A scenario-wise analysis of economic and environmental indicators

How European Agricultural Policy affects the development of farms

Die Unterschiede zwischen Regionen in Europa müssen bei der Umsetzung von Politikansätzen berücksichtigt werden. Das gilt insbesondere für die verschiedenen Faktoren, die die Landwirtschaft beeinflussen. Durch eine integrierte Modellierung kann die Anpassung politischer Entscheidungen unterstützt werden.

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The demand for publicly documented objective evaluations of policy programmes both ex post and ex ante arises from the need of transparency and justification of policy programmes to the public. Both, efficiency and distributional consequences of political programmes have attracted increasing attention, inducing the development of a variety of evaluative criteria, methods and modelling tools acting at different spatial and temporal scales that are proposed for assessing the suitability of programmes. None of the existing single approaches can lay claim to primacy, all have their advantages and disadvantages. This situation has motivated the European Commission with the Sixth Framework Program to support research projects such as SEAMLESS, SENSOR or MEA-Scope with a focus on model linking and integration (1).

MEA-Scope has chosen a modelling approach that is based on three farm-level models (Piorr et al. 2006; Happe et al. 2006). The agent-based model AgriPoliS simulates the interactions among the farms and their investment decisions, the linear programming model MODAM simulates the cropping and livestock systems of the farms which are the basis for a fuzzy-logic-based environmental impact assessment and, the biophysical model FASSET simulates the nitrogen flow on the farms. The approach usually runs over a time period of ten to 15 years, starting with the initial policy situation of the Agenda 2000 and introducing a new policy always in the forth period. The first three years are always equal in all scenarios; a different development path can only start from year four onwards. The particular advantage of MEA-Scope lies in its dynamic perspective by considering the interactions among the farms and their investment decisions. The approach acts spatially-explicit. Typical farms are spatially located and each farm owns or rents particular plots of land with different soil, climate and elevation characteristics.

This paper compares both economic and environmental impacts of four alternative scenarios with varying policy settings of the first and second pillar of the Common Agricultural Policy of the European Union (CAP). After a brief characterisation of the four regions and an overview of the implemented policy scenarios, both similar and opposite economic and environmental trends will be contrasted along selected indicators, followed by concluding comments.

Case study regions

From the altogether seven MEA-Scope case study regions four regions have been selected for this cross-region comparison. The regions are very heterogeneous with regard to the area they cover, their geo-physical conditions, agricultural practices, and also their socio-economic potentials in terms of off-farm activities, economic growth, labour input and other criteria. Parts of the areas of all regions belong to the Natura 2000 network. The German case study region Ostprignitz-Ruppin (OPR) covers an utilised agricultural area of about 125,000 hectares and is situated in north-eastern Germany, comparably rich in grassland, forests and woodland. The overall landscape structure is versatile including water bodies, heath land and swamp areas. In 2003, the region counted 585 farms with an average farms size of 200 hectares and an average livestock density of 0.5 livestock units per hectare, due to intensive indoor dairy, cattle and pig production, and extensive suckler cows and baby beef production. The Danish region River Gudenå is situated near the city of Viborg in the Western part of Denmark, characterised by numerous lakes. The Region covers the 112,000 hectares river catchment north of Lake Tange, and is charcterised by an intensive agricultural production. In 2002, 1871 farms larger than 1 hectare were situated in the landscape, with an average farm size of around 42 hectares.

The mountainous Mugello territory lies in Tuscany, Italy and covers an agricultural area of 26,000 hectares. It is characterised by small mixed crop-livestock farms with a total number 1237 and an average farm size of 22 hectares, mostly engaged in the total cow-calf line mixed farming. The beef sector is made of traditional farms with forage crops or grassland for grazing. Mountain pastures and permanent grasslands dominate the land-use, followed by fodder crops such as alfalfa and forage sorghum. Important arable crops are grain maize, barley and durum wheat.

The Piestany district is situated in the east-north part of Slovakia and includes 22,000 hectares utilised agricultural area used by a total number of 125 farms with an average farm size of 170 hectares and an average livestock density of 0.43 livestock units per hectare. The region includes various protected areas with

high value flora and fauna and is characterised by a very extensive agricultural management involving extensive dairy, pig and cattle production.

Scenarios and indicators analysed

The development of scenarios involves the identification of main driving forces, the definition of a base and reference year as well as the time horizon and time steps to be analyzed and eventually the scenario results description in a storyline (Alcamo 2001). To identify main drivers of the future development of the CAP, MEA-Scope conducted a participatory approach that involved stakeholders from the seven MEA-Scope case study regions, the end-users of the MEA-Scope tool, thus officials form the European commission, and scientific experts. Four alternative policy scenarios for the European Union resulted, with varying first and second pillar policy settings of the CAP. 2002 was set as base year, the simulations covered a 15 years period.

The baseline scenario (BAS) imitates the Agenda 2000 CAP settings with coupled crop and livestock payments and mandatory set aside obligations (first pillar) in combination with agri-environmental payments and Natura 2000 payments for the adoption of extensive, more environmentally friendly farming practices (second pillar). The reference scenario (REF) reflects the implementation of the current policy framework in the MEA-Scope regions. Each farm receives a lump-sum payment based on its historical payment rates independent from its production level (first pillar). The only condition for eligibility is that farming has to be maintained. The second pillar settings equal the baseline scenario. In addition, two 'liberalisation' scenarios were identified (S1 and S2). Both scenarios assume a complete abolition of direct payments from period four onwards. The only difference between the two scenarios is that S1 offers the same second pillar schemes as BAS and REF, while in S2 both first and second pillar payments are entirely phased out.

Table 1: Overview of analysed environmental and economic indicators

	Indicator	DE	DK	IT	SK
Environmental	Risk of nitrate entries into ground-water (NO_3)	▮	▮	▮	▮
	Risk of nutrient (N/P) entries into surface waters (NP)	▮			▮
	Risk of pesticide entries into ground- and surface waters (Pest)	▮	▮	▮	
	Risk of water erosion (WaEro)	▮	▮	▮	▮
	Habitat potential for red belly toad (amphibians) (Amph)	▮		▮	▮
	Habitat potential for skylarks (field breeding birds) (Sky)	▮	▮		▮
	Habitat potential for wild flora species (winter annuals) (Flora)	▮	▮	▮	▮
Economic	Farm Income per hectare	▮	▮	▮	▮
	Farm size in hectare	▮	▮	▮	▮
	Livestock units per hectare	▮	▮	▮	▮
	Participation in 2nd pillar programs [%]	▮	▮	▮	▮
	Share of income from 2nd pillar programs [%]	▮	▮	▮	▮

Source: www.mea-scope.eu

The definition of a set of suitable multifunctionality indicators was one of the major challenges within the MEA-Scope project. From an extensive indicator list, the indicators in Table 1 have been found to be relevant in the four regions (Waarts 2005).

To represent the environmental dimension, altogether three abiotic and three biotic indicators have been chosen, not all of which are relevant to all regions depending on the region-specific characteristics. The impact assessment for these indicators makes use of expert-knowledge that is processed with the help of fuzzy-logic and results in Indexes of Goal Attainment, shortly IGA per hectare (Sattler et al. 2006). To cover the economic dimension in this analysis, indicators such as farm size, farm income per hectare, livestock densities per hectare have been analysed, as well as second pillar-progam participation and the share of income created from this.

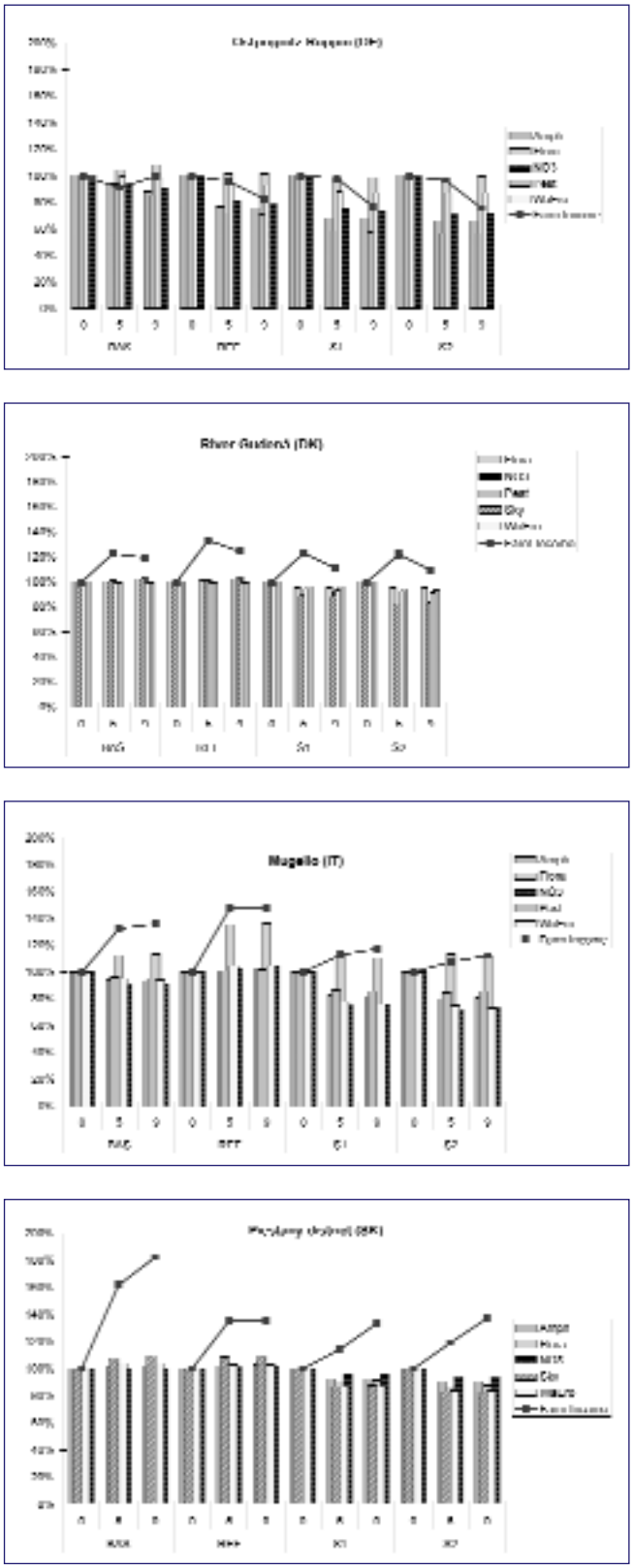
Environmental effects and farm income

Figure 1 shows the change of the considered indicators in all scenarios compared to the baseline situation (period 0). The blue line always shows the change in average farm income per hectare, while the vertical bars represent the change of the environmental indicators. All four scenarios are presented side by side, with three selected time steps for each scenario to compare with the initial situation (period 0) short-term and medium-term effects (period 5 and 9).

For all regions, five environmental indicators were selected from table 1 according to the regional ranking priorities: NO3, the Risk of nitrate entries into groundwater; Flora, the Habitat potential for wild flora species; WaEro, Risk of water erosion are relevant to all four regions, while Amph, the Habitat potential for amphibians; Sky, the Habitat potential for skylarks and Pest, the Risk of pesticide entries into ground- and surface waters are only relevant to some of the regions.

The most drastic changes could be observed in the German region Ostprignitz-Ruppin, where both environmental and economic indicators face a strong decrease in the liberalisation scenarios S1 and S2. From the initially 585 farms only 44 farms survived in period nine of the worst-case scenario S2 and the average farm size increases by 138 hectares. The average farm income of the remaining farms is reduced by more than 20 percent in period nine in the S2 scenario. The income in S1 is slightly less because of the income from the second pillar programs. At the same time an overall agricultural intensification takes place, expressed for example in the worse performance of the environmental indicators Pest with minus 45 percent, Amph with minus 34 percent, NO3 with minus 27 percent and WaEro with minus 12 percent. Although the stocking densities are reduced in S1 and S2 (see Figure 2), this reduction concerns exclusively the extensive animal husbandry types such as suckler cows and extensive beef cattle, while intensive dairy and pig production prevail. ➜

Figure 1: Change of Index of Goal Attainment compared to the change of average farm income



Source: www.mea-scope.eu

A continuation of the Agenda 2000 conditions would have been the most favourable from the economic perspective of the farms. The average farm income stays on the highest level of all scenarios with even a slight increase in period nine. All other scenarios lead to a worse economic situation. The short-term effects of the policy change, as seen in period 5, are nearly equal in REF, S1 and S2 with five to seven percent decline. In the same time the medium-term effects in period nine are the most drastic in S2.

The Danish region River Gudenå reacts entirely different. The environmental performance in this region is much less sensitive to the drastic policy changes of the scenarios. Selected environmental indicators remain unchanged in both the BAS and the REF scenario, but even in the liberalisation scenarios only a slight decrease could be observed. In the worst-case scenario from the farm perspective, the period 9 in scenario S2, the average farms size increases while the number of farms is cut in half. The economic situation of the remaining farms expressed by the average farm income per hectare increases directly after the policy changes to then decline again later in period 9 (see Figure 1).

In environmental terms, the Italian region Mugello reacts similar to the German region. All environmental indicators face a considerable decline, in particular in the liberalisation scenarios. The only environmental indicator benefiting from the liberalisation scenarios is Flora, the habitat potential for wild flora species, namely winter annuals, at least in relative terms. This indicator strongly depends on the share of winter crops in the cropping pattern while a higher share of spring crops and perennials provide much less favourable conditions. Since the liberalisation scenarios lead to a drastic reduction of extensively management grassland, that is perennials, the average risk for this indicator declines. As seen in Figure 2, the average farm size increases only slightly with two hectares at most, while the number of farms is cut in half (period 9 in S2).

Slovakia, the only accession country in this analysis joined the European Union in 2004. Therefore, a classic baseline scenario based on Agenda 2000 payments is not existent for the Piestany District. Instead specific scenario settings had to be defined to imitate the transitional accession period with yearly increasing payment rates to the current level. These special settings explain the considerable increase in average farm income in the BAS scenario with an increase of 85 percent at most. In the liberalisation scenarios (S1 and S2), a strong increase of average farm size can be observed in Figure 1, accompanied by a corresponding decrease of the number of farms. The environmental performance in this rather extensively managed region is not very sensitive to the different scenarios, but stays always on a high level in both absolute and relative terms.

Participation in second pillar programs

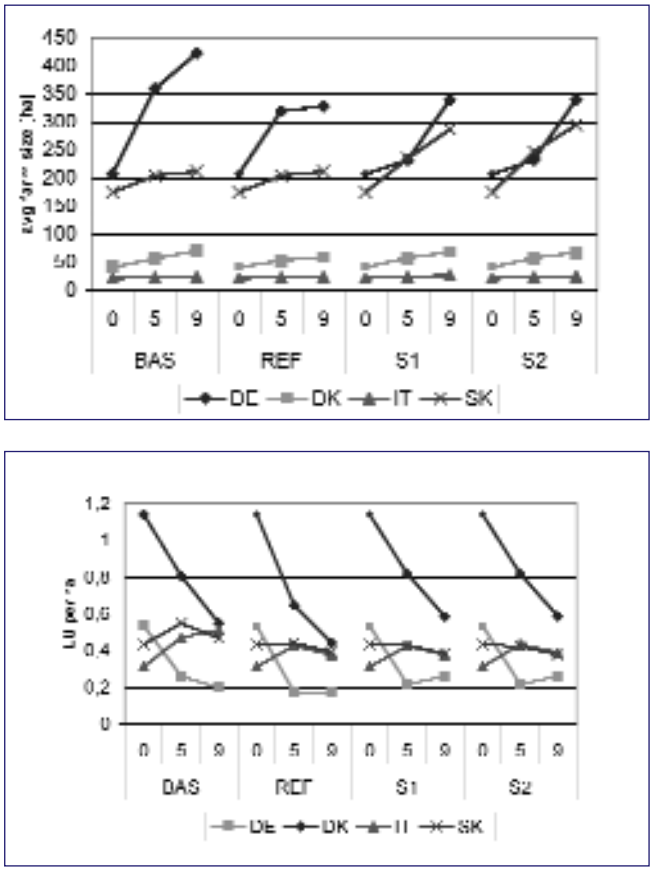
An removal of direct payment as in the scenarios S1 and S2 leaves room for the assumption that the farms will look for other sources of income to compensate the resulting losses. A pos-

sible alternative income source can be the participation in second pillar programs. These programs remunerate farmers for the adoption of extensive, more environmentally friendly farming practices. Especially, smaller farms with a large share of grassland in the total utilised agricultural area are potential participants of such programs, while big mixed but also specialised farms often have other options to cope with upcoming challenges (for example increase of farm size or off-farm activities). In the base year the participation in second pillar programs ranges from 8 percent in Denmark to 51 percent in Germany of all farms in the regions. This can be seen in Figure 3. The absolute value however is only of limited interest as it is directly dependent on the share of available grassland and Natura 2000 areas in the regions. More relevant is how this share changes over time in the different scenarios. In the German region, with the highest initial participation in Figure 3, the change is always negative in all scenarios as a result of structural change towards less and bigger farms suppressing smaller farms with extensive cattle production, the latter being a major potential target group for the second pillar programs. From the remaining farms, only a lower share chooses second pillar participation over pure market orientation in the S1 scenario. However, although the absolute farm participation in S1 declines, the share of income of these farms coming from the second pillar, both agri-environmental payments and Natura 2000 payments, increased.

In the Danish and in the Slovakian region, in particular in the S1 scenario, the share of participating farms increases, in Denmark by five percent and in Slovakia by twelve percent in period 9. This development is accompanied by an increased share of income from the second pillar. In both regions, much less grassland and Natura 2000 area is taken out of production compared to Ostprignitz-Ruppin.

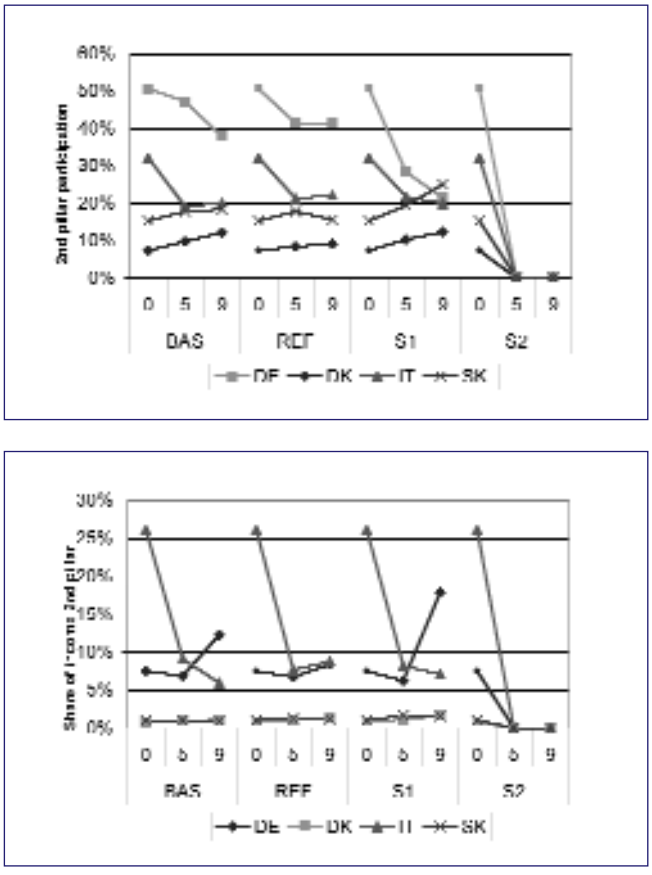
In the Italian region, the opposite behaviour can be observed, as seen in Figure 3. Starting with an initial relatively high participation rate of 33 percent, period 5 in all scenarios is characterised by a drastic decline in participation to a rate of 19 percent slightly recovering in period 9 in BAS and REF. In the S1 scenario the participation is further going down as a result of a huge loss of grassland and Natura 2000 areas despite the overall increase of livestock density reflecting a trend towards more intensive indoor livestock husbandry types, which can be seen in Figure 2. For the remaining participating farms, the share of income coming from the second pillar is decreasing over time, for example from 26 percent in period 0 to only 6 percent in period 9 of the BAS scenario. ➜

Figure 2: Average farm size and livestock units per hectare



Source: www.mea-scope.eu

Figure 3: Participation in second pillar programs and share of income from second pillar (participating farms only)



Source: www.mea-scope.eu

Conclusions

A major objective of the MEA-Scope approach is to analyse and assess the effects of alternative policy options on the economic, social and environmental performance of individual farms in seven European case study regions. All four case study regions experienced the impacts of structural change expressed by a decreasing number of farms over time and an increase of average farm size. Both effects were more pronounced in the two liberalisation scenarios (S1 and S2) compared to the two direct-payments-scenarios (BAS and REF). Also the farm composition changed, as particularly beef-producing farms were very sensitive to the abolition of livestock specific direct payments. From the environmental perspective, we could observe that in all scenarios the biotic indicators were much more sensitive than the abiotic indicators as their performance is directly related to the use of grassland. If grassland falls out of production or is used more intensively, for example in the S2 scenario in all regions, the situation for the biotic indicators gets worse. A comparison of the S2 and the S1 scenario shows that in this situation the introduction of second pillar programs, such as agri-environmental measures or a grassland-related Natura 2000 program, to some extent can act as a corrective. The offered measures could improve the overall biotic situation despite of also some negative impacts on single indicators. Particularly the REF scenario, designed as an implementation of the current Common Agricultural Policy framework of the European Union, led to an intensification on arable land as a result of a stronger market-orientation of the farms but also to an extensification on grassland as a result of the reduced stocking numbers. This farm behaviour is directly reflected in the environmental risks. On arable land, the REF scenario caused an environmental deterioration while on grassland the decoupling of payments in combination with the introduction of grassland-related-cross-compliance standards produced relief compared to the baseline scenario (Uthes et al. 2007).

The greatest income losses occurred in the German region, while the Slovakian region located in the only accession country experienced a strong increase in average farm income in all scenarios. At the same time, the participation in second pillar programs in the German region decreased while the share of income coming from this source increased. In contrast, in the Slovakian region the participation rates went up accompanied only by a moderate increase in the share of income from the second pillar. In the Danish and the Italian region all scenarios led to an increase in average farm income in the short term. While in Italy this trend further continued, the Danish farm income eventually declined again. Although the liberalisation scenarios affected the participation in second pillar programs, the share of second pillar income in Denmark remained constant and even decreased in Italy.

In conclusion, the numerous analyses conducted within the MEA-Scope project demonstrate how much the heterogeneity between European regions matters. A broad-brush implementation of policy measures, which is usually favourable from a monitoring and administration perspective, takes not adequate account of the huge geo-physical but also socio-economic diversity and dynamics that characterise European regions.

Annotations

(1) Die Internetseiten der Projekte sind: www.seamless-ip.org, www.sensor-ip.eu, www.mea-scope.org

Literature

Alcamo, J.: Scenarios as Tools for international environmental assessments, Environment Issue Report 24, Experts Corner report Prospects and Scenarios No 5. 2001.

Happe, K. / Damgaard, M. / Osuch, A. / Sattler, C. / Zander, P. / Uthes, S. / Schuler, J. / Piorr, A.: CAP-reform and the provision of non-commodity outputs in Brandenburg. In: German Journal of Agricultural Economics 55, 5-6/2006. S. 268-279.

Piorr, A. / Müller, K. / Happe, K. / Uthes, S. / Sattler, C.: Agricultural management issues of implementing multifunctionality: commodity and non-commodity production in the approach of the MEA-Scope project. In: Mander, Ü. (Hrsg.) Multifunctional land use: meeting future demands for landscape goods and services, Berlin 2007. S. 167-181.

Sattler, C. / Schuler, J. / Zander, P.: Determination of Trade-off-functions to analyse the provision of agricultural Non-commodities. In: International Journal of Agricultural Resources, Governance and Ecology 5, 2-3/2006. S: 309-325.

Schader, C. / Stolze, M. / Moschitz, H.: Case study on regional differences in social demand on commodity and non-commodity concerns, MEA-Scope Project report series 6/2007.

Uthes, S. / Sattler, C. / Reinhardt, F.-J. / Piorr, A. / Zander, P. / Happe, K. / Damgaard, M. / Osuch, A.: Ecological effects of payment decoupling in a case study region in Germany. In: O'Reilly, S. (Hrsg.): Proceedings of the 16th International Farm Management Association Congress: a vibrant rural economy - the challenge for balance, University College Cork, Ireland, 15-20 July 2007. S. 761-770.

Waarts, Y.: Indicators for the quantification of multifunctionality impacts, MEA-Scope Project report series 4/2005. Internet: http://www.zalf.de/home_meascope/website/publications/mea-scope_vol4_indicators_for_multifunctionality.pdf

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