ENVIEVAL

Development and application of new methodological frameworks for the evaluation of environmental impacts of rural development programmes in the EU

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Area 2.1.4: Socioeconomic research and support to policies

KBBE.2012.1.4-08: Development and application of methodologies and tools, including indicators, for the assessment of environmental impacts of rural development programmes in the EU

Report D2.1

Summary report on the review of indicator sets and monitoring approaches

Appendix B

List of recommended indicators for measures that lack of indicators per public good

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SEVENTH FRAMEWORK PROGRAMME

Appendix B

List of recommended indicators for measures that lack of indicators per Public Good

List of Tables

Table B1 Indicators for Climate Change Mitigation

Setting up of farm management/advisory services (115)

Indicator	Causal chain	Scale	Data	Comment
Contribution to combating climate change: Increase of production of renewable energy from agriculture and forests	Fight against climate change through the growth of the production of renewable energy.	Nuts1	Number of projects.	Projects which focus on the production of renewable energy
Number of farmers who use advisory services for climate change mitigation	Indirect impact on sustainable management practices and cross compliance requirements.	National	Number of farmers who use advisory services for climate change mitigation, amount of payments realised.	

Improvement of the economic value of forests (122)

Indicator	Causal chain	Scale	Data	Comment
Contribution to combating climate change: Increase of production of renewable energy from agriculture and forests	Fight against climate change through the growth of the production of renewable energy.	Nuts1	Number of projects.	Projects which focus on the production of renewable energy from forestry
UAA devoted to energy and biomass crops (non-food set aside + energy crops + short rotation coppice on UAA)	Larger territories used for bioenergy production indicate positive effect on climate change mitigation.	National	Area under the measure	
Production of energy from renewable sources (Toe) and GHG emission reduction (Mg CO_2 eq/year)	The aim of the measure is to decrease the GHG emissions.	Regional	IACS, GIS data, Corine land cover, results of business surveys for the structural measures. Parameters and data taken from literature, National and International agencies (IPCC). Annual data.	
Increase in C sequestration	For the calculation of C sequestration through afforestation a model developed to Hungarian circumstances (Casmofor 3.0 model) has been used. The model takes into account forestry tending and timber production models for the individual species as its basis to determine C sequestration, including also natural dieback, decay and the impact of forestry technology. The data which provided the basis for the calculations was the land data for the individual types of tree stocks. In the model, the main species were given as the type of tree stocks.	National	Forestry data, IACS.	
Increased renewable energy production	Implementation of renewable energy use from agricultural	Regional	Data from AVEPA (Paying Agency),	

	sector. In addition to the SRF (Short-Rotation Forestry), such as poplar or eucalyptus, it is important to highlight the potential arising from the construction of power plants for co-firing, such as coal and fuel from renewable sources.		ISTAT (National Statistical Office), APAT (Agency for the environmental protection).	
Sequestration of CO_2 (tonnes per year and tonnes per life time of biomass)	The growing trees affect the volumes of CO_2 captured. Therefore support to artificial or natural reforestation activities which results in new forests impacts on CO_2 emission balance.	Measure	Area of afforestated land, coefficients of CO_2 sequestration for living and dead biomass of trees. It seems that a special study/estimation has been made.	

Cooperation for development of new products, processes and technologies (124)

Indicator	Causal chain	Scale	Data	Comment
Contribution to combating climate change: Increase of production of renewable energy from agriculture and forests	Fight against climate change through the growth of the production of renewable energy.	Nuts1	Number of projects.	Projects which focus on the production of renewable energy
Number of beneficiaries - enterprises processing plant materials into products used for energy purposes	Investments under this measure could have an indirectly impact on environmental protection, i.e. through the purchase and installation of equipment the protection of the environment is improved.	Regional	Number of beneficiaries, area covered by the measure, amount of payment realised.	

Improving and developing infrastructure related to the development and adaptation of agriculture and forestry (125)

Indicator	Causal chain	Scale	Data	Comment
Contribution to combating climate change: Increase of production of renewable energy from agriculture and forests	Fight against climate change through the growth of the production of renewable energy.	Nuts1	Number of projects.	projects which focus on the production of renewable energy

Supporting farmers who participate in food quality schemes (132)

Indicator	Causal chain	Scale	Data
Calculation of humus balance (CO_2 balance)	Increase of humus content in soil. The reduced/improved fertiliser application has positive effects on the C balance in the soil contributing to reduction of GHG emissions by the maintenance and accumulation of organic C and reduction of N_2O emissions.	Regional and national	
Extend of additional CO_2-fixation in agricultural used soils (t ha-1 a-1) on sites with organic agriculture	Maintenance or increase of humus content in the soil. AEMs contribute to the protection or increase of the sequestration of CO_2 in the soil, also promote land-use that could lead to reduced emissions of GHG or NH_3 compared to conventional land-use.	Farm level, data analysed at regional	IPCC-Guidelines, Freibauer et al. (2004). The VDLUFA Method (VDLUFA, 2004) is used, without considering the supply of farm fertiliser.

		level	
Reducing emissions of N from mineral fertilisers	The emission coming from the agriculture fertilization represents one of the highest emissions productions from the agriculture, the objective is to decrease the GHG emissions.	Regional	IACS data. Results of previous analysis of impact. Results of business surveys for the structural measures. Parameters and data taken from the literature and from national and international agencies (Institute for Environmental Protection and Research-ISPRA, IPCC).

Natura 2000 payments (213)

Indicator	Causal chain	Scale	Data
Balance carbon with mathematic model CENTURY	Estimation of carbon sequestration on area covered by the measure. Balance carbon is better on area covered by the measure.	National	Area covered by the measure.
Change in annual regional emissions of GHG in the agricultural sector (N_2O from fertilization and C sink in forest biomass)	Emissions coming from the agriculture fertilization represent one of the highest emission productions from the agriculture. Since the proposed CMEF indicator doesn't capture the GHG emissions, the additional impact indicator is built in order to be a more complex and complete indicator for the GHG reduction.	Regional	Data from AVEPA (Paying Agency), ISTAT (National Statistical Office), APAT (Agency for the environmental protection). Secondary data from the FADN database-REA for the counterfactual analysis.
Livestock density LU/ha UAA	Area covered by the measure and number of beneficiaries have a significant impact on climate change. Extensive farming systems (less LU density/UAA) and rational fertiliser application (less than average use means of production- e.g. less pesticides, fertilisers, petroleum) contribute to GHG emissions.	National	Qualitative data of livestock density LU/ha UAA
Production of energy from renewable agricultural sources		Regional	IPCC data
Production of energy from renewable sources (Toe) and GHG emission reduction (Mg CO_2 eq/year)	The aim of the measure is to decrease the GHG emissions.	Regional	IACS, GIS data, Corine land cover, results of business surveys for the structural measures. Parameters and data taken from literature, National and International agencies (IPCC). Annual data.
Reducing emissions of N from mineral fertilisers	The emission coming from the agriculture fertilization represents one of the highest emissions productions from the agriculture, the objective is to decrease the GHG emissions.	Regional	IACS data. Results of previous analysis of impact. Results of business surveys for the structural measures. Parameters and data taken from the literature and from national and international agencies (Institute for Environmental Protection and Research-

			ISPRA, IPCC).
Reduction of NH_3 emissions through low-loss fertiliser and liquid/biogas manure application	Indicator comes from a study for the NH_3 losses during the application of farm fertiliser related to the sub-measure "minimal loss application of farm fertiliser and biogas manure". The application of mineral fertiliser causes CO_2 and N_2O emissions. Through improved application the emissions of NH_3 and thereby N_2O are reduced. The calculation of reduced emissions is based on the share of farm fertiliser that was applied close to the ground in 2009. A reduction about 30% of NH_3 emissions is assumed by close to the ground application.	Regional and national	Share of close-to-the-ground fertiliser application, data from TIHALO Study (Amon et al., 2007), INVEKOS
Amount of emission reduction of CO_2, CH_4, N_2O, NH_3 from agriculture through AEMs (GG a-1)	A reduction of N-fertiliser application leads to a reduced emission of N_2O. NH_3 contributes through the release of N to the eutrophication and acidification of soils.	Farm level, data analysed at regional level	Emission factors from the NIR based on literature analysis and international agreements, impact of measures are based on estimations from a literature analysis. Emissions from N-fertiliser application of agricultural land use and emissions from non-fertilised agricultural areas (indirect emissions from N-deposition and eroded and drained N from agriculture).
Calculation of humus balance (CO_2 balance)	Increase of humus content in soil. The reduced/improved fertiliser application has positive effects on the C balance in the soil contributing to reduction of GHG emissions by the maintenance and accumulation of organic C and reduction of N_2O emissions.	Regional and national	
Extend of additional CO_2-fixation in agricultural used soils (t ha-1 a-1) on sites with organic agriculture l	Maintenance or increase of humus content in the soil. AEMs contribute to the protection or increase of the sequestration of CO_2 in the soil, also promote land-use that could lead to reduced emissions of GHG or NH_3 compared to conventional land-use.	Farm level, data analysed at regional level	IPCC-Guidelines, Freibauer et al. (2004). The VDLUFA Method (VDLUFA, 2004) is used, without considering the supply of farm fertiliser.
Agricultural land area supported	Impact assessment is based on evaluation question.		Number of management contracts (output) & area of maintained landscape (results), survey among beneficiaries and interviews with experts.
Achievement of environmental objective: Climate change mitigation = Area to be contributing to Climate change mitigation in the specific action (ha) X % financial uptake for this action.	The calculation of the area under climate change mitigation action as a function of the proportion of the financial uptake and the programmed target area is provided as an estimation of the impact. Furthermore reduction in use of agrochemicals and machinery results to an overall reduction of indirect GHG emissions.	Action	Financial uptake, targeted area.

First establishment of agroforestry systems on agricultural land (222) - Natura 2000 payments (224)

Indicator	Causal chain	Scale	Data
Contribution to combating climate change: Increase of production of renewable energy from agriculture and forests	The aim of the measure is to decrease the GHG emissions.	Regional	IPCC data.
	The aim of the measure is to decrease the GHG emissions as one of the action of the fight against climate change.	Programme (PDRH)	RICA data.
			Declarations (Ha of supported area)
Net carbon storage with fossil origin, storage between the 2000-2012 thanks to assistance (millions of tons/year)	Less environmental impact thanks to the carbon storage.	Regional	Regional maps, agricultural land use, data from ISTAT (Statistical Institute). Annual data.
	Less environmental impact thanks to the carbon storage.	Regional	Data from AIEL (Italian Association for Agroforestry Energy), data related with Short rotation forestry, due to the irrelevant carbon fixation (Reg 2080/92).
Increase in C sequestration	For the calculation of C sequestration through afforestation a model developed to Hungarian circumstances (Casmofor 3.0 model) has been used. The model takes into account forestry tending and timber production models for the individual species as its basis to determine C sequestration, including also natural dieback, decay and the impact of forestry technology. The data which provided the basis for the calculations was the land data for the individual types of tree stocks. In the model, the main species were given as the type of tree stocks.	National	Forestry data, IACS.
Sequestration of CO_2 (tonnes per year and tonnes per life time of biomass)	The growing trees affect the volumes of CO_2 captured. Therefore support to artificial or natural reforestation activities which results in new forests impacts on CO_2 emission balance.	Measure	Area of afforestated land, coefficients of CO_2 sequestration for living and dead biomass of trees. It seems that a special study/estimation has been made.
CO_2 fixation of afforestated areas (t CO_2/year/ha)	Increased carbon sequestration through afforestation.	Regional	Literature analysis (e.g. Paul et al. 2009)
Reduction of CO_2 emissions equivalent thanks to the program	The aim of the measure is to decrease the GHG emissions. Since the proposed CMEF indicator doesn't capture the GHG emissions, the additional impact indicator is built in order to be a more complex indicator for the GHG reduction.	Regional	Source AVEPA (Paying Agency), ISTAT (National Statistical Office), APAT (Agency for the environmental protection) Acquisition of secondary data from the FADN database-REA The information resulting from the FADN database-REA are used for the counterfactual analysis.
Area of agricultural land converted to forest	Impact assessment based on EU evaluation questions. Forests contribute to carbon sequestration and renewable resources.		Analysis of management agreements, monitoring output indicators and survey/interviews with experts.

UAA devoted to renewable energy production (thousand ha)	The additional impact indicator is built in order to be a more complex indicator for the GHG reduction.	Programme level (PDRN)	Data from Paying Agency and Agency for the environmental protection
	The objective of the measure is to increase the land use devoted to renewable energy and the indicator measures this UAA.	Programme level (PDRH)	Annual data from RICA
Achievement of environmental objective: Climate change mitigation = Area to be contributing to Climate change mitigation in the specific action (ha) X % financial uptake for this action.	The calculation of the area under climate change mitigation action as a function of the proportion of the financial uptake and the programmed target area is provided as an estimation of the impact. Furthermore reduction in use of agrochemicals and machinery results to an overall reduction of indirect GHG emissions.	Action	Financial uptake, targeted area.

Encouragement of tourism activities (313) - Conservation and upgrading of the rural heritage (323)

Indicator	Causal chain	Scale	Data
Reduction of CO_2 emission (equivalents)	The production of the renewable energy sources substitutes the use of fossil resources. Support is given to produce renewable energy sources. It seems that a special study/estimation has been made.	Measure	Produced RES (Ktoe/y)

Table B2 Indicators for Biodiversity-Wildlife

Setting up of farm management/advisory services (115)

Indicator	Causal chain	Scale	Data
Number of farmers who use advisory services for sustainable land management and sustainable land management of natural resources	Indirect impact on sustainable management practices and cross compliance requirements.	National	Number of farmers who use advisory services for sustainable land management and sustainable land management of natural resources, amount of payments realised.

Improvement of the economic value of forests (122) - Improving and developing infrastructure related to the development and adaptation of agriculture and forestry (125)

Indicator	Causal chain	Scale	Data	Comment
Number of farm holdings that received investment support in LFAs, NATURA 2000, Nitrates Directive areas		National	Number of beneficiaries, amount of payments realised.	Specify for NATURA 2000 and HNV
Level of improvement of the overall performance of the agricultural holdings (competitiveness, sustainability and protection of environment)	One of the objectives of the measure is to improve the environmental protection. From the survey, conducted during the MTE with 279 beneficiaries, 30 % of them reported that investments are indirectly related to the protection of biodiversity and 39% declared that there is a significant improvement of nature preservation and preservation of biodiversity.	National	Number of holdings supported and number of holdings in livestock breeding, number of farms meeting the requirements of the nitrate Directive 91/676/EEC were used as additional indicators. Survey results.	Specify for Biodiversity related
Reversing biodiversity decline (FBI)	The use of farmland bird indicators as a (sole) biodiversity indicator is based on the concept of umbrella species. AEMs and their prescriptions maintain and improve land use, habitat and landscape elements which support a high biodiversity and are important parts of suitable bird habitats.	National, differentiating between different agricultural land use systems, area designations	FBI data	

	Different versions of the farmland index, including European, Latvian, Boreal protected species. Additional indicators give supplementary information.	National, Natura 2000 sites	National monitoring of birds and additional inventories.	
	For the reversal of biodiversity decline analysed how the general environmental condition of farms has been preserved or improved due to the application of AES requirements, considering their habitat function and if the organic farming facilitates biological diversity. According to the survey on bird species richness, abundance and population density, the potential indirect positive impact of various types of AE support cannot be underestimated despite the lack of aid type impact. Without the agricultural support, many habitats necessary for open field birds may remain fallow and overgrow with woods, resulting irreversible loss of habitat for these species.	Monitoring in 3 regions	Data from 3 transect counts (May-June). Bird monitoring data, using Shannon diversity index (number of nesting species as well as diversity), number of nesting species on farmland, total population of nesting birds (number of nesting specimens).	
		Nuts3	Counting, case study of 55 follow-up areas across the country	
	The impact indicator is related to the species diversity. Common bird indicators are commonly used for synthetic comparisons. The bird populations are recognised as excellent bio-indicators as they reflect an overall quality of the environments in which they live.	Regional	IFEN, evolution of the bird population in forest	
	The report refers to a study from Vetter and Storch (2009), which showed that the umbrella function was effective for 50% of the examined farmland bird species while one third showed a negative result. Overall, the report concludes the farmland birds respond to changes in agricultural land management, but the umbrella effect on other species and habitats requires further examinations. Structural changes in agriculture and changes in land management practices affect the suitability of the habitats for birds, e.g. field margins as breeding habitat for birds, which is reflected in a decline of the FBI. RDP measures such as creation of field margins improve the suitability of the habitat for birds.	Regional, programme	FBI data, IACS and payment data	
	Biodiversity abundance and diversity of birds species	Regional	Data from IACS, LPIS and GIS.	

Amphibian - species diversity and abundance	The CMEF impact indicator FBI is not sufficient to assess measure-specific impacts on biodiversity. Amphibians are an important animal group for farmland biodiversity and many amphibian species are threatened by habitat loss. The measure 214 promotes the maintenance and creation of suitable habitats and biotopes for amphibians. Changes in the diversity and abundance of amphibians thus provide one measure or indicator for the (potential) biodiversity impacts of measure 214.	10 pilot areas	Species data from monitoring of trial areas, annually	
Indicator plant species	Rare and protected plant species are an important indicator for the ecological quality and biodiversity of grasslands. The number and abundance of these plant species often depends on the (timing of) certain management activities of meadows. The measure 214 promotes the maintenance and creation of suitable meadow habitats for plant species diversity. Changes indicator plant species thus provides an indicator for the (potential) biodiversity impacts of measure 214. The CMEF impact indicator FBI is not sufficient to assess measure-specific impacts on biodiversity.	119 trial areas with and without support covering different land use and habitat types	Monitoring data of trial areas, annually. Trials are done in three different regions of agriculturally used habitats.	
Changes of population of great bustard (Otis tarda) related to AEMs	Specific AEMs aim to the protection of great bustard population. Through actions aimed at special crop rotation, winter forage, nest protection and an overall habitat management for the great bustard (which is based on former surveys and experiences) an increase of the population is expected.	National, HNVs involved in great bustard protection	Population census data	
Composition of tree species	The indicator has been modified taking into account soft and hard broadleaves and conifer trees. Maintaining species composition within the natural variability is an important aspect to conserve biodiversity. Furthermore, maintaining species composition typical of the range of natural variation enables the ecosystem to respond and recover from disturbance. A productive and resilient ecosystem is sustainable and is capable of providing the many products and services desired by the public.	National		

Trend in protection of vulnerable non-commercial (i.e. non-traded forest products) species/varieties of flora & fauna on land subject to assisted actions (description, e.g., number of different species/varieties affected and where possible change in the abundance of key species)	Improvement of biodiversity in agricultural areas.	Regional	Data come from the Land use CENSUS (1998-2005)	
Area planted/ regenerated/ improved with indigenous tree species (ha) -of which in mixture -of which providing in situ conservation of genetic resources	The indicator is related to species diversity.	Regional	Data come from the Land use CENSUS (1998-2005)	
Area under successful land management contributing to biodiversity and HNV farming/forestry	Reference to 'ecological functions' of forests including the prevention of forest fires, but without reporting on concrete biodiversity-related impact indicators.	Scales range from the forest to the English national.	Result indicator for biodiversity and High Nature Value Forest, indirect and secondary literature (Quine & Watts, 2007), countryside surveys on biodiversity.	
Status of higher plants (quality of grasslands)	Quality of grasslands is higher in maintained areas.	Case study in 18 sites covering all 5 regions	Investigation in a case study area.	
Number and diversity of day butterflies.	The properly maintained grasslands host higher number of butterflies compared to non-managed grasslands.	Case study in 18 sites covering all 5 regions	Investigation in a case study area.	
Number of ground beetles' species and abundance of ground beetles (Carabidae sp.)	Number of ground beetles is higher in organic farms than in conventional areas.	Case study (crop fields) in Latgale region	Investigation in a case study area.	

Reversal in biodiversity decline: Diversity and abundance of bumblebees.	The diversity of species of bumblebees and Shannon diversity index is higher in areas under actions of organic production and environmentally friendly management. Although for the abundance of bumblebees such trends is not observed.	National	3 transect counts during June-August.	
Reversal in biodiversity decline: Structure of vascular plants community, species richness and coverage	The survey of structure of vascular plants, species richness and coverage showed that the flora diversity of field edges decreased slightly in the field edges of monitoring farms under actions of environmentally friendly management and organic production.	National. Monitoring farms	15 monitoring units per field (5+5 opposite edges, 5 on field).	
Reversal in biodiversity decline: Species richness and abundance of earthworms and the activity of soil biomass	The indicator analyse the extent and direction of changes in the composition of species (especially for tolerant and adapted species), the total number of earthworms and also the microbial biomass activity. The proportion of earthworms and micro-organisms in the soil of organically and conventionally cultivated fields was compared. Earthworm abundance showed no significant differences between the cultivation types.	National, (66 producers)	Manual sampling (50x50x50cm) and soil sample. Monitoring activities conducted every 2 years	
Achievement of environmental objective: Biodiversity conservation = Area to be contributing to biodiversity conservation in the specific action of 223 (ha) X % financial uptake for this action within the measures	The calculation of the area under biodiversity conservation measure as a function of the proportion of the financial uptake and the programmed target area is provided as an estimation of the impact.	Action	Financial uptake and targeted area.	

Supporting farmers who participate in food quality schemes (132)

Indicator	Causal chain	Scale	Data
(A) Share of UAA under environmentally benign farming systems: -of which used for organic farming -of which used as pasture with less than 1.4 LU/ha (B) Share of UAA used for arable farming where the quantity of nitrogen applied (farm manure and synthetic) is less than 170 kg/ha per year.	Programme indicator has been used to answer the evaluation questions. The LU/ha was reduced from 2 to 1.4. The selected indicators are used as a proxy for environmental impact indicators, based on the assumption that an expansion of UAA of organic farming or other environmental friendly land management systems and practices will increase the provision of public goods from agriculture.	Regional (Mountain areas and other disadvantaged areas)	IACS data 2000-2006; Census data, FADN data. In addition, case studies in other Federal States have been carried out by the evaluators in order to obtain additional information on public goods and services from agriculture in those areas. The case studies comprised of expert interviews and stakeholder surveys. In a next step interviews with key stakeholders and experts in Baden Württemberg were held to validate the possible relevance of the case study findings for different regions in Baden Württemberg.
Share of organic farmland on LFA farms	Organic farmland in Austrian LFAs is of high natural value (and will be classified as HNV in the future) and high biodiversity value. The extent of organically managed land on LFA farms provides an indication to what extent LFA payments contribute to maintaining farmland biodiversity. The CMEF impact indicators could not be used for the measure specific evaluation of LFA payments due to missing data.	Farm level data analysed at national/LFA level	IACS data and FADN data, annually. Also, results from surveys and expert interviews carried out in previous evaluation phases were integrated in the qualitative assessment of biodiversity impacts.
Share of extensive grassland of total UAA of LFA farms	Extensive grazing land in Austrian LFAs is of high natural value (and will be classified as HNV in the future) and high biodiversity value. The extent of extensive grassland on LFA farms provides an indication to what extent LFA payments contribute to maintaining farmland biodiversity. The CMEF impact indicators could not be used for the measure specific evaluation of LFA payments due to missing data.	Farm level data analysed at national/LFA level	IACS data and FADN data, annually. Also, results from surveys and expert interviews carried out in previous evaluation phases were integrated in the qualitative assessment of biodiversity impacts.

Animal welfare payments (215)

Indicator	Causal chain	Scale	Data
(A) Share of UAA under environmentally benign farming systems: -of which used for organic farming -of which used as pasture with less than 1.4 LU/ha (B) Share of UAA used for arable farming where the quantity of nitrogen applied (farm manure and synthetic) is less than 170 kg/ha per year.	Programme indicator has been used to answer the evaluation questions. The LU/ha was reduced from 2 to 1.4. The selected indicators are used as a proxy for environmental impact indicators, based on the assumption that an expansion of UAA of organic farming or other environmental friendly land management systems and practices will increase the provision of public goods from agriculture.	Regional (Mountain areas and other disadvantaged areas)	IACS data 2000 - 2006; Census data, FADN data. In addition, case studies in other Federal States have been carried out by the evaluators in order to obtain additional information on public goods and services from agriculture in those areas. The case studies comprised of expert interviews and stakeholder surveys. In a next step interviews with key stakeholders

			and experts in Baden Württemberg were held to validate the possible relevance of the case study findings for different regions in Baden Württemberg.
Share of organic farmland on LFA farms	Organic farmland in Austrian LFAs is of high natural value (and will be classified as HNV in the future) and high biodiversity value. The extent of organically managed land on LFA farms provides an indication to what extent LFA payments contribute to maintaining farmland biodiversity. The CMEF impact indicators could not be used for the measure specific evaluation of LFA payments due to missing data.	Farm level data analysed at national/ LFA level	IACS data and FADN data, annually. Also, results from surveys and expert interviews carried out in previous evaluation phases were integrated in the qualitative assessment of biodiversity impacts.
Share of extensive grassland of total UAA of LFA farms	Extensive grazing land in Austrian LFAs is of high natural value (and will be classified as HNV in the future) and high biodiversity value. The extent of extensive grassland on LFA farms provides an indication to what extent LFA payments contribute to maintaining farmland biodiversity. The CMEF impact indicators could not be used for the measure specific evaluation of LFA payments due to missing data.	Farm level data analysed at national / LFA level	IACS data and FADN data, annually. Also, results from surveys and expert interviews carried out in previous evaluation phases were integrated in the qualitative assessment of biodiversity impacts.
Area with beneficial lay out of crops (types of crop, including associated livestock, crop-combinations and size of uniform fields) maintained/reintroduced thanks to assisted actions (ha)	The indicator is related to the diversity in crop system.	Regional	Data from the Land use CENSUS.

Competitiveness (411)

Indicator	Causal chain	Scale	Data	Comment
Number of trainings on sustainable land management and sustainable land management of natural resources	The aim of the measure is to diffuse scientific knowledge and innovative practises in the agricultural and forestry sector. Indirect impact.	National	Number of beneficiaries, amount of payments realised.	
Number of farmers who use advisory services for sustainable land management and sustainable land management of natural resources	Indirect impact on sustainable management practices and cross compliance requirements.	National	Number of farmers who use advisory services for sustainable land management and sustainable land management of natural resources, amount of payments realised.	
Change in grassland area	Investments to expand and/or rationalise dairy systems can reduce the extent of grazing activities and reduce the amount of grass fed to cattle which can induce the ploughing up of grassland with negative consequences for biodiversity.	Farm level data assessed at regional	IACS data 2000-2010	

		level (Federal State)		
Number of farm holdings that received investment support in LFAs, NATURA 2000, Nitrates Directive areas		National	Number of beneficiaries, amount of payments realised.	Specify for NATURA 2000 and HNV

Environment/land management (412)

Indicator	Causal chain	Scale	Data
Reversing biodiversity decline (FBI)	The use of farmland bird indicators as a (sole) biodiversity indicator is based on the concept of umbrella species. AEMs and their prescriptions maintain and improve land use, habitat and landscape elements which support a high biodiversity and are important parts of suitable bird habitats.	National, differentiating between different agricultural land use systems, area designations (LFA and Natura) and groups of federal states.	FBI data
	Different versions of the farmland index, including European, Latvian, Boreal protected species. Additional indicators give supplementary information.	National, Natura 2000 sites	National monitoring of birds and additional inventories.

	For the reversal of biodiversity decline analysed how the general environmental condition of farms has been preserved or improved due to the application of AES requirements, considering their habitat function and if the organic farming facilitates biological diversity. According to the survey on bird species richness, abundance and population density, the potential indirect positive impact of various types of AE support cannot be underestimated despite the lack of aid type impact. Without the agricultural support, many habitats necessary for open field birds may remain fallow and overgrow with woods, resulting irreversible loss of habitat for these species.	Monitoring in 3 regions	Data from 3 transect counts (May-June). Bird monitoring data, using Shannon diversity index (number of nesting species as well as diversity), number of nesting species on farmland, total population of nesting birds (number of nesting specimens).
		Nuts3	Counting, case study of 55 follow-up areas across the country
	The impact indicator is related to the species diversity. Common bird indicators are commonly used for synthetic comparisons. The bird populations are recognised as excellent bio-indicators as they reflect an overall quality of the environments in which they live.	Regional	IFEN, evolution of the bird population in forest
	The report refers to a study from Vetter and Storch (2009), which showed that the umbrella function was effective for 50% of the examined farmland bird species while one third showed a negative result. Overall, the report concludes the farmland birds respond to changes in agricultural land management, but the umbrella effect on other species and habitats requires further examinations. Structural changes in agriculture and changes in land management practices affect the suitability of the habitats for birds, e.g. field margins as breeding habitat for birds, which is reflected in a decline of the FBI. RDP measures such as creation of field margins improve the suitability of the habitat for birds.	Regional, programme	FBI data, IACS and payment data
	Biodiversity abundance and diversity of birds species	Regional	Data from IACS, LPIS and GIS.
Amphibian - species diversity and abundance	The CMEF impact indicator FBI is not sufficient to assess measure-specific impacts on biodiversity. Amphibians are an important animal group for farmland biodiversity and many amphibian species are threatened by habitat loss. The measure 214 promotes the maintenance and creation of suitable habitats and biotopes for amphibians. Changes in the diversity and abundance of amphibians thus provide one measure or indicator for the (potential) biodiversity impacts of measure 214.	10 pilot areas	Species data from monitoring of trial areas, annually
Indicator plant species	Rare and protected plant species are an important indicator for the ecological quality and biodiversity of grasslands. The number and	119 trial areas with	Monitoring data of trial areas, annually. Trials are done in three different regions of

	abundance of these plant species often depends on the (timing of) certain management activities of meadows. The measure 214 promotes the maintenance and creation of suitable meadow habitats for plant species diversity. Changes indicator plant species thus provides an indicator for the (potential) biodiversity impacts of measure 214. The CMEF impact indicator FBI is not sufficient to assess measure-specific impacts on biodiversity.	and without support covering different land use and habitat types	agriculturally used habitats.
Changes of population of great bustard (Otis tarda) related to AEMs	Specific AEMs aim to the protection of great bustard population. Through actions aimed at special crop rotation, winter forage, nest protection and an overall habitat management for the great bustard (which is based on former surveys and experiences) an increase of the population is expected.	National, HNVs involved in great bustard protection	Population census data
Composition of tree species	The indicator has been modified taking into account soft and hard broadleaves and conifer trees. Maintaining species composition within the natural variability is an important aspect to conserve biodiversity. Furthermore, maintaining species composition typical of the range of natural variation enables the ecosystem to respond and recover from disturbance. A productive and resilient ecosystem is sustainable and is capable of providing the many products and services desired by the public.	National	
Trend in protection of vulnerable non-commercial (i.e., non-traded forest products) species/varieties of flora & fauna on land subject to assisted actions (description, e.g. number of different species/varieties affected and where possible change in the abundance of key species)	Improvement of biodiversity in agricultural areas.	Regional	Data come from the Land use CENSUS (1998-2005)
Area planted/ regenerated/ improved with indigenous tree species (ha) -of which in mixture -of which providing in situ conservation of genetic resources	The indicator is related to species diversity.	Regional	Data come from the Land use CENSUS (1998-2005)
Area under successful land management contributing to biodiversity and HNV farming/forestry	Reference to 'ecological functions' of forests including the prevention of forest fires, but without reporting on concrete biodiversity-related impact indicators.	Scales range from the forest to the English	Result indicator for biodiversity and High Nature Value Forest, indirect and secondary literature (Quine & Watts, 2007), countryside surveys on biodiversity.

		national.	
Status of higher plants (quality of grasslands)	Quality of grasslands is higher in maintained areas.	Case study in 18 sites covering all 5 regions	Investigation in a case study area.
Number and diversity of day butterflies	The properly maintained grasslands host higher number of butterflies compared to non-managed grasslands.	Case study in 18 sites covering all 5 regions	Investigation in a case study area.
Number of ground beetles' species and abundance of ground beetles (Carabidae sp.)	Number of ground beetles is higher in organic farms than in conventional areas.	Case study area (crop fields) in Latgale region	Investigation in a case study area.
Reversal in biodiversity decline: Diversity and abundance of bumblebees.	The diversity of species of bumblebees and Shannon diversity index is higher in areas under actions of organic production and environmentally friendly management. Although for the abundance of bumblebees such trends is not observed.	National	3 transect counts during June-August.
Reversal in biodiversity decline: Structure of vascular plants community, species richness and coverage	The survey of structure of vascular plants, species richness and coverage showed that the flora diversity of field edges decreased slightly in the field edges of monitoring farms under actions of environmentally friendly management and organic production.	National. Monitoring farms	15 monitoring units per field (5+5 opposite edges, 5 on field).
Reversal in biodiversity decline: Species richness and abundance of earthworms and the activity of soil biomass	The indicator analyse the extent and direction of changes in the composition of species (especially for tolerant and adapted species), the total number of earthworms and also the microbial biomass activity. The proportion of earthworms and micro-organisms in the soil of organically and conventionally cultivated fields was compared. Earthworm abundance showed no significant differences between the cultivation types.	National, (66 producers)	Manual sampling (50x50x50cm) and soil sample. Monitoring activities conducted every 2 years
Achievement of environmental objective: Biodiversity conservation = Area to be contributing to biodiversity conservation in the specific action of 223 (ha) X % financial uptake for this action within the measures	The calculation of the area under biodiversity conservation measure as a function of the proportion of the financial uptake and the programmed target area is provided as an estimation of the impact.	Action	Financial uptake and targeted area.

Quality of life/diversification (413)

Indicator	Causal chain	Scale	Data
Influence to endangered species	Assessment about the influence of measure on endangered species.	Nuts 1	Expert assessment, combined data produced by Information Centre of the Ministry of Agriculture and Forestry.
Created natural areas (ha)		National	Interviews results on the basis of EU evaluation questions
Ecological network connections (km)		National	Interviews results on the basis of EU evaluation questions

Table B3 Indicators for Biodiversity-HNV

Setting up of farm management/advisory services (115)

Indicator	Causal chain	Scale	Data
Number of farmers who use advisory services for climate change mitigation	Indirect impact on sustainable management practices and sustainable management of natural resources.	National	Number of farmers who use advisory services on sustainable land management and sustainable management of natural resources, amount of payments realised.

Cooperation for development of new products, processes and technologies (124)

Indicator	Causal chain	Scale	Data	Comment
Number of enterprises introducing new technologies and innovations		Regional	Number of beneficiaries, area covered by the measure, amount of payment realised.	Specify within HNV areas or using HNVF products
Total value of investment		Regional	Number of beneficiaries, area covered by the measure, amount of payment realised.	Specify within HNV areas or using HNVF products

Improving and developing infrastructure related to the development and adaptation of agriculture and forestry (125)

Indicator	Causal chain	Scale	Data
Maintenance of HNV farmland and forestry: Changes in high nature value areas	This is a baseline indicator of HNV areas, taking into account areas under successful land management contributing to improvement of biodiversity. The presence of natural habitats and the distribution of wildlife species populations that exist in farmland and forest can characterise these areas as HNV.	National, all agricultural land under successful land management contributing to improvement of biodiversity.	Maps and statistical data of agricultural land where measures are implemented for successful land management contributing to improvement of biodiversity. The monitoring data concern: Corine Land Cover Classification for y2000, biodiversity data, IBAs of Greece, distribution of bear, wolf and bird of prey populations, SCI and habitat mapping of Greek Natura 2000 network, data from environmental protected areas, data gathered by NVZs, data from agricultural census for y2000, olive fields' cadastre, expert surveys.
		Regional	Database measurements of the RDP, regional land use map, FADN data

	Three different types of HNV areas are defined: agricultural areas with natural HNV meadows- extensively managed agricultural areas with natural or semi-natural areas distinguished by high landscape heterogeneity - agricultural areas for preservation of international important species or habitats, parts of international networks (Andersen et al., 2003). During evaluation period (2007-2009) only second and third group of HNV areas were eligible for support.	National	Declaration data (Ha of agricultural area)
	Many agricultural habitats managed through extensive and traditional farming systems are classified as HNV farm land. The maintenance or introduction of extensive and traditional farming systems contributes to the protection of HNV habitats.	Regional, programme	ATKIS data (share of HNV area on total UAA, share of Natura 2000 area, share of protected forests)
	The measure contributes to the continued use of agricultural activities with positive impact on biological diversity as a result of compliance with the environmental requirements.	Changes in HNV areas	
	Checks of logic consistencies between the RDP strategy and measure descriptions have been summarised. Indicator has been modified and differentiates between different HNV areas and elements classified into different HNV types.	Regional, programme	IACS-GIS data, HNV-GIS data, databases of protected areas.
Agricultural areas with high natural value (HNV farmland)	HNV are important areas for the conservation of the biodiversity.	Regional	Database measurements of the RDP, regional land use map, FADN data
Ecological infrastructure object of engagement with habitat function or plots of land not cultivated linked to agriculture (hectares and / or kilometers and / or number of sites / commitments) of which enhancing existing high nature-value habitats by alleviating their fragmentation (%)	The impact indicator is proposed as an assessment indicator of measures aimed at the maintenance of biodiversity. One of the characteristics of HNV areas is the prevalence of low intensity farming systems, these areas tend to coincide with those less productive and marginal areas, in which agriculture practices are extensive.	Regional	Regional data based on IACS (2005), regional technical maps, Corine Land Cover, maps of the extent of agricultural land under measure 214, Network of Threatened Species in GRID format for the regional distribution of threatened species prepared by the Project 'National Ecological Network' (REN) by the Ministry of the Environment.

Supporting farmers who participate in food quality schemes (132)

Indicator	Causal chain	Scale	Data	Comment
HNV farmland habitats that have been protected by supported actions (number of sites/agreements; total hectares, average -of which habitats that in particular benefit specific species or groups of species (%) -of	The impact indicator is proposed as an assessment indicator of measures aimed at the maintenance of biodiversity. One of the characteristics of HNV areas is the prevalence of low intensity farming systems, these areas tend to coincide with those less productive and marginal areas, in which agriculture practices	Regional	Regional data based on IACS (2005), regional technical maps, Corine Land Cover, maps of the extent of agricultural land under measure 214, Network of Threatened Species in	

which considered rare habitats at the relevant geographical level (%) size)	are extensive.		GRID format for the regional distribution of threatened species prepared by the Project 'National Ecological Network' (REN) by the Ministry of the Environment.	
Number of semi-subsistence farm holdings which entered the market and meet the obligatory Community standards related to veterinary and phyto-sanitary requirements, animal welfare, environmental protection, hygiene and occupational health and safety		National, regional	Monitoring data. Survey data.	Specify within HNV areas

Animal welfare payments (215)

Indicator	Causal chain	Scale	Data	Comment
Ecological infrastructure object of engagement with habitat function or plots of land not cultivated linked to agriculture (hectares and / or kilometers and / or number of sites / commitments) of which enhancing existing high nature-value habitats by alleviating their fragmentation (%)	The impact indicator is proposed as an assessment indicator of measures aimed at the maintenance of biodiversity. One of the characteristics of HNV areas is the prevalence of low intensity farming systems, these areas tend to coincide with those less productive and marginal areas, in which agriculture practices are extensive.	Regional	Regional data based on IACS (2005), regional technical maps, Corine Land Cover, maps of the extent of agricultural land under measure 214, Network of Threatened Species in GRID format for the regional distribution of threatened species prepared by the Project 'National Ecological Network' (REN) by the Ministry of the Environment.	
HNV farmland habitats that have been protected by supported actions (number of sites/agreements; total hectares, average -of which located in Natura 2000 areas (%) -of which habitats that in particular benefit specific species or groups of species (%) -of which considered rare habitats at the relevant geographical level (%) size)	The impact indicator is proposed as an assessment indicator of measures aimed at the maintenance of biodiversity. One of the characteristics of HNV areas is the prevalence of low intensity farming systems, these areas tend to coincide with those less productive and marginal areas, in which agriculture practices are extensive.	Regional	Regional data based on IACS (2005), regional technical maps, Corine Land Cover, maps of the extent of agricultural land under measure 214, Network of Threatened Species in GRID format for the regional distribution of threatened species prepared by the Project 'National Ecological Network' (REN) by the Ministry of the Environment.	
Proportion of eligible farms accepting payments in compensation for	There is a casual chain between the indicator and the programme due to payment given for the protection of the	Programme	Data from National agriculture Agency (PDRN)	

environmental constraints. (HNV)	HNV areas.	(PDRN) and regional		
Proportion of the UAA subject to environmental constraints for farmers to receive payments	There is a casual chain between the indicator and the programme due to payment given for the protection of the HNV areas.	Programme (PDRN) and regional	Data from National agriculture Agency (PDRN)	
HNV farmland habitats that have been protected by supported actions (number of sites/agreements; total hectares, average -of which resulting from specific land-uses or traditional farming systems (%) -of which resulting from prevention of encroachment (colonisation by scrub, etc) or abandonment (%)-of which located in Natura 2000 areas (%) -of which habitats that in particular benefit specific species or groups of species (%)-of which considered rare habitats at the relevant geographical level (%) size)	Many agricultural habitats managed through extensive and traditional farming systems are classified as HNV farm land. The maintenance or introduction of extensive and traditional farming systems contributes to the protection of HNV habitats.	Regional (Federal State)	IACS annual data. Quantification of habitat changes over the programme period.	
	The impact indicator is proposed as an assessment indicator of measures aimed at the maintenance of biodiversity. One of the characteristics of HNV areas is the prevalence of low intensity farming systems, these areas tend to coincide with those less productive and marginal areas, in which agriculture practices are extensive.	Regional	Regional data based on IACS (2005), regional technical maps, Corine Land Cover, maps of the extent of agricultural land under measure 214, Network of Threatened Species in GRID format for the regional distribution of threatened species prepared by the Project "National Ecological Network" (REN) by the Ministry of the Environment.	
Number of semi-subsistence farm holdings which entered the market and meet the obligatory Community standards related to veterinary and phyto-sanitary requirements, animal welfare, environmental protection, hygiene and occupational health and safety	The impact indicator is proposed as an assessment indicator of measures aimed at the maintenance of biodiversity. One of the characteristics of HNV areas is the prevalence of low intensity farming systems, these areas tend to coincide with those less productive and marginal areas, in which agriculture practices are extensive.	Regional	Regional data based on IACS (2005), regional technical maps, Corine Land Cover, maps of the extent of agricultural land under measure 214, Network of Threatened Species in GRID format for the regional distribution of threatened species prepared by the Project "National Ecological Network" (REN) by the Ministry of the Environment.	Specify within HNV areas

Maintenance of HNV farmland and forestry: Changes in high nature value areas	This is a baseline indicator of HNV areas, taking into account areas under successful land management contributing to improvement of biodiversity. The presence of natural habitats and the distribution of wildlife species populations that exist in farmland and forest can characterise these areas as HNV.	National, all agricultural land under successful land management contributing to improvement of biodiversity.	Maps and statistical data of agricultural land where measures are implemented for successful land management contributing to improvement of biodiversity. The monitoring data concern: Corine Land Cover Classification for y2000, biodiversity data, IBAs of Greece, distribution of bear, wolf and bird of prey populations, SCI and habitat mapping of Greek Natura 2000 network, data from environmental protected areas, data gathered by NVZs, data from agricultural census for y2000, olive fields' cadastre, expert surveys.	
		Regional	Database measurements of the RDP, regional land use map, FADN data	
	Three different types of HNV areas are defined: agricultural areas with natural HNV meadows- extensively managed agricultural areas with natural or semi-natural areas distinguished by high landscape heterogeneity - agricultural areas for preservation of international important species or habitats, parts of international networks (Andersen et al., 2003). During evaluation period (2007-2009) only second and third group of HNV areas were eligible for support.	National	Declaration data (Ha of agricultural area)	
	Many agricultural habitats managed through extensive and traditional farming systems are classified as HNV farm land. The maintenance or introduction of extensive and traditional farming systems contributes to the protection of HNV habitats.	Regional, programme	ATKIS data (share of HNV area on total UAA, share of Natura 2000 area, share of protected forests)	
	The measure contributes to the continued use of agricultural activities with positive impact on biological diversity as a result of compliance with the environmental requirements.	Changes in HNV areas		

	Checks of logic consistencies between the RDP strategy and measure descriptions have been summarised. Indicator has been modified and differentiates between different HNV areas and elements classified into different HNV types.	Regional, programme	IACS-GIS data, HNV-GIS data, databases of protected areas.	

First establishment of agroforestry systems on agricultural land (222)

Indicator	Causal chain	Scale	Data
Maintenance of HNV farmland and forestry: Changes in high nature value areas	This is a baseline indicator of HNV areas, taking into account areas under successful land management contributing to improvement of biodiversity. The presence of natural habitats and the distribution of wildlife species populations that exist in farmland and forest can characterise these areas as HNV.	National, all agricultural land under successful land management contributing to improvement of biodiversity.	Maps and statistical data of agricultural land where measures are implemented for successful land management contributing to improvement of biodiversity. The monitoring data concern: Corine Land Cover Classification for y2000, biodiversity data, IBAs of Greece, distribution of bear, wolf and bird of prey populations, SCI and habitat mapping of Greek Natura 2000 network, data from environmental protected areas, data gathered by NVZs, data from agricultural census for y2000, olive fields' cadastre, expert surveys.
		Regional	Database measurements of the RDP, regional land use map, FADN data
	Three different types of HNV areas are defined: agricultural areas with natural HNV meadows- extensively managed agricultural areas with natural or semi-natural areas distinguished by high landscape heterogeneity - agricultural areas for preservation of international important species or habitats, parts of international networks (Andersen et al., 2003). During evaluation period (2007-2009) only second and third group of HNV areas were eligible for support.	National	Declaration data (Ha of agricultural area)
	Many agricultural habitats managed through extensive and traditional farming systems are classified as HNV farm land. The maintenance or introduction of extensive and traditional farming systems contributes to the protection of HNV habitats.	Regional, programme	ATKIS data (share of HNV area on total UAA, share of Natura 2000 area, share of protected forests)

	The measure contributes to the continued use of agricultural activities with positive impact on biological diversity as a result of compliance with the environmental requirements.	Changes in HNV areas	
	Checks of logic consistencies between the RDP strategy and measure descriptions have been summarised. Indicator has been modified and differentiates between different HNV areas and elements classified into different HNV types.	Regional, programme	IACS-GIS data, HNV-GIS data, databases of protected areas.
Area under successful land management contributing to biodiversity and HNV farming/forestry	Reference to "ecological functions" of forests including the prevention of forest fires, but without reporting on concrete biodiversity-related impact indicators.	Scales range from the forest to the English national.	Result indicator for biodiversity and High Nature Value Forest, indirect and secondary literature (Quine & Watts, 2007), countryside surveys on biodiversity.

Environment/land management (412)

Indicator	Causal chain	Scale	Data	Comment
Conservation of biodiversity and HNV farmland habitats	HNV areas are important areas for the conservation of the biodiversity. This aspect is really important when the impact of the measure "agri- environmental payments" is evaluated.	Regional	Database measurements of the RDP, regional land use map "farmers data"	
Ecological infrastructure object of engagement with habitat function or plots of land not cultivated linked to agriculture (hectares and / or kilometers and / or number of sites / commitments) of which enhancing existing high nature-value habitats by alleviating their fragmentation (%)	The impact indicator is proposed as an assessment indicator of measures aimed at the maintenance of biodiversity. One of the characteristics of HNV areas is the prevalence of low intensity farming systems, these areas tend to coincide with those less productive and marginal areas, in which agriculture practices are extensive.	Regional	Regional data based on IACS (2005), regional technical maps, Corine Land Cover, maps of the extent of agricultural land under measure 214, Network of Threatened Species in GRID format for the regional distribution of threatened species prepared by the Project "National Ecological Network" (REN) by the Ministry of the Environment.	
Proportion of the UAA subject to environmental constraints for farmers to receive payments	There is a casual chain between the indicator and the programme due to payment given for the protection of the HNV areas.	Programme (PDRN) and regional	Data from National agriculture Agency (PDRN)	

HNV farmland habitats that have been protected by supported actions (number of sites/agreements; total hectares, average -of which resulting from specific land-uses or traditional farming systems (%) -of which resulting from prevention of encroachment (colonisation by scrub, etc) or abandonment (%)-of which located in Natura 2000 areas (%) -of which habitats that in particular benefit specific species or groups of species (%)-of which considered rare habitats at the relevant geographical level (%) size)	Many agricultural habitats managed through extensive and traditional farming systems are classified as HNV farm land. The maintenance or introduction of extensive and traditional farming systems contributes to the protection of HNV habitats.	Regional (Federal State)	IACS annual data. Quantification of habitat changes over the programme period.	
	The impact indicator is proposed as an assessment indicator of measures aimed at the maintenance of biodiversity. One of the characteristics of HNV areas is the prevalence of low intensity farming systems, these areas tend to coincide with those less productive and marginal areas, in which agriculture practices are extensive.	Regional	Regional data based on IACS (2005), regional technical maps, Corine Land Cover, maps of the extent of agricultural land under measure 214, Network of Threatened Species in GRID format for the regional distribution of threatened species prepared by the Project "National Ecological Network" (REN) by the Ministry of the Environment.	
Number of semi-subsistence farm holdings which entered the market and meet the obligatory Community standards related to veterinary and phyto-sanitary requirements, animal welfare, environmental protection, hygiene and occupational health and safety		National, regional	Monitoring data. Survey data.	Specify within HNV areas
Maintenance of HNV farmland and forestry: Changes in high nature value areas	This is a baseline indicator of HNV areas, taking into account areas under successful land management contributing to improvement of biodiversity. The presence of natural habitats and the distribution of wildlife species populations that exist in farmland and forest can characterise these areas as HNV.	National, all agricultural land under successful land management contributing to improvement of biodiversity.	Maps and statistical data of agricultural land where measures are implemented for successful land management contributing to improvement of biodiversity. The monitoring data concern: Corine Land Cover Classification for y2000, biodiversity data, IBAs of Greece, distribution of bear, wolf and bird of prey populations, SCI and habitat mapping of Greek Natura 2000 network, data from environmental protected areas, data gathered by NVZs, data from agricultural census for y2000, olive fields' cadastre, expert surveys.	

		Regional	Database measurements of the RDP, regional land use map, FADN data	
	Three different types of HNV areas are defined: agricultural areas with natural HNV meadows- extensively managed agricultural areas with natural or semi-natural areas distinguished by high landscape heterogeneity - agricultural areas for preservation of international important species or habitats, parts of international networks (Andersen et al., 2003). During evaluation period (2007-2009) only second and third group of HNV areas were eligible for support.	National	Declaration data (Ha of agricultural area)	
	Many agricultural habitats managed through extensive and traditional farming systems are classified as HNV farm land. The maintenance or introduction of extensive and traditional farming systems contributes to the protection of HNV habitats.	Regional, programme	ATKIS data (share of HNV area on total UAA, share of Natura 2000 area, share of protected forests)	
	The measure contributes to the continued use of agricultural activities with positive impact on biological diversity as a result of compliance with the environmental requirements.	Changes in HNV areas		
	Checks of logic consistencies between the RDP strategy and measure descriptions have been summarised. Indicator has been modified and differentiates between different HNV areas and elements classified into different HNV types.	Regional, programme	IACS-GIS data, HNV-GIS data, databases of protected areas.	

Table B4 Indicators for Water Quality

Setting up of farm management/advisory services (115)

Indicator	Causal chain	Scale	Data	Comment
Number of farmers who use advisory services for climate change mitigation	Indirect impact on sustainable management practices and cross compliance requirements.	National	Number of farmers who use advisory services on sustainable land management and sustainable management of natural resources, amount of payments realised.	Water protection oriented

Improvement of the economic value of forests (122)

Indicator	Causal chain	Scale	Data
Resources/assets enjoying improved protection due to assisted forest actions (hectare): (b) of which water bodies (%)		Regional	ISTAT, Agricultural census
Area under the effective management of the territory, which has successfully contributed: to improve water quality	The additional indicator was created to evaluate the impact of the use of the principal fertilisers in agriculture that provoke the water pollution.	Regional	Agricultural census and regional database (info about the fertilisers and pesticide used in agriculture)
Achievement of environmental objective: Area to be contributing to Water quality in the specific action (part of 211 in ha) X % financial uptake for this action.	The calculation of the area under water quality measure as a function of the proportion of the financial uptake and the programmed target area is provided as an estimation of the impact.	Action	Financial uptake, targeted area
Improvement in water quality-Changes in gross nutrient balance GNB	Forestry is a more extensive land-use than agriculture, lower fertiliser application reduces N and P surpluses.	Supported area	
		National	Different ground and surface water quality monitoring data, studies on discharge from agriculture land and forested areas
	Reduced nutrient inputs from agriculture (N, P and pesticides) improve water quality. Comparison of the GNB of AEM participants with non-participants.	Regional	GNB

Cooperation for development of new products, processes and technologies (124)

Indicator	Causal chain	Scale	Data	Comment
Number of enterprises introducing new technologies and innovations		Regional	Number of beneficiaries, area covered by the measure, amount of payment realised.	Improvement of water quality or decrease water consumption projects

Area of land affected by measure (ha) and Added value by land use and operation		National		Improvement of water quality or decrease water consumption projects

Supporting farmers who participate in food quality schemes (132)

Indicator	Causal chain	Scale	Data
Concentration of plant nutrients in drainage water	It is very difficult to evaluate the impact of measures on water quality and results can only be seen after many years. The evaluators, in order to assess the indirect impact of environmentally friendly management and organic farming, conducted studies, analysing the use of nutritional elements, pesticides performance load and plant nutritional elements concentration in drain water.		Analysis of water and soil samples, interviews and focus group.
Proportion of UAA subject to friendly farming systems environment which affected area (a) to organic farming, (b) Integrated production or integrated control agencies harmful, and (c) pasture with less than 2 LU / ha.	The quantification of nutrient impact thanks to the indicator.	Programme level (PDRN)	Data from PDRN monitoring system RICA
Improvement in water quality-(Changes in gross nutrient balance GNB	Reduced nutrient inputs from agriculture (N, P and pesticides) improve water quality. Comparison of the GNB of AEM participants with non-participants.	Regional	GNB
	The impact indicator "Improvement in water quality" is proposed by the CMEF. Quantitative change in the estimations of GNB that can be attributed to the intervention should be measured. The GNB indicates potential nutrient losses to the water bodies likely to be detrimental for the quality of water.	NUTS III regions	Nutrient balances, nitrate and phosphate, by the OECD/EUROSTAT Method, (years 1995, 1999, 2003, 2005 and 2007) EUROSTAT Project (Grant 2007, topic 67, Pilot Survey on the use of fertilisers, conducted for Austria by Statistic Austria and the Federal Environmental Agency, 2010).
		National	Different ground and surface water quality monitoring data, studies on discharge from agriculture land and forested areas
Amount of organic fertiliser: stock density (LU)/ha	Nitrogen inputs from organic fertiliser in ground and surface water bodies are detrimental to water quality.	Farm level	InVeKos, (year 2008), stock density (LU)/ha; comparison participants/non-participants.
Gross nutrient balance: reduction of nitrogen and phosphorus surplus in the areas of intervention)	Measure 214 Agri-environment is related to several environmental aspects, such us fertilization impacts. The overall objective of this indicator is to asses the benefit of implementing a series of measures that have among their objectives the improvement of the quality of water that run off from	Regional	Measures' database of the RDP, statistical data, agricultural production and agri-environmental system commitments. Technical itineraries for major crops

	cultivated fields.		
Reduction of "risk index" resulting from use of pesticides	Measure 214 Agri-environment is related to several environmental aspects, such us fertilization impacts.	Regional	Measures' database of the RDP, statistical data. Production specifications and system agri-environmental commitments. Technical itineraries for major crops (contributed by experts)
Reduction of agricultural inputs per hectare thanks to agreements (%)	The impact indicator is related to the multifunctional approach of the soil system. In fact the Measure "Agri- environment" is related with several environmental aspects.	Regional scale, all agriculture land that contributed to the use of inputs	ISTAT (2001-2003), Agricultural census

Animal welfare payments (215)

Indicator	Causal chain	Scale	Data
Livestock density per ha UAA near body of water		National	Livestock density per ha UAA near body of water
Amount of organic fertiliser: stock density (LU)/ha	Nitrogen inputs from organic fertiliser in ground and surface water bodies are detrimental to water quality.	Farm level	InVeKos, (year 2008), stock density (LU)/ha; comparison participants/non-participants.
Improvement in water quality-(Changes in gross nutrient balance GNB	Reduced nutrient inputs from agriculture (N, P and pesticides) improve water quality. Comparison of the GNB of AEM participants with non-participants.	Regional	GNB
	The impact indicator "Improvement in water quality" is proposed by the CMEF. Quantitative change in the estimations of GNB that can be attributed to the intervention should be measured. The GNB indicates potential nutrient losses to the water bodies likely to be detrimental for the quality of water.	NUTS III regions	Nutrient balances, nitrate and phosphate, by the OECD/EUROSTAT Method, (years 1995, 1999, 2003, 2005 and 2007) EUROSTAT Project (Grant 2007, topic 67, Pilot Survey on the use of fertilisers, conducted for Austria by Statistic Austria and the Federal Environmental Agency, 2010).
		National	Different ground and surface water quality monitoring data, studies on discharge from agriculture land and forested areas
Proportion of UAA subject to friendly farming systems environment which affected area (a) to	The quantification of nutrient impact thanks to the indicator.	Programme level	Data from PDRN monitoring system RICA

organic farming, (b) Integrated production or integrated control agencies harmful, and (c) pasture with less than 2 LU / ha.		(PDRN)	
Reduction of agricultural inputs per hectare thanks to agreements (%)	The impact indicator is related to the multifunctional approach of the soil system. In fact the Measure "Agri- environment" is related with several environmental aspects.	Regional scale, all agriculture land that contributed to the use of inputs	ISTAT (2001-2003), Agricultural census
Achievement of environmental objective: Area to be contributing to Water quality in the specific action (part of 211 in ha) X % financial uptake for this action.	The calculation of the area under water quality measure as a function of the proportion of the financial uptake and the programmed target area is provided as an estimation of the impact.	Action	Financial uptake, targeted area

First establishment of agroforestry systems on agricultural land (222)

Indicator	Causal chain	Scale	Data
Improvement in water quality-(Changes in gross nutrient balance GNB	Forestry is a more extensive land-use than agriculture, lower fertiliser application reduces N and P surpluses.	Supported area	
		National	Different ground and surface water quality monitoring data, studies on discharge from agriculture land and forested areas
	Reduced nutrient inputs from agriculture (N, P and pesticides) improve water quality. Comparison of the GNB of AEM participants with non-participants.	Regional	GNB
Resources/assets enjoying improved protection due to assisted forest actions (hectare): (b) of which water bodies (%)		Regional	ISTAT, Agricultural census
Area under successful land management contributing to improvement of water quality	Afforestation contributes to flood risk management, and also to the deduction if diffuse water pollution. Generic conclusions drawn from indirect sources.	National,	Scientific literature, such as Morrow, Silgram & Nisbett (2010), generic conclusions from the Environment Agency (2009) and the Forestry Commission
Area under the effective management of the territory, which has successfully contributed: to improve water quality	The additional indicator was created to evaluate the impact of the use of the principal fertilisers in agriculture that provoke the water pollution.	Regional	Agricultural census and regional database (info about the fertilisers and pesticide used in agriculture)

Achievement of environmental objective: Area to be contributing to Water quality in the specific action (part of 211 in ha) X % financial uptake for this action.	The calculation of the area under water quality measure as a function of the proportion of the financial uptake and the programmed target area is provided as an estimation of the impact.	Action	Financial uptake, targeted area

Diversification into non-agricultural activities (311) - Support for business creation and development (312) - Conservation and upgrading of the rural heritage (323)

Indicator	Causal chain	Scale	Data	Comment
Number of supported actions	Indirect influence of measure on water quality.	National	Number of operations	Improvement of water quality or decrease water consumption projects
Total volume of investment	Indirect influence of measure on water quality.	National	Amount of payment	Improvement of water quality or decrease water consumption projects

Training and information for economic actors operating in the fields covered by axis 3 (331)

Indicator	Causal chain	Scale	Data	Comment
Number of trainings on sustainable land management	The aim of the measure is to diffuse scientific knowledge and innovative practises in the agricultural and forestry sector. Indirect impact.	National	Number of training days, number of beneficiaries, amount of payments realised, annually.	Water protection oriented

Table B5 Indicators for Soil Quality

Setting up of farm management/advisory services (115)

Indicator	Causal chain	Scale	Data	Comment
Number of farmers who use advisory services for climate change mitigation	Indirect impact on sustainable management practices and cross compliance requirements.	National	Number of farmers who use advisory services on sustainable land management and sustainable management of natural resources, amount of payments realised.	Soil protection oriented

Improvement of the economic value of forests (122)

Indicator	Causal chain	Scale	Data	Comment
Level of improvement of the overall performance of the agricultural holdings (competitiveness, sustainability and protection of environment)	The measure supports the modernisation of the production factors, introducing new technologies and processes. This is directly linked to improved soil quality.	National	Survey results. Number of holdings supported and number of holdings in livestock breeding, number of farms meeting the requirements of the nitrate Directive 91/676/EEC were used as additional indicators.	Soil protection oriented
Number of enterprises introducing new technologies and innovations		Regional	Number of beneficiaries, area covered by the measure, amount of payment realised	Soil protection oriented
Risk of soil erosion	Regeneration of forest stands reduces the risk for soil erosion.		Ha of promoted areas	
Soil erosion - estimation of the C factor for soil erosion	Different cropping and land management practices affect the vegetation coverage of soils which has an influence on the risk and extent of soil erosion. The crop management factor C measures the impact of different management practices on soil erosion, which reduces the soil functionality and quality. The CMEF does currently not include an impact indicator for soils.		IACS data. Indicator is based on data and applications of the State Authority for Mining, Energy and Geology.	
Achievement of environmental objective: Area to be contributing to Soil quality in the specific action (part of 211 in ha) X % financial uptake for this action.	The calculation of the area under soil quality measure as a function of the proportion of the financial uptake and the programmed target area is provided as an estimation of the impact.	Action	Financial uptake, targeted area	
Yearly soil loss (t/ha)	Soil loss through erosion is detrimental to soil quality.	Regional	Estimation of soil loss rate per year; impact of the measures is based on literature.	
Change in risk of erosion	The erosion risk is an indicator of the soil loss due to the		IACS data	

	process and is in relation with the measure that evaluates the impact on soil characterisation.			
Areas at risk of erosion (tn/ha/year)	CMEF does not provide soil impact indicator. The measure does not allow land ploughing, so declared territories should be more resistant to erosion processes as well as have natural chemical cycles.	National	Declarations (ha of area under measure)	
	Soil plays a number of key environmental, social and economic issues, is relevant for the protection of water, air and biodiversity (habitat), the conservation of the landscape and cultural heritage.	Programme level (PDRH)	Regional database, CORINE Land Cover, land use maps.	
	For this environmental resource, the purpose is related to the knowledge and the preservation of its many functions, and productive environment. The need for a sustainable use of soil resources is linked to its slow regeneration capacity, the need to maintain and promote all of its functions, to conserve resources present in it, but also to its possible role as a "biological filter" that can within certain limits, to curb any negative impacts on the environment and likely produced by other major environmental matrices compromised by human activities. The protection of soil from erosion and pollution, is one of the objectives of the Sixth Environment Action Programme.	Regional	2005 monitoring database is the most representative of the number of beneficiaries and areas affected by agri-environmental measures. Regional database, CORINE Land Cover, AVEPA, Land use maps.	

Cooperation for development of new products, processes and technologies (124)

Indicator	Causal chain	Scale	Data	Comment
Number of enterprises introducing new technologies and innovations		Regional	Number of beneficiaries, area covered by the measure, amount of payment realised	Soil protection oriented

Supporting farmers who participate in food quality schemes (132)

Indicator	Causal chain	Scale	Data
(Risk of soil erosion)-Phosphorus content, humus content and pH of the soil	Measures key aspects of soil quality		Ha of area supported
Soil loss	Determine areas threatened by soil erosion (water and wind erosion) and areas of actual erosion in Estonia based on land use.		Studies conducted on selected areas by analysing orthophotos and IACS/LPIS databases. GIS land use data. LIDAR relief

			data (2011 study)
Changes in the content of plant nutrients (P, K, Ca, Mg, Cu, Mn, B), acidity, nitrogen mineralization (Nmin) and organic matter content		Monitoring in 3 areas across Estonia (areas with different soil-climatic conditions and different production types)	Analysis of soil samples (extra analysis of organic matter content and Nmin).
Proportion of UAA subject to friendly environment farming systems which affected area (a) to organic farming, (b) Integrated production or integrated control agencies harmful, and (c) pasture with less than 2 LU/ ha.	The introduction of innovative management projects aimed at promoting and developing methodologies and organization system, with specific reference to "quality certification in agriculture", "computerization in agriculture" and "food safety and traceability products". These aspects are linked with the measure and the investments in agricultural farms.	National, programme level (PDRN)	Agricultural survey PDRN (RICA).
Soil erosion - estimation of the C factor for soil erosion	Different cropping and land management practices affect the vegetation coverage of soils which has an influence on the risk and extent of soil erosion. The crop management factor C measures the impact of different management practices on soil erosion, which reduces the soil functionality and quality. The CMEF does currently not include an impact indicator for soils.		IACS data. Indicator is based on data and applications of the State Authority for Mining, Energy and Geology.
Maintenance / increase the organic matter content in soils	For the conservation of the soil and its fertility, the monitoring activities on the soil organic matter become essential, for this purpose this indicator evaluate the impact on this aspects in soil		IACS data, results of the previous analysis of the impact. Results of business surveys for the structural measures. Parameters and data taken from the literature and national, international agencies (Padua University).

First establishment of agroforestry systems on agricultural land (222)

Indicator	Causal chain	Scale	Data
(Risk of soil erosion)-Phosphorus content, humus content and pH of the soil	Measures key aspects of soil quality		Ha of area supported
Changes in the content of plant nutrients (P, K, Ca,		Monitorin	Analysis of soil samples (extra analysis of

Mg, Cu, Mn, B), acidity, nitrogen mineralization (Nmin) and organic matter content		g in 3 areas across Estonia (areas with different soil-climatic conditions and different production types)	organic matter content and Nmin).
Maintenance / increase the organic matter content in soils	For the conservation of the soil and its fertility, the monitoring activities on the soil organic matter become essential, for this purpose this indicator evaluate the impact on this aspects in soil		IACS data, results of the previous analysis of the impact. Results of business surveys for the structural measures. Parameters and data taken from the literature and national, international agencies (Padua University).
Model Universal Soil Loss Equation per ha per year (USLE)	This indicator has linked to the provision of public good, it refers to raise qualities of the soil and increase humus.	National	Number of beneficiaries, amount of payment realised
Soil erosion - estimation of the C factor for soil erosion	Different cropping and land management practices affect the vegetation coverage of soils which has an influence on the risk and extent of soil erosion. The crop management factor C measures the impact of different management practices on soil erosion, which reduces the soil functionality and quality. The CMEF does currently not include an impact indicator for soils.		IACS data. Indicator is based on data and applications of the State Authority for Mining, Energy and Geology.
Achievement of environmental objective: Area to be contributing to Soil quality in the specific action (part of 211 in ha) X % financial uptake for this action.	The calculation of the area under soil quality measure as a function of the proportion of the financial uptake and the programmed target area is provided as an estimation of the impact.	Action	Financial uptake, targeted area
Soil loss	Determine areas threatened by soil erosion (water and wind erosion) and areas of actual erosion in Estonia based on land use.		Studies conducted on selected areas by analysing orthophotos and IACS/LPIS databases. GIS land use data. LIDAR relief data (2011 study)
Yearly soil loss (t/ha)	Soil loss through erosion is detrimental to soil quality.	Regional	Estimation of soil loss rate per year; impact of the measures is based on literature.
Change in risk of erosion	The erosion risk is an indicator of the soil loss due to the process and is in		IACS data

	relation with the measure that evaluates the impact on soil characterisation.		
Areas at risk of erosion (tn/ha/year)	CMEF does not provide soil impact indicator. The measure does not allow land ploughing, so declared territories should be more resistant to erosion processes as well as have natural chemical cycles.	National	Declarations (ha of area under measure)
	Soil plays a number of key environmental, social and economic issues, is relevant for the protection of water, air and biodiversity (habitat), the conservation of the landscape and cultural heritage.	Programme level (PDRH)	Regional database, CORINE Land Cover, land use maps.
	For this environmental resource, the purpose is related to the knowledge and the preservation of its many functions, and productive environment. The need for a sustainable use of soil resources is linked to its slow regeneration capacity, the need to maintain and promote all of its functions, to conserve resources present in it, but also to its possible role as a "biological filter" that can within certain limits, to curb any negative impacts on the environment and likely produced by other major environmental matrices compromised by human activities. The protection of soil from erosion and pollution, is one of the objectives of the Sixth Environment Action Programme.	Regional	2005 monitoring database is the most representative of the number of beneficiaries and areas affected by agri-environmental measures. Regional database, CORINE Land Cover, AVEPA, Land use maps.

Diversification into non-agricultural activities (311) - Support for business creation and development (312) - Conservation and upgrading of the rural heritage (323)

Indicator	Causal chain	Scale	Data	Comment
Number of supported actions	Indirect influence of measure on soil quality.	National	Number of operations	Soil protection oriented
Total volume of investment	Indirect influence of measure on soil quality.	National	Amount of payment	Soil protection oriented

Training and information for economic actors operating in the fields covered by axis 3 (331)

Indicator	Causal chain	Scale	Data	Comment
Number of trainings on sustainable land management	The aim of the measure is to diffuse scientific knowledge and innovative practises in the agricultural and forestry sector. Indirect impact.	National	Number of training days, number of beneficiaries, amount of payments realised, annually.	Soil protection oriented

Competitiveness (411)

Indicator	Causal chain	Scale	Data	Comment
Number of trainings on sustainable land management	The aim of the measure is to diffuse scientific knowledge and innovative practises in the agricultural and forestry sector. Indirect impact.	National	Number of training days, number of beneficiaries, amount of payments realised, annually.	Soil protection oriented

Number of farmers who use advisory services for sustainable land management	Indirect impact on sustainable management practices and cross compliance requirements.	National	Number of farmers who use advisory services on sustainable land management and sustainable management of natural resources, amount of payments realised.	Soil protection oriented

Quality of life/diversification (413)

Indicator	Causal chain	Scale	Data	Comment
Number of supported actions	Indirect influence of measure on soil quality.	National	Number of operations	Soil protection oriented
Total volume of investment	Indirect influence of measure on soil quality.	National	Amount of payment	Soil protection oriented

Table B6 Indicators for Landscape

Setting up of farm management/advisory services (115)

Indicator	Causal chain	Scale	Data
Number of farmers who use advisory services f		National	Number of farmers who use advisory services on sustainable land management and sustainable management of natural resources, amount of payments realised.

Improvement of the economic value of forests (122)

Indicator	Causal chain	Scale	Data	Comment
Patch Density Index		National	Number of complex with mosaic UAA, forest on areas covered by measure	
Preservation of traditional landscape features	From contextual information can be concluded that indicator is based on prerequisite, that schemes which determine particular requirements from environmental point of view are important also for preservation of landscape. Therefore supports for territories where those schemes are applied allow to preserve landscape.	National	Declarations (area under support)	
Maintenance of a diverse landscape and landscape elements	Study: changes in landscape features (e.g. tree rows, hedgerows) are visualised by comparing orthophotos between 1994 and 2008 in 5 regions and are assessed with the participation data of AEMs. Changes in landscapes are assessed qualitatively and additionally, farmers are interviewed regarding their attitude towards AEMs and their impacts on landscape.			
Farmland under agreement contributing to perceptive/ cognitive, in particular visual, differentiation (homogeneity/diversity) in the landscape (number of sites and	The aim of the impact indicator is to assess the extent to which agri-environmental activities can contribute to the protection / enhancement of the landscape, this is the link with the measure 214 that promotes the agri-environmental activities.	Regional	Land use Veneto Region	

hectares/ kilometres) (a) of which due to the visual complexity resulting from land-use/crop patterns influenced by the supported actions (extent, spatial arrangement including height, colours) (%) (b) of which due to environmental features such as flora, fauna or habitats directly/indirectly resulting from the supported actions (%) (c) of which due to man-made objects (hedgerows, ditches, tracks) introduced/preserved by the supported actions or the possibility, thanks to support for vegetation management, of viewing the landscape differentiation (homogeneity /diversity) (%)		Regional (Federal State)	IACS data, Ha of promoted areas.	
Measuring the attractiveness of the area: Effect of abandonment on the landscape	There is a casual chain between the link indicator and the programme.	Regional	National statistics on agricultural production and agri-environmental system commitments;	Needs further elaboration
Additional attractive/valuable area or sites due to assistance	The relationship between the areas that received the aid and the measure is given by the assessment of the monetary help and the impact on the agricultural landscape	Regional	ISTAT database	
Created natural areas (ha)		National	Monitoring data, questionnaire or interviews.	
Ecological network connections (km)		National	Monitoring data, questionnaire or interviews.	
Changes in the structure of the landscape in terms of point, linear- and areal elements - Changes in the general upkeep of the farms.	The objective of the indicator is to assess if the application of AES requirements has affected the visual attractiveness, coherence, cultural characteristics and homogeneity/diversity of agricultural land		All elements of the landscape structure must be indicated on the field work map, the condition of the farms is identified by using photos and descriptions. Monitoring activities are carried out on the first and last year of the programme	

Adding value to agricultural/forestry products (123)

Indicator	Causal chain	Scale	Data
Preservation of traditional landscape features	From contextual information can be concluded that indicator is based on	National	Declarations (area under support)

	prerequisite, that schemes which determine particular requirements from environmental point of view are important also for preservation of landscape. Therefore supports for territories where those schemes are applied allow to preserve landscape.		
Maintenance of a diverse landscape and landscape elements	Study: changes in landscape features (e.g. tree rows, hedgerows) are visualised by comparing orthophotos between 1994 and 2008 in 5 regions and are assessed with the participation data of AEMs. Changes in landscapes are assessed qualitatively and additionally, farmers are interviewed regarding their attitude towards AEMs and their impacts on landscape.		
Farmland under agreement contributing to perceptive/ cognitive, in particular visual, differentiation (homogeneity/diversity) in the landscape (number of sites and hectares/ kilometres) (a) of which due to the visual complexity resulting from land-use/crop patterns influenced by the supported actions (extent, spatial arrangement including height, colours) (%) (b) of which due to environmental features such as flora, fauna or habitats directly/indirectly resulting from the supported actions (%) (c) of which due to man-made objects (hedgerows, ditches, tracks) introduced/preserved by the supported actions or the possibility, thanks to support for vegetation management, of viewing the landscape differentiation (homogeneity /diversity) (%)	The aim of the impact indicator is to assess the extent to which agri-environmental activities can contribute to the protection / enhancement of the landscape, this is the link with the measure 214 that promotes the agri-environmental activities.	Regional	Land use Veneto Region
		Regional (Federal State)	IACS data, Ha of promoted areas.

Animal welfare payments (215)

Indicator	Causal chain	Scale	Data	Comment
Stocking density (LU) per ha forage area	Low stocking density protects ecologic sensitive areas and biodiversity.	National	Stocking density (LU) in different regions	
Preservation of traditional landscape features	From contextual information can be concluded that indicator is based on prerequisite, that schemes which determine particular requirements from environmental point of view are important also for preservation of landscape. Therefore supports for territories where those schemes are applied allow to preserve	National	Declarations (area under support)	

	landscape.			
Maintenance of a diverse landscape and landscape elements	Study: changes in landscape features (e.g. tree rows, hedgerows) are visualised by comparing orthophotos between 1994 and 2008 in 5 regions and are assessed with the participation data of AEMs. Changes in landscapes are assessed qualitatively and additionally, farmers are interviewed regarding their attitude towards AEMs and their impacts on landscape.			
Farmland under agreement contributing to perceptive/ cognitive, in particular visual, differentiation (homogeneity/diversity) in the landscape (number of sites and hectares/ kilometres) (a) of which due to the visual complexity resulting from land-use/crop patterns influenced by the supported actions (extent, spatial arrangement including height, colours) (%) (b) of which due to environmental features such as flora, fauna or habitats directly/indirectly resulting from the supported actions (%) (c) of which due to man-made objects (hedgerows, ditches, tracks) introduced/preserved by the supported actions or the possibility, thanks to support for vegetation management, of viewing the landscape differentiation (homogeneity /diversity) (%)	The aim of the impact indicator is to assess the extent to which agri-environmental activities can contribute to the protection / enhancement of the landscape, this is the link with the measure 214 that promotes the agri-environmental activities.	Regional	Land use Veneto Region	
		Regional (Federal State)	IACS data, Ha of promoted areas.	
Measuring the attractiveness of the area: Effect of abandonment on the landscape	There is a casual chain between the link indicator and the programme.	Regional	National statistics on agricultural production and agri-environmental system commitments;	Needs further elaboration
Additional attractive/valuable area or sites due to assistance	The relationship between the areas that received the aid and the measure is given by the assessment of the monetary help and the impact on the agricultural landscape	Regional	ISTAT database	

First establishment of agroforestry systems on agricultural land (222)

Indicator	Causal chain	Scale	Data	Comment
Patch Density Index		National	Number of complex with mosaic	

			UAA, forest on areas covered by measure	
Preservation of traditional landscape features	From contextual information can be concluded that indicator is based on prerequisite, that schemes which determine particular requirements from environmental point of view are important also for preservation of landscape. Therefore supports for territories where those schemes are applied allow to preserve landscape.	National	Declarations (area under support)	
Maintenance of a diverse landscape and landscape elements	Study: changes in landscape features (e.g. tree rows, hedgerows) are visualised by comparing orthophotos between 1994 and 2008 in 5 regions and are assessed with the participation data of AEMs. Changes in landscapes are assessed qualitatively and additionally, farmers are interviewed regarding their attitude towards AEMs and their impacts on landscape.			
Farmland under agreement contributing to perceptive/ cognitive, in particular visual, differentiation (homogeneity/diversity) in the landscape (number of sites and hectares/ kilometres) (a) of which due to the visual complexity resulting from land-use/crop patterns influenced by the supported actions (extent, spatial arrangement including height, colours) (%) (b) of which due to environmental features such as flora, fauna or habitats directly/indirectly resulting from the supported actions (%) (c) of which due to man-made objects (hedgerows, ditches, tracks) introduced/preserved by the supported actions or the possibility, thanks to support for vegetation management, of viewing the landscape differentiation (homogeneity /diversity) (%)	The aim of the impact indicator is to assess the extent to which agri-environmental activities can contribute to the protection / enhancement of the landscape, this is the link with the measure 214 that promotes the agri-environmental activities.	Regional	Land use Veneto Region	
		Regional (Federal State)	IACS data, Ha of promoted areas.	
Measuring the attractiveness of the area: Effect of abandonment on the landscape	There is a casual chain between the link indicator and the programme.	Regional	National statistics on agricultural production and agri-environmental system commitments;	Needs further elaboration

Additional attractive/valuable area or sites due to assistance	The relationship between the areas that received the aid and the measure is given by the assessment of the monetary help and the impact on the agricultural landscape	Regional	ISTAT database	
Characteristic landscape	Extensification of grassland use increases biodiversity which has positives effects on landscape characteristics (e.g. increased diversity).	Regional	Frida database (DLR RNH): floristic and faunistic survey of 470 selected areas covering AEM participants and non-participants	
Created natural areas (ha)		National	Monitoring data, questionnaire or interviews.	
Ecological network connections (km)		National	Monitoring data, questionnaire or interviews.	

Competitiveness (411)

Indicator	Causal chain	Scale	Data
Number of trainings on sustainable land management	The aim of the measure is to diffuse scientific knowledge and innovative practises in the agricultural and forestry sector. Indirect impact.	National	Number of training days, number of beneficiaries, amount of payments realised, annually.
Number of farmers who use advisory services		National	Number of farmers who use advisory services on sustainable land management and sustainable management of natural resources, amount of payments realised.
Area of land affected by measure (ha) and Added value by land use and operation		National	Area of land affected by measure (ha) and Added value by land use and operation
Maintenance and creation of cultural landscapes (e.g. landscape protective forest roads)			

Environment/land management (412)

Indicator	Causal chain	Scale	Data	Comment
Stocking density (LU) per ha forage area	Low stocking density protects ecologic sensitive areas and biodiversity.	National	Stocking density (LU) in different regions	
Changes in the structure of the landscape in terms of point, linear- and areal elements - Changes in the general upkeep of the farms.	The objective of the indicator is to assess if the application of AES requirements has affected the visual attractiveness, coherence, cultural characteristics and homogeneity/diversity of agricultural land		All elements of the landscape structure must be indicated on the field work map, the condition of the farms is identified by using photos and descriptions. Monitoring activities are carried out on the first and last year of	

			the programme	
Patch Density Index		National	Number of complex with mosaic UAA, forest on areas covered by measure	
Preservation of traditional landscape features	From contextual information can be concluded that indicator is based on prerequisite, that schemes which determine particular requirements from environmental point of view are important also for preservation of landscape. Therefore supports for territories where those schemes are applied allow to preserve landscape.	National	Declarations (area under support)	
Maintenance of a diverse landscape and landscape elements	Study: changes in landscape features (e.g. tree rows, hedgerows) are visualised by comparing orthophotos between 1994 and 2008 in 5 regions and are assessed with the participation data of AEMs. Changes in landscapes are assessed qualitatively and additionally, farmers are interviewed regarding their attitude towards AEMs and their impacts on landscape.			
Farmland under agreement contributing to perceptive/ cognitive, in particular visual, differentiation (homogeneity/diversity) in the landscape (number of sites and hectares/ kilometres) (a) of which due to the visual complexity resulting from land-use/crop patterns influenced by the supported actions (extent, spatial arrangement including height, colours) (%) (b) of which due to environmental features such as flora, fauna or habitats directly/indirectly resulting from the supported actions (%) (c) of which due to man-made objects (hedgerows, ditches, tracks) introduced/preserved by the supported actions or the possibility, thanks to support for vegetation management, of viewing the landscape differentiation (homogeneity /diversity) (%)	The aim of the impact indicator is to assess the extent to which agri-environmental activities can contribute to the protection / enhancement of the landscape, this is the link with the measure 214 that promotes the agri-environmental activities.	Regional	Land use Veneto Region	
		Regional (Federal State)	IACS data, Ha of promoted areas.	
Additional attractive/valuable area or sites	The relationship between the areas that received the aid and the	Regional	ISTAT database	

due to assistance	measure is given by the assessment of the monetary help and the impact on the agricultural landscape			
Characteristic landscape	Extensification of grassland use increases biodiversity which has positives effects on landscape characteristics (e.g. increased diversity).	Regional	Frida database (DLR RNH): floristic and faunistic survey of 470 selected areas covering AEM participants and non-participants	
Measuring the attractiveness of the area: Effect of abandonment on the landscape	There is a casual chain between the link indicator and the programme.	Regional	National statistics on agricultural production and agri-environmental system commitments;	Needs further elaboration
Created natural areas (ha)		National	Monitoring data, questionnaire or interviews.	
Ecological network connections (km)		National	Monitoring data, questionnaire or interviews.	

Table B7 Indicators for Animal Welfare

Setting up of farm management/advisory services (115)

Indicator	Causal chain	Scale	Data	Comment
Number of farmers who use advisory services		National	Number of farmers who use advisory services on sustainable land management and sustainable management of natural resources, amount of payments realised.	Specify for animal welfare issues

Improvement of the economic value of forests (122)

Indicator	Causal chain	Scale	Data
Type of animal husbandry system after support: share of particularly animal appropriate husbandry systems; conversion from 'stanchion barns' to 'free stall barn'	(Changes in the indicator and impacts on animal welfare have not been assessed. Animal welfare aspects were only referred to in the synopsis of the assessment)	Regional	

Adding value to agricultural/forestry products (123)

Indicator	Causal chain	Scale	Data	Comment
Type of animal husbandry system after support: share of particularly animal appropriate husbandry systems; conversion from 'stanchion barns' to 'free stall barn'		Regional		
A large set of ethological indicators differentiated by functions (social behaviour, movement, rest and sleep, food intake, excretion, reproduction, comfort and exploration) and animal species (cattle, pigs).	Animal welfare changes or different levels of animal welfare can be observed and measured through behavioural indicators. Different husbandry systems affect animal behaviour and allow animals to show different extents of natural behaviour patterns which can be measured through ethological indicators. Ethological indicators are widely accepted as a sensitive measure of animal welfare.	Regional (Federal States)	IACS data, since sufficient husbandry data are not available from secondary data, hence, a farmer survey was carried out to collate husbandry data.	Needs further clarification
Share animals on assisted holdings enjoying improved welfare thanks to assisted investments (%) (a) of which with animal welfare as a direct aim (%) (b) of which with animal welfare as a collateral effect (e.g., due to new housing or equipment acquired	The measure 133 is related to the producer group support for information and promotion activities of agricultural quality products, is linked with the impact indicator for the improvement of animal welfare conditions occur indirectly through assisted investments.	Regional	Regional monitoring system, the sources also report uses national statistics (ISTAT) and the regional database of the Italian network of agricultural accounting (RICA) provided by INEA for the years 2000-	

mainly for other reasons) (%) (c) of which related to welfare standards (%) (d) of which related to EU-welfare standards (%)			2006.	
Share of assisted products sold with quality label (%) (a) of which EU-level labelling schemes (%) (b) of which national level labelling schemes (%) (c) of which other labelling schemes (%)	The introduction of innovative management projects are aiming to promote and develop methodologies and innovative systems management and organization, with specific reference to 'quality certification in agriculture', 'computerization in agriculture' and 'food safety and traceability', these aspects are linked with the measure and investments in agricultural farms.	Regional	Regional monitoring system, (ISTAT) and regional database of the Italian network of agricultural accounting (RICA)	

Adaptation of demanding standards based on Community legislation (131)

Indicator	Causal chain	Scale	Data
Share animals on assisted holdings enjoying improved welfare thanks to assisted investments (%) (a) of which with animal welfare as a direct aim (%) (b) of which with animal welfare as a collateral effect (e.g., due to new housing or equipment acquired mainly for other reasons) (%) (c) of which related to welfare standards (%) (d) of which related to EU-welfare standards (%)	The measure 133 is related to the producer group support for information and promotion activities of agricultural quality products, is linked with the impact indicator for the improvement of animal welfare conditions occur indirectly through assisted investments.	Regional	Regional monitoring system, the sources also report uses national statistics (ISTAT) and the regional database of the Italian network of agricultural accounting (RICA) provided by INEA for the years 2000-2006.
Share of assisted products sold with quality label (%) (a) of which EU-level labelling schemes (%) (b) of which national level labelling schemes (%) (c) of which other labelling schemes (%)	The introduction of innovative management projects are aiming to promote and develop methodologies and innovative systems management and organization, with specific reference to 'quality certification in agriculture', 'computerization in agriculture' and 'food safety and traceability', these aspects are linked with the measure and investments in agricultural farms.	Regional	Regional monitoring system, (ISTAT) and regional database of the Italian network of agricultural accounting (RICA)

Natura 2000 payments (213)

Indicator	Causal chain	Scale	Data	Comment
Action 3.3 Breeding animal species in danger of extinction or % of area used for any pets indicates the traditional farm animal species with agri-environmental aid		Regional	UAA and regional agricultural database	
Number of supported farms and number of contracts, and two additional output type indicators were used number of supported		National	IACS data	

animals and area of grazed land				
Animal welfare: number of animals breeds endangered subject of aid		Regional	Data from RICA, FADN	
Relationship between intensification and extensification		Regional	UAA and regional UAA	Needs further clarification
Organic Farming -% of organic UAA in the total regional UAA		Regional	UAA and regional UAA	

First afforestation of non agricultural land (223) - Restoring forestry potential and introducing prevention actions (226)

Indicator	Causal chain	Scale	Data	Comment
Action 3.3 Breeding animal species in danger of extinction or % of area used for any pets indicates the traditional farm animal species with agri-environmental aid		Regional	UAA and regional agricultural database	
Number of supported farms and number of contracts, and two additional output type indicators were used number of supported animals and area of grazed land		National	IACS data	
Animal welfare: number of animals breeds endangered subject of aid		Regional	Data from RICA, FADN	
Relationship between intensification and extensification		Regional	UAA and regional UAA	Needs further clarification