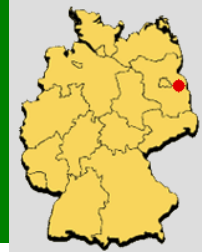




Transatlantic Land Use Conference,  
Washington DC, USA  
24th to 26th September 2007



Agri-environmental measures as an instrument  
to enhance sustainability – theoretical  
considerations and practical implications for a  
German case study region

Sandra Uthes, Klaus Müller, Bettina Matzdorf and  
Claudia Sattler (ZALF, Germany)



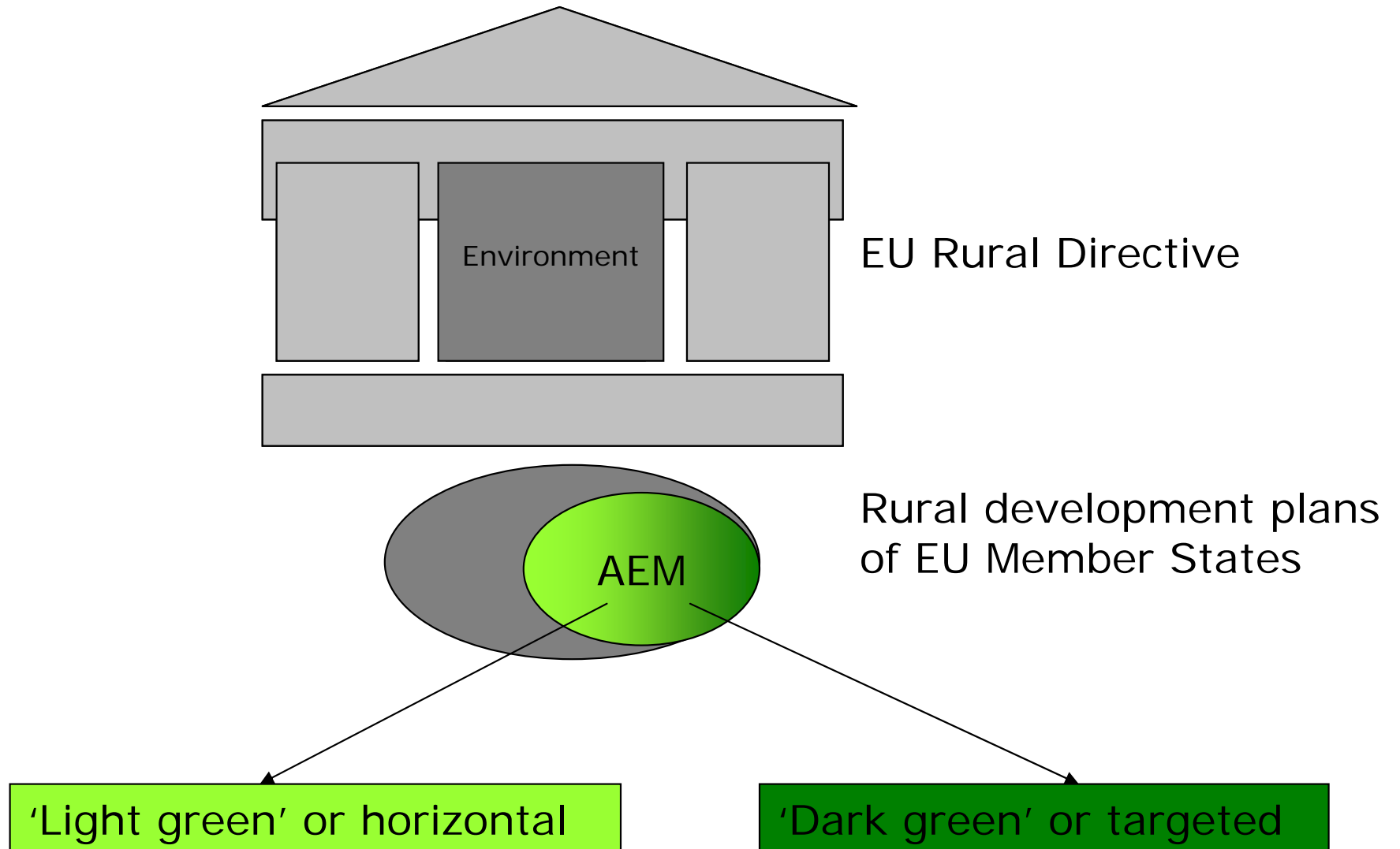


# Outline

1. Brief introduction
2. Sources of inefficiencies
3. Modeling framework
4. Case study results
5. Conclusions
6. Outlook



# General overview





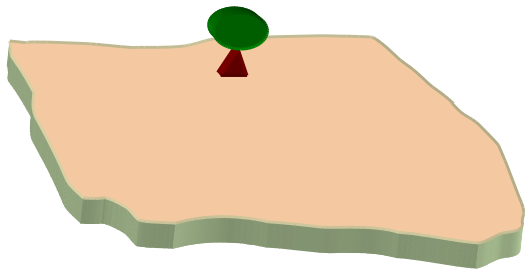
## Sources of inefficiencies

- High administration effort, elaborating reconciliation of designated areas
- Multitude of set up AEM complicate the planning process
- Overhang of planned versus effectively spent resources
- Administration often lacks technological but also knowledge resources to avoid a possible imperfect mapping of agri-environmental measures



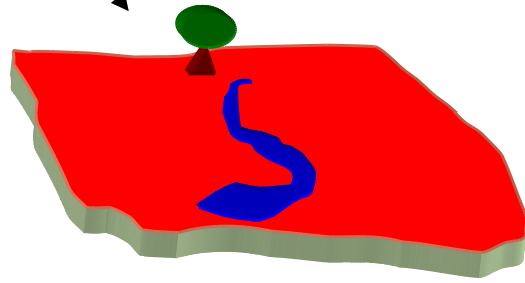
# Imperfect mapping of the measures

AEM  
100 EUR/ha



Low vulnerability

Environmental  
benefit/EUR



High vulnerability

Environmental  
benefit/EUR

<



# CLAPS modeling framework

## CLAPS

an analysis and planning tool to determine the optimal spatial and financial design of agri-environmental measures (AEM)



## Modeling assumptions

- Data integration from different sources can save transaction costs and allows for more sophisticated ways of policy implementation
- Analysis and demonstration of ex post inefficiencies can encourage policy makers to question their instruments and priorities
- Scenarios can visualize the impacts of different policy settings and can help to find the necessary steps to adjust existing programs or set up new programs



# CLAPS methodology

<ol style="list-style-type: none"><li>1. Verbal formulation of the decision problem</li><li>2. Political objectives of the measures</li><li>3. Data collection (e.g. GIS data, financial data etc.)</li><li>4. Environmental impact assessment<ul style="list-style-type: none"><li>• Site-independent Impact Assessment</li><li>• Site Vulnerability Classification</li></ul></li></ol>	} site-specific impact assessment	Intelligence phase
<ol style="list-style-type: none"><li>5. Mathematical formulation of the decision problem<ul style="list-style-type: none"><li>• Goal programming</li><li>• Constraints (e.g. spatial areas, budget)</li><li>• Decision-makers' preferences</li></ul></li></ol>		Design phase
<ol style="list-style-type: none"><li>6. Scenarios</li><li>7. Result visualization</li><li>8. Recommendation</li></ol>		Choice phase

## Case study area Brandenburg, Germany

- UAA 1.34 mill. hectares
- 14 rural communities
- 2.5 Mill inhabitants, sparsely populated (43 inhabitants/km<sup>2</sup>)
- Rich in high nature value grasslands, biotopes, heath lands ..
- Dominated by sandy (less fertile) soils



Germany (82 Mill inh.)



## Set up AEM in Brandenburg (2000-2006)

- AEM focus on the extensive agricultural use of grassland, organic farming, extensive and erosion-reducing cultivation methods, integrated horticulture, the maintenance of species diversity in general and the tendance and maintenance of small water bodies used in fishery
- Payments for arable AEM range from 49 to 405 Euro/ha (mean payment 170 Euro/ha) and for grassland AEM from 105 to 720 Euro/ha (mean payment 220 Euro/ha)
- overall budget for AEM amounts to app. 42 mill. Euro/year



## STEP 1: Decision problem

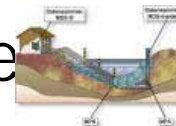
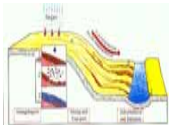
1. How to finance alternative agri-environmental measures (AEM) to achieve politically set multiple objectives with a limited budget in an optimal way?
2. What is the (therefore necessary) optimal spatial allocation of AEM?



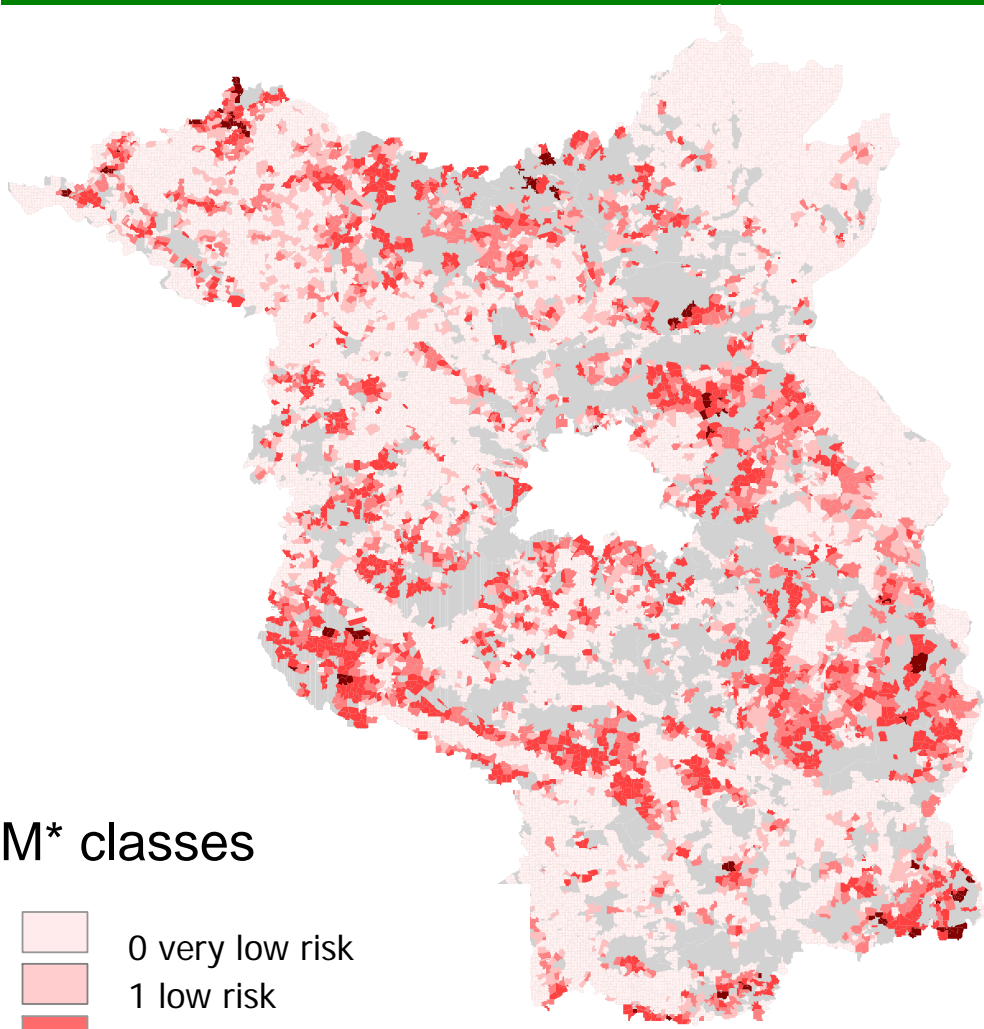
## STEP 2: Political objectives of the measures

Objectives (as stated in the corresponding regulations)

- Reduce risk of water and wind erosion (ERO)
- Reduce risk of biodiversity loss on farm land (BIO)
- Maintain and improve habitat quality (HAB)
- Reduce risk of nitrate entry into ground and surface water (NO<sub>3</sub>)
- Maintain and improve visual diversity of the landscape (DIV)
- ...

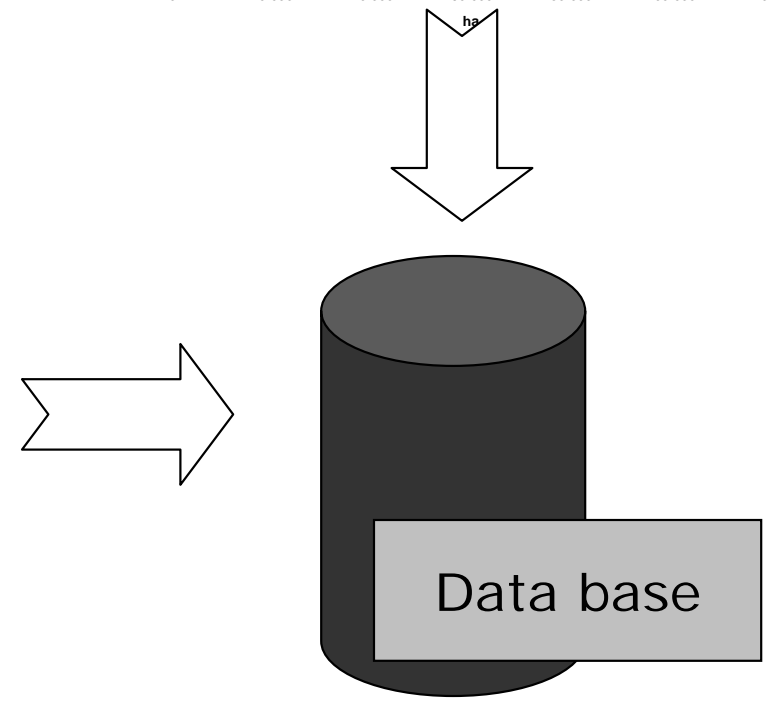
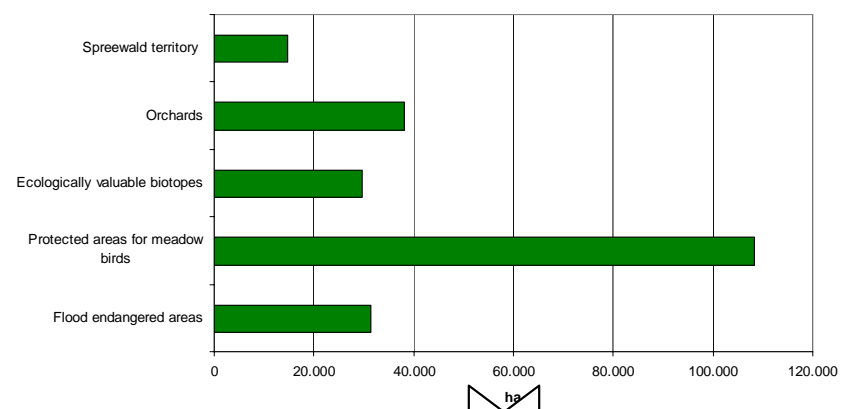


# STEP 3: GIS analysis and site classification



## SICOM\* classes

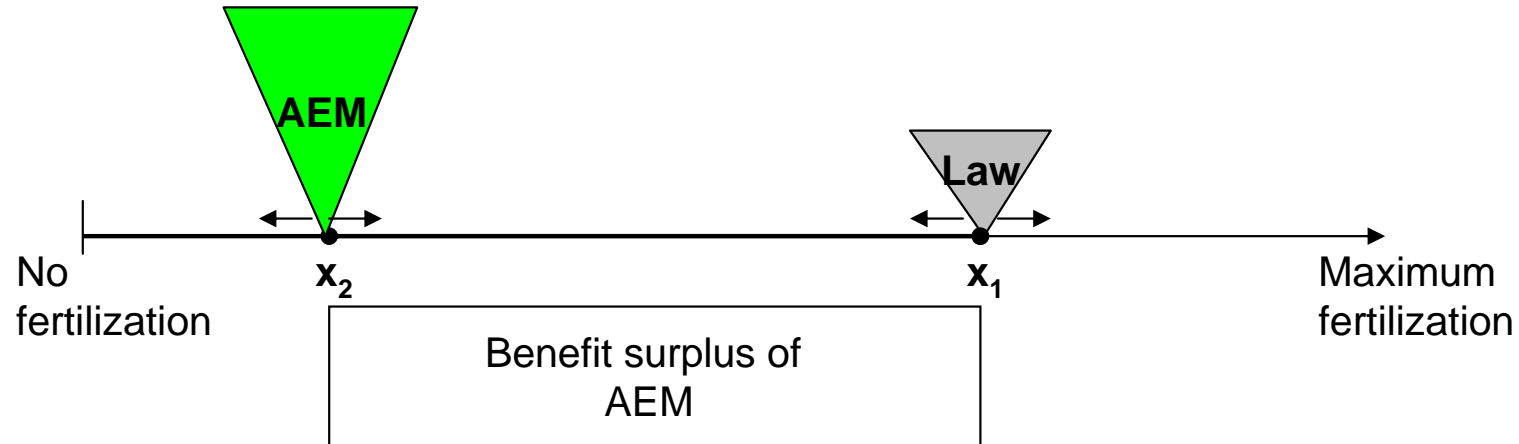
- 0 very low risk
- 1 low risk
- 2 medium risk
- 3 high risk
- 4 very high risk





## STEP 4: Impact assessment

- Assessing the benefit surplus of the measures in comparison to a reference



$x_2$  Fertilization rate according to AEM

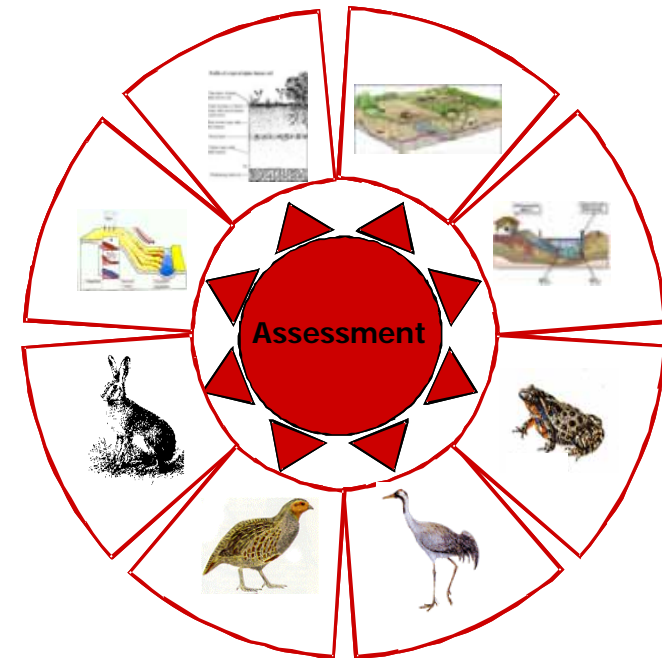
$x_1$  Fertilization rate according to the standard of 'Good Agricultural Practice'



## STEP 4: How to do it?

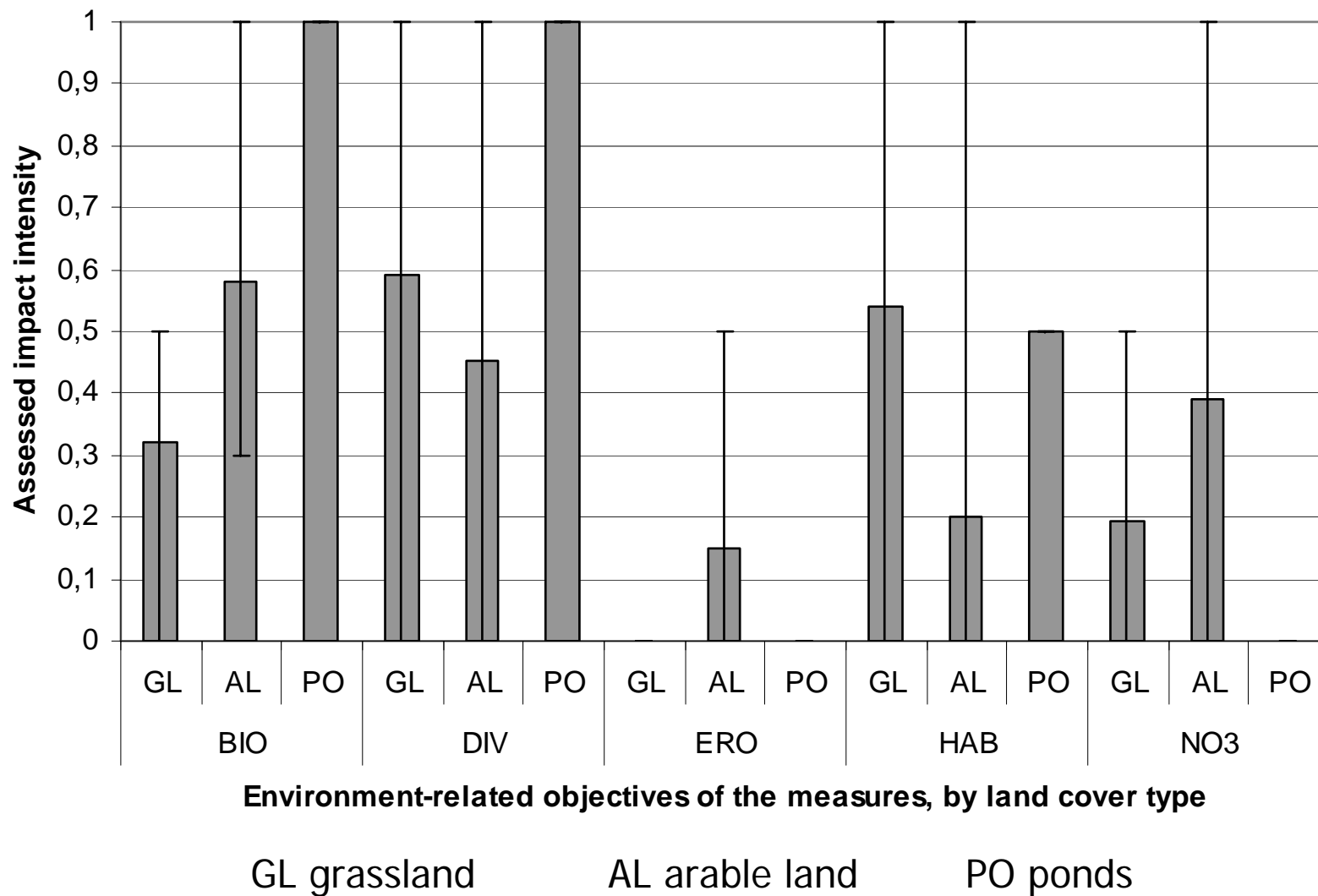
- Expert assessment based on existing monitoring data, GIS classification, IACS and FADN data, farm surveys
- Farm-level risk assessment approaches (goal attainment values)
- Bio-physical modeling outputs

abiotic  
biotic



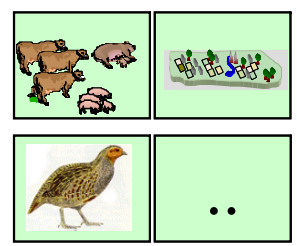
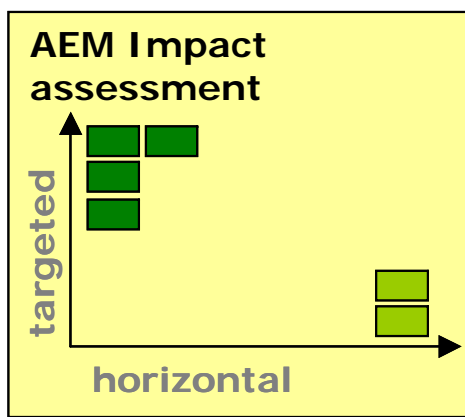


# STEP 4: Site-dependent impact assessment



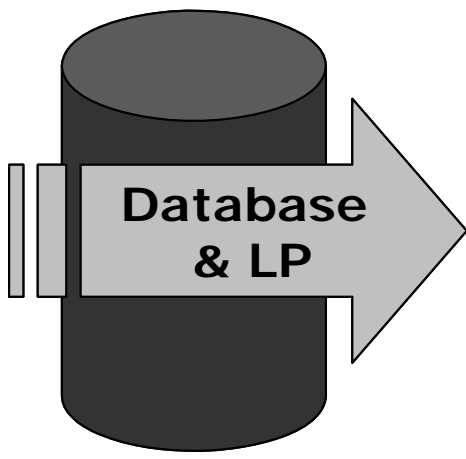


# STEP 5: Goal programming



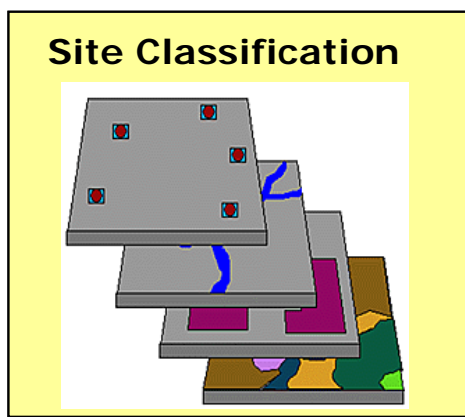
Objectives

Goal contribution coefficients



Subject to:

- Budget
- Area
- ..



### Budget allocation

### Spatial allocation

### Optimal mix of AEM

	BA_2004	BA_MICHELL
K.5	1111.73	2546.67
K.4	2536.43	4767.54
K.3	5568.79	4460.00
K.2	4142.39	0.00
K.1	2471.08	0.00
K.0	1065.44	0.00



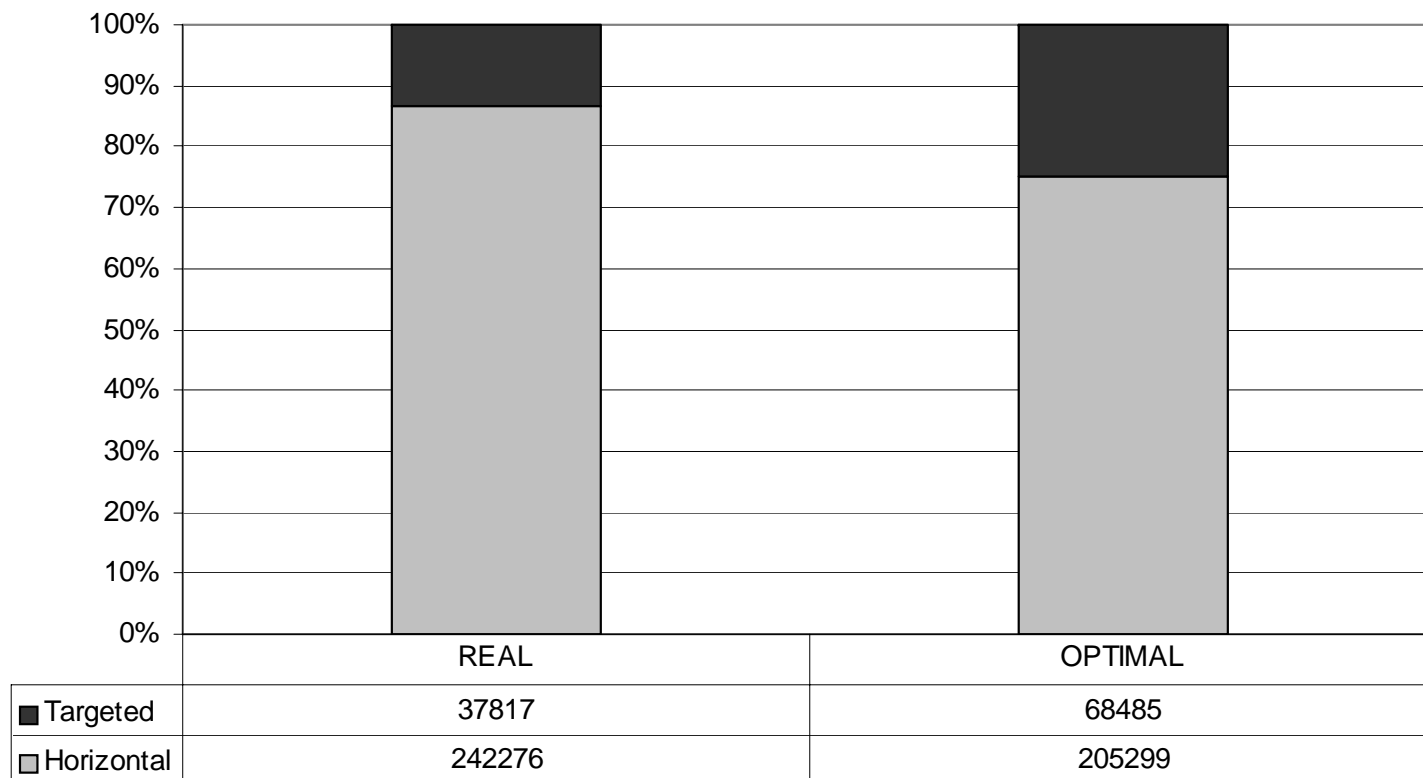
## STEP 6: Scenarios

- Reference year 2004
- REAL (budget allocation fixed, only spatial re-allocation of the measures possible)
- OPTIMAL (both budget and spatial allocation not fixed)
- ....



# STEP 7: result visualization

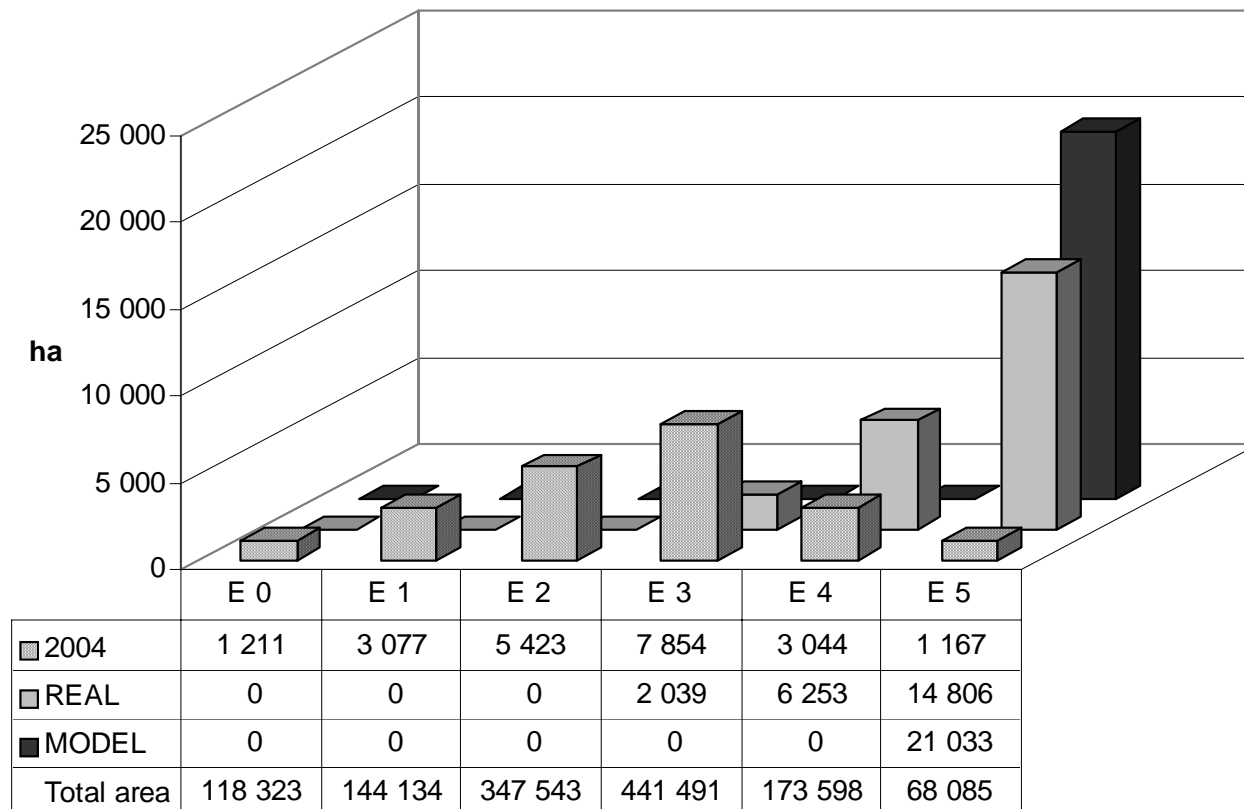
Optimal mix between horizontal and targeted AEM in Brandenburg, [%] and [ha]





# STEP 7: result visualization

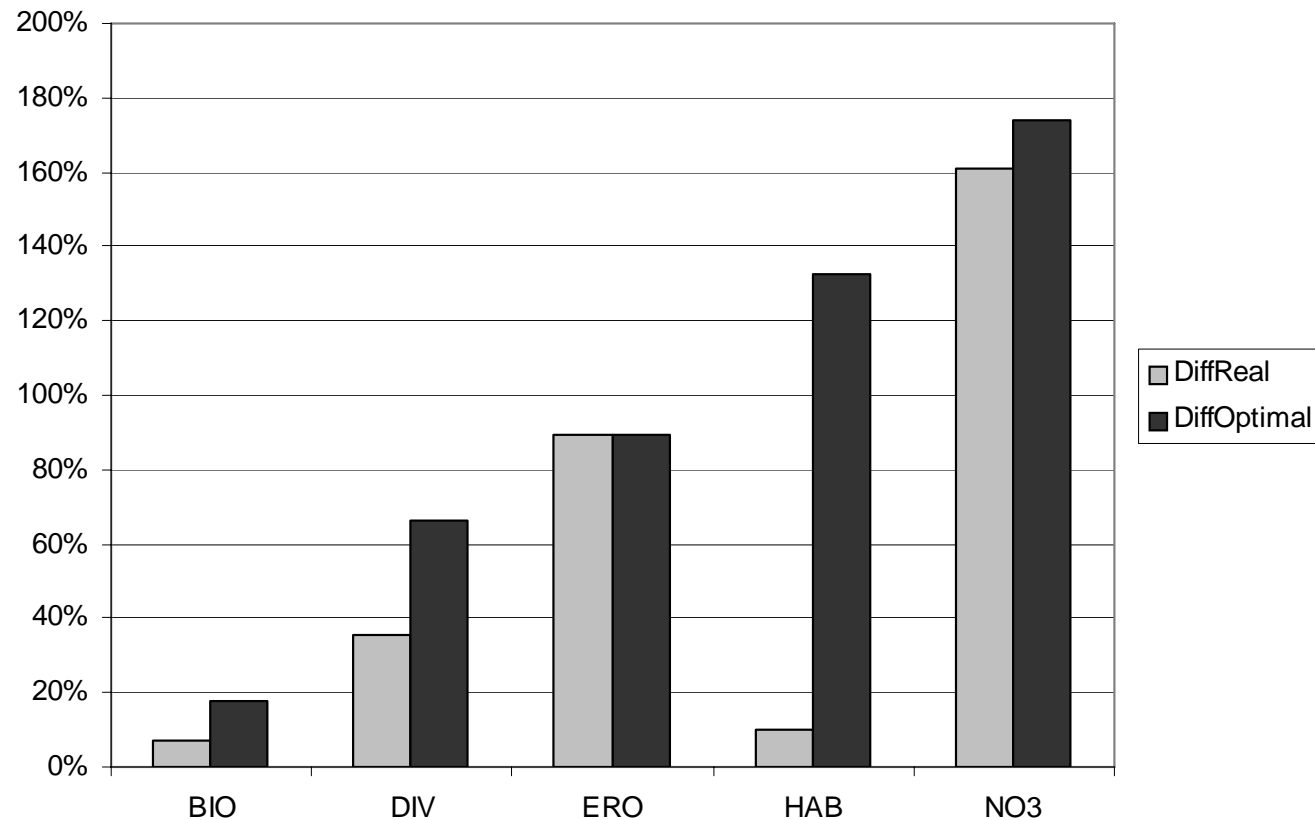
Supported area with erosion-reducing AEM, by erosion-vulnerability class [ha] - reference situation in 2004 compared to the scenario results





# STEP 7: result visualization

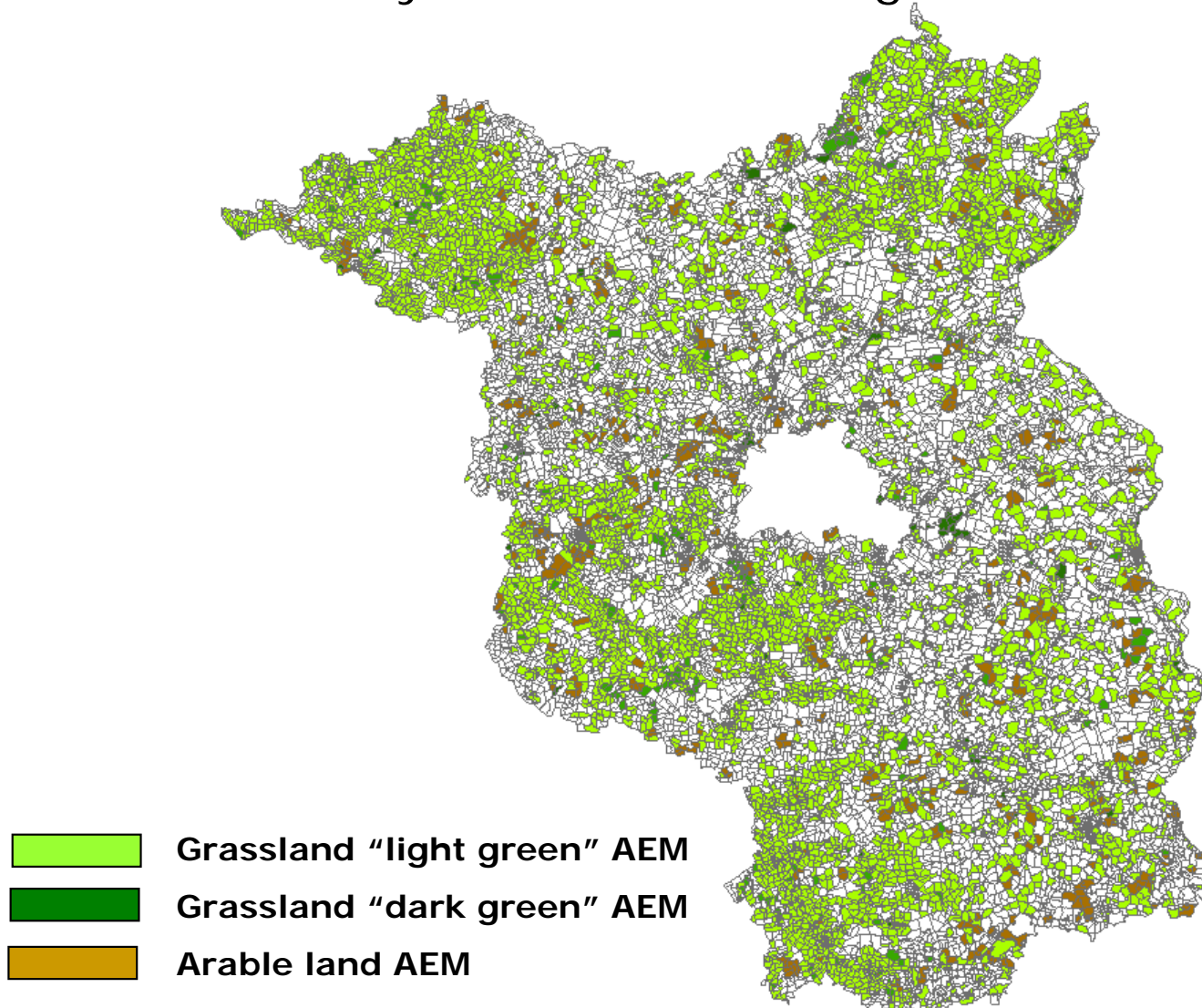
Change in total goal attainment level [%]





# STEP 7: result visualization

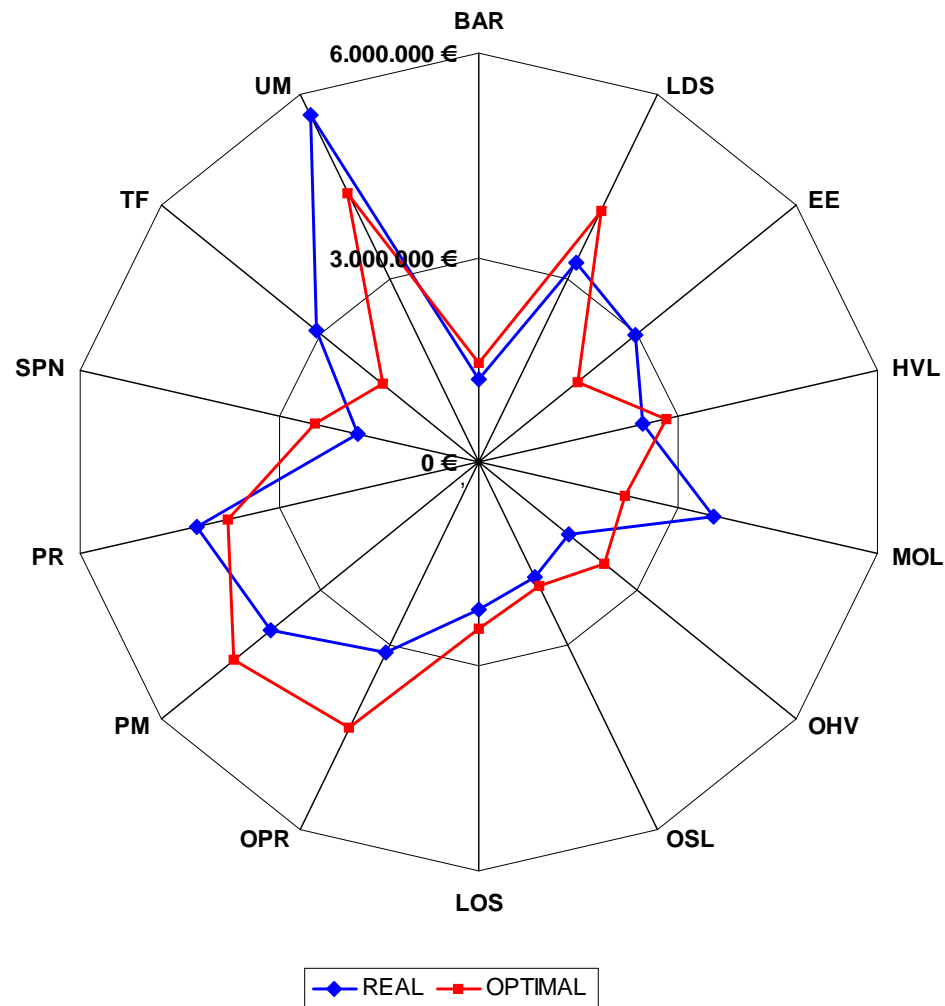
Area covered by horizontal and targeted AEM in Brandenburg





# STEP 7: result visualization

Distributive effects of REAL and OPTIMAL, financial output for the 14 communities in Brandenburg





## STEP 8: Recommendation

- Observed inefficiencies are bad for the reputation of AEM
- Drop some measures?
- Introduce some new AEM addressing underrepresented objectives?
- Payment variation depending on the vulnerability of the sites?
- Restrict some horizontal AEM to special areas?
- ...



## Conclusions

- The spatial dimension plays the foremost important role for an effective and efficient implementation of AEM
- By gathering evaluation data and GIS data in one data pool, all in combination with financial aspects, data management and data analyses get more facilitated
- Scenario results are always extremes, but they can help channeling and highlighting key interconnections and interdependencies to allow for the weighing out of possible alternatives
- Identified inefficiencies in the past depend also on which objectives are considered and which not

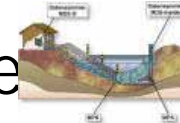
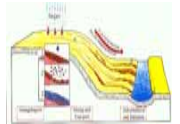


# Political objectives of the measures

Explicit objectives (stated in corresponding regulations)

- Reduce risk of water and wind erosion
- Reduce risk of biodiversity loss on farm land
- Maintain and improve habitat quality
- Reduce risk of nitrate entry into ground and surface water
- Maintain and improve visual diversity of the landscape

Environment-  
related

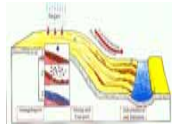




# Political objectives of the measures

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- Reduce risk of water and wind erosion
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- Maintain and improve visual diversity of the landscape



Implicit objectives

- Save jobs in agricultural sector
- Income support for beef producing farms



Environment-  
related

Socio-  
economic

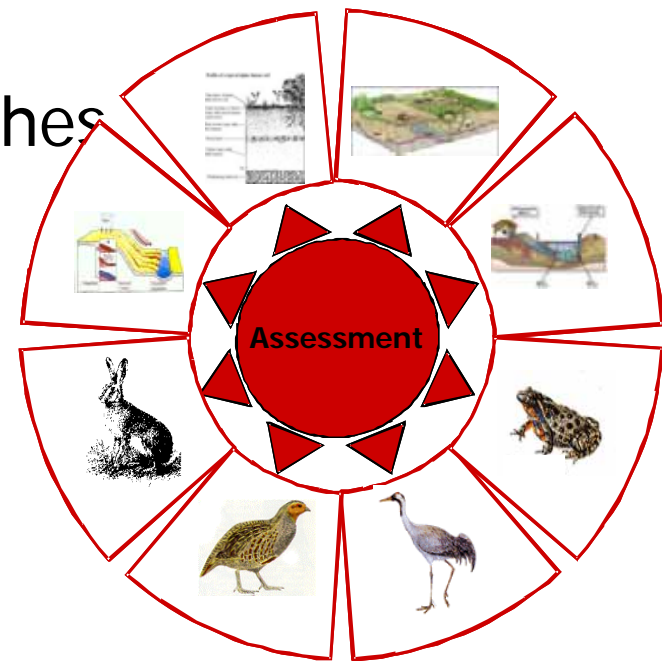


# How to do the impact assessment?

## Environment-related objectives

- Expert assessment based on existing monitoring data, IACS and FADN data, farm surveys
- farm-level impact assessment approaches
- Bio-physical modeling

abiotic  
biotic





# How to do it?

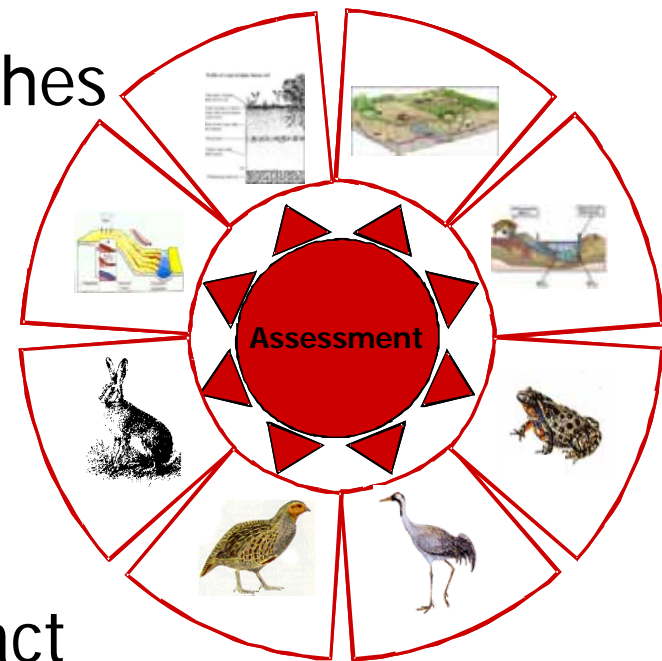
## Environment-related objectives

- Expert assessment based on existing monitoring data, IACS and FADN data, farm surveys
- farm-level impact assessment approaches
- Bio-physical modeling

## Socio-economic objectives

- Expert assessment
- Econometrics
- Scenario results of ex-ante policy impact assessment tools (with and without AEMs)

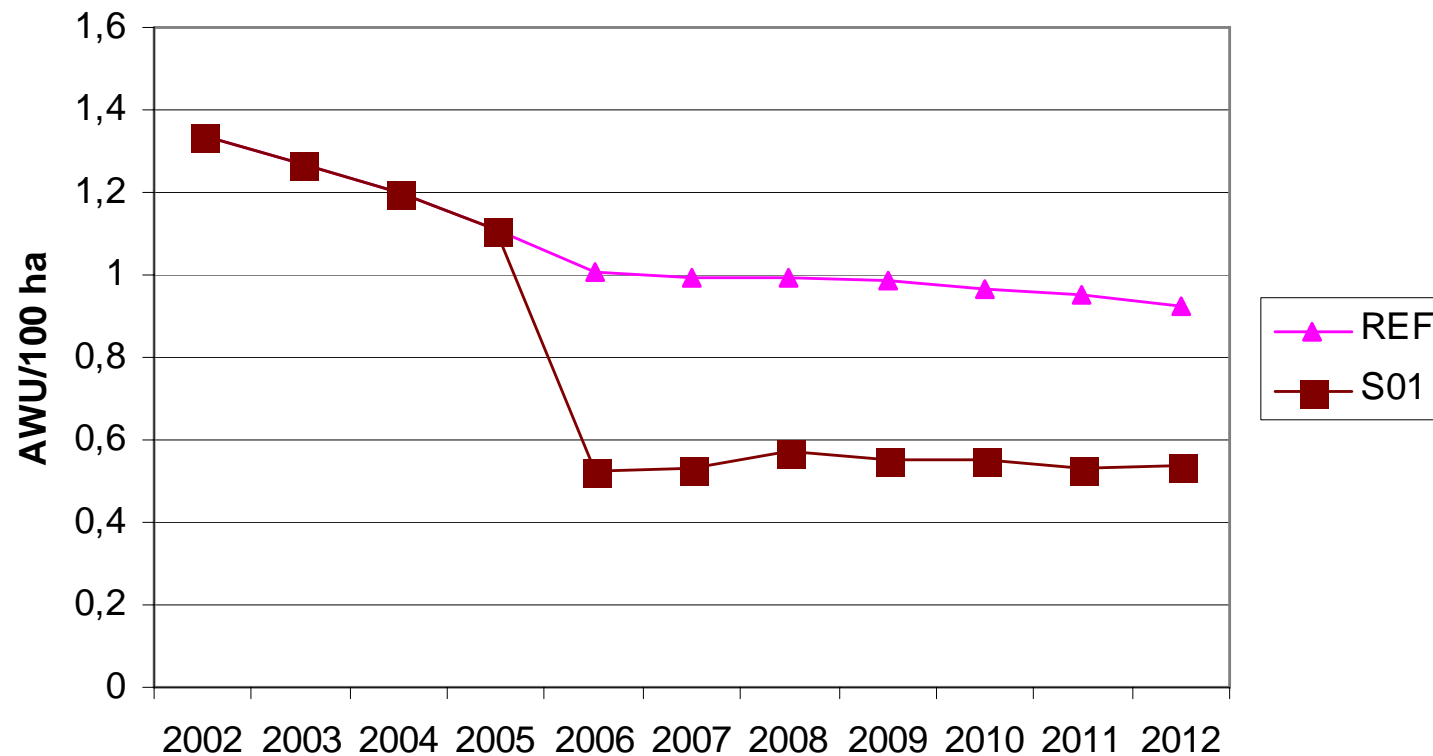
abiotic  
biotic





# Labor effects of AEM

Simulated impacts on average labor input with (REF) and without agri-environment schemes (S01) in a case study region in Germany (Brandenburg)





Thank you!



# Environmental Impact Assessment (EIA)

→ data basis for the environmental impact assessment are the production practices in the region (defined by regional experts)

Country	RegionID	Production practices	Crops	Intensities	Sites
Denmark	1	119	20	2	4
Germany	2	1246	35	2	6
Poland	3	37	14	1	6
Slovakia	4	14	13	1	2
Hungary	5	43	8	2	4
Italy	6	188	25	2	12
France	7	659	14	1	12



## EIA results – Index of Goal Achievement (IGA)

### Indicators:

*Nitrate leaching*

*Skylark*

### Environmental goal:

→ *Lower the risk of nitrate leaching into groundwater*

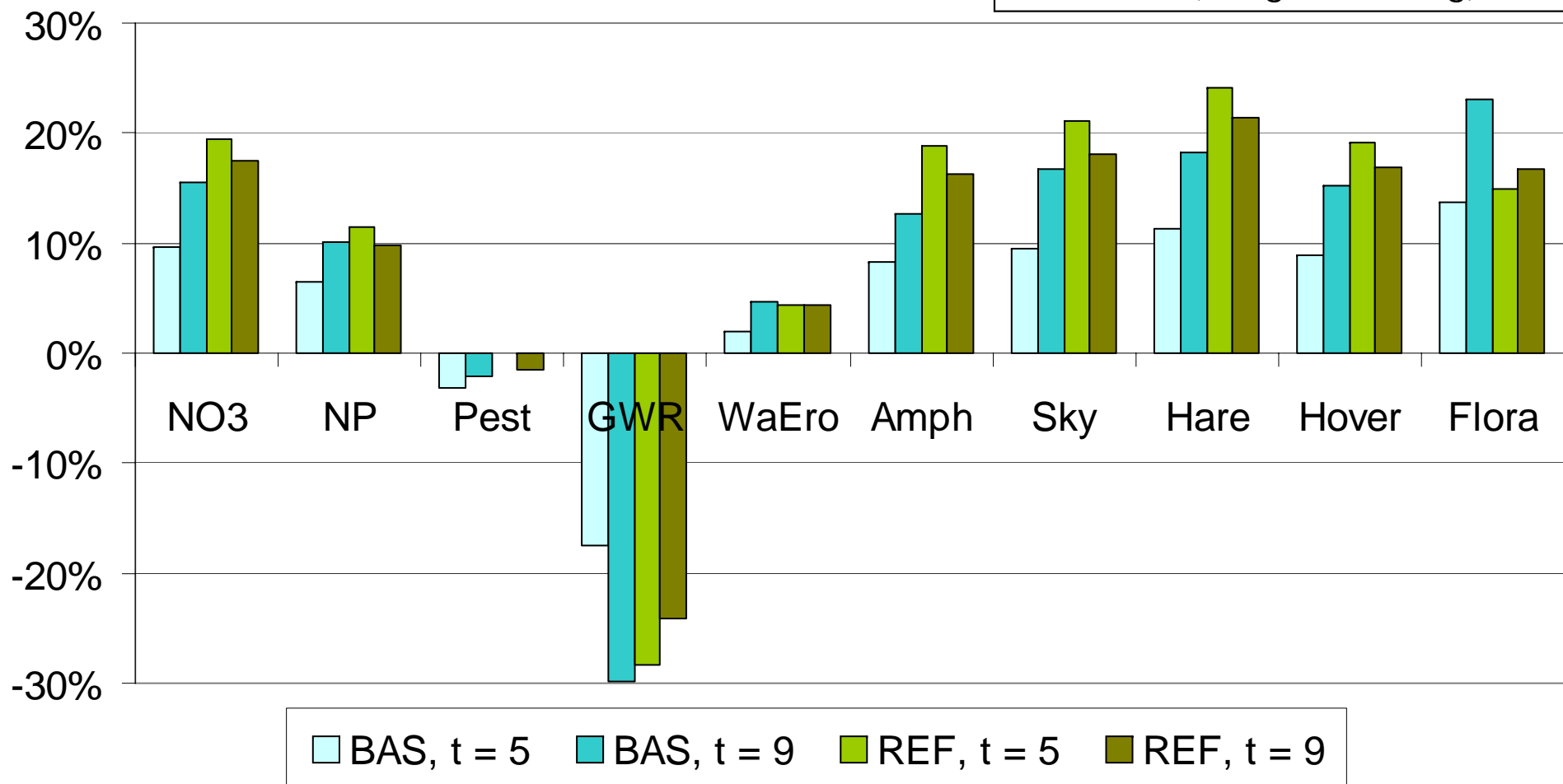
→ *Retain or improve the habitat potential for skylarks*

- IGA is calculated per production practice (PP)
- IGA is a dimensionless index value, ranging between 0 and 1
- IGA indicates a PP's suitability to fulfill a certain goal
- IGA = 0 means low suitability
- IGA = 1 means high suitability
- IGA can be aggregated (per site category, at farm or regional level)

# Change in Average IGA per ha

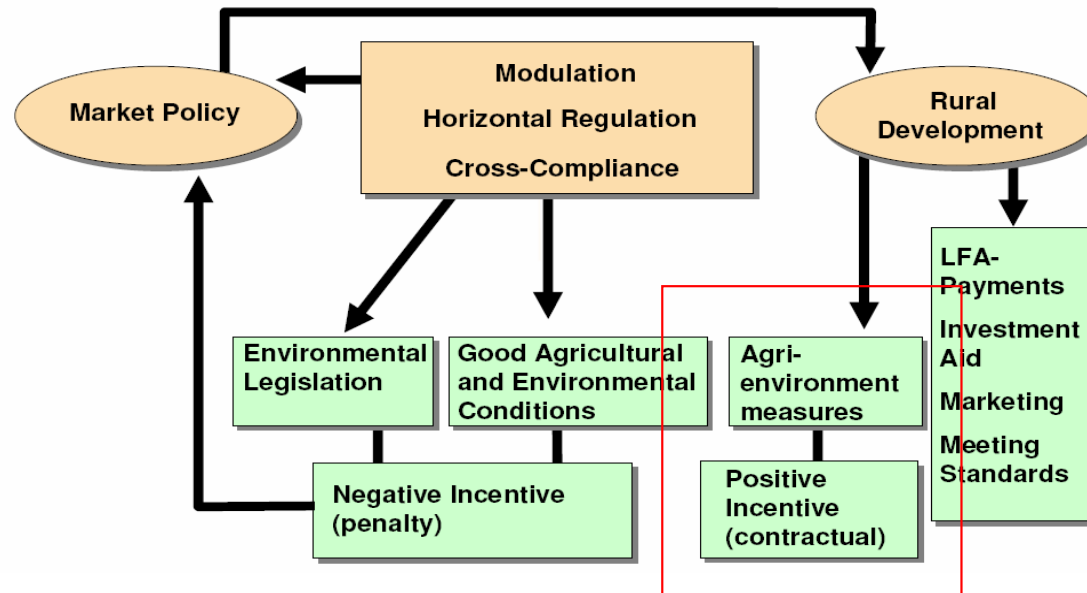
- NO3 = Nitrate leaching
- NP = N/P-entries surface water
- Pest = Pesticide entries water
- GWR = Groundwater recharge
- WaEro = Water erosion
- Amph = Amphibians
- Sky = Skylark
- Hare = Field hare
- Hover = Hover fly
- Flora = Wild flora species (fall germinating)

**Change in Average IGA [%]  
in comparison to baseyear (BAS, t = 0)**





# Why AEM?



*Source: European Commission*

- Negative incentives, such as a permanent conversion of land for the purpose of environmental conservation encounter much more resistance because of economic, legal and psychological reasons
- Positive incentives, such as agri-environmental measures (AEM) are therefore a more preferred instrument