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Case Study – Germany

Sustainable Agriculture and Soil Conservation (SoCo Project)

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Preface

Agriculture occupies a substantial proportion of European land, and consequently plays an important role in maintaining natural resources and cultural landscapes, a precondition for other human activities in rural areas. Unsustainable farming practices and land use, including mismanaged intensification and land abandonment, have an adverse impact on natural resources. Having recognised the environmental challenges of agricultural land use, in 2007 the European Parliament requested the European Commission to carry out a pilot project on 'Sustainable Agriculture and Soil Conservation through simplified cultivation techniques' (SoCo). The project originated from close cooperation between the Directorate-General for Agriculture and Rural Development (DG AGRI) and the Joint Research Centre (JRC). The JRC's Institute for Prospective Technological Studies (IPTS) coordinated the study and implemented it in collaboration with the Institute for Environment and Sustainability (IES). The overall **objectives of the SoCo project** are:

(i) to improve the understanding of soil conservation practices in agriculture and their links with other environmental objectives;

(ii) to analyse how farmers can be encouraged, through appropriate policy measures, to adopt soil conservation practices; and

(iii) to make this information available to relevant stakeholders and policy makers EU-wide.

In order to reach a sufficiently detailed level of analysis and to respond to the diversity of European regions, a case study approach was applied. Ten case studies were carried out in Belgium, Bulgaria, the Czech Republic, Denmark, France, Germany, Greece, Italy, Spain and the United Kingdom between spring and summer 2008. The case studies cover:

- a screening of farming practices that address soil conservation processes (soil erosion, soil compaction, loss of soil organic matter, contamination, etc.); the extent of their application under the local agricultural and environmental conditions; their potential effect on soil conservation; and their economic aspects (in the context of overall farm management);
- an in-depth analysis of the design and implementation of agri-environmental measures under the rural development policy and other relevant policy measures or instruments for soil conservation;
- examination of the link with other related environmental objectives (quality of water, biodiversity and air, climate change adaptation and mitigation, etc.).

The results of the case studies were elaborated and fine-tuned through discussions at five stakeholder workshops (June to September 2008), which aimed to interrogate the case study findings in a broader geographical context. While the results of case studies are rooted in the specificities of a given locality, the combined approach allowed a series of broader conclusions to be drawn. The selection of case study areas was designed to capture differences in soil degradation processes, soil types, climatic conditions, farm structures and farming practices, institutional settings and policy priorities. A harmonised methodological approach was pursued in order to gather insights from a range of contrasting conditions over a geographically diverse area. The case studies were carried out by local experts to reflect the specificities of the selected case studies.

This Technical Note is part of a series of ten Technical Notes referring to the single case studies of the SoCo project. A summary of the findings of all ten case studies and the final conclusions of the SoCo project can be found in the **Final report on the project 'Sustainable Agriculture and Soil Conservation (SoCo)'**, a JRC Scientific and Technical Report (EUR 23820 EN – 2009). More information on the overall SoCo project can be found under http://soco.jrc.ec.europa.eu.

BE - Belgium	**West-Vlaanderen** (Flanders)
BG - Bulgaria	**Belozem** (Rakovski)
CZ - Czech Republic	**Svratka river basin** (South Moravia and Vysočina Highlands)
DE - Germany	**Uckermark** (Brandenburg)
DK - Denmark	**Bjerringbro and Hvorslev** (Viborg and Favrskov)
ES - Spain	**Guadalentín basin** (Murcia)
FR - France	**Midi-Pyrénées**
GR - Greece	**Rodópi** (Anatoliki Makedonia, Thraki)
IT - Italy	**Marche**
UK - United Kingdom	**Axe and Parrett catchments** (Somerset, Devon)

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Acronyms

AES	Agri-environmental scheme
CAP	Common Agricultural Policy
e.g.	exempli gratia, for example
EU	European Union
GPS	global positioning system
ha	hectare
i.a.	inter alia
kg	kilogramme
KULAP	Kulturlandschaftsprogramm (Agri-environmental programme)
LSU	livestock unit
LUA	Landesumweltamt (State Authority for Environment, short: Environment Agency)
LVLF	Landesamt für Verbraucherschutz, Landwirtschaft und Flurneuordnung (State Authority for Consumer Protection, Agriculture and Land Consolidation)
MLUR	Ministerium für Landwirtschaft, Umweltschutz und Raumordnung (Ministry for Agriculture, Environmental Protection Regional Planning, short: Agriculture Agency)
MLUV	Ministerium für Ländliche Entwicklung, Umwelt und Verbraucherschutz (Ministry for Rural Development, Environment and Consumer Protection)
N	nitrogen
n/a	not applicable
SOM	Soil organic matter
P	phosphorus
UAA	Utilised Agriculture Area

1 Introduction to the case study area

The Uckermark region was chosen as a case study because the area is at high risk of soil degradation especially in form of water erosion. Soil degradation has become a relevant environmental issue in this area. Soils are especially degraded by soil erosion and soil compaction which leads to changes in soil quality and soil fertility. It is expected that different forms of adapted land use (such as farming practices and soil conservation measures) have a strong impact on properties of soil and can directly influence its further development. Therefore, the region can serve as an example how best management practices can improve soil conditions.

A further selection criterion of the study region is related to its structural transformation in conjunction with the German reunification in 1990. This transformation was characterised by a restructuring of farm sizes, changes in the farm organisation from large cooperative farms to other legal organisations (e.g. smaller family run farms), an increasing share of organic farming, changes of farming practices, soil conservation policy measures and rules, as well as improved technical measures and increasing yields. In this aspect, the case study region is typical for all five East German Federal States.

A further selection criterion is the availability of abundant data for the region as a result of several former research projects that have been conducted in the region.

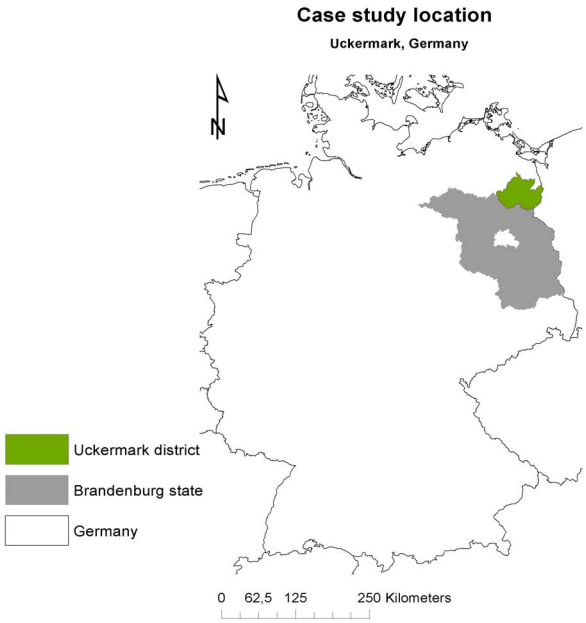
1.1 Spatial and natural characteristics

The district of Uckermark covers 3,058 km^2 of land and is located in north-east Germany in the north of the federal state Brandenburg with a north-east border to the landscape Randowbruch, an eastern border to Poland along the Oder River and a south-eastern border to the district Barnim (Figure 1). Apart from the major cities (Prenzlau, Schwedt, Angermünde, each less than 30.000 inhabitants) population density is low (2006: 46 inhabitants/km^2) (Landesamt für Bauen und Verkehr, 2006; Amt für Statistik Berlin-Brandenburg, 2007). Agriculture and nature conservation are the major land use systems in rural areas.

The soils in the case study area Uckermark are heterogeneous (Figure 2). The dominating soil types in the area of the Uckermark are formed by glacial till soils (Haplic Luvisol). These base-rich Luvisols are characterised by a distinct clay accumulation horizon. They are widely used under both agriculture and forestry and are generally easier to keep fertile than other humid-climate soils. Luvisols show marked textural differences within the profile. The surface horizon is depleted in clay while the subsurface horizon has accumulated clay. Hence, movement of clay means the main soil development process. Parent materials of the soils of the Uckermark are shaped on tills, thus are granular soil. Note that the character and chemical composition of the parent material plays an important role in determining soil properties, especially during the early stages of development. Another group of soils are sandy soils that show low field capacity and content in organic matter. These soils are considered to be less productive and are typically used for rye.

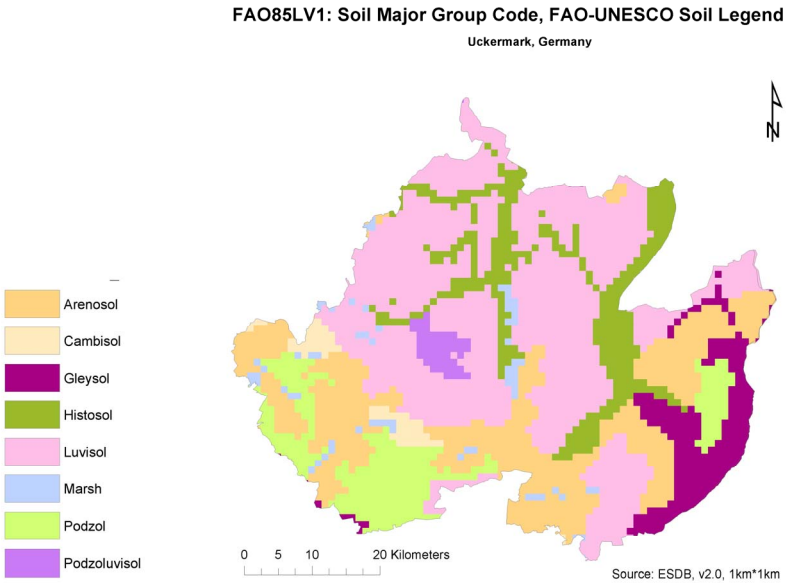
A result of the last glacial period, the relief in the case study area is highly structured. Recent alluvial sediments have formed undulated landscapes consisting of moraines (hills of glacial till deposited directly by a glacier) and valleys which were carved into the landscape by glaciers. Many potholes of glacial origin pose a further element in the agricultural landscape interrupting the fields with ‘hotspots’ of high biodiversity. Since the region also includes habitats for endangered species (Bayerl, 2006), a considerable potential for nature conservation is evident.

Figure 1: Location of the case study area Uckermark



Source: designed by ZALF on the basis of data from infas GEODATEN GmbH, purchased from: http://www.infas-geodaten.de/ (26/02/08)

Figure 2: Soil map of Uckermark, Germany



Source: designed by ZALF on the basis of data published by the European Soil Database, available at: http://eusoils.jrc.it/ESDB_Archive/ESDB/index.htm (26/02/08)

The climate of the region is oceanic with continental influences. This means a climatic situation between the Maritime Temperate and Continental Subarctic climate and is generally described by cold winters and warm summers. Mean annual temperature is 8.6º C with maxima in July and minima in January. Average annual precipitation is very low (562 mm). Because of the relation between temperature and precipitation there is a strong potential for evapo-transpiration.

The Nature conservation features result from a high density of potholes of glacial origin with high biodiversity. The Uckermark contains habitats for endangered species.

1.2 Land use and farming

The Utilised Agricultural Area (UAA) of the total territory comprises 176,956 ha (58 %) of which 150,090 ha are used as arable farm land, 26,671 ha are covered by grassland and partly fen land concentrated along rivers. Forests cover 72,858 ha (22 %) of the area (Amt für Statistik Berlin-Brandenburg, 2008).

In 2007, arable land was mainly cultivated with winter wheat (44,109 ha), winter rapeseed (34,557 ha) and winter barley (16,962 ha). In 2003, livestock numbers consisted of cattle (55,673), pigs (69,861), poultry (211,873) and sheep (13,364). There are 581 agricultural firms in total which are classified into 399 individual farms, 13 cooperatives, 66 limited companies and 71 civil-law partnerships. The average farm size is 304 ha. In 2005, man-land ratio in Brandenburg accounted for 2.9 persons per 100 ha (Amt für Statistik Berlin-Brandenburg 2008 and Landesbetrieb für Datenverarbeitung und Statistik Land Brandenburg, 2004).

The case study area consists of 62 nature conservation areas covering a total of 40,604 ha. They are defined as areas designated on a legally binding basis as areas requiring special protection with regard to nature and landscape. In addition, about 48 % of total land cover is designated as landscape protection area, even including a national park (Nationalpark Unteres Odertal).

Apart from an industrial region in Schwedt (oil refinery and related industries) and a renewable energy sector (production of solar panels in Prenzlau, biogas plants), agriculture is one of the major employers.

1.3 Main soil degradation issues

Soil erosion (in particular water and wind) and soil compaction are the main soil conservation problems in the Uckermark.

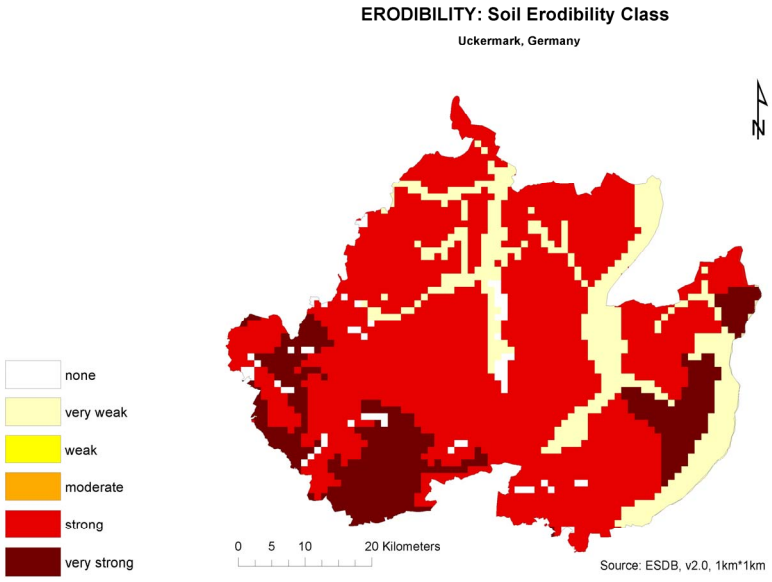
Soil erosion where soil is naturally removed by the action of water or wind, affects both agriculture and the natural environment. Soil loss, and its associated impacts, is one of the most important of today's environmental problems. In the region Uckermark, there is a medium to high risk of soil erosion (Matzdorf et al., 2003) – due to large plots and hilly landscape. Figure 3 shows soil erodibility representing an approximation of the ability of soils to resist erosion, based on the physical characteristics of each soil. Generally, soils with faster infiltration rates, higher levels of organic matter and improved soil structure have a greater resistance to erosion. Sand, sandy loam and loam textured soils tend to be less erodible than silt, very fine sand, and certain clay textured soils.

Processes of water erosion include loss of topsoil by sheet erosion and surface wash, deformation of landscape by gully and/or rill erosion as well as off-site effects of water erosion in up-stream areas such as flooding. Water erosion rates after strong rainfalls (yet, infrequent in the region) is very high in periods of low soil coverage (up to 170 t/ha; Frielinghaus et al., 1997). In relation to other natural resources, water erosion leads to eutrophication of potholes and deterioration of habitats (Kalettka et al., 2001). First interviews revealed, that rapeseed is the crop with the highest risk of erosion events, due to the fine seedbed needed for drilling. Rainfalls in this season contribute to this risk.

Erosion processes caused by the action of wind belong to eolian processes and may create adverse operating conditions in the field. In fact crops can be totally lost so that costly delay and reseeding is necessary – or the plants may be damaged (“sandblasted”) with a resulting decrease in yield, loss of quality, and market value. Wind erosion is fostered by large size of plots and the lack of natural structural elements, such as hedges and trees (large-scale

farms). In total, 16 % of all utilised agricultural areas in Brandenburg have been degraded by water erosion and 8 % by wind erosion (Federal Soil Protection Report, 2002). In conclusion, soil erosion potential is affected by tillage operations, depending on the depth, direction and timing of ploughing, the type of tillage equipment and the number of passes. Generally, the less the disturbance of vegetation or residue cover are at or near the surface, the more effective are the tillage practice in reducing erosion.

Figure 3: Soil erodibility classes of Uckermark, Germany



Source: designed by ZALF on the basis of data published by the European Soil Database, available at: http://eusoils.jrc.it/ESDB_Archive/ESDB/index.htm (26/02/08)

Soil compaction, as a process of increasing the density of soil, leads to a deterioration of soil structure caused by heavy machinery used in the large-scale farms, in particular when wet soils are worked. After reunification in 1989, the use of heavy machinery has been reduced, yet soil compaction is still prevailing in the plough pans and sub soil. Soil compaction is a typical soil threat in the macro-region due to the prevalence of large-scale farming.

Decline in organic matter in fen land areas (about 15,000 ha) is another, less severe soil conservation problem, that has been caused by intensive drainage and non-adapted land use. The reduced organic matter content limits the water retention capacity, and increases the soils' tendency to become compacted. As a consequence of these changes, the runoff and soil erosion are accelerated. Especially in the case of row crops cultivation (e.g. maize), soil erosion by water becomes a problem because of missing vegetation cover between the rows. As a consequence a decline in the amount of organic matter can cause a reduction in the fertility of a soil, increase the risk of soil erosion and contribute to increased carbon emissions. The loss of fertile soil is estimated at 1-2 cm per year.

1.4 Land tenure system

81.3 % of the utilised agricultural area in Brandenburg is farmed under lease hold. In this context, only 17.6 % is owned by the agricultural firms with increasing tendency. Duration of lease contracts usually is 10-12 years.

Furthermore, there is a highly fragmented, mostly non-residential land ownership. 13 % of the utilised agricultural area in Brandenburg is leased out by the German land privatization company (BVVG), an agency responsible for the administration and privatisation of state-owned farm and forest land in East Germany.

2 Methodology

For this case study report, semi-structured interviews have been conducted with farmers and stakeholders with expertise in soil conservation practices and policies. A literature review revealed further information for the analysis of soil conservation and policy measures.

In total, four different questionnaires have been used as guidelines for the interviews. ZALF was responsible for the soil experts' questionnaire (1), and the farmers' questionnaire (2) in the case study area. Administrative as well as governmental actors and civil society actors have been interviewed by Humboldt-University (Questionnaire 3 and 4).

Questionnaire 1 was designed to gather detailed information on farming practices, soil conservation measures and the links between certain practices and soil degradation types. In detail, an analysis was conducted covering the current soil conditions, their risk of degradation mainly caused by and related to farming practices, the effectiveness, costs, benefits, economic performance and practicability of soil conservation measures and farm management issues often remarked by farmers (e.g. restricted time spans for certain measures or difficulties handling crop residues when reduced tillage is applied). This questionnaire was developed as an excel spreadsheet and has been directly filled in by soil science and farming practices experts.

Questionnaire 2 was intended for farmers, farming cooperatives, cooperative associations and other relevant land users. It was designed to gather information on stakeholders' perception of soil degradation problems, farming practices being employed to conserve soils, experiences with and evaluation of soil conservation policies, impacts and motivation for the uptake of measures, different approaches to policy administration and implementation. A total of six farmers operating different farm types covering the case study area Uckermark have been interviewed face-to-face in April 2008 (Annex 1a). It was difficult to identify farmers willing to participate, because many of them faced time constraints due to the sowing season. However, the farmers participating were very helpful in gathering the necessary data.

The identification of administrative and governmental actors (Questionnaire 3) showed other difficulties as many stakeholders did not consider themselves as experts in soil conservation policies. There is only one law in Germany that identifies agricultural soils as its specific objective while all other policy measures target soil conservation only as a secondary task. However, the administrative representatives who agreed to participate in the survey provided helpful insights in the policy design as well as the policy implementation process.

The survey among environmental protection and nature conservation experts (Questionnaire 4) showed that these groups do not consider agricultural soil conservation as one of their main issue. Most environmental protection and nature conservation groups at the local and regional level communicated not to have an expert for soil conservation among their members. Many stakeholders were not able to answer all parts of the questionnaire, because they only participate in the policy design process. Except for extension officers, most of the stakeholders do not have a say in policy implementation or monitoring. As a result, some interviews have been rather short.

Most interviews for Questionnaire 3 and Questionnaire 4 have been performed face-to-face; in some cases telephone interviews have been conducted. In three cases, interviewees were only willing to participate in the survey if they could provide their answers in written form. Since a standard questionnaire would have been too long and too specific for most of the stakeholders, the questionnaires were tailored to the specific stakeholder.

A problem with both Questionnaire 3 and 4 was the length of the questionnaire, because many stakeholders did not have the time for a detailed interview. Since some interview partner offered to spend only half an hour on the interview, the interview had to be reduced to the most important questions.

3 Perception of soil degradation in the case study area

3.1 Soil degradation problems

Three main soil degradation problems have been identified by soil experts: erosion (especially soil erosion by water), soil compaction and decline in organic matter. Table 1 shows an overview about the main soil degradation problems, and causes and impacts of these problems in the German case study.

Table 1: Experts' opinions on soil degradation processes, causes and impacts in the German case study

Soil degradation process	Causes	Impact
Soil erosion by water	- Severe rainstorms during summer months - Loamy Luvisols (prone to surface sealing by raindrop impact) - Cultivation of row crops (e.g. sugar beets, potatoes, maize) - Farming practices such as ploughing - Bare soil because of the lack of plant cover (especially in winter months)	- Surface runoff - Loss of soils - Decline in yields - Reduction of water infiltration rates
Soil compaction:	- Seasons of heavy rainfalls - Intensification of arable farming - Intensive field traffic of heavy machinery (especially under wet conditions) - Ploughing) - Working the land when wet	- Soils become waterlogged - Increase of surface runoff - Decline in yields - Reduces water infiltration rates - Changes in soil structure
Decline in organic matter:	- Release of large amounts of plant nutrients to plant uptake or leaching Extending grazing into the wet season - Intensive drainage	- Decrease in soil fertility - Decline in yields

Source: Case study interviews

Soil erosion

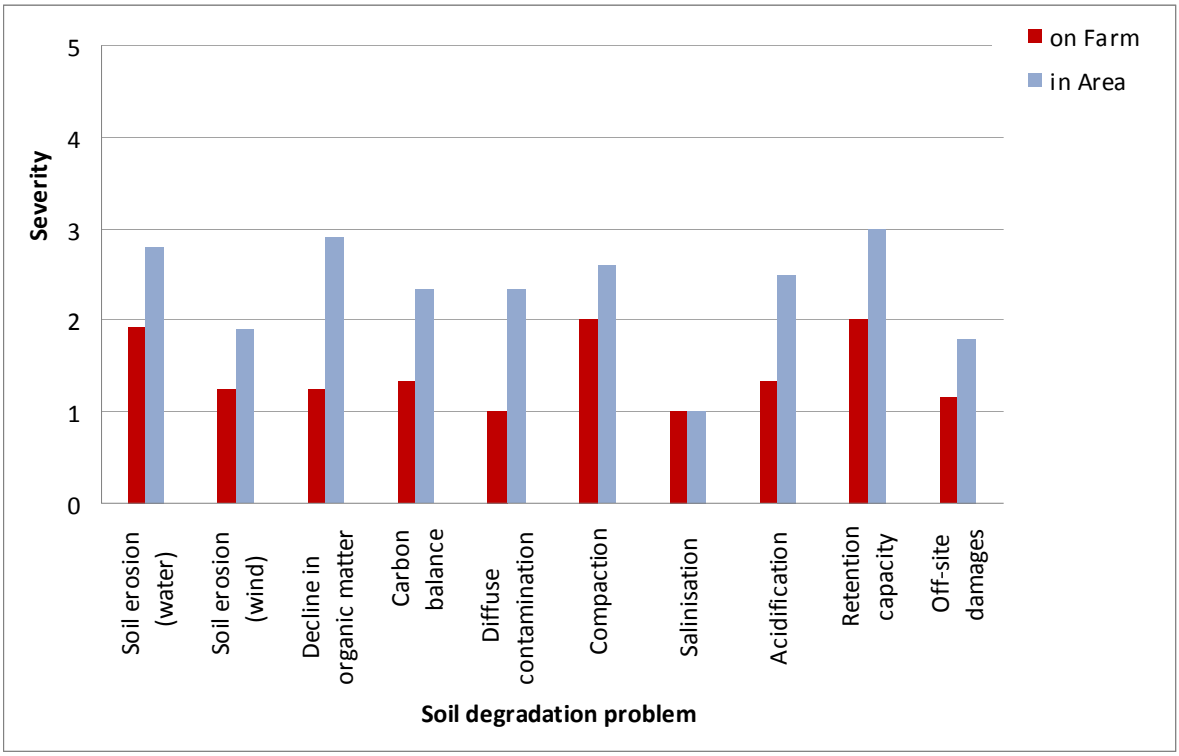
Processes of water erosion include loss of topsoil by runoff sheet erosion and rilling. Erosion starts with the impact of raindrops on the soil surface, which can break down soil aggregates and disperse the aggregate material. Plant cover protects the soil from raindrop impact and splash, and tends to slow down the movement of surface runoff and allows excess surface water to infiltrate.

All interviewed farmers mentioned that soil erosion by water is a major problem in cases of severe rainstorms. Several of the interviewed farmers mentioned the August 2007 rainfall event with about 130 mm (Hertwig and Schuppenies, 2007). This rainfall caused soil losses that in the end led to yield reductions. One organic farmer stressed that there was a decline in yield of about 35 % on his farm in that year.

Soil experts pointed out that water erosion is strongly associated with row crops, namely sugar beets, maize and potatoes. Because of wide row distances found for these crops and hence lower soil cover, water erosion can occur within the rows. Farmers and soil experts reported that inadequate soil cover is a major cause leading to water erosion and soil losses. The severity of soil erosion depends on various factors such as moisture content and soil types. Sugar beets, maize and potatoes are mostly cultivated on loamy Luvisols. These soils

provide good water retention capacity, but they are prone to surface sealing by raindrop impact which leads to reduced infiltration rates and increasing surface runoff. In contrary, all cultivated cereals are seen as plants that reduce the erosion risk due to the dense soil cover almost throughout the entire vegetation period. In conclusion, the potential of water erosion in the Uckermark is very high, if soils are not covered (e.g. in winter months) or affected by compaction and therefore show low infiltration rates.

Figure 4: Perception of the severity of soil degradation problems in the case study Uckermark on the farms and in the area



Note: The numbers indicate the *severity of the soil degradation problems* for the areas on farm and in area of the farm, examined in questionnaire 2 with the level being 5 = severe to 0 = no problem. Ratings have been made by interviewees of the different farms.

Soil compaction

Soil compaction, defined as the process of mechanically increasing the density of soil, pressing soil particles together and reducing pore space between them, is the second soil degradation problem in the Uckermark. The effect of compaction on soils depends not only on the weight of vehicles used, pressure and width of tyres, type and depth of working, but also on soil properties. When farmers were asked for the symptoms of soil compaction, they mentioned that soil compaction is causing lower water infiltration rates, increasing run off by water and yield reductions. Other farmers observed water in the lanes and on the fields. Intensive field traffic of heavy machinery causes changes in soil structure and leads to compaction and productivity losses. Especially under wet conditions, soil compaction can decrease yields as a result of inhibited root respiration due to reduced soil aeration. One farmer noted that compacted soils are more resistant to tillage and hence there is a high abrasion of machinery leading to higher costs for machinery maintenance. After reunification in 1989, the use of heavy machinery has indeed been reduced, yet soil compaction is still prevailing in the plough pans and subsoil. In seasons of heavy rainfalls, compacted soils do not drain properly and become waterlogged. Soil compaction has a wide range of damaging effects on soils and can severely reduce productivity. The amount of damage mainly depends on soil properties (e.g. texture) and climatic factors.

Decline in soil organic matter

Decline in organic matter was mentioned by four farmers and soil experts as a soil degradation problem in the area. Farmers pointed out that this problem mainly results from the release of large amounts of plant nutrients to plant uptake or leaching. Reduced organic matter contents lead to a decrease in soil fertility and yields. Further, soil organic matter levels usually decrease where low residue crops, such as potatoes and sugar beets, are grown. Large amounts of nutrients are extracted with the harvest while little material is left on the field, e.g. silage maize. One farmer explained that intensive drainage is a further cause leading to decline in organic matter by leaching out essential nutrients.

Other soil degradation issues

Wind erosion: Two farmers mentioned that wind erosion is only a local soil degradation problem on small areas in the case study if soil is very desiccated by the lack of precipitation.

Off-site damage by water erosion: Soil experts pointed out that the most severe problem related to soil erosion in the area is off-site damages: eroded sediment is often deposited in glacial depressions (potholes), leading to eutrophication of the otherwise oligotrophic aquatic habitats and reducing the high ecological importance (biodiversity). Contrasting the soil experts the interviewed farmers did not mention off-site damages as a problem in the area.

Organic versus conventional agriculture: One farmer stressed that the occurrence of soil degradation problems primarily depends on the kind of production system. He states, “Conventional farming is more likely to cause soil degradation problems than organic farming”. However, organic farming still relies strongly on ploughing for almost all crops for the purpose of weed control.

Reduced retention capacity was rated as a main soil degradation problem on farms and in the area while salinisation was addressed as the least important problem.

Severity of soil degradation problems: The largest differences between farmers’ and soil experts’ responses are seen in regard to the severity of soil degradation problems. In general, farmers assessed these problems as less severe than soil experts. Moreover, farmers assessed soil degradation problems of their particular farms as being less severe than in the whole Uckermark area (Figure 4).

3.2 Trends in soil degradation during the last ten years and consequences

Different trends in soil degradation could be identified on various farms. In general, all farmers agreed with a slight to moderate improvement of the soil degradation problems during the last ten years, i.e. problems have become less severe (Table 2).

A changed production system and the implementation of soil conservation measures such as reduced tillage or ploughless soil cultivation were named as major drivers for this trend. In addition, two organic farmers stated that soil degradation problems decreased because of legal regulations.

Table 2: Trends in soil degradation in the case study Uckermark

	Trend during the last ten years					
Soil degradation problem	farm 1	farm 2	farm 3	farm 4	farm 5	farm 6
Soil erosion (water)	4	3	1	1	2	4
Soil erosion (wind)	4	3	1	1	2	2
Decline in organic matter	4	3	4	1	2	0
Carbon balance	4	3	1	1	1	0
Diffuse contamination	4	3	1	1	1	0
Compaction	4	3	3	1	- 3	4
Salinisation	4	3	n. s.	1	1	0
Acidification	4	3	n. s.	1	1	3
Retention capacity	4	3	1	1	1	n. s.
Off-site damages	4	3	1	1	1	0

Note: The numbers indicate the trend of soil degradation problems reported by farmers (n = 6) in response to Questionnaire 2 with a scale between -5 and +5; with the level being 5 = large positive change to 1 = small positive change and 0 = no change. Only one interviewee stated negative changes in soil degradation problems, i.e. the severity of the problem increased over the last ten years. n. s. = not specified

Farmers on water erosion

All farmers declared that water erosion decreased during the last ten years because of an increased application of soil conservation measures such as reduced tillage or no tillage leading to a reduction in surface runoff rates. (Farmers' opinions varied between +1 and +4). One farmer emphasised that soil erosion by water was strongly reduced by the switch from conventional farming to ploughless cultivation. However, farmers mentioned that the estimation of the trend in soil erosion by water strongly depends on the climatic situation. As they expect that rainfall intensity during summer months will increase in the future, the potential for water erosion and surface runoff might do so as well.

Farmers on wind erosion

With regards to wind erosion, all farmers agreed that this soil degradation problem has decreased during the last ten years. Given the fact that soil erosion by wind is no critical problem in the case study area, farmers mentioned that it is difficult to estimate a trend.

Farmers on organic matter

All farmers agreed that the organic matter content of the soils in the region has improved. Opinions relative to the trend during the last ten years varied between +1 and +4, with most of the farmers estimating the trend with +4. Especially organic farmers reported that since they had changed from conventional farming to organic farming, contents of organic matter in the soil had increased, because of the adoption of soil conservation measures such as intercrops. In addition, all farmers mentioned that, given high fertiliser costs, the application of chemical fertiliser has decreased. Instead, farmers are using again more manure leading to an accumulation of organic matter in the soil. An important fact mentioned by all consulted farmers is that they are aware of the important role of organic matter in the soil.

Farmers on soil compaction

With regard to soil compaction farmer's opinions differed among each other. While five farmers mentioned that there was a decrease of this problem one farmer (farm 5) noted a medium increase of soil compaction (assessment: -3) over the last ten years on his farm. Unfortunately, this farmer made no statement about the reasons for this trend. The farmers who perceived a decreasing trend in soil compaction stated that this results from decreased application of heavy machinery especially in the last three to five years.

Others

As salinisation, acidification, decline in retention capacity, acidification and off-site damages were not identified as major soil degradation problems in the case study area, farmers mentioned that it is difficult to assess trends.

4 Farming practices and soil conservation measures

4.1 Farming practices and their effects on soil

In the case study area two typical farm types are dominant: arable farms with a conventional production orientation and mixed farms (arable and livestock). Pure livestock farms are not typical for the Uckermark region. Organic arable farms are found to a much smaller extent. The main type of livestock system on pasture is cattle (race: Holstein-Friesian) grazing through the summer months (May to October) with average livestock stocking rates of 0.3 livestock units (LSU) per hectare. Some pastures are mown for silage use. Irrigation is only applied for vegetable production.

Conventional farming is the prevailing farming system in the Uckermark with about 600 farms. Two of the interviewed farmers pointed out that for conventional farming the use of chemical pesticides and chemical (inorganic) fertilisers such as phosphorus, potassium and nitrogen is needed to control pests, to improve soil fertility and to improve yields.

The area under organic farming has increased during the last ten years to 8.9 % of the total agricultural area of the case study region (Landesamt für Verbraucherschutz, Landwirtschaft und Flurneuordnung, 2007). In the Uckermark organic farms particularly are of lower sizes than conventional farms, while most of them were founded in 1996 and 1997 (Hagedorn and Laschewski, 2003). Two farmers interviewed mentioned that organic farming would be financially attractive to them but only if better prices could be achieved. An overview of the typical cropping systems and their characteristics in the Uckermark is given in Table 3. Even though organic farming has an increasing share in the case study region, farms with a conventional production orientation still play a major role in terms of land use. Therefore, the cropping systems of organic farming were not explicitly covered under the expert survey. However, since some of the interviewed farmers practice organic farming, there will be qualitative statements regarding this production orientation in the following chapters.

Table 3: Typical cropping systems, their characteristics and the estimation of impacts of soil degradation problems in the case study Uckermark

Crop	Winter wheat	Rye	Winter Barley	Triticale	Sugar beet	Silage Maize	Rapeseed	Winter Barley	Potatoes	Potatoes
Production orientation	conventional	conventional	conventional	conventional	conventional	conventional	conventional	conventional	conventional	conventional
Farm type	arable farm	arable farm	arable farm	arable farm	arable farm	arable farm	arable farm	arable farm	arable farm	arable farm
Tillage type	reduced tillage	ploughing	ploughing	ploughing	ploughing	reduced tillage	reduced tillage	reduced tillage	ploughing	ploughing
Irrigation type	no irrigation	no irrigation	no irrigation	no irrigation	no irrigation	no irrigation	no irrigation	no irrigation	no irrigation	no irrigation
Soil quality class[a]	2	1	2	2	2	2	2	1	1	2
Soil degradation problem	vulnerability									
soil erosion water	low	low	low	low	high	medium	low	low	medium	high
soil erosion wind	low	low	low	low	high	medium	low	low	medium	high
decline in organic matter	low	low	low	low	high	medium	low	low	high	high
negative carbon balance	low	low	low	low	high	medium	low	low	high	high
diffuse contamination	medium	low	low	low	high	medium	high	low	high	high
compaction	low	low	low	low	high	low	low	low	medium	high

a: Two soil quality classes were aggregated in the case study: Class 1: sandy soils, low fertility; Class 2: Luvisols from glacial loams (glacial deposits) with high fertility and good nutrient matter.

Note: in addition to these results further statements to typical cropping systems were given in the framework of Questionnaire 2.

Source: expert assessment

Farming practices that cause soil degradation

Based on the expert opinion, the occurrence of soil degradation problems in the Uckermark depends mostly on two factors: the type of tillage and the type of cultivated crops.

In the case study area, ploughing as a form of conventional tillage is commonly applied for seedbed preparation. The positive effects of ploughing for agriculture are loosening of the upper soil layers, bringing up more nutrients to the surface, reducing weeds and working in the residues of previous crops in lower soil layers and a quicker warming of soils in spring. However, since ploughing creates a fine seedbed, soil particles can easily be removed and transported by rain splash and infiltration filling up the soil pores. The resulting reduced infiltration capacity at the soil surface promotes superficial runoff. Farmers reported an increasing water erosion rate resulting from uncovered soil as a major single effect of ploughing. They further emphasised that especially during the extreme rainfall event in August 2007, sparse soil cover led to severe soil erosion.

Generally, soil experts point out that ploughing and seedbed preparation (leaving the soil uncovered) may lead to a higher potential for both water and wind erosion, but should be discussed in relation to the crop. Specific seed bed requirements of crops can lead to intensive soil tillage. For example, one farmer argued that the cultivation of potatoes needs a fine seedbed associated with intense soil cultivation by ploughing, which is usually stated by experts for rapeseed. Both farmers and soil experts mentioned that the use of a plough leads also to compaction of the adjacent subsoil (plough layer). Such plough pans cause a reduction of the soils' water retention capacity and increase surface runoff. In addition, ploughing buries crop residues leading to a slow decay and impedes mulching effects on the surface. Soil structure is damaged and the number of earth worms reduced.

Both soil experts and farmers pointed out that the intensification of arable farming associated with an increased use of heavy machinery and crossing tracks within the field lead to serious effects of soil compaction by sealing of the soil surface. The amount of soil water is a critical factor in soil compaction potential: wet soils are more vulnerable to soil compaction because water reduces friction between the particular soil particles, and thus destabilises the soil structure. Some farmers mentioned that the increasing size and weight of machinery in the last years has led to severe soil compaction in the case study area. By contrast, soil experts and other farmers argued that the adoption of bigger wheel sizes, lower weight and an increased working width of the machinery reduced the number of cross-overs and therefore lead to less soil compaction than former techniques. Nevertheless, soil compaction occurs especially within the lanes of the field. Soil experts stressed that the usage of machinery has to be adjusted in the case study area.

Certain crops were associated with the occurrence of soil degradation problems in the Uckermark. These crops were: sugar beets, and to a lesser extent maize and potatoes. As shown in Table 3, sugar beets have a high potential to cause soil degradation problems. Since sugar beets are cultivated in rows with bare furrows between each row, usually no plant material protect these furrows making them vulnerable for erosion. Given the fact that sugar beets are sown in March or April, soil surface is not sufficiently protected until canopy closure in June because of the slow juvenile growth. During this period, intense storms with heavy rainfalls frequently occur and lead to considerable damage by erosion. Furthermore, the mechanical harvesting of these crops can lead to severe soil compaction. Maize is also seen as a problematic crop. The lack of soil cover in maize fields during the summer months causes a higher potential for water erosion leading to surface runoff and slumping of the soil in case of heavy rainfalls. In addition, the wide row distance of maize contributes to the potential for water erosion. Potatoes are also cultivated as row crops and thus have a higher potential for water erosion and compaction of the soil.

As sugar beets and potatoes leave less residues on the field than other crops such as maize or wheat, their contribution to the soil organic matter content (SOM) is lower and additional organic matter should be applied by the farmers in order to maintain the SOM level.

Farming practices that prevent soil degradation

Farming practices that reduce the risk of soil degradation problems are widely used in the case study area (Sattler, 2008). The implementation of conservation tillage practices strongly increased during the last ten years, since farmers are aware of these problems on their farms and try to reduce costs for labour and machinery. Conservation tillage (e.g. reduced tillage) can offer the opportunity to protect soil from degradation without requiring too many changes to the farmers' production systems. The term 'conservation tillage' comprises different tillage types (e.g. reduced tillage, zero tillage, mulching). Reduced tillage is partly used in the case study area as a soil conservation measure. However, the application of reduced tillage depends on the crop type. In the Uckermark, reduced tillage is applied for maize (on 80 % of maize cultures). Furthermore, it is used for winter wheat (60-70 %), but only if cultivated after leaf crops such as sugar beets. Both soil experts and farmers agreed that reduced tillage positively affects soil properties such as soil structure or water retention capacity. Crops grown with reduced tillage can use more water as the water-holding capacity of the soil increases, and water losses from runoff and evaporation are reduced. In general, apart from the tillage type, the choice of less erosive crops (such as winter cereals) reduces the soil erosion risk.

Farmers mentioned that non-inverting soil tillage contributes to a preservation of soil organic matter and is beneficial to soil fauna like earthworms, and reduces soil erosion risk including nutrient losses. However, farmers also pointed out that reduced tillage requires a higher use of pesticides to control weeds. For example, as cultivation of maize requires high demands in terms of seedbed preparation, intense soil tillage is essential. To prevent soil degradation farmers apply other soil conservation measures such as intercrops and change of crop rotations. These measures are described in section 4.2 and section 5.

Further, two organic farmers pointed out that their arable farms differ from those with conventional production in several ways: Livestock manure and green manure (e.g. lupines, mustard, and clover) are used instead of conventional fertilisers. Green manures are primarily grown to add nutrients and organic matter to the soil. Both soil experts and organic farmers stated that in organic farming a wider variety of crops are cultivated which leads to a higher settlement of organisms, a higher biodiversity and a higher input of organic matter to the soil, as compared to conventional farming. The water erosion risk is reduced because of soil conservation measures like intercropping or extended crop rotations, leading to a more permanent soil cover by plants. However, organic farmers mentioned that their cultivation has only positive effects on soil if it is well managed. Organic production is distinguished by a group of principles that comprise abdication of synthetic pesticides, natural plant nutrition, natural pest management, and integrity (Kuepper and Gegner, 2004). However, the impact on soil degradation depends on the specific management practices.

Generally, reduced tillage is widely applied except for crops with high demands towards seedbed preparation. Therefore, these crops are still seen as the ones with the highest risk potential for soil degradation, given the low adoption of conservation measures with such crops.

4.2 Suitable soil conservation measures

In general, farmers' knowledge about suitable farming practices is a result of their own experience and established technologies. All farmers mentioned that the application of a soil conservation measure strongly depends both on the incurred costs of the measure and on the experiences of other farmers. Farmers obtain further information on suitable soil conservation measures from professional journals, advisors, colleagues and farming neighbours.

Cropping/tillage measures

Reduced tillage is widely used in the case study area to prevent or reduce soil degradation. However, there are partly wide differences between the opinions of soil experts and farmers. Farmers use reduced tillage mainly for reasons of cost reduction, while soil experts also point on the potential for soil conservation.

In general cropping/tillage measures applied in the case study region mitigate various forms of soil degradation. Given the fact that soil erosion by water, soil compaction and decline in organic matter are the main soil related problems, some specific soil conservation measures are more relevant. An overview of expert evaluations on the general effects of soil these measures on soil degradation problems in the case study area independent of crop types is shown in the following (Table 4).

Intercrops such as mustard or clover are mainly applicable for the reduction of soil erosion by water and decline in organic matter. As intercrops provide additional soil coverage they predominantly reduce wind and water erosion. Soil experts mentioned that residues of intercrops contribute to the soil organic matter pool and provide an additional source of nutrients for the next crop. In addition, soil experts pointed out that intercrops should be used more by farmers in the case study. Intercrops are only applied on less than 20 % of the Utilised Agricultural Area (UAA) in the case study region (expert estimation) because the generally limited water availability in the case study region poses the risk that the interim crop induces a (higher) water shortage for the main crop.

No tillage/direct drilling is only used to a small extent. Farmers argued that no tillage is linked with non-acceptable disadvantages. Therefore, no tillage is used on less than 20 % of the UAA in the Uckermark (expert estimation). Main reasons for non-application are higher costs through higher management needs and higher investment in equipment. Furthermore, direct drilling decreases the fixation of organic nutrients in the soil. Nevertheless, soil experts suggest no tillage as an important soil conservation measure. The main advantage of direct drilling identified by soil experts is a nearly permanent soil coverage by plants leading to less soil erosion by wind and by water as well as reducing the loss of nutrients from leaching and run-off. Further, less compaction from the impact of heavy machinery occurs. Generally, farmers are discouraged by the economic efforts for this measure while some soil experts underline the positive effects for soil conservation. The main obstacle to a more widely implementation seems the high additional investment in appropriate machinery.

Reduced tillage (Mulch tillage) is more applied by farmers in the case study area (20-40 % of the UAA). Both farmers and soil experts see reduced tillage as a suitable soil conservation measure to prevent or reduce water erosion by improving the soil structure leading to a better water infiltration capacity and to a reduction in surface-runoff. Soil experts stated that mulch tillage is especially applied for maize and partly for rapeseed. The application of reduced tillage for rapeseed depends on the sowing conditions: in case of wet conditions reduced tillage is preferentially applied. Farmers argued that the main disadvantage of this measure is the application of herbicides to control weeds such as brome grasses or shepherd's purses (*Capsella bursa-pastoris*). Reduced tillage is a measure that has the additional advantage to reduce production costs and thus is favourable not only from the point of view of soil conservation but also for economic reasons. Reduced tillage has a number of positive effects on soil but also negative impacts as it usually is accompanied with an increased herbicide and in some cases also increased fungicide usage with negative impacts on biodiversity.

Adjusted wheel size and pressure can have a positive influence on soil compaction which is also stated by the farmers and therefore widely used on their farms. However, farmers pointed out that it is very difficult to estimate suitable conservation measures that reduce soil compaction on their fields because of missing experiences. Soil experts suggested a restriction of excessive heavy machinery use to reduce soil compaction especially on wet soils.

Table 4: Effects of cropping/tillage soil conservation measures on soil degradation problems

	Soil degradation problem									
Measures	soil erosion water	soil erosion wind	decline in organic matter	negative carbon balance	diffuse contamina-tion	compaction	salinisation	acidification	decrease of water reten-tion capacity	Off-site damage
intercrops	2	2	2	2	1	0				2
no tillage/ direct drilling	2	2	0	0		1				2
reduced tillage	2	2	0	0		1				2
wheel sizes and pressure / restricting excessive heavy machinery use	1					2				
restrictions on the max. amount of (liquid) manure application					1					1
restrictions of manure appli-cation to a certain time period					1					1
restrictions on the max. amount of N- fertilisation					1					1
restrictions on the max. amount of P-fertilisation					1					1

Note: The numbers indicate *the general effects of soil conservation measures on soil threats in the case study*, examined in Questionnaire 1 with the following units: 2 = farming practice highly mitigates the threat, 1 = farming practice mitigates the threat, 0 = farming practice has no effect on threat. The grey marked cells are not relevant because this measure has no relationship to the threat.

Table 5: Effects of long term soil conservation measures on soil degradation problems

	Soil degradation problem									
Measures	soil erosion water	soil erosion wind	decline in organic matter	negative carbon balance	diffuse contamination	compaction	salinisation	acidification	decrease of water retention capacity	Off-site damage
change of crop rotation	1	1	1	1	0	0	0	0	1	1
liming			1	1		0	0	2	0	0
controlled traffic tramlines	0	0								2
adjusting duration and season of grazing animals	1				1	1				1

Note: The numbers indicate *the general effects of soil conservation measures on soil degradation problems in the case study area*, as examined in questionnaire 1 with the following units: 0 = farming practice has no effect on threat, 1 = farming practice mitigates the threat,2 = farming practice highly mitigates the threat. The grey marked cells are not relevant because this measure has no relationship to the threat.

Restrictions on the **application of manure and fertilisers** are implemented as legal regulations in the federal state of Brandenburg. They are part of the cross compliance regulations and limit the maximum amount of (liquid) manure and the time span of application. The maximum amount of N- and P-fertilisation is regulated in the federal Fertilisation Ordinance. N-fertilisation on covered soils of arable land is only allowed between 15 November and 15 January. Soil experts argued that these restrictions are necessary to prevent plants and soils from excessive use of fertilisers leading to an increasing nutrient leaching.

Long term measures

The effects of long term measures on the identified soil degradation problems were evaluated by soil experts. In the following these considerations are presented in Table 5.

Change of crop rotation (i.e. adding additional crops to the rotation, omitting certain crops) is suggested by soil experts to reduce the risk of organic matter decline. Soil experts suggested that humus producing crops should alternate with humus depleting crops to maintain organic matter and soil fertility. Crop rotation considerations are widely followed by farmers in the area (over 80 % of the UAA). Farmers stated that from their point of view changes of crop rotation are aiming at two main objectives: firstly, an economic purpose and secondly, soil conservation objectives. Both soil experts and farmers mentioned that a wide, “healthy” crop rotation has positive effects on soil organic matter because of additional accumulation of organic matter by humus producing crops. Furthermore, these changes help to control weeds, plant diseases and insects in combination with a reduced need for herbicides and fertilisers purchases. In general, adjusted crop rotations can provide a permanent soil cover, reducing soil erosion, and improving its water retention capacity. Especially, the soil erosion risk can be reduced by simply avoiding row crops on steep slopes, a measure that is already mandatory in some European member states.

Liming (the application of calcium and magnesium to the soil) is generally suggested by soil experts to prevent and reduce soil acidification. The experts pointed out that this measure increases the efficiency of nutrients and organic matter in soil. Farmers mentioned that they do not apply liming because acidification is no soil degradation problem on their farms. This is due to the calcareous parent material of the soils in the case study area showing high pH values. Only one farmer mentioned that he uses liming from time to time to prevent acidification.

To reduce soil compaction which was identified as a strong soil degradation problem in the area, soil experts suggested the application of **controlled traffic tramlines**. This leads to reduced run-off and erosion by concentrating agricultural machinery on defined tramlines**.** Farmers shared this opinion but also stated that due to high investment costs they were not able to apply the measure. The purchase of a GPS system ensuring the exact position of the machinery on the tramlines is considered very expensive. As a consequence, only a very small number of farmers utilises controlled traffic tramlines to prevent soil compaction.

Adjusting duration and season of grazing animals was suggested by soil experts to reduce soil compaction by trampling of livestock. For all farmers interviewed this measure does not apply since no livestock is kept on their farms.

5 Evaluation of soil conservation measures

Soil conservation measures that are relevant in the case study Uckermark are described below presenting the statements made by soil experts (Questionnaire 1) and farmers (Questionnaire 2).

5.1 Cropping/tillage measures

In the Uckermark region, the following cropping/tillage measures are applied by farmers:

- intercrops
- undersown crops
- no tillage/ direct drilling
- reduced tillage
- adjustment of wheel sizes and pressure / restricting excessive heavy machinery use
- restrictions on the max. amount of (liquid) manure application
- restrictions of manure application to a certain time period
- restrictions on the max. amount of N- fertilisation
- restrictions on the max. amount of P-fertilisation

Intercrops are only widely used in organic farms in the case study area. All farmers agreed that intercrops contribute to soil conservation by ensuring a permanent soil cover leading to a decrease of water erosion and soil runoff. Intercrops are used to accumulate SOM and help to control spreading of weeds, e.g. bromes, and pests such as mice and slugs. Intercrops can also increase soil fertility by accumulation of nutrients. Farmers pointed out that intercrops are producing large amounts of organic matter e.g. by yield and root residues which have positive effects on soil fertility. For example, the cultivation of intercrops can release about 15 kg N/ha for the following crop. In case of perennial forage crops about 40 kg N/ha are released (MLUR, 2000). Intercrops used by farmers in the case study area include mustard (*Sinapis alba, Brassica alba*), clover (*Trifolium*), oil radish (*Raphanus sativus* ssp. *oleifeirus*) and Phacelia (*Phacelia tanacetifolia*).

One farmer stressed that clover and oil radish as intercrops are also used for the production of fodder for livestock. When asked about the costs of intercropping farmers consider these costs as rather high (between 50 and 89 € per ha). Reasons given for the high costs are expensive seed material for intercrops (esp. mustard) and additional costs for seedbed preparation including machinery and labour costs. In the study area intercrops are less cultivated for economic reasons like fodder but rather for soil conservation. One farmer using mustard as intercrop stated that the application of intercrops is only an interim solution because of high seed costs. Two other farmers pointed out that they cultivate lupines and vetches as intercrops only on parts of their fields due to high costs. All in all, farmers stated that the economic efficiency of intercrops compared to other soil conservation measures is relatively low.

Nevertheless, intercrops are suggested by soil experts as a suitable measure to prevent or reduce soil degradation. However, after some late harvested crops such as maize and sugar beet intercrops may not produce sufficient biomass to economically justify the measure.

The opinions towards **undersown crops** differ: Soil experts mentioned that this measure is not widely applied in the case study area because of additional costs for seeding as well as increased labour and machinery costs. By contrast, three out of six interviewed farmers apply this measure for soil conservation since about ten years. Farmers are mainly undersowing main crops such as maize with grass (e.g. *Lolium perenne*). One organic farmer pointed out that clover grass used as undersown crop provides soil with nutrients, especially nitrogen. The most positive effect of undersown crops expressed by farmers is the reduction of erosion by permanent soil coverage. Further, undersown crops are applied by farmers to accumulate

organic matter in the soil and to improve soil fertility. One organic farmer also mentioned that undersown crops are used on his farm to eliminate weeds (e.g. *Bromus L.* and *Elytrigia repens*). An economic advantage in application of undersown crops is given by the fact that there are less seeds needed in comparison to intercrops. Nevertheless, undersown crops are not as widely applied in the region because the related costs are relatively high and the positive effects are doubted by the farmers. For example, when clover grass is used as an undersown crop, there are costs of about 68 € per ha and year. Both types of conservation practices (intercrops and undersown crops) have in common that they can lead to a yield reducing competition between main and intercrops for water. Especially in the low precipitation regions of Brandenburg this effect prohibits any additional crop since as much water as possible has to be saved for the main crop. Dry summers often prevent germination of intercrops and undersown crops. Thus, the option for these two types of conservation measures is only available in situations with sufficient water provision.

No tillage as a way of growing crops from year to year without soil cultivation and without seedbed preparation is partly used by farmers in the Uckermark. One farmer applying no tillage for four years (wheat after rapeseed) mentioned that this measure reduces water erosion, decreases surface runoff and increases water infiltration and soil moisture retention. Rosner et al. (2003) noted that no tillage systems reduce soil erosion by 82 % in comparison to conventional tillage with ploughing. Since crop residues are left on the field there is an additional accumulation of soil organic matter.

Several farmers pointed out that no tillage is a suitable measure to improve soil fertility leading to better and solid yields. As tilling is considered the major cause of soil compaction in the case study area, no tillage is used to improve soil structure and trafficability to reduce these damages. From an economic point of view, some farmers adopt this measure to save labour, time and fuel. One farmer stated that the disadvantage of this measure is the higher abrasion of machinery and sees this is a consequence of the measure leading to soil hardening. Further, by using no tillage, weed and pests can increase (Birkás and Gyuricza, 2000). Soil experts argued that the need for increased herbicide input and for specialised seeding equipment is a critical disadvantage. Additional costs for no-tillage constitute about 58 € per ha and year.

Reduced tillage (seedbed preparation without plough) was mentioned by four out of six interviewed farmers as a suitable soil conservation measure. This practice is usually used for main crops such as maize. In general, farmers mentioned that the effects of reduced tillage on soil depend on the kind of machinery used while in comparison to conventional tillage other kinds of machinery are needed. As an example, in comparison to ploughing tilling the soil with a grubber at a lower working depth leads to reduced soil erosion and conserves soil moisture. Further positive effects of reduced tillage stated by farmers and soil experts included an increase in soil fertility and an increase of soil organic matter. Both farmers and soil experts agreed that reduced tillage is characterised by less cross-overs within the field and hence also reduces soil compaction risk. Farmers stressed that a disadvantage of reduced tillage is the dispersion of weeds. One farmer mentioned that long term non inversion tillage increased weed problems, in particular with perennial weeds, on his farm. Farmers agreed that reduced tillage causes less costs than conventional tillage by ploughing. The economic advantages of reduced tillage given by farmers include lower fuel costs due to less power needed by tractors, reducing the amount of tillage equipment needed and lower labour time, which reduces labour costs. Soil experts argued that reduced tillage lowers the costs between 28 and 70 € per ha and year with a neutral yield effect. Farmers agreed that reduced tillage has even positive effects on the yield by producing higher and more stable yields. However, the main benefits of reduced tillage perceived by farmers were savings by reduced labour and machinery use and to a lesser extent soil conservation aspects.

One of the interviewed farmer also mentioned that he uses mulching of organic residues as a form of reduced tillage on his farm as an explicit soil conservation measure. Positive effects

of mulching on soil given by the farmer include protecting the soil from erosion, reducing soil compaction and conserving soil moisture. In addition, mulch can reduce the growth of weeds.

As the extent of soil compaction depends on wheel sizes and contact pressure of the machinery used, an adaptation of these factors to the respective soil type is required. Soil experts pointed out that a **restriction of heavy machinery use** is necessary to reduce or prevent soil compaction. In the Uckermark such measures are not widely used because the costs for the purchase of new tyres or a tyre pressure adjustment system are too high corresponding to the farmers. Nevertheless, when asked about positive effects of this measure all farmers agreed that a restriction of heavy machinery use and/or an adaption of wheel sizes and pressure effectively reduce soil compaction especially on wet soils. The measures can decrease waterlogging, improve infiltration, increase soil capillarity and thus lower the risk of water erosion.

Restrictions on the maximum amount of (liquid) manure application, restrictions on manure application to a certain time period, restrictions on the maximum amount of N- and P- fertilisation have to be implemented in the case study area because of legal demands (Federal Fertilisation Ordinance, Pesticide Ordinance) and can be considered as standard practice. The Fertilisation Ordinance is accepted by the farmers. As this ordinance includes obligatory requirements in terms of application of fertilisers, one farmer stressed that he no longer has influence on the amount of fertilisation on its farm.

However, soil experts agree that the management of nutrients strongly influences soil properties and yields. Restrictions on the maximum amount of fertilisers contribute to soil conservation and environmental protection by lowering nutrient leaching and providing adjusted nutrient supplies to the crop. When conventional and organic farmers were asked about the application of fertilisers on their farms their opinions widely differed. Conventional farms usually apply inorganic fertilisers containing synthesised mineral fertilisers such as N-fertilisers or P-fertilisers on soils. The interviewed farmers pointed out that the fertiliser application strongly depends on the cultivated crops. For example, in case of sugar beets the amount of nitrogen in one farming period is 100 kg/ha whereas the nitrogen fertilisation of winter barley is 104 kg/ha in one farming period.

Organic farmers cultivate grain legumes such as lupines and peas or forage legumes such as clover and fetches and add green manure to their fields. Legume plants are cultivated to fix atmospheric nitrogen and hence to increase soil fertility. For example, lupines are able to fix 100 kg N/ha and clover is able to fix 280 kg N/ha (MLUR, 2000).

5.2 Long term measures

Long term measures applied by farmers in the region Uckermark include:

- change of crop rotation
- liming
- controlled traffic tramlines
- adjusting duration and season of grazing animals

Changes of crop rotation (i.e. well adapted rotations towards soil degradation risks) were suggested by soil experts to keep soils mostly covered by plants over the year to reduce erosion risk. Soil experts mentioned that well adapted crop rotations contribute to the organic matter of the soil improving soil fertility and soil productivity. Organic farming usually has a wider crop rotation which leads to a lower vulnerability to soil degradation. From the farmers' point of view it has to be considered that changes of crop rotation are not simple because the positive effects of new crops on soil are uncertain. However, farmers are aware of the positive effects of crop rotations to soil conservation.

Liming is partly used by farmers as a soil conservation measure in the case study and its application depends on soil conditions, predominantly the soil pH. Two out of six farmers mentioned that this measure helps to maintain a balance between the soil's acidity and alkalinity by increasing the soil pH and improving the soil fertility and the soil structure by fixing of nutrients, particularly in clay soils. Hence, liming is only applied on soils with a tendency to acidification. As acidification is no major soil degradation problem in the region, liming is rarely applied. Costs of lime given by farmers are perceived as high, while soil experts estimate the costs of liming at 35 €/ha.

Controlled traffic tramlines are partly used in the region as a soil conservation measure. Soil compaction can be concentrated with this measure to a small surface, which allows higher yields on the remaining area by improving the conditions for plant growth. There are two options to implement this measure. The first one is to drive on tramlines without any technical support, resulting in low costs but also low precision. The second option based on GPS is very expensive (one farmer stressed that there are costs of about 40.000 € per machinery). Farmers also pointed out that there are environmental problems resulting from the even increased compaction in the tramlines. Nevertheless, the application of controlled traffic tramlines represents a suitable measure for soil conservation.

Adjusting duration and season of grazing animals is less applied in the case study region. All interviewed farmers mentioned that livestock causes no soil degradation problems on their farms. The need to adjust the duration and season of grazing animals is therefore not given. In case of high livestock densities, soil experts stressed that overgrazing leaves the soil less covered by plants which leads to an increased risk of soil erosion by water. Furthermore, livestock affect vegetation communities through removal of biomass. Soil experts suggested in the case of damages, an adjusting of duration and season of grazing animals to reduce soil erosion by water and to reduce or prevent soil compaction by trampling of livestock.

5.3 Conclusion

Soil erosion by water, decline in organic matter and soil compaction are the most affected soil degradation problems in the Uckermark region. The application of soil conservation measures by farmers is strongly influenced by the measures' costs. For soil erosion by water, no tillage is regarded as the most efficient soil conservation measure followed by reduced tillage. For decline in organic matter, intercrops and undersown crops are assessed as suitable soil conservation measures in terms of their cost efficiency. Well adapted crop rotations can mitigate the risk of SOM decline. In order to prevent soil compaction, the adaptation of wheel sizes and pressure, restricting excessive heavy machinery use and no tillage are seen as cost-efficient measures.

Soil conservation measures such as restrictions on the amount of fertilisers can be considered as standard practice in the case study. Other measures such controlled traffic tramlines are very cost intensive and hence are only applied by few farmers. Furthermore, some measures such as intercrops or cover crops have the potential for wider application. Reasons for no application of these measures are high costs and agronomic obstacles (e.g. water shortage).

Farmers in the case study area Uckermark are aware of the possible effects of agriculture on soils and the resulting soil degradation problems. Hence, many soil conservation measures are already applied in the case study area if the costs of the measure are seen as affordable the land users.

6 Soil related actors

6.1 Actors in the farming practices arena

6.1.1 Description of characteristics and attitudes

In total, 581 agricultural firms work in the case study region Uckermark, out of which are 399 individual farms, 13 cooperatives, 66 limited companies and 71 civil-law partnerships. The average farm size is 304 ha; the average field size is 25 ha.

Land tenure system in the case study is not uniform. 81.3 % of the utilised agricultural area in Brandenburg is farmed under lease hold. In this context, only 17.6 % is owned by the agricultural firms with increasing tendency. Duration of lease contracts is usually 10-12 years. There is a highly fragmented, mostly non-residential land ownership. 13 % of the utilised agricultural area in Brandenburg is leased out by the German Land Privatization Company (BVVG), an agency responsible for the administration and privatisation of state-owned farm and forest land in East Germany. Table 6 shows the characteristics of the interviewed farmers.

Table 6: Characteristics of the farmers interviewed

Affiliation/position of the interviewee	Type of the farm	Size of the farm [ha]	Typical crops	Typical livestock
limited liability company, manager of the farm	arable, livestock, ploughless management	2,180	wheat, rape, sugar beets, maize	bovine
limited liability company, manager of the farm	arable, livestock, conventional	1,620	winter wheat, rape, winter barley, rye	pigs, bovine
civil law association, manager of the farm	arable, livestock, conventional	1,060	wheat, rape	pigs
private enterprise, manager of the farm	arable, conventional	88	wheat	none
civil law association, manager of the farm	arable, organic	3,018	grass-clover, rye, lupines, wheat, barley	none
limited partnership with a limited liability company as general partner, manager and owner of the farm	arable, livestock, organic	1,400	rye, wheat, summer barley, spelt	bovine, sheep

Five out of six interviewed farmers hold a university degree in agriculture. Farmers had achieved their expert knowledge on farming practices, soil conservation measures and their technical feasibility from academic studies, advisors, professional workshops and meetings. In two cases, farmers complained about lacking information about soil conservation measures and their practical application. Decisions regarding farm management and the application of farming practices and soil conservation measures are mostly made by the manager of the farm and are not influenced by others.

Farmers criticised that they are not involved and had no influence in policy design and decision making even though they are affected by policies. It was underlined that it would be beneficial to account for farmers' opinions during the policy design process.

6.1.2 Factors influencing adoption of soil conservation measures

Farmers were asked in the survey about their knowledge on soil related policies. The policy measures, schemes, initiatives and regulations known by farmers with the objective of soil conservation are listed in Table 7.

Table 7: Farmers' cognition of policy measures, schemes and regulations (n = 6)

Known policy measures, schemes, initiatives and regulations	**Policy measures, schemes, regulations actively involved with** (number of farmers with knowledge of the measure)	**Reason for adoption**
Cross Compliance (e.g. GAEC standards)	6	compliance is mandatory and required to receive farm payments
Fertilisation Ordinance (as the implementation of the Nitrates Directive)	6	mandatory i.e. action required because certain practices are not longer permitted
Plant Protection Act	3	mandatory i.e. action required because certain practices are not longer permitted
Federal Soil Protection Act (national)	3	mandatory i.e. action required because certain practices are not longer permitted
Specific guidelines of Organic Farming Associations	2	participation is voluntary but required if payments are received
EU Directive for Organic Farming	2	participation is voluntary but required if payments are received
National Law for Organic Farming	2	required if payments are received

The main reason for adoption of these policy measures are legal requirements or subsidies. Legal requirements such as the Fertilisation Ordinance, the Plant Protection Act, and the Soil Protection Act were intended to bring about better protection of soil and water from agricultural sources. Cross compliance intends to promote a more sustainable agriculture by the prevention of erosion, increased soil organic matter and improving soil structure. The organic farms of the region work along the EU Directive for Organic Farming, the specific guidelines of organic farming associations and the national Law for Organic Farming. Farmers did not perceive agri-environmental schemes under the Rural Development Programme as soil conserving policy measures, although grassland extensification and organic farming are measures that have a direct influence on soil conservation, and according to Matzdorf et al. (2003), 36 % of farmers were enrolled in Brandenburg's agri-environmental schemes (in 2002) which have a focus on grassland extensification.

Sufficient information on policy measures is provided by the federal state Brandenburg, by the ministry of agriculture, by advisors and by professional publications.

The most important aspect for the adoption of a voluntary policy measure is the sufficient compensation of the inherent costs. Farmers mentioned that it is essential whether a measure is financed by payments. Consequently, application of a policy measure depends on the economic advantage farmers would have. However, as shown in the preceding chapter some soil conservation measures are applied without compensation (e.g. reduced tillage, intercrops).

Farmers are well aware of the monitoring of certain policy measures. The breach of cross compliance regulations results in sanctions in the form of a reduction of the single farm payment. The amount of reduction is based on the extent, severity and permanence of non-compliance, as well as whether the offence is repeated within any three year period. Compliance with policy measures is controlled with random checks.

As farmers are aware of soil degradation problems on their farms, most of the technical measures applied in the case study area are standard practices. Some regulations on soil use existed before the introduction of cross compliance. When cross compliance was introduced in 2003 as a new policy, farmers stated that this measure is only regrouping already existing policy measures. In general, farmers mentioned that the adopted technical measures are suitable for reducing soil degradation problems such as water erosion, decline in organic matter and soil compaction in the region, while the application of the new regulations inflicts higher costs. In general, farmers estimated the effort and time involved for the enrolment in voluntary policy measures (e.g. for fill in forms) as very high. As a result, the adoption of voluntary conservation schemes (if they were available) is seen very critically. However, farmers wish for sufficient payments if such voluntary policy measures were offered.

The observations from our interviews are in line with findings in Prager (2002) who interviewed 28 actors (farmers and advisors) in the Uckermark region on factors influencing farmer adoption of soil conservation measures. The main objectives of the farmer are to decrease costs and to increase yields in order to maximise income. Costs may be decreased by reducing labour, work time needed, fuel or by receiving compensation payments while they increase with expenditures for seed material, and additional farming or computer equipment. If soil conservation measures are associated with a decrease in yields, e.g. due to more weeds and pests, more wear on machinery, or lack of compatibility with local climatic and soil conditions e.g. less water for the main crop, farmers are less likely to adopt them. Motivation to experiment with soil conservation measures comes from a perceived problem, e.g. soil structure makes ploughing difficult, soil erosion events coupled with off-site damages, loss of soil fertility, or previous experience with a certain conservation measure.

Based on a survey of 11 farmers in a sub-region of the Uckermark, Sattler and Nagel (2008) ascertain the factors above and point out that while reputation among fellow farmers is less important for the acceptance of a measure, it is relevant if the measure can help to protect resources for future generations, improve farmers' image in society, and challenge their knowledge and therefore add to the farmers' satisfaction with his/her work. A large heterogeneity in responses showed that the personal attitude of the individual plays a major role in adoption processes.

6.2 Actors in the policy design and implementation arena

For soil conservation policy there is no consistent network of actors as soil conservation is a by-product in several different policy measures and therefore the actors in the arena of each policy measure know each other very well, but there is a deficit in communication between the actors involved in various policy measures.

6.2.1 Governmental organisations

Governmental organisations concerned with soil conservation measures are the European Union in case of the Nitrate Directive, the Sewage Sludge Directive and the Direct Payment Obligations Act. At the German national level the German Federal Soil Protection Act (Bundesbodenschutzgesetz)[4] was designed and implemented. It is also the national level that has to implement the European directives, which are mainly mandatory policy measures,

[4] The German Federal Soil Protection Act (Bundesbodenschutzgesetz) is the legal basis for several Länder Soil Protection Acts. For further information on the regulation please refer to 7.2.1 in this report.

into national law such as the Sewage Sludge Directive, the Nitrate Directive and Direct Payment Obligations Act.

The Federal Republic of Germany is a decentralised state where the administrations of the 16 Länder (States) are responsible for the implementation of national laws. In some cases they also have the possibility to pass their own programmes as is the case for agri-environmental schemes (AES). Therefore, the main focus of the following analysis lies on the regional level that is the Brandenburg level.

Administrative authorities in the State of Brandenburg are arranged in a hierarchical structure, i.e., the Highest State Authority, the Upper State Authorities and the Lower State Authorities. The Highest State Authority responsible for soil conservation is the Ministry for Rural Development, Environment and Consumer Protection (Ministerium für Ländliche Entwicklung, Umwelt und Verbraucherschutz, MLUV). The Upper State Authorities report to the ministries and are mainly responsible for the state-wide implementation of different policies. The State Authority for Environment (Landesumweltamt, LUA), in the following referred to as the Environment Agency, and the State Authority for Consumer Protection, Agriculture and Land Consolidation (Landesamt für Verbraucherschutz, Landwirtschaft und Flurneuordnung, LVLF), in the following referred to as the Agriculture Agency, are implementing the policy measures for soil conservation. Brandenburg is divided into 14 administrative districts each with a number of Lower State Authorities. In the case study Uckermark the local Authority for Agriculture and Environmental Protection (Landwirtschafts- und Umweltamt), in the following referred to as the Local Agriculture Authority, has a number of departments. The Department for Soil Conservation and Fertilisation and the Department for Nature Conservation and Landscape Conservation are concerned with agricultural soil conservation (Figure 5).

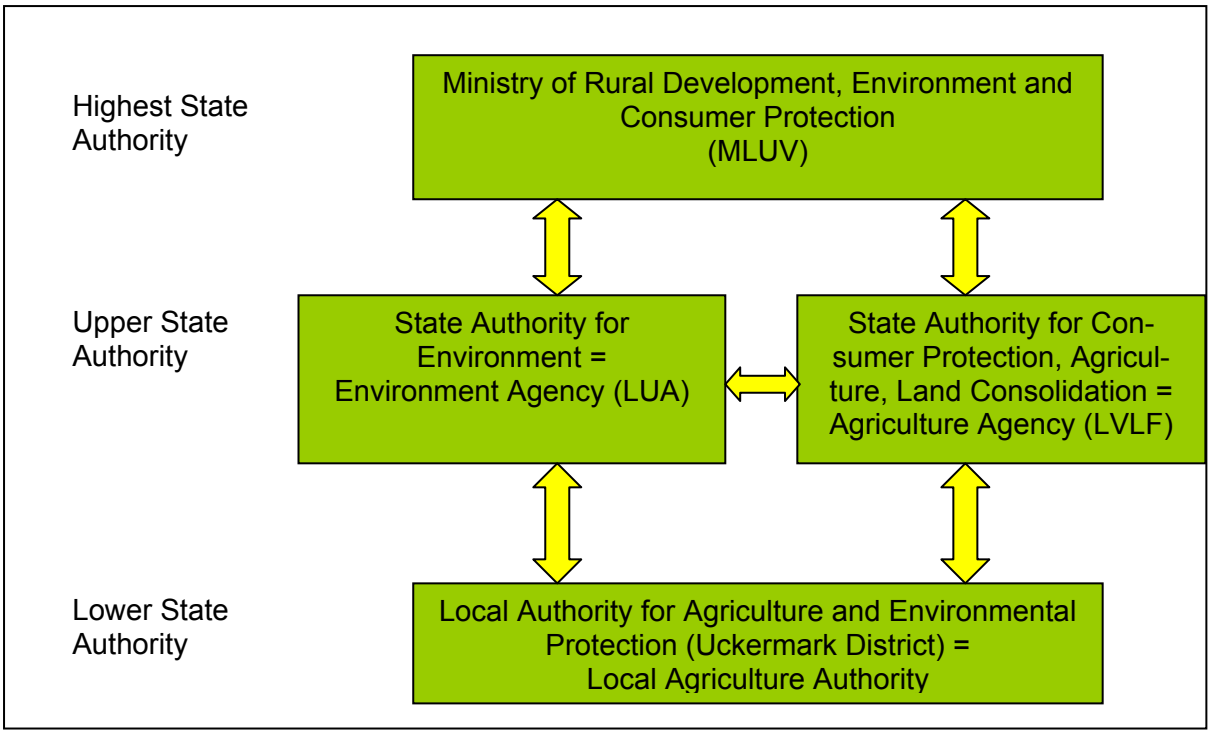
At the regional level MLUV[5] is responsible for some incentive-based policy measures such as the agri-environmental schemes (the implementation of the regulation 1698/2005/EC) and the Scheme for Nature Conservation Management Agreements (Vertragsnaturschutz), in short Management Agreement Scheme[6]. Both LUA and LVLF are involved in the implementation of these policies. LUA plays an important role in handling the Management Agreement Scheme but also has a special department for the Large Protected Areas and thus oversees the Biosphere Reserve Schorfheide-Chorin in the Uckermark district. Further tasks of LUA are the scientific support to the Ministry and other administrations at the local level regarding soil protection and nature protection (Hurrelmann et al., 2005).

LVLF is responsible for the implementation of the Fertilisation Ordinance, the Federal Soil Protection Act, the Sewage Sludge Directive, AES and the Direct Payment Obligations Act. Additionally they are in charge of training the advisory services and they are responding to questions from the Local Agriculture Authority. The Technical Control Authority (Technischer Prüfdienst) is the only administrative part that has been created during the last years in the context of implementing several regulations such as the Direct Payment Obligations Act. It is assigned to LVLF.

[5] The Ministry for Rural Development, Environment and Consumer Protection has been established in 1999 when the former Ministry for Environment, Nature Conservation and Regional Planning has been merged with the Ministry for Nutrition, Agriculture and Forestry to become the Ministry of Agriculture, Environmental Protection and Regional Planning. The Ministry has been renamed in 2004 to the current Ministry for Rural Development, Environment and Consumer Protection.

[6] The Scheme for Nature Conservation Management Agreements is a policy measure developed by some Länder to enhance nature protection. It consists of contracts between the LUA and individual farmers. The Scheme for Nature Conservation Management Agreements is a very popular policy measure among farmers “since these individual contracts have been more flexible in terms of measure design and compensation level, and more open to subsequent adjustments” (Eggers et al. 2004)

Figure 5: Administrative organisation involved in soil conservation in Brandenburg



Source: Own presentation

At the local level the Authority for Agriculture and Environmental Protection is responsible for the implementation and administrative control of policy measures. They are also the contact point for farmers when questions arise concerning policy measures.

Mandatory measures are decided on at a higher level, i.e. the state ministry. In contrast, regional and local authorities have more influence on the design of incentive measures although the final decision remains in the hands of the ministry.

6.2.2 Civil society and non-governmental organisations

Due to the federal structure in Germany most organisations are organised at the local, regional and national level and are more or less dependent on the higher level.

In Brandenburg there are only a few actors directly concerned with agricultural soil conservation. On the one hand there are the farmers' unions such as the Brandenburg Farmers' Union (Brandenburgischer Bauernverband) or the Farmers' Federation (Bauernbund)[7] including the organic farming associations such as Bioland, Grüne Liga[8] or Demeter. On the other hand are the environmental protection and nature conservation groups such as NABU or BUND, but are more active in the areas of water protection or the protection of animals. In the past they did not make a high effort to influence soil conservation policies at the national and regional level (Choudhury et al., 2001). Additionally the Water and Soil Associations as well as Soil Associations at the regional and local level are involved in general soil protection, but they are not primarily concerned with agricultural soils. As one member of the soil association said, agricultural soils do not play such a big role in their policies. They are more concerned with contaminated soils.

The local universities such as the University of Applied Sciences Eberswalde (Fachhochschule Eberswalde) or Humboldt University of Berlin, and Research Centres such as the Leibniz-Centre for Agricultural Landscape Research (Leibniz-Zentrum für Agrarlandschafts-

[7] The Farmers' Federation is an association organised only in East Germany
[8] The Grüne Liga is an organisation in the East German Länder.

forschung, ZALF) are also important actors in the field of soil conservation policy. Especially the Research Centres such as ZALF are important actors when it comes to the implementation of soil conservation policies, because they have the expertise that is needed for the implementation of different policy measures and they are active in the basic research.

Another actor in the civil society arena is the advisory services that are organised privately or as an organisation. They transfer their knowledge and specific information about the policy measures to the farmers. One actor that belongs to this group is the Manure Association (Düngeverein) that has been established when the EU-Nitrate Directive was implemented.

Despite the number of actors named above it is interesting to note that there is not much activity at the local and the regional level concerning soil conservation. Almost all interviewees stated that there are agricultural soil problems in the region, but no one has been proactive on the topic. For most of the local and regional environmental protection organisations agricultural soils are not one of the main issues and as a result it has not been easy to find actors who could say a lot about soil conservation in the region. One non-governmental actor said that there has once been an agricultural commission in their house but it does not exist anymore. When asked the question if there are local soil conservation associations, a representative of the Farmers' Union said that he is not aware of any and that he sees the Farmers' Union as the organisation being active on soil conservation issues. Soil conservation has not such a high status as for example water protection and therefore the groups at the local and regional level do not put so much emphasis on the topic.

In general, regional civil society actors have more influence on incentive measures such as AES or the Scheme for Nature Conservation Management Agreements, because they are designed at the regional and local level.

6.2.3 Resources, capacities and networks

Policy design

At national level expert committees as well as the national ministries and the Länder ministries are working on policy design. One important actor for information distribution and information exchange at the national level is the Federal-Länder Working Group Soil Conservation (Bund/Länder-Arbeitsgemeinschaft Bodenschutz; LABO)[9]. In addition special committees on different problems are involved in the process of forming an opinion in the policy making process. In most cases interest groups such as the farmers' unions as well as environmental protection and nature conservation groups are consulted.

The only policies concerning soil conservation that are designed at Länder level are the agri-environmental schemes (AES), the Scheme for Nature Conservation Agreements and the Brandenburg Nature Conservation Act. The most important actor for Länder level policy design is the Ministry for Rural Development, Environment and Consumer Protection (MLUV) with the Upper and Lower State Authorities playing an advisory role. In this circle non-governmental actors have the opportunity to contribute their knowledge and concerns by way of written or oral statements. Many actors stated that there are quite a small number of people who are involved in the policy design. The most important non-governmental actors in the field of agri-environmental policy design are the farmers' unions and environmental protection and nature conservation groups as well as Landcare groups. The environmental protection and nature conservation groups together with the Landcare groups tend to work together on some issues to speak with one voice to have a better impact. A representative of one of the largest organic farmers' union said that they do not have a high influence at the Länder level where they can submit written statements but they are not invited to hearings. At the European and national level they have more influence on the policy design. To increase their

[9] For further information on the working group please refer to http://www.labo-deutschland.de/, consulted 12/06/2008.

influence on policy design they cooperate with other organisations and provide a unitary proposal.

Some interviewees from the administrative organisations reported that they get to see the drafts, but they lack the influence to shape them. The State Authority for Environment (Landesumweltamt, LUA) and the State Authority for Consumer Protection, Agriculture and Land Consolidation (Landesamt für Verbraucherschutz, Landwirtschaft und Flurneuordnung, LVLF) also have a say in policy design as they act as a policy advisory body to the Ministry. The respective administrative person said that he has more influence at the national level where he is a member of the Soil Commission that comprises staff from the state administrations and they have impact on the national policy design but on the regional level his influence is quite low.

A major problem is the authorities' lack of information about the actual conditions of the soil. This hampers their ability to monitor soil condition. Authorities do not know how many hectares or agricultural land are covered with intercrops or how many hectares are ploughed. Thus, it is hard to say if there are changes, improvements or otherwise, in soil conservation. There are other states such as Saxony, where the Authorities run a reduced-tillage programme as part of their agri-environmental schemes which increases their data base on soil conditions. One stakeholder suggested that someone, for example from one of the local research institutes should collect, analyse and draw up a land register for nutrient supply and the supply of organic substances to be able to see where for example agri-environmental schemes for erosion prevention are useful.

Large Protected Areas (which represent one of the incentive policy measures) have the problem that the policies are developed at the regional (Länder) level where the principle applies that all regions have to be treated similar. It is not possible for them to implement exemplary targeted strategies because they do not manage the funds and they do not have the authority to develop new schemes that have not been approved by the Ministry. However, the managing authority receives some funding through the Management Agreement Scheme because this scheme is mainly dedicated to protected areas, and through cooperation in research projects such as "Regionen aktiv"[10].

At the local level no relevant decisions concerning agricultural soil conservation policies are taken. Local authorities do not have the possibility to pass laws that concern soil conservation[11].

There are some regulations such as local development plans that are decided on at the local level which certain topics related to soil conservation, e.g. the construction of wind energy parks on agricultural sites. However, these plans are of minor importance because they do not focus on soil conservation.

As Thießen et al. (2006) point out in their study on the involvement of organisations in the policy design process of agri-environmental schemes, the contact between lobbying organisations and the Ministry follows the standard statutory consultation process. In the policy design process of agri-environmental schemes the organisations have the opportunity to contribute with written comments, but often they do not see their suggestions included in the final acts (Thießen et al., 2006). Another problem for environmental protection and nature conservation organisations is the fact that the main focus of the MLUV is on agriculture rather than on environment, a fact that does not contribute to the better inclusion of the respective organisations (Thießen et al., 2006).

[10] Central questions of this programme that lasted from 2006 to 2007 were how can the added value in rural areas be enhanced? What are promising approaches for the cooperation between agriculture and nature protection? How can a high efficiency rural development be ensured? Available at: http://www.nova-institut.de/modellregionen/text.php?fid=100&mexp=1&click=200&PHPSESSID= e9dcf68f1df3640386b9da12d67f80fd, consulted 28/05/08

[11] For example a regulation to protect the *black earth soils (Tschernosem)* in the case study region could not be designed, because the local authorities lacked the authority to pass a law concerning the protection of the black earth soil in the region. A Brandenburg Soil Conservation Act could have been such a parent act, but it has never been designed.

In addition to the above mentioned the following stakeholders are included in the design of agri-environmental schemes: agricultural cooperatives, the German Association of Towns and Municipalities and Hunting Groups. Since they are not directly concerned with soil conservation they were not interviewed.

One of the most influential non-governmental actors at the national level is the State Farmers' Union that has a more conservative view when it comes to setting up new regulations: Just recently they stood up against the European Soil Framework Directive that would include among other things the formulation of measures to reduce soil degradation risks (Brandenburger Bauernzeitung, 14/2008). At the national level the Farmers Union complained about the new specifications on soil erosion regarding the Direct Payment Obligations Act: The new specifications would be an undifferentiated and unjustified intervention into the farming practises and only the farmer knew from his experience if soil erosion is a problem on his site, a fact that the land register that is based exclusively on potential risks would not take into account (Deutscher Bauernverband, 2008).

Policy implementation

The interaction between administrative actors that are responsible for the implementation of the soil policy measures has been described as quite good, the actors know each other well and a good exchange of knowledge is given, maybe as a result of the fact, that the community that is concerned with the implementation of the policy measures is relatively small. Also the communication between scientific organisations such as the local Universities and Research Centres has been described as good. Research is especially needed as a resource by the Environment Agency (LUA) and the Agriculture Agency (LVLF). A number of interviewees criticised the focus of the research: research should be more practically oriented and it needs to start working on solutions for the upcoming problems such as the impact of climate change on farming practices. For policy implementation LUA and LVLF use the knowledge residing in research centres and universities.

One interview partner clearly saw the existing need of State Agencies for specialised staff with expertise in soil, which is likely to become an even more serious problem in the future. Especially when it comes to soils the responsible officers could not just be moved from one position to another. He emphasised that soils also need to play a bigger role in State laboratories. Regarding policy implementation the interviewee stressed that much more staff is needed in order to better implement and monitor the respective policy measures; the current employees are not able to bear more workload than they already do.

In order to distribute information on policy measure LVLF organises activities such as Soil Days (Bodentage). Soil days take place once a year. It is a platform where farmers, scientists, extensionists and representatives from relevant authorities meet and have the chance to learn more about innovations and new practices for soil conservation. A similar instrument is the Manure Day (Düngetag) that is organised by a private advisory body named AgroPlant. Like the Bodentag it provides a platform for actors from different disciplines to come together, exchange ideas and learn more about technical and scientific innovations.

For policy implementation at local level, local authorities use the knowledge from LUA and LVLF and other scientific organisations they are in contact with. Because in the case study area Uckermark the relevant departments of agriculture, nature conservation and soil are "under one roof" of the local Authority for Agriculture and Environmental Protection, the stakeholders perceive the communication between the departments as quite effective.

For the midterm review of Brandenburg's agri-environmental schemes for the period from 2000 to 2006 Matzdorf et al. (2003:14) analysed the implementation process for the agri-environmental scheme in Brandenburg: Farmers applications for the programmes are sent from the local Agriculture Authority to LVLF (Agriculture Agency) that calculates the budget that is needed. On the basis of the calculation the ministry (formerly MLUR, Department 22) decides on the application and communicates the approval to the local Agriculture Authority.

The appointed paying office of the Local Agriculture Authority transfers the payments to the farmer.

Hurrelmann et al. (2005) describe the control process of the agri-environmental schemes: “Administrative controls are applied to 100 % of the applicants. They comprise the control of the stated parcels, as well as of further requirements for receiving payments on the basis of information in the application. On-site-controls that check whether the applicants behave in accordance with the demands of the measures and adhere to the standards of ‘good agricultural practice’ are done for at least 5 % of applicants”.

The local Authority for Agriculture and Environment, Nature Protection Stations, State Environment Agency (LUA) and the Administration of Large Protected Areas are responsible for the design of Management Agreement Scheme (Hurrelmann et al. 2005f[12]). This is the only agricultural soil conservation policy measure where the local authorities have direct influence on the design.

In the case of Cross Compliance the both regional and local authorities are responsible for the control and the final sanctions, each undertaking separate stages of the process: The Technical Control Authority (affiliated with LVLF, the Agricultural Agency) is responsible for the control of the farming practices, while the paying office of the Local Agricultural Authority is responsible for sanctions if regulations have not been followed. Several stakeholders said that the authorities work together quite well but they lack the capacity and financial resources for a more efficient implementation and control of compliance of the policy measures.

Advisory services[13] are an important actor in policy implementation as they "translate" the regulations to the farmer. The interviewed advisor sees his position as very important because “the people above” [referring to the Ministry] do not know what the farmers really need, and the farmers do not understand the complex regulations. He sees himself as translator between the two levels. Several stakeholders believe that the knowledge of the extensionists needs to improve a lot, as they need more knowledge about ecological interrelations. According to Beste (2007a:1) the agricultural training and advisory capacities are not used to the necessary extent, because often agricultural training and extension does not sufficiently communicate technical measures that protect soils. Another interviewee claimed that there is a need for advisory service based because several farmers even ask for a nature conservation plan.

The implementation process of policy measures is considered as quite sufficient by several of the interviewed administrative actors. That might be the result of the clear structure of responsibilities. On the one hand, it is a widely held opinion that the control process is not sufficient, because the local level administrations lack the capacities and financial resources. On the other hand, organic farmers are confronted with a double control – they have to undergo the organic farming control on top of the cross compliance controls. In this case one stakeholder suggested integrating the results of the organic controls into the cross compliance controls.

6.3 Conclusions

At the national level more stakeholders are involved in the policy design process compared with the Länder level. That is true for the participation of non-governmental actors as well as for scientists and representatives of the administrative level.

[12] In this reference Management Agreements are referred to as Contractual Nature Conservation.
[13] In Brandenburg farm extension is privately organised. This is important to note as in many other states such as Bavaria agricultural extension is organised by the state, or agricultural chambers and advisory rings are responsible for the farm extension. The fact that Brandenburg has a privately organised extension service has consequences for the information distribution on soil conservation and as a result for the application of soil conserving technical measures.

The group of stakeholders involved in the policy design at the Länder level is limited and for most stakeholders aspects of soil conversation are more of a by-product. Most of the regulations come from the European level and have to be implemented into national law. This makes the EU the most important actor in the area of policy design. Nevertheless, national legislation allows some space for regional adaption regarding agri-environmental schemes, the Scheme for Nature Conservation Management Agreements or the Brandenburg Nature Conservation Act. Brandenburg did not make use of the possibility to pass its own state legislation under the German Federal Soil Protection Act. At the local level the instruments of implementing regulations are quite limited given the fact that there is no Brandenburg Soil Protection Act which could provide the basis for further legislation at the local level.

Many local nature conservation and environmental protection groups do not have agricultural soil conservation as an explicit goal. For some local environmental protection organisations, soil conservation is something that is a by-product of their actions against other environmentally harmful objectives. In other cases environmental groups may report to local authorities if farmers remove hedges, to let the local authorities take care of the issue. But still these are relatively minor activities. Other non-governmental actors that are concerned with nature conservation or environmental protection at the local level focus on issues other than soil conservation. Even the soil associations are more concerned with non-agricultural soils because problems there are perceived to be of greater priority. The only important group in this arena is the farmers associations. However, they neither promote the design of new soil conservation policy measures nor do they actively encourage the extended implementation (i.e. stricter enforcement) of already existing policy measures.

The Upper and Lower State Authorities do not have enough impact on policy design regarding mandatory policy measures to actually integrate their local knowledge and on-site experiences. These authorities are allowed to comment on policy drafts, but the actual influence is rather limited. Concerning the design of incentive-based measures the authorities have more influence.

Soil conservation is not a prominent policy even though it is seen as a serious problem in the case study area and all stakeholders are aware of it.

Regarding policy implementation the civil society and non-governmental groups do not play a role. The whole implementation process is in the hands of local and regional administrations. The only additional actor that is active in this process is advisory bodies.

Depending on the policy measure the implementation is carried out by the Upper State Authorities or the Lower State Authorities. Nevertheless both actors work together in the sense that the local authority receives instructions and information from the Upper State Authorities as well as from the Ministry (although this is less often the case). Administrative interviewees emphasised that for all levels more staff with expertise is needed to better implement and control the respective policies.

7 Policies for soil conservation

7.1 Existing policies and their classification

Soil conservation objectives for Germany are defined in the Federal Soil Protection Act (Bundesbodenschutzgesetz – BBodSchG, 1998). They relate to the protection and restoration of the soil on a permanent sustainable basis. Related actions include a) prevention of harmful soil changes, b) rehabilitation of the soil, c) rehabilitation of contaminated sites and of waters contaminated by such sites, and d) precautions against negative soil impacts. With respect to agricultural soil use, the Act requires farmers to comply with the principles of good agricultural practice contained in the Act. The Federal Soil Protection Act (BBodSchG) is legislated by the Federal Parliament as a national framework law. The Act supplements other sectoral legislation that does not explicitly cover impacts on soil.

Furthermore, the Federal Soil Protection and Contaminated Sites Ordinance (Bundes-Bodenschutz- und Altlastverordnung – BBodSchV, 1999) refers in Article 8 to preventing the risk of adverse soil alterations resulting from soil erosion by water.

The German National Strategy for Rural Development includes one soil related aim referring to the “prevention or decrease of unwanted deposition in soils and prevention or decrease of soil degradation by means of appropriate management activities” (BMVEL, 2006). In Brandenburg, the Ministry for Rural Development, Environment and Consumer Protection (MLUV) is responsible for the design of Agri-Environment Measures as part of the Brandenburg RDP. De facto, administrative implementation is organised by the Brandenburg State Authority for Consumer Protection, Agriculture and Land Consolidation (LVLF) and, in particular, by the agricultural offices at district level. The RDP Brandenburg/Berlin for 2007-2013 contains general objectives to preserve soil quality. In particular, compensation payments linked to Natura 2000 sites and the Water Framework Directive are expected to contribute indirectly to climate and soil protection objectives (MLUV, 2007). Agri-environment measures are another relevant element of the RDP. The RDP 2007-2013 does not contain any AES that directly addresses soil erosion and compaction. District administrations are insufficiently involved in the design process (Eggers, 2005).

Cross compliance rules for soil protection (BMJ, 2004) apply in Brandenburg (as well as in all other federal states) which have direct and indirect effects on soil conservation. Cross compliance rules with a direct effect are:

1) Soil erosion reduction (§2): no ploughing on 40 % of arable land after harvest until February, 15th, unless a new crop is sown before December 1st and

2) Conservation of soil organic matter (§3): the cropping system of each farm has to include a minimum number of three crops, each covering at least 15 % of the farm land.

Cross compliance rules with an indirect effect include preservation of natural landscape structures (§5): e.g., it is forbidden to cut hedges and tree rows.

In case of the Federal Soil Protection Act (BBodSchG), federal states are responsible for the implementation and enforcement. Unlike several other German federal states, Brandenburg has no law on soil protection to implement the Federal Soil Protection Act.

In order to stop the effects of the trend towards greater intensification and higher productivity in agriculture, which came with a significant increase in the use of inorganic nitrogen fertilisers, the EU Nitrate Directive was issued by the European Commission. It regulates the protection of water against pollution caused by nitrates from agricultural sources. Germany has a national regulation on pesticide and fertiliser use, which regulates the application of fertilizers, soil auxiliary materials, culture substrates and plant aids according to the principles of good agricultural practice (Düngeverordnung).

The Scheme for Nature Conservation Management Agreements (Vertragsnaturschutz) includes individual contracts between the Environmental Agency of Brandenburg (LUA) and individual farmers or private landscape protection associations (Landschaftspflegeverbände). Brandenburg's Nature Conservation Act (Brandenburgisches Naturschutzgesetz § 1b, section 4) prohibits conversion of grassland into arable land on slopes that are prone to erosion. Furthermore, there are specific mandatory regulations on agricultural land use in landscape and nature protection areas (Schutzgebietsverordnungen).

Official and publicly information concerning the effectiveness of the soil conservation policies are available. One is the mid-term review of the Brandenburg RDP 2000-2006, the evaluation of the implementation issues, where one indicator refers to measures preventing soil erosion by wind and water (Matzdorf et al., 2003).

Further, there are various indicators and information in the national 'Information System on Soil Protection' (Fachinformationssystem Bodenschutz, FISBOS) such as properties, functions and use of soil which is a part of the Agriculture and Environment Information System (Landwirtschafts- und Umweltinformationssystem, LUIS).

The local administrative bodies control the farmers taking part in agri-environmental programmes and sanction in cases, in which farmers do not comply with regulations (Matzdorf et al., 2003).

Most of the policy measures in the case study region can be classified as mandatory measures since addressees are subject to fines if non-compliance was discovered. Nonetheless, there are also some incentive-based measures as well as one moral suasion measure. A problem of classification occurred for the Direct Payment Obligations Act because "Technically, cross-compliance is a voluntary instrument, but as it represents a standard for receiving an existing subsidy, in practice it may not strictly be voluntary, particularly when the existing subsidy represents an important share of total farm income. It is difficult for a farmer to for go cross-compliance when the value of the existing subsidies exceeds the farmers' costs of adapting the mandated practices. In this circumstance, loss of these payments is dramatically different from foregoing an additional subsidy that is offered as compensation for adopting conservation practices" (Cooper, 2005).

Table 8: Classification of policy measures in Uckermark (Brandenburg, Germany)

Type of Policy Mechanism/ Mode of governance	Practical classification Nature of the Policy Objective			Policy relationship to agriculture	Geographical level	Analytical classification – Channels of Impact Primary (1) and Secondary (2) impacts. Y = Yes, N = No		
	Soil conservation is the **primary objective** of a policy measure	Soil conservation is the **secondary objective** of a policy measure	Soil conservation is a **by-product**	Agricultural (AG) or non Agricultural (NAG) focused policy	European (E), national (N), regional (R) or local (L) measure, and policy reference	Developing new/altering existing rules (institutions)	Developing and/or altering governance structures/ implementation approaches	Directly impacting on farmer behaviour/ decision making/ factor allocation and management practices
Mandatory policy measures			Restrictions and limitations on use of nitrates in certain areas and during certain time periods	AG	E EU-Nitrate Directive (91/676EEC), implemented into German national law by the Fertilisation Ordinance (Düngeverordnung)	Y Soil analysis; Altering existing rules (German Fertilisation Ordinance before EU Directive); setting up new rules: identification and implementation of restrictions	Y For the implementation of the regulation establishment of Manure Association	Y restrictions on use of fertiliser on certain sites and during different time periods
			Integrated water policy at the European level to increase water quality (all waters in sound condition by 2015)	NAG	E - EU-Water Framework Directive (2000/60/EC), N – implemented through Water Resources Act (Wasserhaushaltsgesetz) and R – through Brandenburg Water Management Act (Brandenburgisches Wassergesetz) and Brandenburg Waters Classifications Act (Brandenburgische Gewässereinstufungsverordnung)	Y Development of Europe-wide standards and criteria	Y Development of governance structures to achieve the objectives outlined in the regulation	Y Reduction of nutrient supply on ground and surface waters
	Securing sustainable soil functions and re-establishing soil functions			NAG	N German Federal Soil Protection Act (Bundesbodenschutzgesetz)	Y Setting up new rules for soil conservation mainly for polluted areas	N	Y Requirements for good farming practices

Type of Policy Mechanism/ Mode of governance	**Practical classification Nature of the Policy Objective**			**Policy relationship to agriculture**	**Geographical level**	**Analytical classification – Channels of Impact** Primary (1) and Secondary (2) impacts. Y = Yes, N = No		
	Soil conservation is the **primary objective** of a policy measure	Soil conservation is the **secondary objective** of a policy measure	Soil conservation is a **by-product**	Agricultural (AG) or non Agricultural (NAG) focused policy	European (E), national (N), regional (R) or local (L) measure, and policy reference	Developing new/altering existing rules (institutions)	Developing and/or altering governance structures/ implementation approaches	Directly impacting on farmer behaviour/ decision making/ factor allocation and management practices
			Establishment of an European network of reserves to contribute to the diversity of species	NAG	E - NATURA 2000 combines the Conservation of Wild Birds Directive (Vogelschutzrichtlinie) and the Flora-Fauna-Habitat Directive, FFH (Fauna-Flora-Habitate-Richtlinie)	Y	Y development of new governance structures to support the implementation and control of the Directive	Y payments for conducting certain actions
			Protection of ecosystems, natural assets, natural habitats of plants and animals and the diversity of nature	NAG	R Brandenburg Nature Conservation Act (Brandenburgisches Naturschutzgesetz)	Y Setting up new rules to require identification and implementation of areas with specific status	Y Development of governance structures to support the implementation and control of the measure	Y bans on the arable use of certain sites, e.g. fens
			Preventing hazards for human beings, animals and the ecosystem caused by the application of plant protection products	AG	E Plant Protection Products Directive (91/414/EEC) N - national implementation though Pflanzenschutzmittelverordnung (Plant Protection Products Directive)	Y Setting up new rules to require identification and implementation of the measure	Y Development of governance structures to support the implementation and control of the measure	Y restrictions on the use of certain plant protection products
		Control and restriction of sewage sludge application on agricultural and horticultural sites		AG	E 86/278/EEC Sewage Sludge Directive, implemented into national law by the Sewage Sludge Directive (Klärschlammverordnung)	Y Setting up to new rules, e.g. soil analysis or restrictions on the application of sewage sludge on certain sites	Y development of governance structures to support the implementation of the Sewage Sludge Directive	Y bans on the use of sewage sludge on certain sites

Type of Policy Mechanism/ Mode of governance	Practical classification Nature of the Policy Objective			Policy relationship to agriculture	Geographical level	Analytical classification – Channels of Impact Primary (1) and Secondary (2) impacts. Y = Yes, N = No		
	Soil conservation is the **primary objective** of a policy measure	Soil conservation is the **secondary objective** of a policy measure	Soil conservation is a **by-product**	Agricultural (AG) or non Agricultural (NAG) focused policy	European (E), national (N), regional (R) or local (L) measure, and policy reference	Developing new/altering existing rules (institutions)	Developing and/or altering governance structures/ implementation approaches	Directly impacting on farmer behaviour/ decision making/ factor allocation and management practices
			Direct payments linked to compliance with environmental standards, animal welfare, food and animal feed security	AG	E- Direct Payment Obligations Act 1782/2003 implemented into national law by the Direct Payment Obligations Act (Direktzahlungen-Verpflichtungengesetz)	Y Setting up new rules like the linkage between several other regulations such as the Nitrate Directive and the direct payments	Y Development of new governance structures such as the Technical Control Authority to support the implementation of the measure	Y Compliance with the standards outlaid in the regulation
Incentive based measures/economic instruments		E.g. encouraging grassland extensification or organic agriculture		NAG	E Agri-environmental scheme, R – Brandenburg State Cultural Landscape Programme (Kulturlandschaftsprogramm, KULAP)	Y Setting up new rules for funding (e.g. co-financing by EU and Länder)	Y development of new governance structures to support the design, implementation and control of the scheme	Y payments for conducting certain actions
			Management of sites with conservation value	NAG	R Scheme for Nature Conservation Management Agreements (Vertragsnaturschutz)	Y Setting up individual contracts between farmer and administration	Y development of new government structures to design and implement the measure	Y farmer has to comply with the contract requirements
Moral Suasion Initiatives ie it has a normative dimension that farmers should protect soils			Instrument for the development, trial and implementation of measures for sustainable use of natural resources	NAG	L Biosphere Reserve Schorfheide Chorin (Biosphärenreservat Schorfheide-Chorin), based on world-wide network	Y Development of new rules for an innovative network	Y Development of new governance structures to implement the programme, development of new networks	Y Impacting on management practices and decision making because of an increase in knowledge

Type of Policy Mechanism/ Mode of governance	Practical classification Nature of the Policy Objective			Policy relationship to agriculture	Geographical level	Analytical classification – Channels of Impact Primary (1) and Secondary (2) impacts. Y = Yes, N = No		
	Soil conservation is the **primary objective** of a policy measure	Soil conservation is the **secondary objective** of a policy measure	Soil conservation is a **by-product**	Agricultural (AG) or non Agricultural (NAG) focused policy	European (E), national (N), regional (R) or local (L) measure, and policy reference	Developing new/altering existing rules (institutions)	Developing and/or altering governance structures/ implementation approaches	Directly impacting on farmer behaviour/ decision making/ factor allocation and management practices
Information and capacity building measures								

7.2 Description, analysis, and evaluation of policy measures

Reasons for choosing the examples in the policy fiches:

German Federal Soil Protection Act: It is the predominant law influencing soil conservation because it is the only legislation that directly addresses soil conservation. Most administrative and civil society actors referred to this law, however only one paragraph explicitly addresses agricultural soil conservation. Of all regulatory legislation, the German Federal Soil Protection Act, the Direct Payment Obligations Act and the Fertilisation Ordinance are the legislation that farmers are most aware of (and know most about). Moreover other interviewees referred to this regulation rather often. The German Federal Soil Protection Act also has the potential to better address soil problems if the potential was used i) at the national level to better define the Code of Good Agricultural Practice and ii) at the regional level to establish a Soil Protection Act.

The **Fertilisation Ordinance** has been mentioned often by the stakeholders and seems to be quite effective because it is linked to the Direct Payment Obligations Act. This implies that who does not comply with the rules of the Fertilisation Ordinance will have his payments reduced. Farmers are familiar with the regulation and it is the only regulation where a "real" monitoring concerning soil conservation takes place.

The **Direct Payment Obligations Act** includes some soil conservation aspects and its importance will increase from 2009 onward when soil erosion and obligations for keeping the soil in good conditions will be better defined. The fact that compliance with other policies (Fertilisation Ordinance, EU-Water Framework Directive) is linked to the Direct Payment Obligations Act makes the regulation even more effective to contribute to soil conservation. Another reason for choosing this policy is the high impact on farmers because they depend on the direct payments without which most farms would not be viable.

Some measures of the **Agri-environmental scheme** have soil conservation as a by-product. It is the only policy measure that has the potential to be better targeted to regional or even local problems. It has also been more soil conservation oriented in the past. Many stakeholders said that the scheme has a high potential to contribute to soil conservation given that more funds are made available.

7.2.1 Fiche 1: German Federal Soil Protection Act (Bundesbodenschutzgesetz)

Part A: Summary of Measure	
Formal title of measure and date of implementation	German Federal Soil Protection Act (Gesetz zum Schutz vor schädlichen Bodenveränderungen und zur Sanierung von Altlasten - Bundesbodenschutzgesetz; 25/03/1998
Short description of the measure	The reason for designing the German Federal Soil Protection Act was the fact that a concept was needed to target the soil problems caused by closed dumpsites and industrial plants (Lee, 2006). The regulation focuses mainly on non-agricultural soils, but it has agriculture included in §17, where the Code of Good Agricultural Practice is defined. It mainly targets soil degradation and polluted areas. The regulation can also act as parent act for Länder Soil Protection Acts. It is not very comprehensive and contains only the basic issues.

Type of policy measure	The German Federal Soil Protection Act applies across Germany. The main objective is not agricultural soil protection but soil issues in general. Nevertheless it defines some issues for the Code of Good Agricultural Practice[14]. It is a mandatory measure as non-compliance will result in sanctions such as imposed conditions or fines.
Objective of policy measure and relevance	The main objective of the measure is to secure sustainable soil functions and to re-establish soil functions where they have been destructed. The main objectives of this measure for agriculture are the protection of soils from water and wind erosion as well as to conserve the soil structure. The actors that affect soils are obliged to minimise risks and to carry out prevention measures (Sächsische Landesanstalt für Landwirtschaft, 2004).
	How relevant are the objectives of the measure to the soil degradation threats in your region?
	☐ X ☐ ☐ ☐ Not very Very
Indirect effects	None.
Linkages to other policy measures	There is a linkage to the Federal Soil Protection and Contamination Ordinance that is an 'implementing regulation' of the German Federal Soil Protection Act. There are linkages to Länder Soil Protection Acts in cases where Länder acts have been passed.
Funding	There is no funding for the legislation; it is a mandatory measure where sanctions are enforced in case of non-compliance.
Summary of assessment and conclusions	The aims and objectives for agricultural soils as well as the Code of Good Agricultural Practice are not defined in sufficient detail. This is also a problem for the control of the measure. The regulation is not integrated in the Direct Payment Obligations Act.
Recommendation	The law has been implemented at the Länder level in Brandenburg, but it has not been used as a parent act for a Brandenburg Soil Protection Act. To be more efficient a better definition of the Code of Good Agricultural Practice is needed. For a better effectiveness of the measure more emphasis should be placed on precautionary instruments. It would also be helpful to formulate objectives that have to be reached within a certain time period as is the case in the Water Framework Directive.
Part B: Detail on the Measures Design, Implementation, Enforcement and Impacts	
Policy design	The policy has been designed at the national level. Several actors such as experts committees and other working groups were included. Each state has the opportunity to pass its own law based on the federal Soil Protection Act. In Brandenburg no such law has been passed yet. One stakeholder claimed that the reason is that the Brandenburg government does not want to go further than the law already does.

[14] The Code of Good Agricultural Practice has been developed by an expert group of "scientists, members of agricultural and environmental bodies, farmers, extension services and others" in the publication "Vorsorge gegen Bodenerosion im Bodenschutzrecht" (Frielinghaus et. al. 2001).

	Another stakeholder believes that the timing for a Länder law had been bad, because the discussion about the design of the Brandenburg regulation co-incided with a period when the actors feared an over-regulation.
Policy implementation I: Implementation at administrative level	The respective department of the MLUV is responsible for the implementation at the Länder level. They can consult the Environment Agency, Agriculture Agency as well as the Local Agriculture Authorities (Figure 5).
Policy implementation II: Method of delivery to farmers	Mainly the Local Agriculture Authority is responsible for the implementation at the local level (i.e. contact for farmer questions). In addition, they may ask for an expert assessment from the LVLF (in the case of §17 where agricultural sites are concerned). Another way to transfer the regulation to the farmer are advisory bodies: „The agricultural extension service instructs farmers about the principles of Good Agricultural Practice“ (Riksen et al., 2003)
Targeting	None at the moment. Brandenburg can pass a legislation that would enhance further legislation on the local level. This would make the regulation more flexible to adapt to local conditions.
	To what extent does the implementing body have flexibility in the targeting of the policy measure so that it is adapted to local conditions?
	☐ ☐ X ☐ ☐ ☐ Low High
What Drives Uptake?	The regulation allows authorities to impose monetary fines or specific conditions if farmers do not comply with the rules laid out in §17.
	X ☐ ☐ ☐ ☐ Obligation Financial incentive Information & support Exhortation Other
Technical measures	The regulation does not include concrete technical measures in the sense of farming practices. It has more general objectives such as site-specific cultivation.
Enforcement and control	The presumption of innocence applies. There is no control of the measure except when non-compliance has been discovered in some cases. This should be handled by the Local Agriculture Authority.
Monitoring and evaluation	No monitoring or evaluation instruments of the measure have been found, presumably because the regulation is relatively recent and – as one stakeholder said – laws are rarely monitored and evaluated. They are amended or specified when gaps have been found.
Outcomes of policy measure	It is hard to say what the outcome of the measure is because it has not been evaluated yet. But it can be said that farmers are aware of the regulation and try to comply with it.
Analysis of drivers of policy measures' outcomes	The problem with the §17 is that is has not been sufficiently defined yet and therefore it is difficult to monitor. Farmers are aware of the measure and try to comply in order to avoid the sanctions that result from non-compliance.

Part C – Evaluation of the Policy Measure	
Effectiveness of policy measure (in relation to the extent to which objectives are achieved, and cost-effectiveness)	There would be some flexibility if the regional government would use the national framework to establish a State Soil Conservation Act, but this possibility has not been made use of. The federal Law does not cover special soil problems such as moor conservation.
Constraints to achieving full potential of the policy measure	The fact that there is no concrete definition of the Code of Good Agricultural Practice is a constraint. Another constraint is that there is only one paragraph concerning agriculture. One interviewee said that the non-agricultural soil conservation is an even bigger problem than the agricultural soil conservation and therefore the law's main focus is not on agricultural soils. Another interviewee said that the regulation is very much based on agro-economic information and to a lesser extent on ecological information (more a 'product' of the agricultural division). The regulation competes with other regulations, i.e., it only applies if there are no other regulations that are applicable (UBA, 2006). One stakeholder identified this as the main problem of the regulation: It has been implemented relatively late compared to others regulations. As a result several soil conservation problems have already been covered by other regulations. Lee (2006) argues that the major and possibly most important part of the German soil conservation is regulated in regulations such as the Federal Building Code or the Federal Nature Conservation Act.
Reasons for the success of the policy measure (where appropriate)	Not applicable.

7.2.2 Fiche 2: Fertilisation Ordinance (Düngeverordnung)

Part A: Summary of Measure	
Formal title of measure and date of implementation	Fertilisation Ordinance, implementation of the EU Nitrate Directive 91/676/EEC (Verordnung über die Anwendung von Düngemitteln, Bodenhilfsstoffen, Kultursubstraten und Pflanzenhilfsmitteln nach den Grundsätzen der guten fachlichen Praxis beim Düngen); implemented 01/07/1996.
Short description of the measure	The measure was introduced in 1996. The reason for the introduction of the measure was the high nutrient pollution of ground and surface water. Therefore the measure targets the nutrient balance of agricultural soils. It is one of the important parts of the Direct Payment Obligations Act. The last time it has been amended was in 2007 following a request from the European Commission that the German implementation of the regulation does not fully comply with the EU-Nitrate Directive.

	The regulation has been called a legal compromise as it tries to react to several different interests concerning the regulation (Landesamt für Verbraucherschutz, Landwirtschaft und Flurneuordnung, 2007).
Type of policy measure	The Fertilisation Ordinance is a mandatory measure, it is mandatory for farmers to comply and a requirement if they want to receive direct payments. Soil conservation is only a by-product of the regulation. The measure addresses only agricultural sites. It impacts on farmers' behaviour by restricting the application of fertiliser.
Objective of policy measure and relevance	The objective is to reduce water pollution caused by agricultural sources. It is an environmental focused measure where soil conservation is a by-product.
	How relevant are the objectives of the measure to the soil degradation threats in your region?
	☐ ☐ X ☐ ☐ Not very Very
Indirect effects	Farmers that have highly productive soils face economic losses because of the limitation of fertiliser application.
Linkages to other policy measures	It is linked to the Direct Payment Obligations Act: In cases where the regulation is neglected payments can be reduced by a certain percentage. It is also one of the important measures of the Water Framework Directive (Osterburg et al., 2007).
Funding	There is no funding for the measure.
Summary of assessment and conclusions	The measure has been in place for more than ten years and its importance increased when it was linked to the Direct Payment Obligation Act. It is one of the best known measures among farmers. Its main objective does not sufficiently target the soil problems in the case study area such as wind and water erosion, but still it is an important measure to obtain statistical information about the soil condition in the case study area.
Recommendation	None.
Part B: Detail on the Measures Design, Implementation, Enforcement and Impacts	
Policy design	The policy has been designed at the European level, implemented at the national level and later at the Länder level. At the national level stakeholder workshops have been organised where scientists presented research results concerning the topic. Additionally several different organisations were consulted. However, at the end several proposals have not been taken into account by the decision making bodies.
Policy implementation I: Implementation at administrative level	The respective department of the MLUV is responsible for the legal implementation in Brandenburg state. They can consult the Agriculture Agency as well as the Local Agriculture Authorities (Figure 5) which are responsible for the practical implementation.

Policy implementtation II: Method of delivery to farmers	Advisory bodies help farmers to implement the measures. An important actor is the Düngeverein (Manure Association) organising yearly Manure Days where farmer can exchange information with experts and representatives. The farmers' unions are also important partner for distributing information. Both, local Agriculture Authority and Upper State Authorities can be contacted if questions arise concerning the practical implementation of the measure. In addition, MLUV offers a broad range of information in brochures and on its website. Guidelines have been developed by the Brandenburg authorities together with the authorities of Sachsen-Anhalt and Mecklenburg-Vorpommern as accompanying measures. Farmers have to comply with the guidelines in order to receive direct payments.
Targeting	The measure targets all agricultural sites across Germany. Exceptions from the regulation can be made regarding the limit for the amount of organic fertiliser.
	To what extent does the implementing body have flexibility in the targeting of the policy measure so that it is adapted to local conditions?
	☐ X ☐ ☐ ☐ Low High
What Drives Uptake?	The link to the Fertilisation Ordinance and the Direct Payment Obligations Act enforces the compliance with the measure.
	X ☐ ☐ ☐ ☐ Obligation Financial incentive Information & support Exhortation Other
Technical measures	Technical measures are • the limitation of 170 kg N/ha for organic fertiliser • obligation for the incubation of organic fertiliser within a certain time frame • soil analysis every six years • restrictions for the application of fertiliser with an considerable nitrogen and phosphorus on frozen, water saturated, flooded sites • ban on the application of fertiliser with an considerable nitrogen content between 1 November and 31 January • nutrient analysis for nitrogen and phosphorus every year • documentation of several data concerning nutrient application
Enforcement and control	The control is carried out by the Technical Control Authority (affiliated with the Agriculture Agency, LVLF) under prescribed technical guidelines ("Fachrechtskontrolle").
Monitoring and evaluation	The monitoring takes place through the nutrient analysis that farmers have to conduct every year. It is one of the few procedures that provide the administrations with regular information about soil conditions in the region even though the nutrient analysis is not a complete overview of the soil conditions. At national level there is no further regular evaluation.
Outcomes of policy measure	As the measure is linked with the Direct Payment Obligations Act the farmers comply with the rules, i.e. they reduce fertiliser application.

Analysis of drivers of policy measures' outcomes	The link between the Fertilisation Ordinance and the Direct Payment Obligations Act enforces the compliance with the measure.
Part C – Evaluation of the Policy Measure	
Effectiveness of policy measure (in relation to the extent to which objectives are achieved, and cost-effectiveness)	The main objective of the regulation - the reduction of ground and surface water pollution - has been achieved by the measure. The effectiveness of the policy measure is high since the measure is linked with the Direct Payment Obligations Act and therefore farmers comply with the regulation. In administrative terms, the implementation of the measure is quite cost-effective compared to other measures such as agri-environmental schemes.
Constraints to achieving full potential of the policy measure	It took quite a while and several requests by the European Commission before Germany fully implemented the measure into national law. One of the reasons was the disagreement between Germany and the Commission on the upper limit of fertiliser application.
Reasons for the success of the policy measure (where appropriate)	Most of the farmers depend on the direct payments; therefore they have to comply with the rules of the Fertilisation Ordinance.

7.2.3 Fiche 3: Direct Payment Obligations Act (Direktzahlungen-Verpflichtungengesetz)

Part A: Summary of Measure	
Formal title of measure and date of implementation	Direct Payment Obligations Act (Direktzahlungen-Verpflichtungengesetz), Commission Regulation 1782/2003; 01/01/2005.
Short description of the measure	For the eligibility for direct payments in the CAP framework farmers have to comply with certain rules outlined in this regulation. It contains standards for environmental protection, animal welfare, food and animal feed security. The measure responds to soil erosion and the organic substance of agricultural soils. The regulation has been implemented in 2005 and since than it has been expanded every year by new requirements.
Type of policy measure	The measure is a regulatory policy measure, because if farmers do not comply with the rules they have to pay back a certain percentage of their direct payments. The main aim of the measure is to combine the direct payments with the compliance of certain standards.

Objective of policy measure and relevance	The objective is to enhance the environmentally friendly production by integrating environmental protection, animal welfare, and food and animal feed security into the CAP. Soil conservation has been a by-product of the regulation, still it contains some soil conservation measures e.g.: • Prevention of erosion • Preservation of organic material and protection of soil structure • Maintenance of sites (for example grassland) • Preservation of landscape elements (such as hedges and wetlands)
	How relevant are the objectives of the measure to the soil degradation threats in your region?
	☐ ☐ X ☐ ☐ Not very Very
Indirect effects	None.
Linkages to other policy measures	The measure is funded by the EU in the framework of the Common Agricultural Policy
Funding	The regulation is linked to many other regulations. Its special importance results from the fact that the direct payments are reduced if farmers do not comply with one of the regulations.
Summary of assessment and conclusions	The regulation is one of the most effective for soil conservation and from 2009 on its importance is likely to increase. It is important that it also takes into account regional differences.
Recommendation	Regional differences should be considered. For example, in the Brandenburg the moors are not targeted by the regulation but they should be taken into account as well.
Part B: Detail on the Measures Design, Implementation, Enforcement and Impacts	
Policy design	The policy is designed by the European Commission and has to be passed by the European Parliament and the Council of the European Union. Several non-governmental organisations such as the farmers' unions, nature conservation and environmental protection groups as well as several industrial branches try to influence the legislative process.
Policy implementation I: Implementation at administrative level	The EU member states are responsible for the implementation of the measure. There is some space for flexibility in the implementation process at the national level. The MLUV is responsible for implementation at Länder level. They can consult the Agriculture Agency, the Environment Agency and the Local Agriculture Authorities (Figure 5). In the course of the implementation of this regulation a new authority has been established, the Technical Control Authority affiliated with the Agriculture Agency (LVLF).

Policy implementation II: Method of delivery to farmers	The policy is delivered to the farmer by LVLF, the local authorities and advisory bodies. If farms exceed a certain size farmers have to consult an advisory body. Several organisations offer trainings and workshops for farmers to raise awareness and understanding of the regulation and to enable farmers to fill out the application forms.
Targeting	There are only a few possibilities for regional exceptions.
	☐ ☐ X ☐ ☐ Low High
What Drives Uptake?	Farmers do not want to lose their direct payments and thus comply with the rules outlined in the regulation.
	X ☐ ☐ ☐ ☐ Obligation Financial incentive Information & support Exhortation Other
Technical measures	For soil conservation the measure regulates that between the harvest of the preceding crop and before the 15th February 40 % of the site must not be ploughed (exceptions may be made by the Länder and also exceptions due to the weather conditions are possible). Another requirement is crop rotation of at least three crops (alternatively top soil balance). For the case study area the technical measures make sense because of the soil erosion problem. From 2009 onwards sites have to be registered according to their degradation status and for sites that are highly endangered by degradation special rules apply.
Enforcement and control	The compliance with the regulation is controlled jointly by the Local Agriculture Authority and the Technical Control Authority. The farms that have to be controlled every year are determined by the European Commission in Brussels. Farms are chosen according to a special key (depending on the size of the farm and other special factors) and have to be controlled by the local authorities. Another kind of control takes place by civil society actors that can be individuals as well as organisations who report certain actions of farmers (e.g. removal of hedges) that do not comply with the regulations.
Monitoring and evaluation	The European Commission monitors the implementation of the regulations in the member states. The result is the Health Check of the CAP with a legislative proposal for several adjustments[15].
Outcomes of policy measure	The combination of the direct payments with the compliance of certain environmental standards results in a change of farmers' behaviour as they make efforts to comply. The control of the measure seems to be quite sufficient. Nevertheless the bureaucratic burden for the farmer is considerable.
Analysis of drivers of policy measures' outcomes	The driver of the policy measure is the combination of the direct payments with the compliance of the rules.

[15] Details on the Commissions proposal can be accessed through http://ec.europa.eu/agriculture/ healthcheck/index_en.htm, consulted 03/06/2008.

Part C – Evaluation of the Policy Measure	
Effectiveness of policy measure	The farmers comply with the rules because if they do not, they have to pay back a percentage of the payments they received.
(in relation to the extent to which objectives are achieved, and cost-effectiveness)	Until 2008 the impact on soil degradation has been limited due to the imprecise definition of the good farming practice. From 2009 on the good farming practice includes measures for soil conservation practices which make it easier to achieve certain standards. This will make the policy measure more effective.
Constraints to achieving full potential of the policy measure	The reason that contributes to the success of the measure – that is the tight regulation - has not only a positive but also a negative effect: For example the fact that farmer try to maintain the size of their plots, and that results in nature damaging acts such as removal of hedges or ploughing tracks adjacent to fields.
Reasons for the success of the policy measure (where appropriate)	Most of the farmers depend on the payments they receive, therefore they have to comply with the rules.

7.2.4 Fiche 4: Agri-environmental scheme (Kulturlandschaftsprogramm, KULAP)

Part A: Summary of Measure	
Formal title of measure and date of implementation	Agri-environmental schemes (AES) in the framework of the Rural Development Plan according to regulation 1698/2005/EC (Kulturlandschaftsprogramm, KULAP im Rahmen des “Plan für die Entwicklung des Ländlichen Raums”, 01/01/2007
Short description of the measure	AES offer financial compensation to farmers that are willing to go beyond the Code of Good Agricultural Practice. Several measures that should contribute to the rural development in Brandenburg by enhancing environmentally friendly cultivation and maintenance of grassland, environmentally friendly agriculture and horticulture, and genetic diversity (Ministerium für Ländliche Entwicklung, Umwelt und Verbraucherschutz des Landes Brandenburg, 2007). The contract with the farmer lasts for five years. The measure exists since 1992 but has been expanded since then. The last programme period has just started in 2007.
Type of policy measure	It is an incentive-based measure.
Objective of policy measure and relevance	The measures should contribute to the protection and preservation of the rural habitat, landscape, natural resources, soil and genetic diversity (Ministerium für Ländliche Entwicklung, Umwelt und Verbraucherschutz des Landes Brandenburg, 2007).

	How relevant are the objectives of the measure to the soil degradation threats in your region?
	☐ ☐ ☐ X ☐ Not very Very
Indirect effects	None.
Linkages to other policy measures	The measure is linked to the Code of Good Agricultural Practice (for example in the Direct Payment Obligations Act) as it is the aim of the scheme to encourage the uptake of measures that go beyond the requirements of the Code of Good Agricultural Practice.
Funding	75 % of the scheme is financed by the European Union and 25 % by the State of Brandenburg. However, a share of the 25 % may also be co-financed by the Federal Government if the measure is eligible for funding under the German Joint Task for the Improvement of Agrarian Structures and Coastal Protection (Gemeinschaftsaufgabe "Verbesserung der Agrarstruktur und des Küstenschutzes", GAK).
Summary of assessment and conclusions	Brandenburg's KULAP contains some measures contributing to soil conservation such as grassland extensification measure addressing soil erosion problem. A particular KULAP measure that directly targets soil is not applicable in the case study area. Shortcomings are • the low compensation payments for some measures, i.e. some regions with highly productive soils the uptake of the scheme would not pay off; and • that two soil protection measures of the scheme (intercrops and undersown crops) were closed at the end of the last programming period, thus reducing the scheme's relevance for soil protection. Despite these shortcomings, AES have the potential to directly target regional problems because a lot of local actors are involved during the phase of developing the individual measures and AES are one of the few policy measures that is decided on at the regional level.
Recommendation	Environmental protection organisations recommend that the duration of the scheme should be prolonged to assure the success of the measure (Thießen et al., 2006:19). Suggestions from research institutes for new measures, e.g. "Internal Field Segregation" (Schlaginterne Segregation) should be taken into account. The scheme has to be adjusted to the current development of prices for agricultural products to ensure continuous uptake by the farmers. There needs to be more flexibility for the implementation when it comes to certain restrictions concerning timing because sometimes these restrictions are increase soil degradation.
Part B: Detail on the Measures Design, Implementation, Enforcement and Impacts	
Policy design	The prescriptions for individual measures of the agri-environmental scheme are designed by several departments of MLUV in cooperation with the farmers' unions, environmental protection and nature conservation groups, and the administrations in Brandenburg that are concerned with the implementation of the scheme. The design of the AES has been described as "a rather complex negotiation process" (Eggers et al., 2004).

	As some schemes are partly financed by the Federal State the Länder check availability of funding under the German Joint Task for the Improvement of Agrarian Structures and Coastal Protection (Gemeinschaftsaufgabe "Verbesserung der Agrarstruktur und des Küstenschutzes", GAK).
Policy implementation I: Implementation at administrative level	AES are implemented by LUA and the Local Agriculture Authorities. Applications are submitted together with the application for the direct payments at the Local Agriculture Authorities.
Policy implementation II: Method of delivery to farmers	The MLUV has several ways to distribute information about the scheme to farmers: notifying the farmers' unions that distribute the information among members, notifying advisory bodies, press releases, and brochures. Since the programme has existed since the 1990s it is well known by the farmers. They are able to obtain information from the Local Agriculture Authorities, LVLF, LUA and to a lesser extent from MLUV. Additionally they can obtain information from advisory bodies.
Targeting	The measure applies to all farms as well as forestry enterprises in Brandenburg.
	☐ ☐ ☐ X ☐ Low High
What Drives Uptake?	Financial incentives are the reasons why farmers take part in AES. It can be expected that some farmers would also apply measures without payments, therefore information probably plays a role as well as the knowledge that the measures are preventing soil degradation.
	☐ Obligation ☒ Financial incentive ☐ Information & support ☐ Exhortation ☐ Other
Technical measures	The technical measures depend on the respective scheme. One measure is grassland extensification where the application of manure and fertiliser is forbidden. Another measure restricts grassland use to a certain time (the exact dates vary). During the last programme periods technical measures such as intercrops and undersown crops were funded but these schemes are closed now. One measure that directly targets soil degradation is the greenbelt setting that applies for fruit and vegetable production and another one is the re-cultivation of former mining sites with legumes. However, these measure do not apply to the case study area.
Enforcement and control	The compliance with the measure is controlled by the Local Agriculture Authority. In critical cases the Environment Agency (LUA) is responsible if the measure has not been applied adequately. 5 % of the farmers are controlled by on-farm visits. The on-farm visits are conducted by the Technical Control Authority (affiliated with LVLF). Further controls are conducted directly by the European Commission.

Monitoring and evaluation	Different monitoring mechanisms are in place for AES: Ex-ante evaluation, midterm evaluation and ex-post evaluation. The last KULAP (2000-2006) has been evaluated by researchers from the Leibniz-Centre for Agricultural Landscape Research (ZALF) on behalf of MLUV. In the evaluation also non-governmental actors have been consulted in workshops. In addition, there was an evaluation at the European level including case studies.
Outcomes of policy measure	Matzdorf et al. (2003) found that 80 % of the AES budget is devoted to measures that aim at reducing the chemical supply and thus have a positive effect on soil, water, and to some extent on biodiversity.
Analysis of drivers of policy measures' outcomes	Reasons for enrolling in the scheme are financial incentives provided by the scheme to compensate for economic losses as well as moral persuasion to conserve soils and the environment. A contributing factor is farmers' high awareness of the scheme.
Part C – Evaluation of the Policy Measure	
Effectiveness of policy measure (in relation to the extent to which objectives are achieved, and cost-effectiveness)	The programme is well accepted as in 2002 around 36 % of the Brandenburg's farmers took part in the scheme (Matzdorf et al., 2003). AES are effectively contributing to soil, water and biodiversity improvement. Some programmes are quite complicated to implement and therefore it is harder to deliver the programme to the farmer.
Constraints to achieving full potential of the policy measure	Constraints are financial restrictions and limited flexibility. The limited flexibility results from the fact that the scheme does not take changing weather conditions into account, e.g. a site might not be trafficable on the date a certain activity is supposed to be carried out. Although the scheme has been made more flexible for the new programme period, this needs further improvement. Grassland extensification is not profitable in some regions because of the high yields farmers have on fertile soils.
Reasons for the success of the policy measure (where appropriate)	A reason for success is that farmers are able to keep their grassland and their economic losses are limited by the financial compensation they receive. Another reason is that the scheme is well known and it is easy to access information via MLUV or other administrative bodies.

7.3 Summary of policy use and effectiveness

Regarding soil erosion the Code of Good Agricultural Practice and the substantial requirements of the German regulatory laws are an adequate tool to meet erosion problems, but for the case of soil compaction the laws are not sufficient to prevent degradation (Marahrens, 2008).

As the central problem of agricultural soil conservation many interviewees identified that there is just a patchwork of measures with soil conservation being only a by-product of regulations targeting other issues. Several stakeholders even considered the whole soil conservation policy “a gap”. One interviewee claimed the state administration of Brandenburg supports a policy that does not go beyond the regulations that already exist. The major lobby, in this case the Farmers’ Union, even blocked the European Soil Framework Regulation as well as a soil register that was planned to be implemented. Compared to water and air, soil plays a minor role. However, there are a number of policies that target agricultural soil conservation to some extent.

The most effective policies targeting soil conservation seem to be the well-defined policies such as the Direct Payment Obligations Act where the rules and the respective sanctions for non-compliance are well defined. The same applies to the Fertilisation Ordinance: its advantage seems to be the linkage with the Direct Payment Obligations Act that makes the violation of the law costly in the sense that a certain percentage of the direct payments may be claimed back by the responsible authority. Despite its positive effects, several stakeholders also commented on downsides of the Direct Payment Obligations Act: in some cases its strict rules result in nature damaging scenarios. For example, hedges and pathways have been ploughed to ensure the amount of land that has been declared in the application for direct payments under INVEKOS, the European payment management systems. The Direct Payment Obligations Act is relevant to soil the degradation problems in the region as the crop rotation mitigates the decline in soil organic matter and together with the obligation that at least 40 % of sites have to be covered during winter it mitigates soil erosion. Almost all stakeholders agreed that the control of the measure works quite well for both, the Direct Payment Obligations Act and the Fertilisation Ordinance. However, the Direct Payment Obligations Act – as well as German Federal Soil Protection Act – fail to take fen land degradation into account that exists to a larger extent in Brandenburg. Additionally the bureaucratic requirements are seen as a burden by many farmers. Administrations criticise that their resources for monitoring and evaluating the regulations are not sufficient. Especially at the local level well-trained staff is necessary to obtain more comprehensive and detailed knowledge about the current condition of the soils as well as the effects of the measures that target soil degradation in the case study area.

The German Federal Soil Protection Act refers to agricultural soils only in paragraph 17, and its wording does not provide concrete definitions of the required Good Agricultural Practice. Some stakeholders considered an amendment to the German Federal Soil Protection Act a useful step to increase its precision and applicability at the local level. At this point the law’s impact on the soil degradation issues in the case area is quite low. Another point is the capacities to control the measure as the local administrations are more concerned with polluted areas than agricultural sites. For the German Federal Soil Protection Act the same problem arises as for the Direct Payment Obligations Act that is the lack of knowledge about the current condition of the soils and the effects of the policy.

Schemes such as the Scheme for Nature Conservation Management Agreements have a limited budget because they are 100 % state financed. In times of decreasing state budgets some Länder closed such schemes. Brandenburg still offers management agreements fro nature conservation, but the scheme’s budget has been reduced over the last years. The Management Agreement Scheme has two objectives: 1) It should be used as an instrument to reach farmers that are not eligible for participation in agri-environmental schemes; and 2) the scheme should fund activities that are important from a nature conservation point-of-

view and that need more flexibility than AES allow. The measure's main advantage over all other soil conservation measures is that "the procedures of design are flexible and adjusted to local and individual circumstances" (Hurrelmann et al., 2005). One advantage of the measure is the fact that less administrative levels are included in the implementation process which makes the whole process more transparent and easier to coordinate. Several measures of the Management Agreement Scheme contribute to soil conservation as they prevent soil erosion and soil compaction.

Agri-environmental schemes have the potential to target the soil degradation problems in the region: Local and regional actors from all disciplines are included in the policy design and evaluation process. They have extensive knowledge about the specific problems in the region and ways to solve them. The integration of this knowledge is limited by the extent to which actors' ideas are taken into account by the administration that makes the final decision. Another advantage of the measure is its popularity and the good acceptance by farmers. An important aspect is that the prescribed measures need to be profitable for farmers, which implies that the scheme needs sufficient funding. Scientists from ZALF already made some suggestions for a programme called "Internal Field Segregation" (Schlaginterne Segregation)[16] that would improve soil conservation and has also been recommended by some stakeholders. The measures that are included in the agri-environmental scheme have the potential to reduce soil erosion and soil compaction, but it has been more efficient at the time when it still included farming practices like mulching. The control of the measure has been perceived as quite effective by many interviewees.

Some initiatives such as the Large Protected Areas that would have the potential to initiate more specific programmes targeting the problems in the region face restrictions, e.g the fact that all regions have to be treated equally to maintain comparable conditions and avoid distortion of competition.

Although there are massive problems with soil erosion in the region and no adequate policies to target these problems, no regulations are under way. Andrea Beste, a German soil expert, subsumes that the currently funded measures are not solving the existing soil problems. She hopes that the EU Soil Framework Directive will lead to the development of effective soil conservation measures and that in the future more financial resources are provided for practical soil conservation extension (Beste 2007b).

Administrative as well as civil society stakeholders perceived no visible attempts for further soil policy development. At the federal level and the Länder level no regulations are on the way whatsoever and it is likely that there will be more cut-backs in Brandenburg's Management Agreement Scheme and AES. The European Soil Framework Directive has just been rejected by the Council of the European Union but it might be put on the agenda again in the future.

[16] For further reference see http://www.bfn.de/0202_sis.html, accessed 03/06/2008.

8 Conclusions

The case study region Uckermark has a high potential for soil degradation related to the dominance of intensive farming on large fields. Farming takes place on two main soil quality types: While productive soils formed on glacial till are used for exigent crops such as wheat and sugar beets, poor sandy soils area mainly used for rye cultivation. Row crops (e.g. sugar beets, maize, and potatoes) are associated with a higher risk of soil erosion that in turn causes serious economical and ecological damage. The main problem of soil erosion lies in its off-site effects: eroded sediment is deposited in small water bodies, so-called potholes, which were formed by glacial depressions and often serve as a refuge for biodiversity. Sediment deposition leads to the eutrophication of the otherwise oligotrophic habitats.

The case study area experienced structural transformation during the German reunification in 1990 leading to a variety of changes in the agricultural landscape. Farm and machinery sizes decreased, several agricultural enterprises disappeared and the remaining firms had to adapt to federal and EU standards. Whole production systems changed as did the regulatory environment. Some farms converted to organic agriculture, mainly in the years 1997/98, as a result of available funding schemes and better sales prices.

The main soil degradation problems identified by farmers as well as soil experts are water erosion, compaction and decline of organic matter. Farmers tended to rank soil degradation on their farm to be lower than the regional average. Regarding trends, farmers perceived a slight to moderate decline of soil degradation during the last ten years due to increased awareness of soil degradation issues and adaptation of production systems.

Farmers' adoption of soil conservation measures is influenced by cost aspects. Many farmers adopted reduced tillage practices to mitigate erosion and compaction, but their main incentive was to decrease machinery and labour costs. Experts also proposed the application of controlled traffic tramlines or the adjustment of wheel sizes and pressure to reduce soil compaction but interviewed farmers considered these measures too expensive.

Overall, agricultural soil conservation in the case study area is based on three pillars.

The first pillar is the mandatory requirements such as the German Federal Soil Protection Act, Brandenburg Nature Conservation Act or the Fertilisation Ordinance. Farmers have to comply with these regulations otherwise they face sanctions. These mandatory requirements present an important part for the soil conservation in the case study area. Predominantly interviewees named these measures first when they were asked which policy measures they are aware of. Additionally most of the policy measures that exist for soil conservation are mandatory measures.

The second pillar contains incentive-based measures such as the agri-environmental schemes and the Scheme for Nature Conservation Management Agreements. These measures accompany the mandatory requirements by encouraging farming practices that go beyond the mandatory requirements. Although the pillar comprises only two measures these are very important because they are designed at the state level and that makes it easier to adopt them to local soil conservation problems. Another positive aspect of these programmes is that they are well known and comparatively popular among farmers.

The third pillar contains technical measures that farmers apply without incentives implied by policy measures. Such technical measures comprise intercrops, reduced tillage, crop rotation or the employment of special soil conserving machinery. These are measures that are neither included in the mandatory requirements nor is their uptake supported by voluntary measures. Farmers apply these measures because they are cost-neutral or cost-reducing, do not decrease yields, and because farmers are convinced that these measures contribute to soil conservation.

Interestingly, the most important practices to tackle the soil degradation problems in the case study area (as discussed in chapter 5 and 6) are undertaken by some farmers purely based on their individual initiative. These practices are not supported by the existing policy measures. Reduced tillage, adapted crop rotations, undersown crops and intercrops are an efficient way to prevent soil conservation problems in the case study area but the farmers do not receive any financial assistance. However, there was funding available for selected measures during the last period of AES and some farmers continued to apply these practices when the funding ceased. Although reduced tillage is already applied for most crops in the region, the crops with the highest soil erosion potential, e.g. maize, are still cultivated by plough. The adoption of soil conservation measures on “high risk crops” should be an objective of a policy measure.

The current soil conservation policies do not adequately target the soil problems in the Uckermark, because the existing measures are neither defined well nor binding enough to have the necessary effect on applied farming practices. The regulation that includes the most soil conserving measures is the Direct Payment Obligations Act. It is the only regulation that requires soil conservation measures such as wider crop rotations, which farmers already apply to some extent because they are convinced that they prevent their soils from further degradation. The forthcoming amendment of the Direct Payment Obligations Act will increase the number of measures with impact on soil conservation. Still there will be space for regulations that target the specific problems that exist in the Uckermark and therefore regional and even local solutions are needed where regional practitioners, scientists, administrative representatives and landscape planners are included in the policy design process. To address soil compaction, financial incentives for soil conserving machinery are needed.

The main obstacle is that for whatever could be done financial resources are needed. This applies to the funding of agri-environmental schemes that directly address soil conservation measures, the expansion of Management Agreements, and the employment of additional administrative staff to better control and monitor the existing policy measures. The same is true for the idea to create financial incentives for farmers to buy new machines that limit compaction of soils. One way to go may be tax incentives connected to the purchase of such machinery, because the bureaucratic control needed would be lower. This is a possible short term solution, where no new staff needs to be employed.

Several stakeholders emphasised importance of distributing information to farmers persuading them that protecting their soil is the best thing to do. Providing advice would not require as much money as some of the measures suggested above. Stakeholders suggested that better training and education of the advisory bodies would support the distribution of information and awareness rising.

The current mixture of mandatory and incentive-based policy measures is seen as a good combination: many stakeholders said that some mandatory regulations are necessary to ensure a minimum standard that all farmers have to adhere to, but regulations should be complemented by programmes with financial incentives that are tailored to local problems and conditions. Local targeting is particularly important considering Brandenburg’s heterogeneous soils. Therefore, mandatory regulations need to be more flexible when it comes to implementing the measure at the regional level. To target regional or even local problems more efficiently, AES and Management Agreement Schemes are suitable instruments, but they require sufficient funds. The same holds true for the Large Protected Areas that have the potential to experiment with instruments to target soil degradation in the area. These measures have in common the broad range of actors included in the policy design and the implementation process. This offers the opportunities to include local knowledge and make the measures more efficient. The flexibility of the agri-environmental scheme has been improved for this programme period: the dates for using the sites can be adapted to some extent to the weather conditions and the trafficability of the site.

Furthermore, a common database is essential for the design of new policies addressing soil conservation in order to make information available on the actual soil conditions as a basis from where to start.

At European level the EU Soil Framework Directive is needed as a reference for the member states and to give soil conservation policy in the EU a basis. Due to the differences of soil degradation problems in the member states the regulations concerning soil conservation need to be more flexible when it comes to the implementation at the national or regional level.

At the federal level the German Federal Soil Protection Act needs to be extended and in the process a wide range of actors has to be included. Tax incentives may also be an instrument that would encourage farmers to buy machinery that has a less damaging effect for the soils. Länder administrations need more flexibility for the implementation of the measures to adapt them to local conditions.

Brandenburg should make use of its opportunity to establish its own Soil Protection Act based on the Federal Soil Protection Act in order to create a legal basis for the local level to pass regulations that target the problems adequately. In addition, agri-environmental schemes should include measures that directly target soil conservation. More staff is needed at the local level to control policies, to make soil a more prominent topic, and to compile and manage information on local soil conditions. This would be the starting point for better targeted actions.

In conclusion, the most important aspect for a good soil conservation policy in Brandenburg is the local flexibility. As one interviewee expressed it, “there is no technical measure that works perfect for all soils”. Measures have to fit to the local condition because soils in the case study region are very heterogeneous. Therefore, wherever policies and technical measures are designed – at the European, national or Länder level – the aspect of regional applicability and flexibility has to be secured.

References

Amt für Statistik Berlin-Brandenburg (2007): Statistischer Bericht – Siedlungs- und Verkehrsfläche im Land Brandenburg 2006. Potsdam. Available at: http://www.statistik-berlin-brandenburg.de/Publikationen/Stat_Berichte/2007/AV5_j-06.pdf.

Amt für Statistik Berlin-Brandenburg (2008): Statistischer Bericht - Bodennutzung der landwirtschaftlichen Betriebe im Land Brandenburg 2007. Potsdam. Available at: http://www.statistik-berlin-brandenburg.de/Publikationen/Stat_Berichte/2008/SB_C1-1_j-07_BB.pdf.

Bayerl, G. (2006): Geschichte der Landnutzung in der Region Barnim-Uckermark. Materialien der Interdisziplinären Arbeitsgruppe Zukunftsorientierte Nutzung ländlicher Räume Nr. 12. Available at: http://www.bbaw.de/bbaw/Forschung/Forschungsprojekte/Land/bilder/arbeitspapier12.pdf.

Beste, A. (2007a): Boden und Bodenschutz. Fortbildung und Beratung zu Humusmanagement und Strukturaufbau notwendig. B&B Agrar 6/2007.

Beste, A. (2007b): Den Boden vor dem Kollaps retten! Plädoyer für ein Umdenken im Umgang mit der Ressource Boden. Der kritische Agrarbericht 2007, pp. 66-70.

Birkás, M. and Gyuricza, C. (2000): Results of long-term trials on the direct drilling of maize in Hungary. *Die Bodenkultur* 51 (1), pp. 19-34.

Brandenburger Bauernzeitung (2008): Nicht zu viel reglementieren. LBV-Fachausschuss zu EU-Bodenschutz und Grünlanderhaltungsgebot. 14. Woche 2008.

Bundesministerium der Justiz (BMJ) (2004): Verordnung über die Grundsätze der Erhaltung landwirtschaftlicher Flächen in einem guten landwirtschaftlichen und ökologischen Zustand (Direktzahlungen-Verpflichtungenverordnung – DirektZahlVerpflV vom 4.11.2004) Bundesgesetzblatt Jahrgang 2004 Teil I Nr. 58, ausgegeben zu Bonn am 12. November 2004: 2778-2784. Available at: www.bgblportal.de/BGBL/bgbl1f/bgbl104s2778.pdf (19/02/08).

Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz (BMVEL) (2006): Nationaler Strategieplan der Bundesrepublik Deutschland für die Entwicklung ländlicher Räume 2007- 2013. Available at: http://www.bmelv.de/cln_044/nn_751686/SharedDocs/downloads/08-LaendlicheRaume/Strategiepapier,templateId=raw,property=publicationFile.pdf/Strategiepapier.pdf (19/02/08).

Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU) (2002): German Federal Government Soil Protection Report. Available at: http://www.bmu.de/files/pdfs/allgemein /application/pdf/soilreport.pdf.

Choudhury, K., Kraemer, R. A., Hollerbuhl, S. and Nickel, D. (2001): Machbarkeitsstudie zur Entwicklung von Anforderungen an den nachhaltigen Bodenschutz: Kriterienentwicklung zur Leistungsfähigkeit von Bodenfunktionen. Available at: http://www.ecologic.de/download/projekte/900-949/945/945_Projektbericht_de.pdf.

Cooper, J. (2005): Global Agricultural Policy Reform and Trade. Cheltenham, Elgar.

Deutscher Bauernverband (ed.) (2008): Sonnleitner wendet sich gegen Erosionsgefährdungskataster. DBV-Präsident kritisiert Regelungseifer von Bund und Ländern. *DBV-Informationen* 7/2008, 14/02/2008.

Eggers, J. (2005): Dezentralisierung der Agrarumweltmaßnahmen in der europäischen Agrarpolitik: Hemmnisse eines institutionellen Wandels. In: Beckmann, V. and Hagedorn, K. (eds.): Institutioneller Wandel in der Landwirtschaft und Ressourcennutzung 25. Shaker Verlag, Berlin.

Eggers, J., Laschewski, L. and Schleyer, C. (2004): Agri-Environmental Policy in Germany. Understanding the Role of Regional Administration. In: ICAR Discussion Paper 4/2004. Available at: http://www.agrar.hu-berlin.de/struktur/institute/wisola/fg/ress/publikationen/icar.

Frielinghaus, M. (ed.) (1997): Merkblätter zur Bodenerosion in Brandenburg, ZALF-Bericht Nr. 27. Müncheberg.

Frielinghaus, M.; Höflich, G.; Joschko, M.; Rogasik, H. and Schäfer, H. (1997): Possibilities of conservation tillage on sandy soils- analysis of a long-term experiment. *Archives of Agronomy and Soil Science* 41 (5).

Frielinghaus, M., Brandhuber, R. and Schmidt, W.-A. 2001. Vorsorge gegen Bodenerosion im Bodenschutzrecht. Wasser und Boden 53 (9), pp. 25-31

Hagedorn, K. and Laschewski, L. (2003): Institutionelle Erfolgsfaktoren einer Ausdehnung des Ökologischen Landbaus – Analyse anhand von Regionen mit einem besonders hohen Anteil an ökologisch bewirtschafteter Fläche. Bericht, Geschäftsstelle Bundesprogramm Ökologischer Landbau, Bundesanstalt für Landwirtschaft und Ernährung (BLE), Bonn. Available at: http://orgprints.org/7321/01/7321-02OE383-ble-hu-berlin-2003-institutionelle-faktoren.pdf.

Hertwig, F. and Schuppenies, R. (2007): Ernteterminschätzung über Wärmesummen. Available at: http://www.mluv.brandenburg.de/cms/media.php/2335/ernte_ts.pdf.

Hurrelmann, A., Beckmann, V., Lütteken, A., Große, N. and Raupack, V. (2005): Integrated tools to design and implement Agro Environmental Schemes: Case Study Germany: Brandenburg. Unpublished Research Paper by Humboldt University.

Institut für Landwirtschaft und Umwelt (ed.) (2008): Strategien zum Bodenschutz – Sachstand und Handlungsbedarf. Tagungsband zur Fachveranstaltung von ilu, GKB und KTBL am 5. und 6. Dezember 2007 in Bonn.

Kalettka, T.; Rudat, C. and Quast, J. (2001): Potholes in Northeast German agro-landscapes: functions, land use impacts, and protection strategies. In: Tenhunen, J.D., Lenz, R. and Hantschel, R. (eds.): Ecosystem approaches to landscape management in central Europe. *Ecological studies* 147, pp. 291-298.

Kuepper, G. and Gegner, L. (2004): Organic Crop Production. Fundamentals of Sustainable Agriculture. Available at: http://attra.ncat.org/attra-pub/PDF/organiccrop.pdf.

Landesamt für Bauen und Verkehr (2006): Landkreis Uckermark. Available at: http://www.lbv.brandenburg.de/dateien/stadt_wohnen/Kreis_UM.pdf.

Landesamt für Verbraucherschutz, Landwirtschaft und Flurneuordnung (2007): Gemeinsame Hinweise der Länder Brandenburg, Mecklenburg-Vorpommern und Sachsen-Anhalt zur Umsetzung der novellierten Düngeverordnung. Available at: http://www.mluv.brandenburg.de/cms/media.php/2331/hinwduev.pdf.

Landesbetrieb für Datenverarbeitung und Statistik Land Brandenburg (2004): Viehzählung im Land Brandenburg, 03. Mai 2003 Allgemeine Erhebung Pferde, Rinder, Schweine, Schafe und Geflügel. Available at: http://www.statistik.brandenburg.de/sixcms/media.php/4055/CIII1-1endg_2j-03.pdf.

Lee, Y.H. (2006): Nachhaltiger Bodenschutz – international, europäisch, national. Berlin: Universitätsverlag der TU Berlin.

Marahrens, S. (2008): Strategien zum Bodenschutz – welche Auswirkungen der europäischen Politik sind in Deutschland zu erwarten? In: Institut für Landwirtschaft und Umwelt (ed.): Strategien zum Bodenschutz – Sachstand und Handlungsbedarf. Tagungsband zur Fachveranstaltung von ilu, GKB und KTBL am 5. und 6. Dezember 2007 in Bonn, pp. 21-27.

Matzdorf, B., Piorr, A. and Sattler, C. (2003): Halbzeitbewertung des Plans zur Entwicklung des ländlichen Raums gemäß VO (EG) Nr. 1257/1999 des Landes Brandenburg. Available at: http://www.mluv.brandenburg.de/cms/media.php/2317/halbzeit.pdf.

Ministerium für Ländliche Entwicklung, Umwelt und Verbraucherschutz des Landes Brandenburg (MLUV) (2007): Entwicklungsplan für den ländlichen Raum Brandenburgs und Berlins 2007 – 2013 as of 13.7.2007 (Rural Development Plan). Available at: http://www.mluv.brandenburg. de/cms/media.php/2317/swot.pdf (19/02/08).

Ministry for Agriculture, Environmental Protection Regional Planning (ed.) (2000): Rahmenempfehlungen zur Düngung 2000 im Land Brandenburg. Potsdam.

Ministry for Agriculture, Environmental Protection Regional Planning (ed.) (2002): Informationsheft zum landwirtschaftlichen Bodenschutz im Land Brandenburg, Teil Bodenerosion. Potsdam.

Ministry for Rural Development, Environment and Consumer Protection Brandenburg (2007): Richtlinie des Ministeriums für Ländliche Entwicklung, Umwelt und Verbraucherschutz (MLUV) des Landes Brandenburg zur Förderung umweltgerechter landwirtschaftlicher Produktionsverfahren und zur Erhaltung der Kulturlandschaft der Länder Brandenburg und Berlin (KULAP 2007) vom 20.11.2007. Available at: http://www.mlur.brandenburg.de/cms/media.php/2317/kulap07.pdf.

Osterburg, B., Rühling, I., Runge, T., Schmidt, T.G., Seidel, K., Antony, F., Gödecke, B. and Witt-Altfelder, P. 2007. Kosteneffiziente Maßnahmenkombination nach Wasserrahmenrichtlinie zur Nitratreduktion in der Landwirtschaft. In: Osterburg, B. and Runge, T. (ed.): Maßnahmen zur Reduzierung von Stickstoffeinträgen in Gewässer – eine wasserschutzorientierte Landwirtschaft zur Umsetzung der Wasserrahmenrichtlinie. Braunschweig: Landbauforschung Völkenrode – FAL Agricultural Research, Special Issue 307, pp. 3-138.

Prager, K. (2002): Akzeptanz von Maßnahmen zur Umsetzung einer umweltschonenden Landbewirtschaftung bei Landwirten und Beratern in Brandenburg. Weikersheim: Margraf. *Schriftenreihe Kommunikation und Beratung* 48.

Riksen, M., Brouwer, F. and de Graaff, J. (2003): Soil conservation policy measures to control wind erosion in northwestern Europe. *Catena* 52, pp. 309-326.

Rosner, J., Zwatz, E. and Klik, A. (2003): Minimalbodenbearbeitung und Erosionsschutz in Österreich. In: Bundesanstalt für alpenländische Landwirtschaft Gumpenstein (ed.). Bericht – 10. Lysimetertagung, 29. und 30. April 2003. Gumpenstein, pp. 225-226.

Sächsische Landesanstalt für Landwirtschaft (2004): Bodenschutz in der Landwirtschaft. Dresden: Sächsische Landesanstalt für Landwirtschaft.

Sattler, C. (2008): Ökologische Bewertung und Akzeptanzanalyse pflanzenbaulicher Produktionsverfahren. Dissertation, Berlin.

Sattler, C. and Nagel, U.J. (2008): Factors affecting farmers' acceptance of conservation measures – A case study from north-eastern Germany. Land Use Policy. doi:10.1016/j.landusepol.2008.02.002

Thießen, B., Prager, K. and Nagel, U.J. (2006): Mitwirkung von Umweltverbänden an der Gestaltung von Agrarumweltprogrammen auf Ebene der Länder. SUTRA Working Paper 11. Humboldt Universität zu Berlin.

Umweltbundesamt (2006): Jahresbericht 2006. Available at: http://www.bmu.de/files/pdfs/allgemein/application/pdf/uba_jahresbericht2006.pdf.

Annexes

Annex 1a: List of interviews (Questionnaire 2)

Interview Date	Interviewee (affiliation/position)	Type of interview
21/04/2008	limited liability company, manager of the farm	face-to-face
22/04/2008	limited liability company, manager of the farm	face-to-face
22/04/2008	civil law association, manager of the farm	face-to-face
23./04/2008	private enterprise, manager of the farm	face-to-face
23/04/2008	civil law association, manager of the farm	face-to-face
29/04/2008	limited partnership with a limited liability company as general partner, manager and owner of the farm	face-to-face

Annex 1b: List of interviews (Questionnaire 3 and 4)

Interview Date	Interviewee (affiliation/position)	Type of interview
02/04/08	Upper State Authority (Q3)	face-to-face
02/04/08	Upper State Authority (Q3)	face-to-face
14/04/08	Local State Authority (Q3)	face-to-face
14/04/08	Local State Authority (Q3)	face-to-face
22/04/08	Lower State Authority (Q3)	face-to-face
30/04/08	Member of Länder Parliament (Q3)	face-to-face
06/05/08	Member of Local Parliament (Q3)	face-to-face
03/06/08	Higher State Authority(Q3)	face-to-face
03/06/08	Higher State Authority(Q3)	face-to-face
06/06/08	Higher State Authority (Q3)	face-to-face
06/05/08	Policy advisor for environmental protection organisation (Q4)	written answers
08/04/08	Member advisory body (Q4)	face-to-face
24/04/08	BUND (Environmental Protection Organisation) (Q4)	phone interview
22/04/08	Farmers Union (Q4)	face-to-face
	NABU (Nature Conservation Organisation) (Q4)	face-to-face
07/05/08	Member of German Soil Association and advisor (Q4)	face-to-face
15/05/08	Landscape conservation organisation(Q4)	written answer
20/05/08	Scientist (University) (Q4)	face-to-face
29/05/08	Agri-environmental expert (Q4)	phone Interview
20/05/08	Organic farming association (Q4)	written answers

Annex 2: Overview of the results of Questionnaire 1

Main farm types	arable, mixed
Main crops	wheat, rye, barley, sugar beet, maize, potatoes
Livestock	bovine (race: Holstein-Friesian)
Main production orientation	conventional, organic
Average field size	25 ha
Irrigation methods	none
Source of irrigation water	n/a
Usual salt content of irrigation water	n/a
Drainage systems	tube system
Existing grass strips	none
Separation of fields by hedges	yes
Main soil degradation problems	water erosion, decline in organic matter, soil compaction
Applied soil conservation measures (cropping/ tillage measures)	intercrops, undersown crops, no tillage/direct drilling, reduced tillage, wheel sizes and pressure/restricting excessive heavy machinery use, restrictions on the max. amount of (liquid) manure application, restrictions of manure application to a certain time period, restrictions on the max. amount of N- fertilisation, restrictions on the max. amount of P-fertilisation
Applied soil conservation measures (long term measures)	change of crop rotation, liming, controlled traffic tramlines, adjusting duration and season of grazing animals

Annex 3: Glossary of policy measures

English title of policy measure (law, regulation, initiative)	**National title of policy measure**
German Federal Soil Protection Act	Bundesbodenschutzgesetz
Contractual Nature Conservation	Vertragsnaturschutz
Water Framework Directive	Wasserrahmenrichtlinie
Agri-environmental schemes	Agrarumweltprogramme
Direct Payment Obligations Act	Direktzahlungen-Verpflichtungengesetz
Brandenburg Nature Conservation Act	Brandenburgisches Naturschutzgesetz
Fertilisation Ordinance	Düngeverordnung
Plant Protection Products Directive	Pflanzenschutzmittelgesetz
Sewage Sludge Directive	Klärschlammverordnung
European Soil Framework Directive	Europäische Bodenrahmenrichtlinie
Water Resources Act	Wasserhaushaltsgesetz
Brandenburg Water Management Act	Brandenburgisches Wassergesetz
Brandenburg Waters Classifications Act	Brandenburgische Gewässereinstufungsverordnung

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Abstract

This Technical Note 'Case Study – Germany' is part of a series of case studies within the 'Sustainable Agriculture and Soil Conservation' (SoCo) project. Ten case studies were carried out in Belgium, Bulgaria, the Czech Republic, Denmark, France, Germany, Greece, Italy, Spain and the United Kingdom between spring and summer 2008. The selection of case study areas was designed to capture differences in soil degradation processes, soil types, climatic conditions, farm structures and farming practices, institutional settings and policy priorities. A harmonised methodological approach was pursued in order to gather insights from a range of contrasting conditions over a geographically diverse area. The case studies were carried out by local experts to reflect the specificities of the selected case studies.

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