods of implementation (1992-1998; 1999-2007; 2007-2012).

1.1. Policy objectives

Problems relating to groundwater quality, especially high nitrate levels, have been known of since the 1970s.

Since 2000, the overall objective has been to achieve "good ecological status" for all water bodies following the Water Framework Directive (WFD) goals and to reduce nitrate values at all measuring stations below the threshold stated in the Drinking Water Directive, i.e. 50mg/l by 2015.

Prior to 2000, but still relevant, a long-term goal is that all water protection areas should be categorized as "low-risk zones" (Landtag Baden-Württemberg, 2008).

The objective of the SchALVO is to protect the ground and surface waters in water protection areas from agricultural runoff, particularly nitrates, pesticides and microbial pollutants. In addition, previously polluted water shall be rehabilitated (LTZ, 2010). No quantitative targets were set.

[2] Verordnung des Umweltministeriums über Schutzbestimmungen und die Gewährung von Ausgleichszahlungen in Wasser- und Quellschutzgebieten (Schutzgebiets- und Ausgleichs-Verordnung – SchALVO)

In addition to the SchALVO measures, the MEKA program was introduced in 1992 to cover measures outside of water protection areas and since 2001 measures in low risk areas, which do not receive SchALVO compensations. Its objectives include the maintenance of the cultural landscape, support for the agricultural market, and the introduction of environmentally-friendly and extensive farming practices. The latter include measures to protect groundwater and surface water bodies. As the environmental impact of measures covered in the MEKA programs are sufficiently documented, the targets of these programs are based partially on area-wide coverage and levels of acceptance, rather than on quantitative environmental goals (see Table 1.1).

Table 1.1Goals of the MEKA III programme

	MEKA III (2007-2013)		
	Plan 2013	2007-2009	%
# of farms participating	35,000	33,515	96%
Area covered by MEKA (ha)*	1,520,000	1,548,430	102%
Physical area covered by MEKA (ha)	900,000	864,616	96%
Area covered by MEKA measures to improve water quality	500,000	2,962	59%%
€ spent	657.1 million	295.7million	45%

Source: IFLS (2010)

Note: * the area covered by MEKA measures exceeds the physical area of agriculturally used land, as one physical area may be supported by multiple MEKA measures.

While considerations to introduce the water abstraction charge started with the decision to introduce and need to finance compensation payments to farmers, such as SchALVO (Bergmann and Werry, 1989:2-4), the policy objectives of the water abstraction charge itself were focused on the following [3] (see section 3.5):

- Despite the current water abundance in Baden-Württemberg, water shall be seen as a valuable resource by its users, as its current availability may be reduced in the future by competing uses and climate change-related impacts on hydrology *(awareness raising and precautionary principle);*
- As such, the water abstraction charge shall incentivize water-saving behaviour by its users *(incentive function);*
- Furthermore, the water abstraction charge shall reduce the economic advantage (*Sondervorteilsabschöpfung)* of agents that benefit from the abstraction of water in comparison to those that do not benefit from abstracting water (*competitive rebalancing);*

[3] See the legal text introducing the water abstraction charges (Landtag von Baden-Württemberg, 1987) as well as in its amendment (Landtag von Baden-Württemberg, 2010).

- The government of Baden-Württemberg invests substantially in maintaining and cleaning water bodies – costs which shall be internalised by the users *(cost recovery).*

As such, the policy objectives represent a mix between the incentive and financing function of the abstraction charge. Following the transposition of the WFD into German federal law, the water abstraction charge can be further seen as the implementation of Article 9 of the WFD. No goals for reaching specific targets were quantified—neither for aspired water savings nor indicators on water scarcity nor a specific cost recovery target nor the reduction of the competitive advantage of water abstractors (Bergmann and Werry, 1989:7).

1.2. Design of the policy mix

SchALVO

The SchALVO, which was introduced in 1988 and amended in 2001, curtails standard agricultural practises (*ogL)* in water protection areas.

These areas are divided into three zones in which the constraints on agricultural practices differ, namely, Zones I, II, and III (Mader,2002) (Table 1.2). In the original version, farmers in Zones II and III received 310 DM/ha to compensate any economic losses which may have been caused by the constraints on their agricultural practices.

To optimise the incentive function and increase the effectiveness of the SchALVO, its amendment classified the three zones into three areas, depending on their nitrate levels in groundwater. As such, the SchALVO now links the immissions and emissions of nitrate. Constraints on standard agricultural practices, as well as compensation payments and control mechanisms, are varying between these areas (Table 1.2, LTZ, 2010). Compensation payments are limited to problem and decontamination areas in Zones II and III. If cattle are held, further compensation may be granted for Zone II. Furthermore, site-specific compensatory payments are only made in decontamination zones. The classifications of these areas are evaluated on an annual basis and are re-categorized if the nitrate levels in the groundwater suggest this is necessary (LTZ, 2010).

Compensation payments are conditional upon adhering to the constraints set out in the regulation. A breach of adhering to these constraints is deemed as an administrative offence, while the exceedance of nitrate values in soil is not (Müller, 1988). No fines are imposed in case of not adhering to these constraints. Rejection of compensation payments does not free the farmer from compliance with constraints (LTZ, 2008).

Table 1.2 Compensation payments, zone, and area classifications under SchALVO, from 2001

Zone/ Area	Low Risk Area	Problem Area	Decontamination Area
	<25mg N/l	>35mg N/l OR >25mgN /l if over the past five years nitrate concentrations increased by > 0.5mg N/l	>50mg N/l OR >40mg N/l if over the past five years nitrate concentrations increased by > 0.5mg N/l
I (well head): only grasslands or forests are permitted; the application of fertilizers, plant protection products is banned.	Compensation payments in zone I only in exceptional circumstances		
II (inner protection zone): in addition to Zone III, Prohibition of the application of manure and sewage sludge; prohibition of animal pens; limited manure spreading and grazing;	Compensation payment for Zone II is only made if the farm holds cattle and can be paid additionally to the compensation payments outlined for Zone II and III. Fixed rate (e/ha/year) in all areas based on % of agricultural land in Zone II. • > 20% → 10€ • 20-30% →40€ • 36.50% →85€ • < 50% → 160€		
II (see above) and III (outer protection zone): Prohibition of tilling of permanent pastures and application of terbuthylazine	No constraints requiring compensation. Since 2001 MEKA measures and compensation are allowed	Fixed rate of 165€/ha OR Individually set compensation payments based on proof of their economic loss, which range between the fixed rate of EUR 165/ha and the maximum compensation of EUR 200/ha (§13(3)).	Fixed rate of 165€/ha AND site-specific compensatory payments (15€/ha) OR Individually set compensation payments based on proof of their economic loss, which range between the fixed rate of EUR 165/ha and the maximum compensation of EUR 200/ha (§13(3)).

Regulatory instruments, such as the Fertilizers and Plant Protection Act, are underlying the restrictions imposed by the SchALVO. However, unresolved legal concepts of the Fertilizer Ordinance impede its potential impact (Kiefer, 2005).

MEKA (I, II, and III)

MEKA is a voluntary program for farmers outside of water protection areas in which they would receive compensation for implementing measures that improve environmental services. Farmers can freely choose measures that they deem most

appropriate for their operation and location (modular system). In MEKA III, 17 of the 27 measures (63%) were associated with water quality improvements (IFLS, 2010). Each measure is allocated a point score per hectare. The compensation payment is then calculated by multiplying the total points with EUR 10 per point. The measures need to be undertaken for a minimum of five years. The maximum compensation payment is capped at EUR 40,000 per company with the exception of cooperatives (Ministerium für Ernährung und Ländlichen Raum, 2008).

Water abstraction charge

The water abstraction charge was first introduced in 1988 by amending Baden-Württemberg's Water Act *(Wassergesetz)* and fundamentally revised in its amendment in 2010 (enforcement in 2011). The amendment aimed to optimise the incentives for conservation and protection of water resources and to incentivize investments by water-intensive industries by introducing offsetting options, simplifying the tariff structure, and offering legal certainty (Landtag von Baden-Württemberg, 2010:1)

In 1988, the size of the water abstraction charge was based on the origin of the water (surface or groundwater), the amount of water abstracted, and its proposed use (Landkreis Karlsruhe, 2010). From 2011 onwards, there were only three cost categories, i.e., surface water, groundwater, and water used by public water supply, and this has facilitated administrative procedures (Table 1.3).

Table 1.3 Water Abstraction Charges, 1988, 1998, and 2011 (€/m³)

	Cost Categories	Original Charges (1988, €/m³)	Revised Charges (1998, €/m³) (1)	Revised Charges (2011, €/m³)
Surface water	Public water supply	0,0256	0.0511	0.051
	Cooling	0,0051	0.0102	0.010
	Irrigation	0,0026	0.0051	/
	Other (incl. production, fisheries)	0,0103	0.0205	0.010
Ground water	Public water supply	0,0256	0.0511	0.051
	Heat production	0,0026	0.0051	0.051
	Other (incl. cooling, irrigation, production, fisheries)	0,0256	0.0511	0.051

Sources: Rott and Meyer, 1998; Haug, 2007; Landtag von Baden-Württemberg, 2010

Note: Euro conversion rates from 1998 were applied (€1=1.95583 DM) ;(1) the original charges are derived by halving the revised charges, based on the statement by Haug (2007:45) that charges had doubled in 1998.

Before the amendment in 2010, exemptions included abstractions below 2,000 m³/yr, abstractors that were exempt from requiring water abstraction permits according to the Federal Water Act or the Water Act of Baden-Württemberg (Kraemer & Jäger 1997:.65), and abstractions below the minimum threshold of EUR 100. Charges for

abstractions between 2,000 and 3,000 m³/yr were reduced by 50%. Water-intensive industries could apply for reductions of a maximum of 90% if they could prove that the abstraction charge impinged on their competitive position, i.e., profits before taxes were reduced by 5% due to the water abstraction charge (Bundesverfassungsgericht, 2007). Reductions of the charge were made conditional on water saving efforts and on substitution of groundwater with surface water where possible.

The amendment of 2010 (*Entgelt für Wasserentnahmen, 2010*) led to further exemptions, namely, water for cooling of buildings or irrigation purposes, water used for damage aversion or soil, and groundwater remediation, as well as any water abstractions below 4,000m³/year. To increase investment incentives, a maximum of 75% of abstraction charges for surface water could be offset by investment costs for measures which reduce heat pollution, improve the ecology of water bodies, or enable the substitution of groundwater with surface water (§17f). Groundwater charges can be reduced by at most 25% in specific industries if environmental management systems (EMAS or ISO 14001) are used (§17g). Further reductions are only possible in the case of particular and atypical burdens (§17h) – these do not include competitive disadvantages caused merely by the abstraction charge (MU, 2011).

The accompanying regulation states that equipment used to abstract water that is not exempt from water abstraction payments needs to be fitted with appropriate equipment which measures the quantities of water abstracted (§1, WMeßVO, 1987). Ultimately, the adequacy of these tools is judged by the water authority (§2, WMeßVO, 1987).

1.3. Monitoring

The *Land* Baden-Württemberg as well as the water suppliers (*Grundwasserdatenbank-Wasserversorgung*) closely monitor the water quality in Baden-Württemberg and use this data to control and assess the measures taken to improve groundwater quality (i.e., SchALVO and MEKA).

Compliance with the constraints from the SchALVO is monitored on the ground by Rural District Offices and by taking samples of the soil nitrate levels (Nmin) in the autumn. Compliance with constraints should result in certain nitrate values; however, the actual nitrate levels in the soil strongly vary with weather and site characteristics (LTZ, 2010:1). In 2004, soil samples were taken from 40% of the decontamination areas, 25% of the problematic areas and 3% of the low risk areas (Finck and Übelhör, 2010). In addition, 5% of the farms and 20% of the problematic and decontamination areas are controlled for compliance with restrictions on standard agricultural practices (Fink and Übelhör, 2010).

Compliance with MEKA measures and eligibility for compensation are monitored by the competent licensing office through site visits.

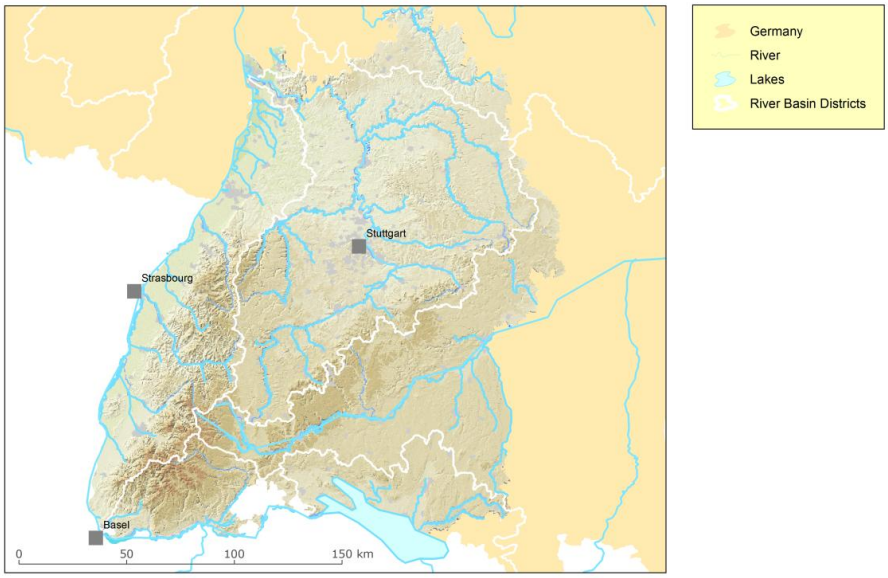
For the tasks relevant to the water abstraction charge, i.e., the approval process for water abstraction and the official monitoring, the water authorities are responsible. In Baden-Württemberg there are three levels of water authorities: the Ministry of Environment (Supreme Water Authority), Regional Councils (Higher Water Authorities),[4] and the lower administrative authorities, such as the city and county (Lower Water Authorities).[5] Water abstractors need to hand in their declaration of water abstracted on an annual basis. If this is not done, the charge will be based on estimates from the water authorities (§17b, WEEG, 1987).

1.4. Public participation

In Germany, policy formulation usually involves a high degree of openness. The legislative procedures include hearings of associations, committee meetings of the *Länder* parliaments, ballots in the relevant departments, stakeholder consultations on the internet, and targeted written hearings with affected stakeholders to assess the consequence of the legalisation as accurately as possible and to get input for the design of the legislation.

2. Characterisation of the case study area

Baden-Württemberg is a *Land* located in south-western Germany (Map 2.1).



Map 2.1 Map of Baden-Württemberg, Germany
Source: EEA Database, 2011

[4] *Regierungspräsidien*

[5] *Untere Verwaltungsbehörden (Stadt- und Landkreise)*

2.1. Environmental characterisation

As can be seen in Table 2.1, agriculture was the main land user in Baden-Württemberg in 1988 (49.1%) and 2010 (45.7%), experiencing only a 7% decrease over 22 years. Water protection areas increased significantly over time. In 1985, around 379,000 hectares (10% of the total area) were designated for water protection, while in 2010 they increased to around 1 mil ha (25% of total area). Around 360,000 ha within the present water protection zones are dedicated to agricultural practices (Finck and Übelhör, 2010).

Table 2.1 Geographical characterisation[6]

	km² (1988)	% of total area (1988)	km² (2010)	% of total area (2010)	% change of km² between 1988 and 2010
Forests:	13,242.1	37.0	13,688.00	38.3	3
Agriculture:	17,531.55	49.1	16,356.05	45.7	-7
Built-up areas: (1)	4,232.52	11.8	5,053.80	14.1	19
Water & wetlands:	324.29	0.9	385.68	1.1	19
Other uses	411.08	1.2	267.94	0.7	-35
Total:	35,741.53	100.0	35,751.48	100.0	+0.03

Source:StaLaBW, 2011a

Note: (1) Buildings and open spaces, operating area without land degradation, traffic area, recreation area, cemetery

Baden-Württemberg's average annual water supply between 1970 and 2000 amounted to around 13.7 billion m³, of which 42% are annually abstracted (5787.1 mil m³) (LUBW, 2011a).[7] Short-term (10-year) averages of groundwater levels are strongly declining, but medium-term (20-year) averages are mostly rising, and long-term (50-year) averages are stable (LUBW 2010:.6). While Baden-Württemberg is generally a water abundant *Land*, some areas, such as the plateau of the Schwäbische Alb, suffer from local water scarcity (LW, 2011).

The mean residence time of water in the wide range of hydrogeological units present in Baden-Württemberg spans between a few years and a couple of decades. Residence times in Baden-Württemberg's wide karst areas, however, can amount to only two to six years, with strong rainfalls and snow melts reducing the residence time to mere days or months (LGRB, 2008). Forty percent of Baden-Württemberg's geological structures are karstified, including the Muschelkalkgebiete and the Schwäbische Alb, Germany's largest coherent karst area (LHK, 2011). This has a significant impact on groundwater pollution.

[6] Earliest available data: 1988

[7] Please note, abstractions include consumptive and non-consumptive uses. Abstraction value is from the year 2000.

Pressures and impacts

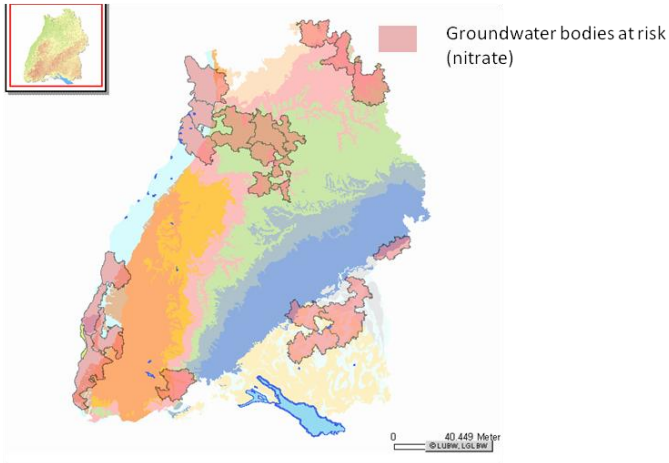
The main pressures on groundwater arise from diffuse pollution (i.e., nitrate). Table 2.2 and Map 2.2 below provide an indication of the extent and geographical spread of nitrate problems in Baden-Württemberg's groundwater bodies. The main pressures on groundwater can be found in regions dominated by agriculture and are often associated with intensive farming practices. Especially the arable loess soils in the plains of the upper Rhine valley and the Kraichgau are affected. Furthermore, groundwater bodies located in the moraine areas of Upper Swabia are also at risk. At the same time, the groundwater reservoirs of the Black Forest and the Swabian Alb show only little contamination (RBMPs). As such, a total of 28 groundwater bodies which make up 19% of Baden-Württemberg's area are categorized as "under risk" because they show concentrations above 50mg N/l.

Table 2.2 Overview of groundwater bodies under risk from nitrates (>50mg/l)

RB	Total Area (1)	Groundwater body under risk (nitrate > 50mg/l)		
		# of groundwater bodies	Area km²	% of total area
Donau	7,894	4	1,342	17
Oberrhein	7,541	8	2,715	36
Hochrhein	2,250	1	291	12
Main	1,622	3	860	53
Neckar	13,490	10	1,484	11
Alpenrhein	2,333	2	70	3
Baden-Württemberg	35,751	28	6,762	19%

Source: River Basin Management Plans of Baden-Württemberg, 2009

Note: (1) Areas of river basins may differ slightly due to rounding errors.



Map 2.2 Groundwater Bodies in Baden-Württemberg at risk (> 50mg N/l)
Source: LUBW (2010a)

When comparing the nitrogen nutrient balances of Baden-Württemberg between 1990 and 2005 with the Germany-wide average, Baden-Württemberg has a lower nutrient balance, i.e., less nitrogen leaks into the environment. Between 1990 and 2005, the nitrogen nutrient balance decreased by 34% in Baden-Württemberg, compared to 29% for the Germany-wide average. Germany sought to achieve an average of 80mg/l by 2010 (Destatis 2010). Baden-Württemberg has already achieved this goal.

Table 2.3 Nitrogen Nutrient Balance in Baden-Württemberg and Germany

Kg/ha	1990	1995	2000	2005	% change between 1990 and 2005
Baden-Württemberg	116	98	95	76	(-34%)
Germany-wide average	149	118	120	106	(-29%)

Source: BMU, 2008; BMELV

According to the River Basin Management Plans of basins within Baden-Württemberg, the main pressures on surface water include flow regulation and morphological changes, such as a lack of consistent flow, changes in structure of water bodies, backwater in rivers, and water diversions for hydropower and industrial processes. Furthermore, in 50% of the river basins (Alpenrhein, Oberrhein, and Donau) water abstractions lead to *local* groundwater level reductions (Umweltministerium Baden-Württemberg, 2009).

As Figure 2.2 illustrates, overall water abstraction increased significantly between 1975 and 1987 by 79%. Afterwards, abstraction levels decreased by 34% between 1987 and 2007 (see also Annex 1 - Table A1). It is apparent that the energy sector is far and away the largest water abstractor in Baden-Württemberg (64% in 1975, 81% in 1987, and 77.7% in 2007) and drove these significant fluctuations in water abstraction. The share of surface water abstracted by the energy sector is constantly 99% (StaLaBW,

2010b). With the exception of evaporative and distribution losses, 97% of the abstracted surface water is returned after its use, mostly to surface water bodies. Aquatic ecosystems are harmed as a result of the higher temperatures of the returned water (thermal pollution) and as a result of residues from coolants (e.g., glycol) (Haug, 2007). Water abstraction from agriculture (3.6 mil m^3 in 2007) and services (25.3 mil m^3 in 2007) are minor abstractors.

2.2. Economic characterisation

With a GDP per capita of € 33,655 in 2008 (StaLaBW 2011b), Baden-Württemberg is one of the wealthiest *Länder* in Germany. Its 10,749,000 inhabitants also make Baden-Württemberg one of the more populous *Länder* (StaLaBW 2011b). The population density amounts to 301 inhabitants / km^2 (SÄBL 2011).

The sectoral split of economic activities shows that services make up the highest share of GDP in Baden-Württemberg. Energy supply only contributes around 2% to total GDP, and agriculture contributed 0.17% in 1991 and 0.84% in 2007 to total GDP.

Table 2.4 Economic Activity in Baden-Württemberg per sector, 1991 and 2007

Economic activity	1991 Mil €	1991 % of total GDP	2007 (1) Mil €	2007 % of total GDP
Total	1,534,600		2,428,200	
Manufacturing (2)	477,890	31.14%	607,720	25.03%
Energy Supply (3)	32,150	2.10%	48,940	2.02%
Agriculture and Forestry	2 ,629	0.17%	20,430	0.84%
Services (4)	863,480	56.27%	1,499,240	61.74%
Other activities (5)	156,451	10.33%	251,870	10.37%

Source: StaLaBW, 2010a

Notes: (1) latest available data for agriculture and forestry; (2) includes construction, mining, extraction of stones and earth, and manufacturing; (3) includes public water supply; (4) includes trade, catering and transport, financing, leasing and business services, and public and private service; (5) includes fisheries and taxes minus subsidies.

2.3. Baseline

It is assumed that the agricultural sector would have had no incentive to change production practices without the introduction of the SchALVO and the MEKA programs. Contrarily, the increasing food prices would have incentivized the agricultural sector to increase production, in terms of space and by intensity, thus leading to even more pollution (Landtag von Baden-Württemberg, 2008). Assuming

that no other measures (regulatory or economic) had been instituted, the baseline will be set at the constant nitrate level of 1994. Changes in the measurements outside of the water protection zones are further seen as baseline for the SchALVO compensation payments. As the *Länder*-wide groundwater monitoring stations were introduced in 1990 and the first reliable data which may be compared with the following years was that of 1994, no prior baseline data can be derived.

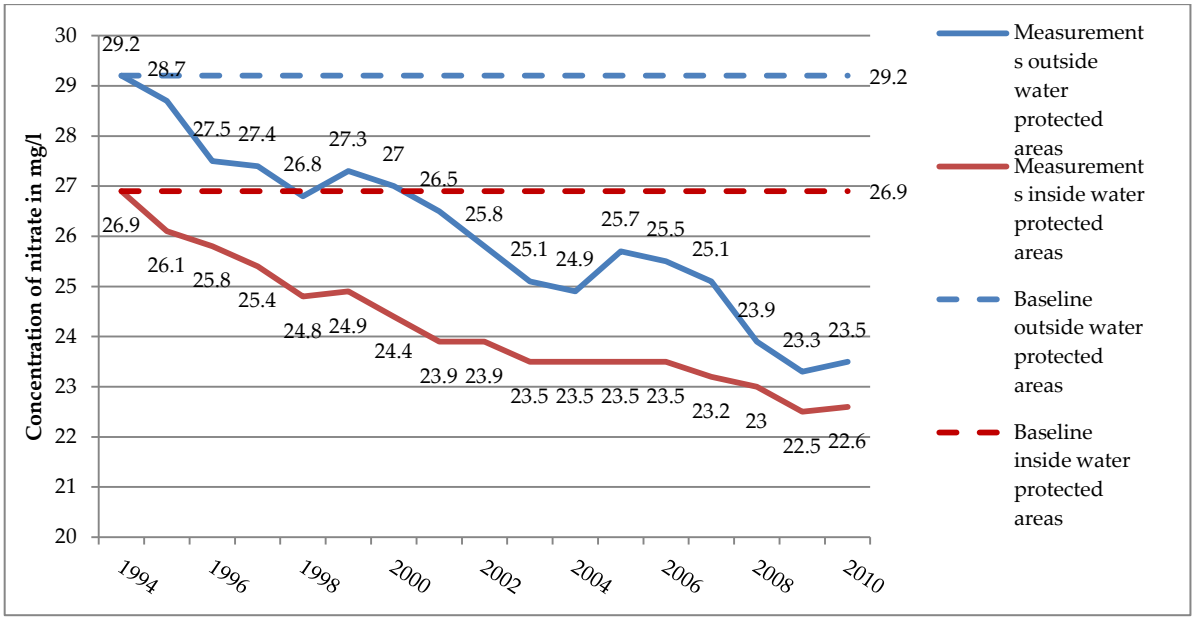


Figure 2.1 Development of nitrate levels between 1994 and 2010 in and outside of water protected areas and baselines
Source: *LUBW (2010:42); Authors' estimate*

As the economic activity of the energy and manufacturing sectors has increased over time, it can be assumed that water abstractions had increased as well. However, keeping in mind that technological developments and investments reducing water demand could have taken place to some extent without the water abstraction charge, the baseline is chosen as the 1987 water abstraction level (Figure 2.2).

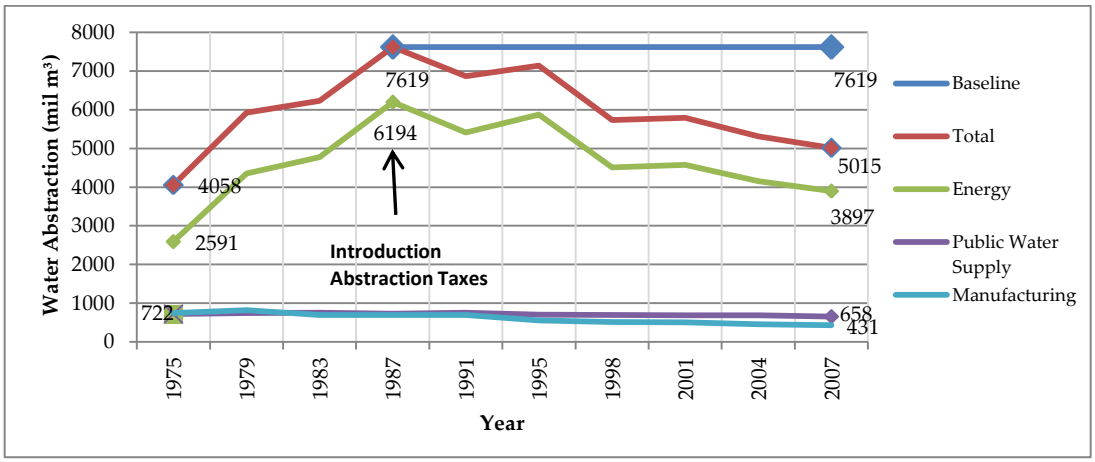


Figure 2.2 Water Abstraction per sector, 197-2007 including this case study's baseline

Source: StaLABW, 2010b; Authors' estimation

3. Assessment Criteria

3.1 Environmental outcomes

The economic agents' effective responses to the policy mix

The introduction of SchALVO in 1988 made compliance with restrictions to the standard agricultural practices, and thus a change in behaviour, compulsory. As part of the compliance monitoring, Figure 3.1 shows the results of nitrate measurements of soils for a number of crops between 1990 and 2008. It demonstrates that farmers changed practices in water protected areas, particularly in the early '90s. Following the amendment, measurements were focused on decontamination and problem areas, and thus are only comparable to a limited extent. Despite the compulsory nature of the SchALVO, 26% of samples in problem areas (2,678 sites) and 23% of samples in decontamination areas (952 sites) exceeded the nitrate threshold value in 2010, indicating that not all farmers altered their behaviour. The focus on problem and decontamination areas led to only 38% of the water protection area being covered by stricter SchALVO restrictions and monitoring. With only 3% of the low risk area being monitored for compliance with the general restrictions to standard agricultural practices valid in water protection areas (Finck and Übelhör , 2010), it was feared that farmers would return to their prior, unrestricted farming practices which do not protect groundwater resources (Kiefer, 2005).

However, as the extremely arid year 2003 illustrates, changes in farmer behaviour and weather-related changes in nitrate levels in soils are difficult to distinguish; thus, the impact of the SchALVO cannot be determined with certainty.

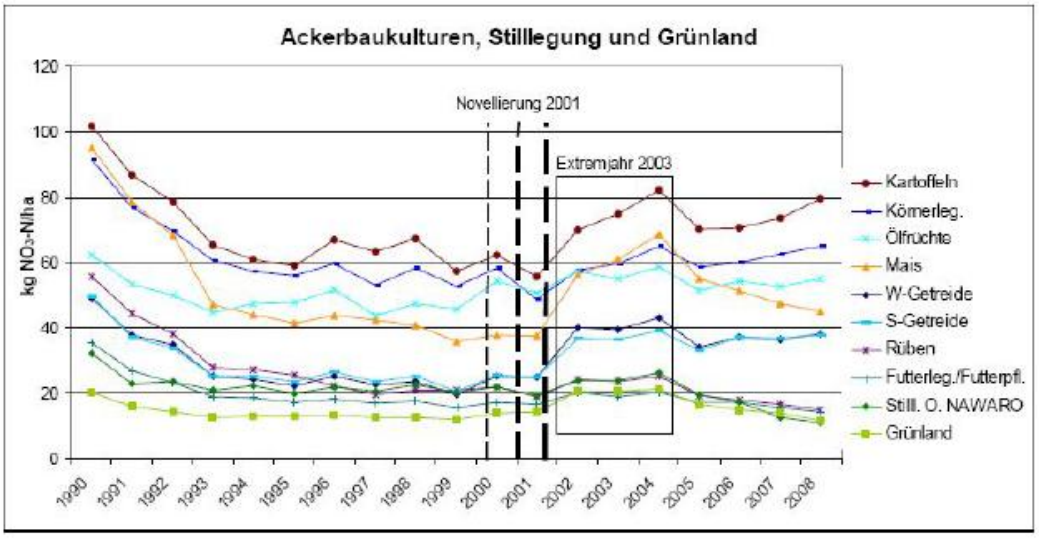


Figure 3.1 Nitrate levels in the soil (Nmin) for certain crops, 1990-2008

Source: Finck and Übelhöhr (2010)

Note: Values show moving averages over 3 years

Contrary to the SchALVO, the MEKA program is voluntary. Changes in behaviour by farmers can be approximated by the take-up of the program measures. The total area in which MEKA measures were introduced grew from MEKA I (815,000 ha, 50% of agricultural area) to MEKA II and III (900,000 ha, 55% of agricultural area). For MEKA III 96% of the targeted area has been achieved between 2007 and 2009. This illustrates a wide acceptance, as MEKA III only ends in 2013. This trend indicates increasing acceptance and willingness to alter farming practices. The main areas in which MEKA measures are being implemented coincide with areas of high nitrate concentrations in groundwater (see Annex 2 – Map A1).

As Figure 3.2 demonstrates, production processes in the energy sector have changed over time, reducing the amount of water required to produce one kilowatt-hour (kWh) of energy by 39%.

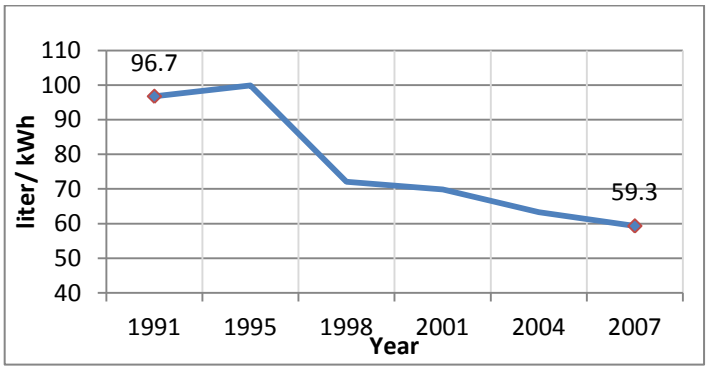


Figure 3.2 Litres/ kWh used in the energy sector, 1991-2007
Source: StaLaBW, 2010b

In addition, water productivity (i.e. the value added per m^3 of water used), has increased by 61.3% in Baden-Württemberg between 1991 and 2007 (Annex 2 – Figure A1). [8]

However, opinions diverge regarding whether these changes in behaviour were caused exclusively by the abstraction charge. For example, a recent study by Fälsch (2011) showed that there has been a substitution effect from industrial self-providers in reaction to the water abstraction charge. The government of Baden-Württemberg also states that the abstraction charge had a clear impact by changing the incentive functions of economic agents (Landtag von Baden-Württemberg, 2010b:6888). However, other factors, such as higher water and wastewater prices, technological innovation, and the introduction of the fish habitat regulation (*VwV-FischgewässerVO, 2001)*, which sets thresholds to the temperature of returned water in Baden-Württemberg, may also have influenced behaviour (Gawel et al, 2011).

8

Consequent lower pressures on water-related ecosystems

Between 1994 and 2010, there was an overall decrease of 19.5% (-5.7mg/l) in nitrate concentrations in groundwater outside of water protected areas, compared to an overall decrease of 15.9% (-4.3 mg/l) in water protected areas (Figure 2.1). When contrasting the change in nitrate concentrations to the baselines of each area, the voluntary MEKA program led to an additional 1.4 mg/l decrease of nitrate.

Since the amendment of SchALVO in 2001, decontamination areas have experienced the greatest reduction in nitrate concentrations in groundwater. Concentrations have decreased from 52.1 mg N/l to 46.5 mg N/l (-10.7%). Nitrate concentrations in problem areas decreased from 34 mg N/l to 31.8 mg N/l (-6.5%). In low risk zones, the levels remained constant at 14.5 mg N/l (LUBW, 2010:53). However, the overall reduction of nitrate concentrations in water protected areas only decreased by 1.3 mg N/l between 2001 and 2010, while it had decreased by 3 mg N/l before the amendment between 1994 and2001. Thus, while the focus on areas with high nitrate concentrations led to a reduction of concentrations below the thresholds (50 mg N/l), overall the reduction of nitrate concentrations in water protected areas slowed down. This could be explained by the fact that only 38% of the water protection area was targeted after the amendment and by the low levels of monitoring in low risk areas.

These differing outcomes illustrate that the differentiated restrictions in each area did have an impact on nitrate concentrations. Comparing the reduced pressure from the SchALVO areas with those of the MEKA areas, however, shows that only an additional 13.6% of reduced nitrate concentrations can be attributed to SchALVO restrictions. It should be noted that other factors, such as differing hydrogeology and thus differing resident time, were not taken into consideration in this analysis. Therefore, these conclusions need to be handled with care.

As a result of reduced pressure from nitrate from agricultural practices, between 2001 and 2010 the percentage of decontaminated and problem areas decreased by 44.3% and 13.4% respectively (Figure 3.3).

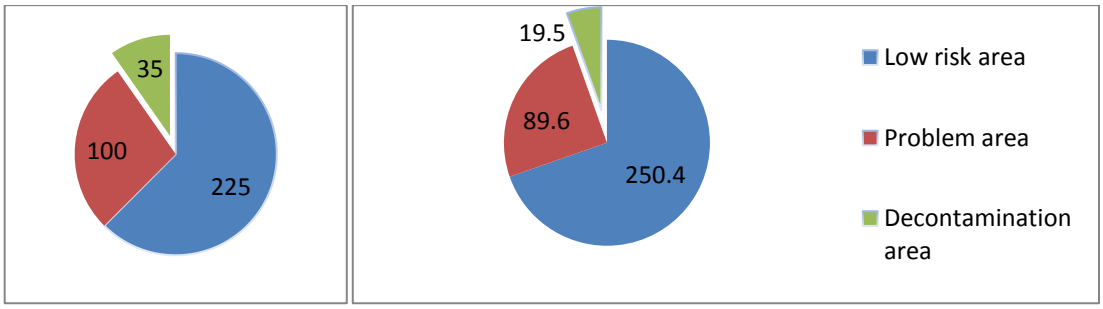


Figure 3.3 Agricultural land classified as low risk, problem, and decontamination areas in Baden-Württemberg, 2001 (left) and 2010 (right), in 1,000 ha

Source: LTZ, 2010

Total water abstraction has decreased from 7,619 million m³ in 1987 to 5,015 million m³ in 2007 (-34%). As the energy sector was the main driving force behind the

increased water abstraction between 1975 and 2007, the behavioural changes described above led to a 37% reduction in water abstraction between 1987 and 2007. Decreased water abstraction is likely to have a positive impact on pressures outlined in the RBMPs, namely flow regulation and morphological changes, including water diversions of hydropower and of industrial water.

3.2 Economic assessment criteria

As described in section 1, this case study describes a policy mix. To achieve a reduction in nitrate concentrations in groundwater, regulatory (SchALVO restrictions) and economic (compensation payments under SchALVO and MEKA) instruments are combined. No regulatory instrument complements the water abstraction charge to reduce water abstractions. Regarding the SchALVO, the exact impact of the economic instrument cannot be singled out.

With the amendment of the SchALVO in 2001, 50% of the current compensation payments were eliminated, as only targeted areas (i.e. problem and decontamination areas) received compensation payments, rather than all farmers in water protected areas. These savings of EUR 30 million were used to co-finance the MEKA program. CAP payments (pillar II) from the EU co-financed the MEKA program, doubling the total to EUR 60 million (Mader, 2002). Thus, the amendment increased the budget for compensation payments from EUR 60 million to EUR 90 million.

Following legal concerns, the revenues from the water abstraction charge are not earmarked for water protection measures, but flow directly into the federal budget of Baden-Württemberg. However, during the introduction of the water abstraction charge and the SchALVO, it was proposed that the revenue, while not earmarked, would be used to finance the compensation payments (e.g., Bergmann and Werry, 1989:2; Müller, 1988).

Comparing the revenues from water abstraction charges with the expenditures for the compensation payments between 2002 and 2007, it becomes apparent that, although abstraction charges are not legally earmarked to compensation payments, there is a degree of cost coverage. Further, the amendment of the SchALVO took place in a time when the water abstraction charge revenue did not suffice to cover the compensation payments, as in 2000. This may suggest that these cash flows are linked "informally" despite their legal disconnection (Table 3.1) [9].
The amendment of the water abstraction charge described in section 1 is estimated to lead to a reduction of revenues from water-intensive industries, such as the energy sector, of around EUR 10 - 11 million (Landtag von Baden-Württemberg, 2010:3).

[9] Additional data can be found in Annex 2-Table A1

Table 3.1 SchALVO and MEKA expenses and revenues from the water abstraction charge, 2000-2007

	Compensation Payments					Revenue
Mio €	SchALVO (3)	MEKA (total) (4)	MEKA (water protection) (4)	MEKA (water protection) paid by BW	Total compensation payments paid by BW (5)	Water Abstraction Charge Revenue
2000	60 (1)	107.6	84.7	42.35	102.35	93
2001	n/a	128.1	103.1	51.55	n/a	79
2002	22	147.2	117.1	58.55	80.55	98
2003	21.3	147.8	118.7	59.35	80.65	88
2004	21.7	146.7	117.9	58.95	80.65	88
2005	18.7	136	104.5	52.25	70.95	81.1
2006	18.3	112.2	95.8	47.9	66.2	86.5 (6)
2007	18.6	95.2	83.2	41.6	60.2	82

Sources: (1) Müller (1988); (2) Mader (2002); (3)Landtag BW (2008); (4) Personal correspondence with MLR.; (6) Fälsch (2011)

Note: (5) EU payments contribute around 50% of the MEKA payments; the exact payment for each year should be seen as an estimate. MEKA payments, as part of CAP payments are planned over fixed periods of time (e.g. MEKA II over 1999-2007) so that the height of compensation payments are fixed to a predetermined maximum over this time.

As the amended SchALVO only provides for compensation payments in problem and decontamination areas, the fact that payments have steadily decreased since 2002 implies that these areas are decreasing in space (Figure 3.3). This correlation allows for the assumption that the SchALVO was effective.

A study comparing the cost-effectiveness of agro-environmental schemes in the *Länder* of Germany revealed that MEKA is the most cost-effective program, i.e. the use of tax payers' money achieves the greatest environmental improvements (MLR, 2011).

Incentive alignment

A study by IFLS (2010) found that without the agro-environmental MEKA program, farmers would have intensified agricultural production in many instances and, due to economic incentives, would have only adhered to the minimum regulations regarding environmental protection. Compensation payments under MEKA are generally considered to partially and in some cases sufficiently compensate for additional burdens and reduced harvests. However, certain practices, such as the

production of biomass and afforestation, are more lucrative to farmers than the agro-environmental compensation schemes. For the compensation schemes to provide a real alternative to these potentially environmentally harmful measures, they need to be expanded and adapted.

Water suppliers, such as the Landeswasserversorgung, feared that the amendment of the SchALVO would reverse incentives for farmers in low-risk and problem areas and lead to increased nitrate pollution in order to receive (higher) compensation payments (Haakh, 2001). However, the Nature Protection Association (NABU) rejects this fear, as farmers can barely cover the additional costs and administrative burdens caused by the strict constraints in problem and decontamination areas (Nabu, 2011a). The decrease in problem and decontamination areas (Figure 3.3) supports this argument. Further, Haakh (2001) stresses that farmers outside of the problem and decontamination areas only need to follow the general restrictions for water protected areas – restrictions he fears are neither well defined, nor well monitored for compliance. With only 3% aerial coverage of monitoring (Fink and Übelhör, 2005), this may indeed set the wrong incentives.

NABU praises the incentives provided by the agro-environmental programs, but criticises the low compensation payments, which in the future are expected to be reduced further due to budgetary constraints (NABU, 2011).

The amendment of the water abstraction charge introduced the option to offset investments which improve water ecology, thus extending the incentive function to ecological measures, rather than to just water savings. The increase in investments related to water protection before the introduction of the water abstraction charge in 1988 and before the enforcement of its amendment by the energy sector (StaLaBW, 2011b), suggests a correlation and shows an announcement effect, as occurred with the introduction of the effluent tax in Germany in 1976 (e.g., Barde, 1997). By analysing the level of the water abstraction charges between 1988 and 2010 for water suppliers, Gawel et al (2011) found that while the nominal rate remained constant, the real rate decreased by around 35%. The charge has not been adjusted to inflation – thus the incentive effect is reduced.

Since this revision, charges for the abstraction of groundwater can be reduced (§17g) by implementing environmental management systems (EMAS or ISO 14001). This also might have a positive effect on risk reduction in the future. Whether a shift from external control to internal environmental management systems empirically increases the awareness of the water abstractors or not remains to be seen.

3.3 Distributional effects and social equity

This section sheds light on the distributional effects and social equity caused by the policy mix. While interviews were conducted with a public water supplier (LW) and an energy company (EnBW), no interviews could be conducted with representatives of farmers. The literature review as well as the interviews provided insights into impacts related to changes in income and expenditure (and thus competitive

position), education of stakeholders and security. Effects on employment are discussed in section 3.6 (transaction costs). Further interviews would have to be conducted to assess the impact of the policy mix on the stakeholders' health and personal activities.

Effect on productive activities

While legally the revenues from the water abstraction charge are not earmarked for compensatory payments in agriculture, this perception still remains among stakeholders (see section 3.5).

Figure 3.4 illustrates a representative split of water abstraction charges paid by industrial sector. It is clear that the energy sector (40.2%) and the public water supply (31.1%) carry most of the burden.

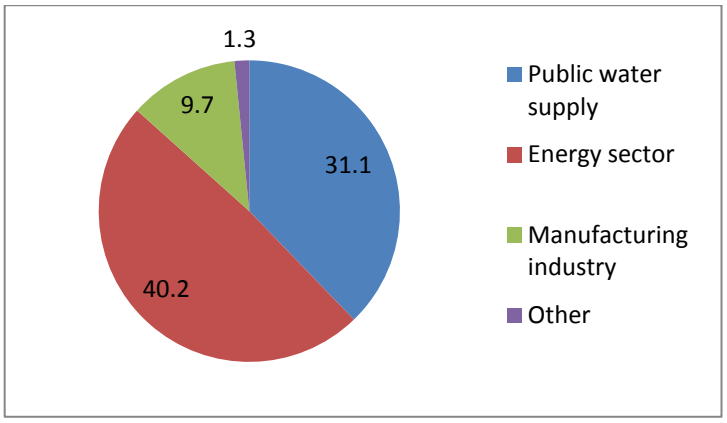


Figure 3.4 Water abstraction charges paid in 2007, per industry (EUR, million)

Source: Landtag von Baden-Württemberg, 2010

While the public water supply could arguably benefit from decreased nitrate levels in untreated water, as treatment costs would be reduced, clear cost savings have not materialized yet due to the limited change in nitrate concentrations. For the Landeswasserversorgung (LW), one of Baden-Württemberg's main water suppliers, the water abstraction charge comprises 8% of its operating costs. As tariffs are set to recover all financial costs, the expense is taken on by consumers, with water costs increasing by 8%. The LW distributes its water to municipal water suppliers at 40 cent/m³, which then reaches the customer at about 2.20€/m³ (LW, 2011). While domestic water prices in Germany are among the highest in Europe, average domestic water in the Netherlands and France still exceed Baden-Württemberg's tariff, at around 3€/m³ (EEA, 2003). The increase in consumer bills is thus negligible.

The regional association for industries in Baden-Württemberg (LVI) states that the water abstraction charges lead to a disproportionate competitive disadvantage, particularly for water-intensive industries, as the surrounding *Länder* do not have this type of charge or, as in the case of Hesse, ceased charging it (LVI, 2005). In particular, the Chemical Industry in Baden-Wurttemberg expressed discontent with the water abstraction charge, as it is perceived to result in a disproportionate burden that affects their national competitiveness in Germany (Ka-News, 2010). To

corroborate this, LVI states that no new water-intensive industrial plants have been constructed in Baden-Württemberg for a long time – a water-intensive industrial corrugated paper plant, with an investment volume of EUR 500 million, was constructed on the other side of the Rhine in the Rhineland-Palatinate which does not charge the abstraction charge (LVI, 2005).

The nuclear power plant in Philipsburg (part of EnBW Kraftwerke AG) stated that the liberalisation of the energy market in 1998 increased the competitive disadvantage caused by the water abstraction charge, as costs could no longer be transferred to consumers. Following a law suit demonstrating that the water abstraction charged reduced its profits by more than 5%, Baden-Württemberg refunded part of the past payments. However, EnBW, which is located in Baden-Württemberg and Germany's third largest energy supply company, states that the average water abstraction charge still contributes to around 1-2% of operating expenditures. The amendment of the water abstraction charge was believed to reduce this competitive disadvantage, due to the option to offset investment costs. Contrary to LVI's opinion that the water abstraction charge could impede new water-intensive investments, EnBW recently constructed a coal-fired power plant (RDK 8) in Baden-Württemberg (EnBW, 2011).

The Ministry of Environment, Climate, and Energy (MECE) in Baden-Württemberg agrees that the "energy location" offers more benefits – such as a central location in the heart of Europe and a high concentration of firms and accredited universities both demanding and supplying services – than the water abstraction charge could outweigh (MU, 2011). In addition, sourcing outside of Baden-Württemberg is discouraged by lengthy and extensive administrative procedures necessary to abstract and transport water from neighbouring *Länder* which have not introduced abstraction charges (LW, 2011).

The amendment of the water abstraction charge reduces the impact on water-intensive industries while increasing their investment incentives. The public water sector is not expected to be affected, although there may be marginal reductions in charges due to a rounding down of the tariff rate and reduction of the minimum claims limit. At the same time, this amendment will not impact residents directly or indirectly. It is expected that, if the discount options are fully realized, the public budget will decrease by an estimated EUR 10-11 million.

While the agricultural sector only paid a marginal amount of the revenue from the water abstraction charge and was exempted in the amendment (see section 3.6), it does benefit from the compensation payments for improved agricultural practices (SchALVO and MEKA). This is perceived, particularly by the water supply industry, as the reversal of the "polluter pays" principle (Müller, 1988).

The compensation payments to farmers, however, are at times perceived to not cover the additional costs (administrative, operational and capital costs) which arise due to production constraints. Further, the annual re-assessment of problem and decontamination areas within the SchALVO, reduce planning security for the farmers and may lead to financial disadvantages (Nabu, 2011).

Capacity Development and stakeholder relations

In the context of SchALVO, water supply companies organised several events for farmers to inform them about agricultural practices which protect groundwater resources, as well as to present findings from research projects. These events furthered the mutual understanding between water suppliers and farmers (LW, 2011).

3.4 Institutions

Two legislative changes have initiated discussions on SchALVO and water abstraction charge. For one, the thresholds of acceptable nitrate concentrations, as stated in the Drinking Water Regulation, were tightened from 90mg N/l to 50mg N/l in 1986. In addition, compensation payments to farmers which were restricted in their agricultural practices by constraints, for example in water protected areas, were made compulsory with the amendment of the Federal Water Law in 1986 (§19(4)).

The *Länder* could decide whether they wanted to implement §19(4) via a centralized model, i.e. the *Land* is responsible for compensation payments to farmers, or via a decentralized model, i.e. the compensation has to occur between the water suppliers and the farmers (Müller, 1988).

Given that around 1,000 water companies in Baden-Württemberg were responsible for water supplies and that agricultural activities took place in the around 2,400 water protected areas, the decentralised model did not seem like a viable option. In addition, Baden-Württemberg's history and geography led to very small average farm sizes (in 1987 13.1 ha), which would have increased transaction costs for negotiating compensation (StaLaBw, 2008). As strict, area-wide constraints would have been difficult (or impossible) to achieve with the decentralized model, it was decided to introduce the SchALVO in 1988 (Müller, 1988).

An array of options was considered to finance the compensation schemes. Following an expert testimony on legal eligibility ("Salzwedel Gutachten"), water abstraction charges crystallized as most promising. This fell in line with the concerns raised in the late 1970s and early 1980s that the current water protection legislation and the *Länder* administrations as a whole were ineffective and not able to fulfil their functions. The choice for water abstraction charges as an economic instrument was in line with the "general movement towards economic and away from regulatory instruments in environmental policy in that time" (Kraemer et al. 1998, pp.6-7).

The introduction of the water abstraction charge in 1988 was very controversial (Anon 2002). It followed at the *Länder* level after earlier discussions at the federal level in the 1950s and 1960s had failed to impose a federal charge. However, as the Federal Water Act did not provide for abstraction charges, the *Länder* were neither obligated to introduce these charges, nor were they limited in their design if they decided to introduce these (Ginzky et al, 2005).

Initially, the government of Baden-Württemberg intended to earmark the revenues of the water abstraction charges for the compensation payments – the Salzwedel testimony, however, raised serious legal concerns to the legitimacy of this earmarking. Following this, the government of Baden-Württemberg reconsidered the focus of the policy objective of this EPI and diminished its importance as a financing tool for compensation payments (Bergmann and Werry, 1989:2-4). Nevertheless, Müller (1988) states that it is unlikely that Baden-Württemberg would have committed to centralized compensation payments if it had not had the revenues from the water abstraction charge to pay for them.

Baden-Württemberg, in cooperation with relevant water stakeholders, initiated a program to monitor groundwater quality in 1984. Water supply companies supported this undertaking from the beginning by introducing and operating data collection stations and delivering the data to the database for free. In 1992, the water supply companies developed its own groundwater quality database (GWD-WV) in order to increase transparency on water quality levels and monitor and assess the impact of the measures taken to improve groundwater quality (i.e. SchALVO and MEKA) (GWD-WV, 2009). These developments facilitated the enforcement of the agro-environmental programs.

The amendment of the EU Nitrates Directive in 1996 tightened the requirements for the "standard agricultural practice" and thus paved the way for the SchALVO amendment in 2001. As the restrictions for farmers were tightened, the focus of measures could be directed to vulnerable zones, without, at least in theory, the deterioration of non-vulnerable zones.

3.5 Policy implementability

The policy mix can be seen as rather flexible and capable of adapting to ex-ante and ex-post situations. The SchALVO was amended in 2001 as a reaction to limited success in reducing nitrate concentrations and was designed in a more focused manner (Mader, 2002). The MEKA measures were adapted over time to match the compensation with the burden or losses the measures implied. Furthermore, the design (modular) of the MEKA measures maximizes the flexibility for farmers. Likewise, the water abstraction charge was amended in 2010 to increase the innovation incentives, increase the incentive for sustainable practices, and increase legal certainty in administrative procedures.

Public participation

In both cases, the introduction of the water abstraction charges in 1987 and its amendment in 2010, the public was involved in the legislative process.

Before the introduction of the SchALVO, water supply companies, such as the Landeswasserversorgung (LW), warned the government about the seriousness of the nitrate problem (LW, 2011). However, the entire water supply industry was strictly against the introduction of water abstraction charges to pay for compensation payments for farmers—these were seen as new subsidies for agriculture and a reversal of the polluter pays principle. They suggested strengthening legislation regulating polluters and enforcing it more vehemently (LW, 1986). The agricultural sector, on the other hand, supported the idea of compensation payments, as they felt crushed by regulations and restrictions in water protection zones and suffered economic losses as compensation payments did not occur regularly (LW, 1986).

Once the water abstraction charge was in force, industries filed constitutional complaints against the lawfulness of water abstraction charges in 1995 (Rott and Meyer, 1998). The legislative competence of the *Länder* to introduce water abstraction charges was substantiated by a decision of the Federal Constitutional Court (2 BvR 413/88 and 1300/93). Following this decision, the acceptance of water abstraction charges gradually improved (MU, 2011).

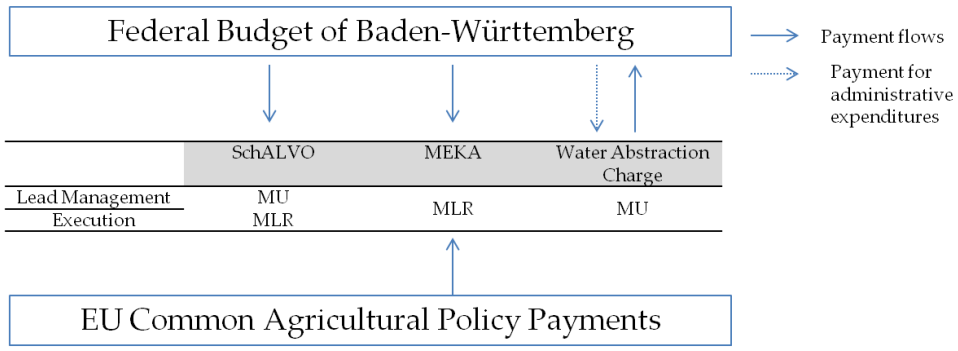
Nevertheless, several law suits were filed based on differing reductions to the water abstraction charge. As administrations were free to grant reductions up to 90%, a great heterogeneity in practices developed, which caused discontent throughout the industry.

Several stakeholder groups, among which were the energy industry, manufacturing industry, agriculture, water supply sector, and environmental and user associations, seized the opportunity of public hearings to get involved in the legal process accompanying the amendment to the water abstraction charge in 2010. While the stakeholders belonging to the industry proposed the cancelation of the water abstraction charges, or at least a drastic reduction in the tariffs, the environmental groups lobbied for a drastic increase. Representatives from agriculture approved of the amendment as irrigation practices were made exempt in the amendment due to the small amount of water used. While the majority of the comments by the industry were denied entry into the legal text, the paper, textile, chemical, and energy industries lobbied for and were granted changes regarding the option to offset the water abstraction charge with investments (Landtag von Baden-Württemberg, 2010). In addition, the fee structure and the basis for reductions were changed to establish legal certainty, which had been lacking in the previous version. Both amendments are expected to result in discounts to the industry of around 10-11 Mio € annually (of a total revenue of ~80 Mio € annually) (LVI, 2010). The water supply sector, however, continues to disapprove of the water abstraction charge, on the grounds that water

prices reflecting financial full cost recovery suffice as incentives for water users to use the resource with care (BEDW, 2011). However, the perception that revenues are being used to finance measures which improve water quality (i.e. MEKA and SchALVO) does increase the acceptability of this charge to water supply companies which depend on water sources endangered by agriculture (LW, 2011). [10] Water companies, however, which abstract most of their water from water bodies which are not endangered by diffuse pollution from agriculture such as the Bodensee water supply company, continue to not accept water abstraction charges (BWV, 2011).
While water supply companies approved of the MEKA program, particularly due to the approach of maximizing areal coverage, the amendment of the SchALVO in 2001 was less favoured. It was feared that nitrate concentrations would increase instead of decrease due to reverse incentives (see section 3.2) and decreased areal coverage (see section 1). The voluntary nature and high degree of flexibility of the MEKA measures resulted in high acceptance levels from farmers (IFLS, 2010).

Cooperation and coordination between governmental levels

Figure 3.5 provides an overview of the responsibilities of ministries in the management and execution of the policy mix. It also clarifies the revenue and payment streams. The Ministry of Environment, Climate and Energy (MU) and the Ministry of Rural Affairs and Consumer Protection (MLR) coordinate and cooperate in a significant and effective way (MU, 2011; MLR, 2011).



MU – Ministry for Environment, Climate and Energy
MLR – Ministry for Rural Affairs and Consumer Protection

Figure 3.5 Overview of responsibilities and revenue flows for the policy mix

Budgetary considerations

Budgetary constraints had a significant impact on the design of the policy mix (see section 3.4). In addition, MEKA payments were curtailed in 1997 and are assumed to be curtailed again in close future, due to a budget gap (MLR, 2005; NABU, 2011). The

[10] This perception was nurtured during the process of the design (see section 3.5) and the fact that both instruments were introduced in 1988.

latter cut may be seen in relation to the amendment of the water abstraction charge which is expected to reduce revenues by EUR 10-11 million annually(see also section 3.2). Monitoring activities for compliance with SchALVO and MEKA can be expected to have increased with higher budgets available.

Synergies and barriers between the policy mix and sectoral policies

When analysing the barriers and synergies between the main sectoral policies and the policy mix, it becomes apparent that the WFD, the Nitrates Directive and the Natura 2000 sites create synergies. Contrary, the combination of the Atomic Energy Act and the Renewable Energy Directive pose barriers to the effective implementation of the MEKA, SchALVO and water abstraction charges. The CAP (Pillar I) create a further barrier to MEKA and SchALVO programs (Table 3.2).

Table 3.2 Synergies and barriers between the SchALVO and MEKA programs (3rd column) and the water abstraction charge (4th column) and main relevant sectoral policies

		SchALVO and MEKA	Water abstraction charge (WAC)
EPI Policy Objective: :		Decrease nitrate concentrations in groundwater levels	Control water abstraction
Other sectoral policies	**Objectives of sectoral policies**	**Synergies and Barriers**	
Water Framework Directive (→WHG)	Ensure good ecological, chemical and quantitative status of water bodies in Germany	++ Measures and incentives to reduce agricultural diffuse sources of pollution.	++ For some sectors (energy), the water abstraction charge follows the same overall objective as the WFD and introduces internalisation of environmental and resource costs of Art 9 of the WFD
CAP (→MEPL) Pillar I	Market and income support measures to provide farmers with a reasonable standard of living and consumers with quality food at fair prices.	-- Single farm payments (SPS) not linked with good env. farm practices lead to a boost in agricultural. production and further release of nutrients into water bodies	0 Agriculture is exempted to pay for water abstractions.
Nitrates Directive (→WHG)	Reduction and prevention of water pollution caused or induced by nitrates from agricultural sources. Sets threshold of 50 mg N/l to groundwater bodies.	++ Same objectives as SchALVO and MEKA	0
Atomic Energy Act (*AtomG*) and Renewable Energy Directive (→EEG)	Phase out of nuclear energy production in Germany and promotion of renewable energy technologies	-- Resultant market incentives may override incentives of compensation payments and lead to increased/ intensified production of biomass with consequent nutrient and pesticide run-off	-- Resultant market incentives may override incentives from WAC and decrease their effectiveness or acceptance respectively It may encourage further water use by renewable energy sector if abstraction charges not set correctly. Only the charge for effluents which do not fulfil WFD standards are covered by the EEG.
Birds and Habitats Directive (Natura 2000)	Protection of biodiversity - increased protection of aquatic areas which are of particular ecological interest Restriction of land use and land development, including agriculture, renewable energy etc.	++ Natura 2000 provides an additional justification of why the SchALVO and MEKA programs follow relevant objectives and may cover restrictions introduced by the programs.	++ Natura 2000 provides an additional basis upon which WAC can be justified

Source: Author's compilation

Notes: + represents a positive synergy between the objectives of the EPI and the other policy; 2 levels:
+ (low positive interaction),++ (high positive interaction)
0 represents no discernible interaction
- represents a negative effect between the objectives of the EPI and the other policy; 2 levels:
- (low negative interaction),-- (high negative interaction)
→ means "transposed via ... German legislation". Please note that this analysis only covers the most relevant policies and is not extensive.

3.6 Transaction Costs

While the introduction of the water abstraction charge required the installation of meters for all water abstractors (see section 1), no estimate of these costs is available.

The conceptualisation of the water abstraction charge legislation and implementation was based on the waste water effluent charge legislation with the goal of minimizing the administrative burden. The water abstraction charge is claimed by the same authorities with an identical procedure as the waste water effluent charge (Landtag von Baden-Württemberg, 1987).

The administrative costs for the water abstraction charge vary between the *Länder* that have introduced water abstraction charges. These costs vary between 1 and 20% of the revenue made from the water abstraction charge, while the average costs range between 4-6% of the revenue (Gawel et al: 135). In 2008, the administrative costs amounted to EUR 5 million in Baden-Württemberg while the revenue from the water abstraction charge totalled EUR 85 million in the same year (Gaulke, 2010:7-8). Increased administrative burden for water management administration made the employment of one additional staff member in each lower water authority necessary. This totalled 44 additional employees in the "*gehobener Dienst*" earning on average EUR 44.800 annually. Taking this average and including overhead expenditures of around EUR 40,200, the additional annual administrative expenses increase by around EUR (85.000 x 44) 3.740.000 (MU, 2011). As the revenues for the water abstraction charge are not legally earmarked, the additional transaction costs are not covered by these revenues but rather by the general budget.

The additional exemptions granted in the amendment to the water abstraction charge in 2010 are expected to decrease administrative expenditures by reducing the number of water abstraction cases by 913 applications (Hollenbach, 2011). These exemptions were made to reduce transaction costs caused by small abstractors, such as for irrigation, which in some cases exceeded the revenue earned.

Furthermore, the amendment decreased transaction costs by establishing legal certainty regarding the rules for reductions—an uncertainty that led to high court expenditures for the government and for the stakeholders (Hollenbach, 2011). Administrative expenditures related to the water abstraction charge are low for water supply companies, as they measure the water abstracted as part of their business, but they are expected to be higher for other industries (LW, 2011).

Administrative costs for farmers applying for compensation payments under the SchALVO and MEKA programs were aimed to be minimized by merging these applications into a joint application (MLR, 2005). The availability of the groundwater monitoring database supplied by water supply companies for free reduces the monitoring costs in water protection areas by around EUR 500,000 annually (GWD-WV, 2009). No information, however, is provided on the costs related to monitoring

on the ground. Since the SchALVO amendment of 2001, monitoring expenditures can be expected to have decreased for administrators because the focus has been shifted from extensive areas to smaller, more vulnerable ones; the frequently changing categorization of land, however, increases the fixed and administrative costs for farmers.

The roles of the ministries and units involved are clearly divided (see section 3.5), thus duplication of work will likely be avoided.

3.7 Uncertainty

The objectives of the SchALVO and water abstraction charge were neither clearly specified nor quantified, i.e., neither the policy target nor the policy deadline nor the reference level was specified (Bergmann and Werry, 1989). The environmental impacts of the MEKA measures, however, are sufficiently understood, and the objectives were defined via output indicators, such as area covered and number of participating farmers.

The interplay between the policy mix and further regulatory measures, such as the Fertiliser Ordinance, as well as the interplay within the policy mix, make the assessment of the partial impact of each instrument difficult and uncertain. As such, a distinction between the regulatory impact and that of compensation payments within the SchALVO are difficult to discern with certainty. In addition, as discussed in section 3.1, the changes in behaviour by economic agents, which ultimatively resulted in decreased abstraction levels, cannot be attributed to the water abstraction charge with complete certainty.

While the baselines established provide a best estimate, the true baseline can be expected to be influenced by further factors, such as national and international market places.

Pedigree tables describing the uncertainty related to the data used in this case study can be found in Annex 2 – Table A2.

4 Conclusions

Problems relating to groundwater quality, especially high nitrate levels, are acknowledged and addressed since the 70s. These concerns are reflected in the tightening of the thresholds for acceptable nitrate concentrations in the Drinking Water Ordinance in 1986 (from 90mg N/l to 50mg N/l). The same year, compensation payments to farmers whose agricultural practices were affected by environmental constraints (e.g. water protected areas) were made compulsory with the amendment of the Federal Water Law in 1986 (§19(4)). These two legislative changes can be said to have triggered the discussions on the need for additional measures which eventually materialized in the SchALVO (i.e. regulation on agricultural practices in water protected areas and compensation payments for resultant economic losses to farmers) and water abstraction charges in 1988. The latter were introduced to address pressures on flow regulation by abstractions and to internalize environmental and resource costs of water abstracted. While the revenues of the water abstraction charge are not legally earmarked, it can be said that the revenues are used to finance compensation payments.

The year 1992 witnessed the introduction of an additional measure with compensation payments to incentivize voluntary environmentally sound agricultural practices (MEKA).

The change in behaviour of the economic agents, as a result of the SchALVO and MEKA, resulted in a decrease of nitrate concentrations. From 1994 to 2010, nitrate concentrations decreased by 5.7 mg N/l, a reduction of 19.5%, outside water protected areas and by 4.3 mg N/l, a reduction of 15.9%, within water protected areas. When contrasting the nitrate concentrations in 2010 to the baselines, the MEKA measures led to an additional 1.4 mg N/l improvement when compared to the SchALVO measures.

The SchALVO was amended in 2001 to focus measures on areas with high nitrate concentrations; measures pertaining to low risk areas were removed. This strategic choice resulted in a drop in average nitrate concentration from 52.1 mg N/l in 2001 to 46.5 mg N/l in 2010 (-10.7%) in decontamination zones. This reduction can be seen as a step towards achieving the goal of 'no measuring station exceeding concentrations of 50mg N/l by 2015'. However, the overall reduction of nitrate concentrations in water protected areas only decreased by 1.3 mg N/l between 2001 and 2010, while it had decreased by 3 mg N/l before the amendment between 1994 and2001. Thus, while the focus on areas with high nitrate concentrations led to a reduction of concentrations below the thresholds (50 mg N/l), overall the reduction of nitrate concentrations in water protected areas slowed down. This could be explained by the fact that only 38% of the water protection area was targeted after the amendment and by the low levels of monitoring in low risk areas. In addition, besides the annulment of the compensation payments, no fines were imposed for non-compliance with the constraints set by the SchALVO. This could explain why 1/5 of controlled farmers did

not comply with the constraints in problem and decontamination areas. However, other factors, such as differing hydrogeologies and consequent differing residence times or the impact of other direct regulation, e.g. Fertiliser Ordinance, and interactions within the policy mix could not taken into account.

Some indicators can provide insights to the effectiveness of the water abstraction charge. For example, total water abstraction has decreased from 7,619 mil m^3 in 1987 to 5,015 mil m^3 in 2007 (-34%). This drop can be attributed to changes in production processes which increased water productivity by 61.3% between 1991 and 2007. The energy sector, for example, decreased the litres needed to produce energy by 39% over this period. As the energy sector was the main driving force behind the increased water abstraction between 1975 and 1987, these changes led to a 37% reduction in water abstraction between 1987 and 2007. However, these changes in behaviour cannot be clearly attributed to the water abstraction charge alone.

A study comparing the cost-effectiveness of agro-environmental schemes in the *Länder* of Germany revealed that the MEKA program is the most cost-effective program, i.e. the use of tax payers' money achieves the highest environmental improvements. However, its compensation volume is strongly dependent on the situation of the public budget and suffers from budget cuts. As the amended SchALVO only provides for compensation payments in problem and decontamination areas, the steadily decreasing payments since 2002 indicate that the areas of high nitrate concentration are decreasing. This correlation suggests that the SchALVO was effective.

Comparing the revenues from water abstraction charges with the expenditures for the compensation payments between 2002 and 2007, it becomes apparent that, although abstraction charges are not legally earmarked to compensation payments, there is a degree of cost coverage. Further, the amendment of the SchALVO took place in a time when the water abstraction charge revenue did not suffice to cover the compensation payments, as in 2000. This may suggest that these cash flows are linked "informally" despite their legal disconnection.

The WFD, the Nitrates Directive and the Natura 2000 sites create synergies with the implementation of the MEKA, SchALVO and water abstraction charges. Contrary, the combination of the Atomic Energy Act and the Renewable Energy Directive pose barriers to the effective implementation of the MEKA, SchALVO and water abstraction charges. The CAP (Pillar I) creates a further barrier to MEKA and SchALVO programs

Further research is needed on the distributional effects and social equity for farmers in Baden-Württemberg. In addition, it would be interesting to discern factors which led to Baden-Württemberg being the first *Land* to introduce abstraction charges and to introduce innovative instruments, such as the MEKA program and SchALVO.

4.1 Lessons learnt

The amendment of water abstraction charge in 2010 clarified the preconditions for exemptions and reductions and harmonized them within Baden-Württemberg. In addition it introduced the option to offset required investments for improving ecology with the charge. These changes led to a decrease in transaction costs, such as legal costs, and increased the acceptance of the water abstraction charge among the water intensive industry (e.g. energy, chemical, paper). The perception that revenues are being used to finance measures which improve water quality (i.e. MEKA and SchALVO) does increase the acceptability of this charge to water supply companies which depend on water sources endangered by agriculture.

Directly targeted measures, such as redirecting SchALVO payments to problem and decontamination areas, are effective to decrease high risk nitrate concentrations. However, measures which cover larger areas, are more effective in reducing overall nitrate concentrations over the territory. To be successful, it is paramount that compliance be monitored.

Voluntary measures which offer a high degree of flexibility to adjust to regional particularities, such as MEKA, enjoy high levels of acceptance among farmers.

Transaction costs can be reduced by introducing joint applications for compensatory measures (e.g. for MEKA and SchALVO) and by harmonizing administrative procedures to already existing economic or regulatory instruments (e.g. the water abstraction charge was linked to existing procedures of the effluent tax).

4.2 Enabling/Disabling factors

Close cooperation between water suppliers and the government enabled the shared use of the water suppliers' water quality monitoring data. This resulted in a reduction of annual transaction costs of EUR 500,000 and facilitated the control and assessment of compensation payment measures.

The fragmented structure of the water supply industry and the small average size of farms essentially prohibited voluntary agreements between farmers and water suppliers to improve water quality programs. This, however, led to the introduction of a regulation covering all water protection areas (SchALVO) that resulted in coherent efforts to reduce nitrate concentrations and decreased the potential for moral hazard.

It must be noted that, increasingly, market incentives, such as increasing food prices and the increased demand for biofuels, outweigh the incentives provided by compensation payments, such as the MEKA, thus disabling their full environmental protection potential. Future developments will have to find the means to compete with these market forces to ensure that the prospect of short term profit does not outmatch sustainability.

Further, the low monitoring levels in low-risk areas under the SchALVO, as well as the lack of punitive measures in case of non-compliance with the constraints, can be assumed to have reduced the effectiveness of the SchALVO program in reducing nitrate concentrations in groundwater. Monitoring the impact of agricultural practices, e.g. via nitrate levels in soil, are aggravated by the impact of climatic conditions on these values and thus pose a challenge to a strict enforcement.

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Annex 1

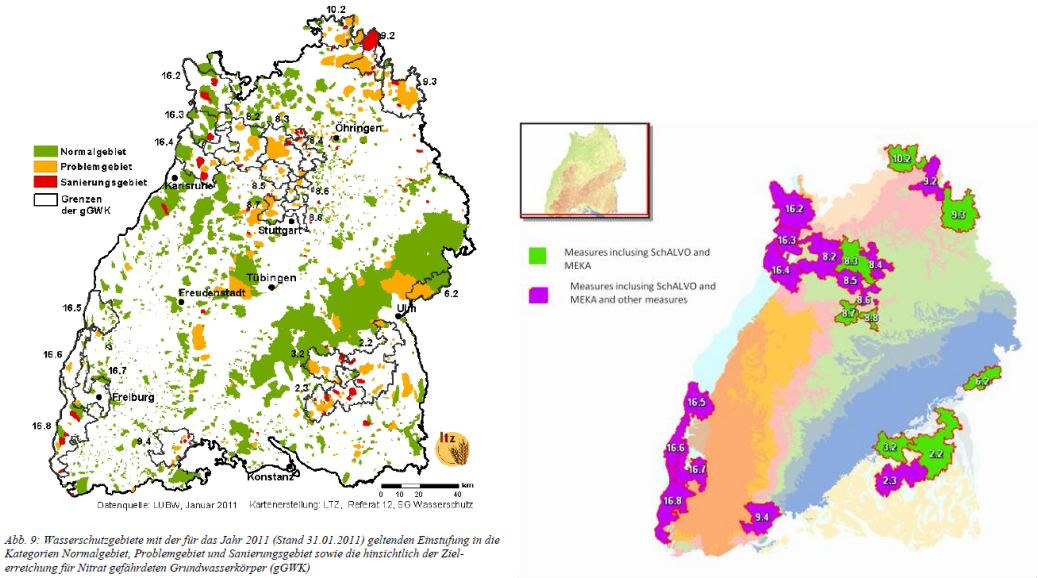
Table A1 Water abstraction per economic activity (per abstraction source) in Baden-Württemberg, mil m³, 1975, 1987 and 2007(1)

Mil m³	1975					1987					2007				
Economic activity	Total	% of total	Groundwater (2)	Spring water	Surface water (2)(3)	Total	% of total	Groundwater (2)	Spring water	Surface water (2)(3)	Total	% of total	Groundwater (2)	Spring water	Surface water (2)(3)
Total	**4,058.9**	**100 %**	**611.6**	**223.6**	**3,223.7**	**7,618.6**	**100 %**	**600.2**	**193.7**	**6,824.7**	**5,014.7**	**100%**	**468.9**	**140.8**	**4,405**
Public water supply	**722.4**	**18%**	373.0	198.8	150.6	**729,0**	**10%**	392.9	175.9	160.2	**657.9**	**13.1 %**	343.4	126.0	188.4
Manufacturing (5)	**745.8**	**18%**	221.9	24.3	499.6	**695.6**	**9%**	192.6	17.8	485.2	**430.6**	**8.6%**	104.4	5.2	320.9
Energy supply (4)	**2,590.7**	**64%**	16.7	0.5	2,573.5	**6,194,0**	**81%**	14.7	-	6,179.3	**3,897.4**	**77.7 %**	5.7	1.1	3,890.6
Agriculture and Forestry	**n/a**	**n/a**	n/a	n/a	n/a	**n/a**	**n/a**	n/a	n/a	n/a	**3.6**	**0.1%**	2.0	0.1	1.5
Services(6)	**n/a**	**n/a**	n/a	n/a	n/a	**n/a**	**n/a**	n/a	n/a	n/a	**25.3**	**0.5%**	13.5	8.2	3.6

Source: Statistisches Landesamt Baden-Württemberg , 2010b, „Wassergewinnung in Baden-Württemberg seit 1975".

Notes: This table illustrates the water abstracted (diverted) and not the water consumed. Especially in the energy sector, most water abstracted is returned to the water bodies. (1) From 2007 modified survey approach; (2) Until 1995 bank-filtered and enriched ground water, if in clean water status, were not associated with the surface water but with groundwater; (3) River, lake, reservoir water, bank filtrate and enriched groundwater, (4) Without water extraction for public water supply. Until 2004, only thermal power plants for public power supply were considered; (5) until 2004 manufacturing and mining and quarrying. From 2007 including manufacturing and construction; (6) New category since 2007.

Annex 2



Map A1 Overview of areas divided into low risk, problem and decontamination areas (left) and corresponding measures applied within the SchALVO and MEKA program (right)

Source: LTZ, 2010; LUBW, 2010

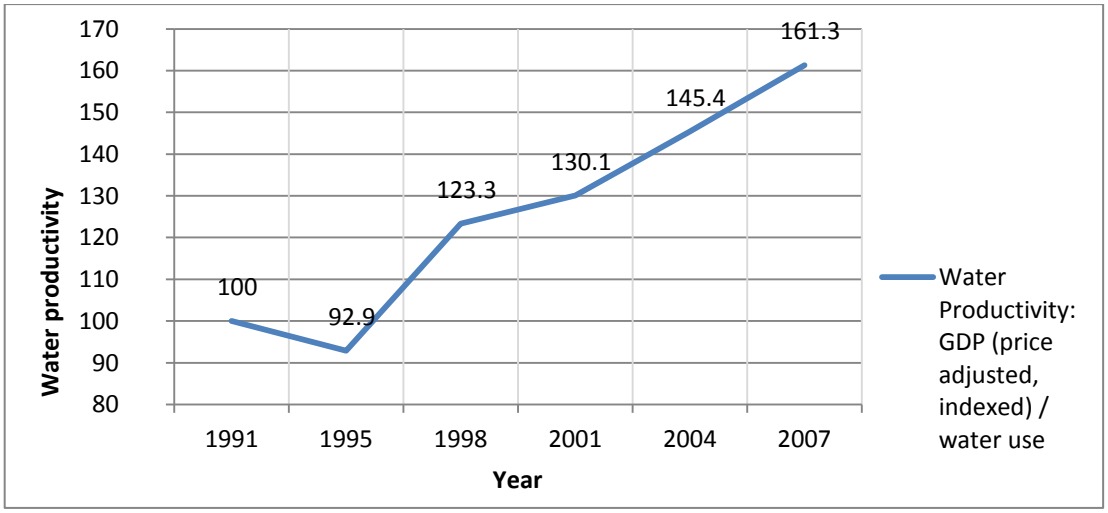


Figure A1 Water Productivity in Baden-Württemberg, 1991-2007 (indexed: 1991=100)
Source: StaLaBW, 2010b

Table A1 Overview of SchALVO and MEKA expenses and revenue from the water abstractin charge, 1988-2010

	Compensation Payments (mio €)					Revenue (mio €)
	SchALVO (3)	MEKA (total) (4)	MEKA (water protection) (4)	MEKA (water protection paid by BW)	Total compensation payments paid by BW	Water Abstraction Charge
1988	49 - 51 (1)					81.8 (1)
1994		70.1	56.5	28.25		
1995		79.1	63	31.5		
1996		86.3	67.5	33.75		
1997		77.7	59.4	29.7		73
1998		76.5	59.1	29.55		81
1999		76.3	58.8	29.4		99
2000	60 (1)	107.6	84.7	42.35	102.35	93
2001		128.1	103.1	51.55		79
2002	22	147.2	117.1	58.55	80.55	98
2003	21.3	147.8	118.7	59.35	80.65	88
2004	21.7	146.7	117.9	58.95	80.65	88
2005	18.7	136	104.5	52.25	70.95	81.1
2006	18.3	112.2	95.8	47.9	66.2	86.5
2007	18.6	95.2	83.2	41.6	60.2	82 (5)
2008		89.6	80.4	40.2		85 (5)
2009		92.8	83.5	41.75		
2010		105.7	94.3	47.15		

Sources: (1) Müller (1988); (2) Mader (2002); (3)Landtag BW (2008); (4) Personal correspondence with MLR; (5) Fälscher, 2011)

Table A2 Pedigree Analysis for data used in this case study

Abstraction Charge	Value	Proxy	Empirical	Method
Water abstraction	See section 2.3	4	4	4
Baseline water abstraction	See section 2.3	3	1	2
Revenue	See section 3.2	4	4	4

SchALVO/ MEKA	Value	Proxy	Empirical	Method
Nitrate concentrations	See section 2.3	4	4	4
Basline	See section 2.3	3	1	2
Compensation Payments	See section 3.2	4	4	4

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