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Impacts of the Austrian Programme of Rural Development 2007-2013 on the Agricultural Sector, the Regional Economy and Aspects of the Quality of Life

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Abstract

The Austrian programme of rural development had an annual volume of 1.1 bilion € of public funds during 2007 to 2013. The support was given in order to improve the agri-environmental situation, to maintain agricultural production in regions with production disadvantages and to make productivity enhancing investments. The evaluation shows the impact on employment, productivity and environmental outcomes. An econometric analysis of the impact at the level of municipalities complemented the analyses of a bottom-up agricultural sector model and a regional input-output model of the Austrian economy. The results show that the programme contributed to maintaining marginal land in agricultural production, that employment and value added in the economy were stimulated and that the impact on the environment was reduced by lower green house gas emissions and lower nitrogen surpluses. The regional effects are very heterogeneous. Results on the indicators of quality of life were not conclusive.

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Impacts of the Austrian Programme of Rural Development 2007 – 2013

1   Introduction

This report gives an overview of the work on an evaluation of the *impacts* of the Austrian Programme of Rural Development 2007 - 2013 (acronym: LE 07-13). This study is an integrated component of the evaluation of the whole programme: data and concepts developed in other studies on specific measures have been taken on board for the impact assessment and results will become an integral element of studies that focus on efficiency and effectiveness of specific measures.

LE 07-13 is co-funded by the European Agricultural Fund for Rural Development (EAFRD) and has to be assessed in the context of 20 other Austrian programmes which are supported by the European Regional Development Funds (ERDF), the European Social Fund (ESF) and the European Territorial Cooperation (ETC). As pointed out by the strategic report for Austria on the implementation of the EU cohesion policy, all programmes are designed to contribute the Europe 2020 strategy and are fully consistent with the National Reform Programme (ÖROK, 2013). Therefore any evaluation has to consider the other programmes implemented at the same time. From an EU tax payer perspective it would be advisable to evaluate all programmes together because many objectives are overlapping. The approach used for this evaluation could be chosen for such an endeavour.

LE 07-13 is covering the whole territory of Austria. In terms of transfers per beneficiary or per utilized agricultural area (UAA) it is among the most important ones in the EU (Figure 6 in Appendix 3). The scope of objectives and measures of LE 07-13 is very broad and not only addressing the agricultural sector but many other activities (Figure 7 in Appendix 3). The programme is designed to bring about economic and environmental benefits and therefore spans over more than one domain. Whereas most of the transfers are targeted to rural areas, a significant share of funds is allocated to beneficiaries in other regions, as well (Figure 9 in Appendix 3). The granularity of the programme is very fine in order to allocate funds towards beneficiaries or regions with specific characteristics. The spatial heterogeneity of measures is therefore noteworthy and has to be taken into account in the evaluation.

The strategic targets of the cohesion funds in Austria are to "ensuring quality of life, incomes and employment" (ÖROK, 2015). These goals are consistent with those of the EU rural development policy which is aiming at "improving the quality of life and encouraging diversification of economic activities". "Improving competitiveness of agriculture and forestry" (in order to raise employment and incomes), and "supporting land management and

improving the environment" are additional objectives specific the programme of rural development (European Commission, 2007). Such a match of central objectives indicates that - at least in Austria - EU funded programmes may be evaluated in similar ways.

2   Research questions

The research questions addressed in this study are from the revised set of programme related *common evaluation questions* (CEQs). They were developed for use in the ex post evaluation of the Programme of Rural Development (European Evaluation network of Rural Development, 2014a). A subset of eight CEQs is covered - at least partially - in this study. The selection of questions was made with reference to the qualification of the research team, the given sets of data and the available methods.

To what extent has the RDP contributed ...

1) to the growth of the whole rural economy?

2) to employment creation?

3) to protect and enhance natural resources and landscape including, biodiversity and HNV farming and forestry?

4) to the supply of renewable energy?

5) to improving the competitiveness of the agricultural and forestry sector?

7) to climate change mitigation and adaptation?

8) to improvement of water management (quality, use and quantity)?

9) to improving the quality of life in rural areas and encouraging diversification of the rural economy?

The indicators to measure the impacts of LE 07-13 are listed in Table 1 in the second column (see Appendix 2 for definitions of the term "impact"). The third column shows which indicators are covered in the evaluation here. Impact indicators related to biodiversity and the nature value of farm land are treated in other studies that partly can make use of some of the results presented here.

Results on item 9 "quality of life" are available for the situation in 2006 based on a representative survey among Austrian citizens (BMLFUW, 2010). For this evaluation an indirect approach was chosen by looking at indicators which are associated with important aspects of quality of life. Such indicators were suggested among others by Stiglitz, Sen, Fitoussi (s.a.). But not for all of them data were available. Aspects like health or security are important elements of quality of life for Austrian citizens (Kettner et al., 2012) but adequate indicators are not available at a scale needed for the analytical tools employed in this study. Because neither human health nor personal security are directly addressed by the programme under consideration, no efforts were made to develop adequate data sets for this evaluation.

Table 1: Impact indicators

#	impact indicator	measurement general	specific
1	economic growth	value added	gross value added in nominal terms
2	employment creation	additional jobs	jobs and full time equivalent (FTE) or annual working unit (AWU)
3	labour productivity	change of value added per full time employed person	gross value added in nominal terms per full time equivalent or annual working unit
4	reverse biodiversity decline	not available	
5	maintenance of high value areas	not available	
6	improve water quality	change of gross nutrient balance	gross nitrate balance at NUTS0 and NUTS3 level (OECD method)
7	combat climate change	change of area for biomass for energy production;	area of short rotation trees and GHG balance
8	quality of life	change residential population unemployment income level gender wage gap	permanent inhabitants unemployed/population non-farm incomes incomes females / males

Source: Own compilation. Indicators 1-7 based Directorate General for Agriculture and Rural Development, 2006. AWU (annual working unit) is the measure of full time equivalents (FTE) in the agricultural sector.

3   The subject of evaluation

The evaluation identifies and quantifies impacts of the Austrian Programme of Rural Development 2007-2013 (LE 07-13)[1]. The planned EU support for the Austrian programme LE 07-13 was 3.9 bn €. That amount was equivalent to 4.2% of total EU support for rural development. That share is significant given that the output of the Austrian agricultural sector is equivalent to 1.4% of EU agricultural production (see also Figure 6 Appendix 3).

The finally approved project costs of LE 07-13 for the programme period were 12.3 bn € and total public funding was 8.1 bn € (of which the EU share was 52 %). A detailed overview of the total volume of the programme and the sources of finance are presented in Table 2 (Appendix 3).

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[1] Details available at http://ec.europa.eu/agriculture/rurdev/countries/au/index_en.htm (accessed 16 Dec. 2015).

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The programme is organized in four axes and contains as a separate element "technical assistance". The specific aims and contents of the axes are:

- Axis 1: Improving the competitiveness of the agricultural and forestry sector
- Axis 2: improving the environment and the countryside
- Axis 3: quality of life in rural areas and diversification of the rural economy
- Axis 4 - LEADER

Whereas Axis 1 and Axis 2 are mainly focussed on the primary sector, the other programme areas address the whole economy and society of rural areas.

4 Methodology

The choice of methods employed for this analysis is explored in detail in Appenix 1 (Notes on treatment and causal effects). The counterfactual situation "LE 07-13 programme was not introduced" is quantified using three approaches:

- **Econometric methods**: Using a detailed data set (see next chapter) a number of econometric models (cross-section as well as panel analyses with fixed regional effects) were developed. These analyses cover all axes of the programme including LEADER.

  Given the programme characteristics and the available data, the identification of causal effects was not always possible. In such cases explanatory variables were identified that show a significant association with the indicator of interest (e.g. level of income).

- The **integrated computational bottom up agricultural and forestry model PASMA[grid]** was used to quantify the effects of axes 2 measures of LE 07-13 (Figure 3 in Appendix 3). This model is designed to evaluate impacts of policy interventions and changing market conditions for the agricultural and forest sector in Austria (Figure 4 in Appendix 3). The model is an improved version of PASMA, an agricultural and forestry sector model that has been frequently used for policy analyses and evaluation studies (e.g. Sinabell et al., 2011). One advancement of PASMA[grid] is the level of spatial resolution with grid cells of 1x1 km (=100 ha). Another feature of PASMA[grid] is its greenhouse gas (GHG) accounting system. Economic (labour, gross value added) and environmental (gross nutrient balance and GHG emission) impacts can therefore be evaluated with unsurpassed spatial detail. The model is calibrated to the base period 2008-2010.

- The **regional input output model BERIO-ASCANIO** is a general equilibrium model. The financial flows of the whole economy (including all sectors not only agriculture and forestry) are represented in this model (Appendix 3 Figure 5). It is based on the input-output-table of Austria from 2007. The specific feature of BERIO-ASCANIO is its regional structure at the level of 99 administrative districts. The district specific structures of the economy are an important element of the model and product flows are represented by internal (within country) and external (rest of the world) trade flows.

The use of more than one method was necessary because of the complexity of the programme and the heterogeneity of evaluation questions on economic and environmental aspects. All three approaches are used to evaluate "impacts" defined as effects that go beyond those to be expected directly by the beneficiary. For the quantitative analysis with the computational models public support of an average year were used as a shock. For the econometric models panel data of public support per municipality was used as explanatory variables.

5   Data

For this analysis various detailed sets of data were collected. Data were needed to calibrate and update the computational model or to specify the base-line situation. The spatial level for the data used in this analysis was:

- farm micro data aggregated to 1x1 km grid for the integrated bottom up agricultural and forestry model PASMA[grid];
- firm level data aggregated to administrative district level for parameterization of the general equilibrium model;
- data at municipality level (n=2,376) for the econometric evaluation of quality of life indicators; efforts were made to develop a balanced panel data set 2000 to 2013 but this was not possible for all variables of interest because several statistics are available only for years of the programme period 2007-2013;
- data on the structure of the economy and regional trade flows in 99 administrative districts;
- various statistics on the economic structure, employment and farm production in 35 NUTS-3 regions.

The information sources and their elements were:

- *Administrative data* on funds related to programme implementation, land use, land use management, farm characteristics, programme participation aggregated either at farm level, grid level or municipality level depending on use (main sources: IACS and files of programme implementation and characteristics of beneficiaries).
- *Statistical information*:
  - NUTS0: input-output table (to be broken down for the regional general equilibrium model); GHG inventory of farm sector;
  - NUTS3: regional economic accounts (REA) and economic accounts of agriculture (EAA); nutrient balances;
  - municipality: population (permanent residents), unemployment (by gender), wages and non-wage incomes of residents (by gender), municipality tax revenues; census data on employment by industry.

- *Expert interviews*: The study on impacts of the LE 07-13 programme was conducted prior to the measure related evaluations; nevertheless measure specific data and results were needed (e.g. sectoral allocation of programme funds and incidence). In order to obtain this information a survey among evaluators was conducted.

The ex-post evaluation of single measures of LE 07-13 is planned to be finished by mid 2016. At the time of writing this report final results on measures were not yet available. Therefore some assumptions were necessary to be made in order to specify important parameters for the quantitative assessment with the computational models (e.g. deadweight, leverage, transaction costs). Implications of such assumptions are identified and discussed in more depth in Appendix 2.

6 Policy significance and evaluation results

6.1 Approach

In this section an overview is presented for major results of the quantitative analysis on impacts of the LE 07-13 programme. An overview of the analytical tools, most important data sources and programme information is provided in Figure 1.

For the evaluation two quantitative computational models were used: PASMA[grid] for the agricultural sector (scale: 1x1 km) and BERIO-ASCANIO (scale: administrative districts) for the whole economy. These models were used to analyse the impacts of complementary elements of the programme. Axis 2 measures were evaluated with PASMA[grid] and all other axes and measures were evaluated with BERIO-ASCANIO. Results from PASMA[grid] on output of the primary sector and input demand were used as an input for BERIO-ASCANIO.

Because the spatial scale of PASMA[grid] is below those of districts, regional effects can be assigned to the appropriate district in BERIO-ASCANIO. In an ideal setting the models PASMA[grid] and BERIO-ASCANIO would be integrated to allow feed-backs and simultaneous simulation of impacts of all axes. The development of new models was not part of the evaluation and therefore the models were linked in the way described above.

Programme information on all axes and measures was used for the econometric analysis on the impact of quality of life. Some results (e.g. impact on employment) of the econometric analysis can be used to cross check the results of the computational models. This is indicated by the lightly blue coloured arrow in Figure 1.

Figure 1: *An overview of analytical tools, data sources and evaluation design*
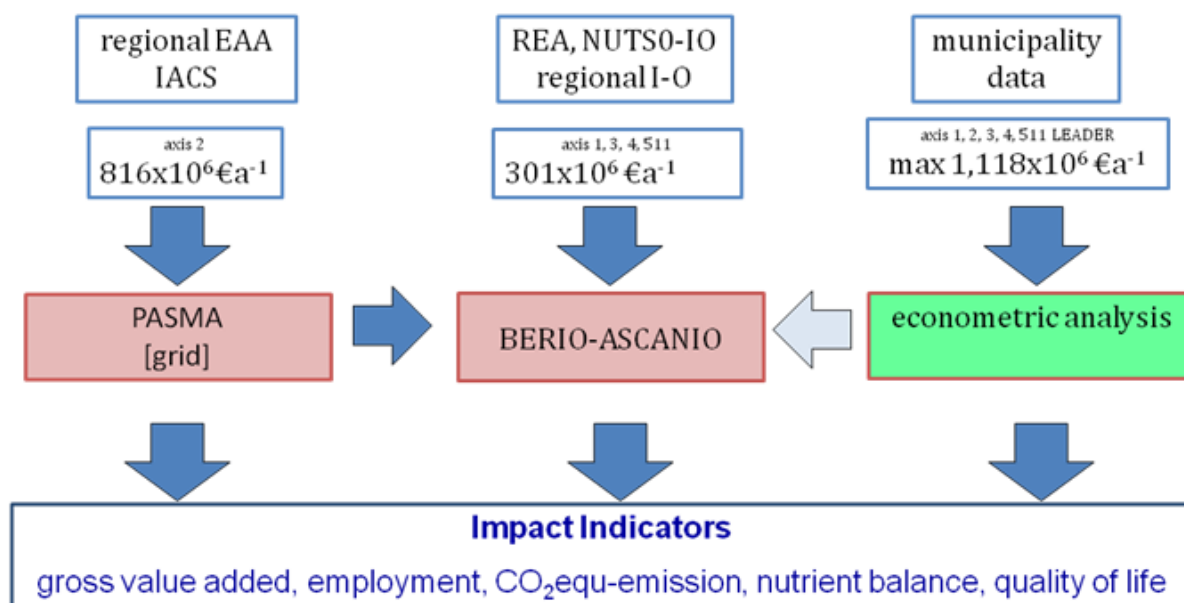
Source: Own construction. The red boxes indicate modules with computational approaches, the green box shows the module with an econometric approach. The figures in the boxes above the coloured boxes indicate the program funds from different axes of the programme. Arrows indicate the flow of data and results.

6.2   Scenario results at national level on economic and environmental impacts

As explored in more detail in appendix 2 there are more than one way to evaluate the impacts of complex policy interventions such as LE 07-13. Results of several approaches are presented in this section. In addition, it has to be considered that some important parameters were unknown when the study was conducted therefore assumptions needed to be made to specify model parameters of BERIO-ASCANIO. The range of uncertainty due to discretionary assumptions on the parameters for the model BERIO-ASCANIO is indicated explicitly. Results of the model PASMA[grid] are less sensitive to parameter assumptions and therefore the range of uncertainty is not indicated here.

Overview of impacts of axis 2 measures of LE 07-13 based on results of PASMA[grid] at national level on agriculture: In a situation **without LE 07-13** the impact indicators would be:

+5.8 %	gross value added in agriculture (0.16 bn €)
-3.1 %	jobs in agriculture (- 6,700 jobs = -4,900 AWU)
+9.1 %	nominal gross value added per hour worked in agriculture
+19.4 %	gross nitrogen balance of agricultural sector
+2.9 %	total greenhouse gas emission of agricultural sector

Gross value added in agriculture would be higher without LE 07-13 according to our results. This needs further explanations because it is an unintended outcome. The reason is that axis 2 measures have among others the following effects:

– agriculture become more labour intensive and more land intensive because of the programme (more organic farming);

– agriculture was maintained in regions where otherwise land owners would plant forests or abandon land (maintenance of agriculture in mountain regions);

– without of the programme agricultural output would be higher because more chemical inputs (mineral fertilizer, herbicides, fungicides) were used;

– because of the programme resources (material, machinery) were used to maintain specific practices on high value nature farmland - the costs are accounted for but the environmental benefit is not accounted for in monetary terms.

All these factors affect *gross value added* of agriculture negatively. Ecological benefits or improvements of the landscape are not accounted for in the output of the agricultural sector whereas the resources to provide them are. Such a result shows that it is important to use a broad range of indicators that can be used to evaluate all aspects of the programme.

Based on BERIO-ASCANIO and PASMA[grid] results at national level such impacts were quantified. The results show that LE 07-13 had significant impacts beyond the agricultural sector. Because there are some uncertainties about the true values of important parameters, three scenarios were developed to show the range of results.

Scenario 1: In a situation **without LE 07-13** the impact indicators would be

-0.5 %   gross value added in the whole economy (-1.6 bn €) and

-0.7 %   jobs in the whole economy (- 30,300 jobs = -25,600 FTE/AWU).

These results rest on the assumption that funds from national public sources do not compromise the public demand for other products and services (see Appendix 2 for an elaboration on this assumption). In this scenario other public expenditures are not reduced in order to finance LE 07-13. The impacts on gross value added and employment are the result of additional demand of 1.1 bn € per year. This sum is equivalent to the total public programme funds (financed from EU and national sources). Selected impacts of this scenario on regional scales are shown in Figure 13 and 14.

In **scenario 2** the impact of public plus private expenditures was evaluated: Additional demand of 1.68 bn € per year (outlays of beneficiaries plus public funds from EU and national sources) would have a higher impact by the order of 1: 1.7 compared to the first scenario.

In **scenario 3** the assumption is made that public expenditures financed from national sources are held constant. The implication is that national funds needed to co-finance community support for LE 07-13 have to be taken from elsewhere: the typical product mix of public demand in Austria is reduced by 0.54 bn € per year and used to finance the LE 07-13 product mix. This implies a shift of labour intensive domestically produced services (including education and health care) to products with a significant larger import share.

According to the assumptions made in scenario 3 the impacts were:

-0.4 %   gross value added in whole economy (-1.4 bn €)

-0.6 %   jobs in the whole economy (- 28,100 jobs = -23,900 FTE)

These figures indicate the impact if alternative uses of national public funds are considered in the evaluation.

6.3   Econometric results on quality of life and economic performance indicators

Several indicators for the quality of life were evaluated using econometric methods. Most of the results show associations or partial correlations between variables of interest using panel econometric methods. Only for some aspects, causal effects of the programme have been tested. The explanatory variables for the indicators of interest are public funds of LE 07-13 and each hypothesis was tested using total funds and funds per axis.

The hypotheses analysed in the econometric models and the results are:

- Hypothesis 1: Payments were targeted to the regions according to the objectives of the programme.
  Results:
  – programme funds are directed towards regions with lower levels of economic activity and incomes;
  – funds are allocated mainly towards regions characterised by rural attributes (non-urban fabric, high share of land used for pastures, arable land)
- Hypothesis 2: LE 07-13 improved that quality of life. Municipalities where relatively more funds were allocated had higher population growth (permanent residents).
  The results are:
  – population growth is not associated with programme funds;
  – the growth rate of permanent residents seems not to be affected by LE 07-13;
  – coefficients are not significant, neither those of total funds nor those of single axes.
- Hypothesis 3: Incomes of residents in municipalities were higher in municipalities where relatively more funds were allocated.
  The results are:
  – higher funds are associated with lower incomes of residents; this outcome is associated with axis 2 funds;
  – this indicates that measures directly supporting extensive farming and maintenance of farming in marginal areas prevent that farmers change in more productive employment positions;
  – in general incomes of farm households are lower than those of non-farm households (Sinabell und Fensl, 2013).

- Hypothesis 4: The number of unemployed persons (relative to permanent residents in municipalities) was lower where more funds are allocated.
  The results are:
  – higher support rates are associated with lower unemployment;
  – funds for measures of axis 1 (weakly) and axis 2 (more strongly) contribute to lowering the rate of unemployed persons;
  – an interpretation is that axis 2 measures reduce the number of farmers entering the non-farm job market and that axis 1measures (among them investment support) slightly stimulate employment.
- Hypothesis 5: LE 07-13 contributed to reduce the gender wage gap.
  The results are:
  – higher levels of support are associated with lower wage gaps between men and women in the municipalities under consideration;
  – the effect of the programme is significant and this is the combined effect of all axes together;
  – an interpretation is that the horizontal goal of the programme to support gender aspects is not just rhetoric but seems to be effective as well.
- Hypothesis 6: LE 07-13 contributed to stimulate employment outside the agricultural sector.
  The results are:
  – a higher level of support is not significantly associated with higher employment outside the agricultural sector due to the programme (all axes together);
  – the programme has antagonistic effects: axis 1 measure stimulate employment outside the agricultural sector and axis 2 measures seem to reduce employment but the result is not unambiguously significant;
  – an interpretation is that axis 2 measures give an incentive to stay in the agricultural sector and to abstain from entering the job market; axis 1 measures (among them investment support) stimulate growth and employment in downstream and upstream industries;
- Hypothesis 7: LE 07-13 contributes to stimulate employment outside the agricultural sector and induced structural change by increasing productivity.
  The results are:
  – a higher level of support is not significantly associated with higher employment outside the agricultural sector due to the programme (all axes together);
  – the programme has antagonistic causal effects: axis 1 measure stimulate employment outside the agricultural sector and axis 2 measures seem to reduce employment in other sectors but the result is not unambiguously significant;
  – not only the number of jobs is positively affected but also the structure of employment: due to axis 1 subsidies employment in sectors with higher productivity is stimulated;
  – an interpretation is that axis 2 measures give an incentive to stay in the agricultural sector and to abstain from entering the job market; axis 1 measures (among them

investment support) stimulate growth and employment in downstream and upstream industries in segments that are slightly more productive.

- Hypothesis 8: LE 07-13 contributed to stimulate local economic activities in a positive way. The results are:
    - a higher level of support is significantly associated with higher local tax revenues, a measure for economic activity (the tax is a fixed rate of 3% of gross earnings of employed persons);
    - that effect is only due to axis 1 subsidies;
    - an interpretation is that axis 1 measures are associated with 15 mn € of local tax revenues (equivalent to gross earnings of 0.5 bn €).

6.4 Discussion and policy significance

The results presented in the previous sections give an overview of the impacts of the Austrian Programme of Rural Development LE 07-13 at national level. More detailed results at regional levels are presented in Appendix 3 (Figure 13 and 14).

The main findings of this evaluation study are:

- The programme had a positive effect on employment and gross value added for the Austrian economy. Without LE 07-13 both employment and value added of the economy would have been lower. The results of a regional Input-Output model are confirmed by an econometric analysis which uses data from municipalities.
- There is uncertainty about the levels of programme effects. Results depend on the choice of some crucial parameters or on the choice of specific indicators.
- Gross value added in agriculture is affected negatively by the programme. Such a result is expected given the Austrian programme priorities: The largest share of support for agricultural holdings in Austria is for the introduction and maintenance of agricultural practices that are environmentally sound but less productive and for the maintenance of farming in marginal regions like mountains (Figure 8 Appendix 3). Without the programme resources would not be allocated to many agricultural regions. An intended consequence of the programme is that agricultural systems with low output levels are maintained.

    The effect of LE 07-13 on farm income was positive. Results on gross value added and farm incomes seem to be contradictory but they are consistent with the accounting rules of EAA. Transfers from LE 07-13 are accounted for in EAA after calculating net value added under the heading "other subsidies on production" (Code New Cronos 2500).

    It has to be noted that the *benefits* of environmental improvements are *not* accounted for the monetary values of outputs or in gross value added. The *costs* of introducing and maintaining environmentally friendly practices are accounted for in the calculation of gross value added. The measure "gross value added" therefore is not an adequate indicator to gauge environmental outcomes.

Due to the programme farming is maintained in marginal regions and more labour intensive practices (e.g. organic farming) are stimulated. As a consequence more jobs are maintained in agriculture. The programme thus reduces the rate of decline of jobs in the agricultural sector (which is approximately 2% per annum in Austria).

- The improvement of environmental indicators shows that LE 07-13 reduced negative impacts due to nutrient losses and greenhouse gas emission. The programme prevented that marginal agricultural areas were turned to alternative non-agricultural uses.
- Indicators on the quality of life show that the level of support was associated with various aspects (employment, unemployment, gender wage gap) in favourable ways. The growth of the number of residents does not seem to be affected by LE 07-13.

The programme LE 07-13 is the biggest among 21 programmes funded by the EU in Austria in the period 2007-2013. There are certainly interactions between the other 20 programmes. Given that the evaluation concentrated just on LE 07-13 it is unknown whether these interactions are positive or negative or if programmes are neutral to each other. A methodological approach as applied in this evaluation seems to be adequate to answer such questions.

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Appendix1: Notes on the validity of results, treatment and causal effects

The analytical framework presented in this section is motivated by the observation that frequently evaluations look only at one aspect of a programme or a few regions or some measures but fail to evaluate overall programme effects covering the whole economy and scope of objectives.

An integrated assessment is necessary if an evaluation is intended to quantify trade-offs among objectives. Such an approach can also be used to evaluate the relative effectiveness of different measures. One motivation of this impact evaluation is to develop a coherent framework of quantitative tools that can be used to analyse complex programmes such as LE 07-13. Another motivation is to explore how many dimensions and aspects of regional development programmes can be evaluated in quantitative terms in a consistent and transparent manner and to identify which dimensions need special treatment and why.

One lesson learned after studying programme documents is that even a very elaborated set of assessment tools is not adequate to cover all aspects of a comprehensive programme. Some of them are very specific e.g. by addressing biodiversity, water quality, high nature value farm systems, and effects on bird populations. Such a diversity of objectives requires a diversity of approaches to measure adequate indicators. In order to answer all subtleties special approaches and methods need to be employed.

From an evaluation point of view, randomized controlled trials (RTC) would be the best case for an evaluation. Such a design would allow to identify causal effects based on statistics on indicators of those in the sample who got a treatment compared to those in the control group.[2]

In the context of evaluation, there is not one second best option but there are several second best options and two of them are chosen for this evaluation study:

- econometric methods aiming at identifying causal effects
- computational economic models

The two approaches are described in more depth in this chapter. This exploration is helpful to make judgments about the validity and reliability of the results of the evaluation. The quality of the results depends crucially on the characteristics of methods and the quality of data.

Econometric methods

Econometric methods are applied to estimate unbiased treatment effects with a variance as low as possible. Still, econometric estimators can produce reliable treatment effects only under strong assumptions. The Institute of Education Science at the U.S. Department of Education has established the 'What Works Clearinghouse' (WWC) initiative. Based on a

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[2] This chapter is based on Sinabell and Morawetz, 2014.

detailed procedure (IES, 2014), WWC reviews studies to provide educators with the information they need to make *evidence-based decisions***.**

According to this assessment, methods considered to meet *strong* evidence standards are only randomized controlled trials (RCT) which meet quality criteria and low attrition.[3]

Figure 2:   Econometric methods: Criteria for study design to meet evidence standards
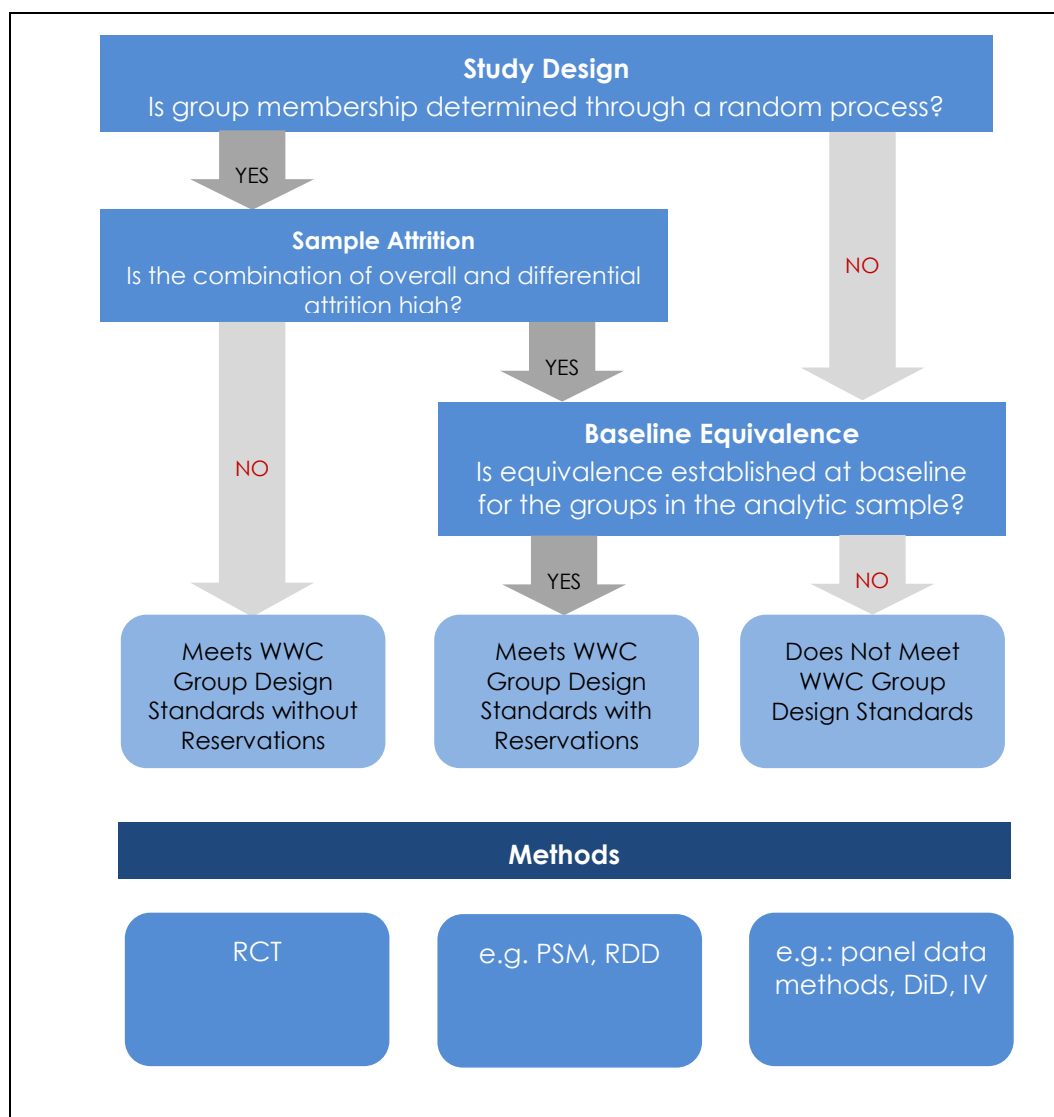
Source: Sinabell and Morawetz, 2014, modified from IES, 2015 and WWC, p. 9.

Quasi-experimental designs (a design in which groups are created through a process that is not random) are only considered to meet evidence standards with reservation if the attrition is low and equivalence of the control and treatment group can be demonstrated. This group includes methods like propensity score matching (PSM) or results of regression discontinuity designs (RDD) studies and single case designs when meeting certain quality criteria (see figure below).[4]

All other methods (e.g. panel data methods, difference in difference (DiD), or instrument variable methods (IV)) are not considered to meet evidence standards of WWC.[5]

Computational economic models

Computational economic models include a very diverse family of models. Relevant for RDP evaluations are the following three groups that can be differentiated according to the level of aggregation and their scope

1. (linear and non-linear, dynamic / static) farm / enterprise models, (micro-economic) household models, and agent based models;
2. partial equilibrium sector and regional models (econometric and optimization models);
3. (dynamic / static and econometric / non-econometric) input-output-models, general equilibrium models on regional, national or global scales;
4. integrated models combining approaches from various disciplines to simulate economic behaviour and the interaction to the natural environment (many of such models are partial equilbrium models or bottom up models).

Grouping models according to the level of aggregation and the level of detail does not impose a ranking of validity as was done in the case of econometric models presented in the previous section. This is because the logic of these models is quite different. Some of them work by solving behavioural equations, others by maximizing a theory based objective function, others by simulating behaviour based on behaviour rules and others by analyzing impulse response functions.

But a comparison with respect to validity is possible based on how the underlying parameters are derived: Following this rationale, three types can be differentiated:

- validity is lowest for models with parameters based on literature, based solely on input-output tables or assuming a linear technology (examples includes some equilibrium displacement models; input-output analyses by matrix manipulation of I-O tables; static single farm models maximizing gross margins; some CGE models);[6]
- validity is higher for models with implicitly estimated parameters e.g. through positive mathematical programming or maximum entropy approaches (e.g. CAPRI, PASMA) and

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[4]   Publications include: Michalek, 2012; Kirchweger, et al., 2011.

[5]   Publications include: Sinabell and Streicher, 2004; Heumesser and Morawetz, 2012; Petrick and Zier, 2009.

[6]   Publications include Feil, Musshoff and Balmann, 2011; Salhofer, Hofreither and Sinabell, 1999

for models that employ some parameters that are based on specific econometrically estimated parameters (in this group are many CGE models and input-output models)[7]

- the third group of models which is based on parameters which are specifically estimated for the model using econometric methods; models in this group are deemed to have the highest empirical validity (e.g. AGMEMOD, Fidelio).[8]

- integrated models have not yet been as widely used as the approaches listed above and should be treated separately; they can be differentiated according to the ways the integration is implemented and how specific effects are accounted for (such models may be spatially explicit and span from a single farm to the global scales e.g. FAMOS space, GLOBIOM, PASMA[grid])[9]

Cleary the method alone does not qualify results as valid. Preconditions for validity are a high quality of data, an adequate research design, a careful analysis and robustness testing. Equally, results from methods with lower validity can be valid enough if the underlying assumptions of the respective method are actually fulfilled.

In a concrete evaluation situation, the use of more than one method may be appropriate. In many cases the complexity of programmes and broad scope of evaluation questions covers aspects of many domains such as economics and environment. If more than one approach are chosen one has to consider that each on has special advantages and limitations.

- For example, in an input-output model the expenditures for the measure "training for farmers" increase demand in the education system. However, the effect that farmers become more productive is neglected because no study was made to check this. The effect of the measure is therefore likely underestimated.

- Some case studies based on micro data indicate that farmers may become less productive after they get investment support. Unless the productivity deterioration is explicitly taken into consideration in the primary sector of an input output model, the effect of the measure will likely be overestimated.

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[7] see Common Agricultural Policy Regionalised Impact - The Rural Development Dimension (CAPRI-RD) (details: http://www.ilr1.uni-bonn.de/agpo/rsrch/capri-rd/caprird_e.htm; publications include: Sinabell et al., 2011

[8] Publications include: Esposti and Bussoletti, 2008;

[9] Publications include Schönhart et al., (2011), Kirchner et al., 2013 and 2015.

Figure 3:   *Computational economic models: Common criteria for validity of results.*
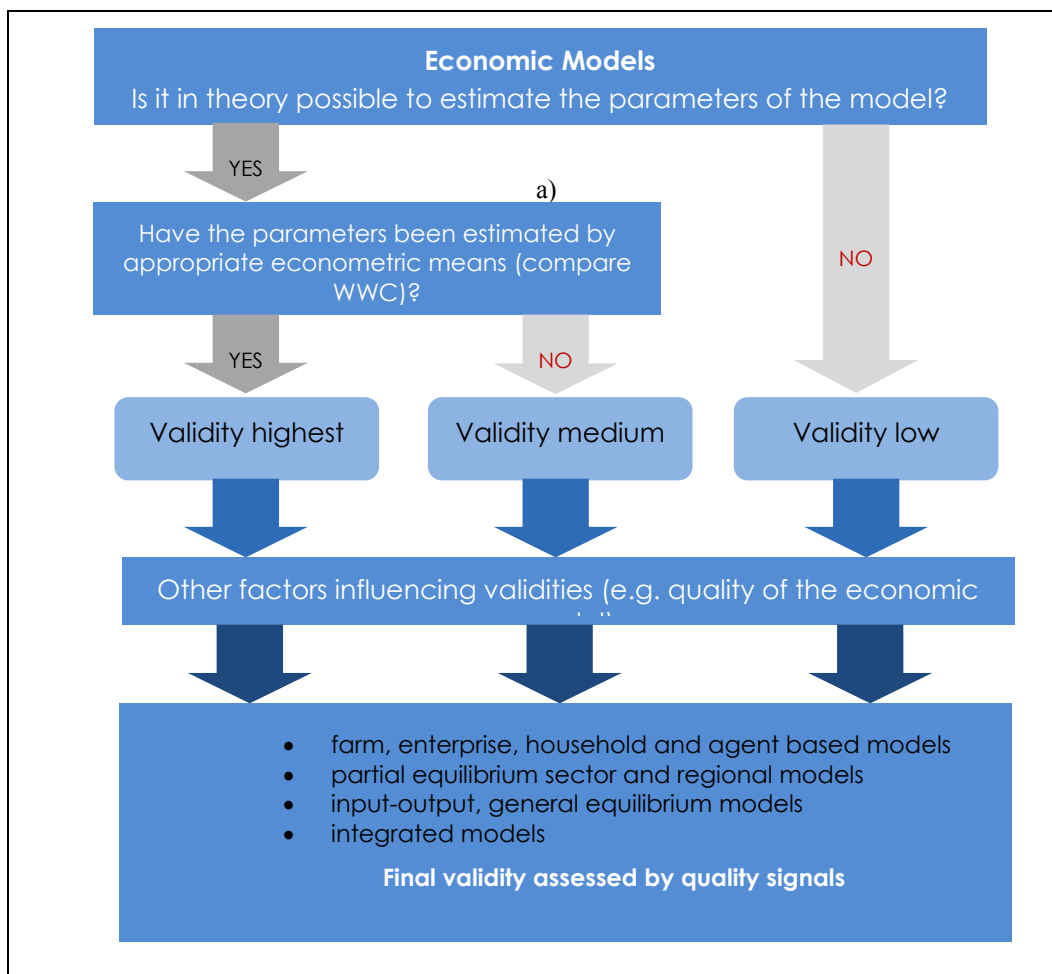
Source: Sinabell and Morawetz, 2014.

These examples show that a combination of methods (econometric analyses of micro data plus computational economic models) would be necessary to avoid such over- or underestimations. At least partly, such an approach is taken in this evaluation study. Results on production and input demand from the partial equilibrium model PASMA[grid] are used as an input for BERIO-ASCANIO, the general equilibrium model. Production related impacts of axis 2 measures cannot be modelled adequately by BERIO-ASCANIO but by PASMA[grid].

Micro data of beneficiaries and control groups for the use in econometric models to perform causal analyses were generally not available for this evaluation. It would have been necessary to collect them already early during the programme period or even before. Only for some measures adequate data can be used (e.g. to analyse investment measures on farms). Such data are most useful in the context of measure specific assessments on

effectiveness or efficiency and in an ideal situation the results are made available for impact assessments.

The use of specific methods which are adequate to identify causal effects (e.g. propensity score matching or regression discontinuity approaches) required additional information that was not yet available when this study was conducted. However, in some cases a causal interpretation of the parameter estimates is feasible. For example, when analysing the number of employees and the employment structure outside agriculture, a causal interpretation is valid, as only very few firms outside the agricultural sector are allowed to apply for funds from the programme.

Appendix 2: Notes on impacts, deadweight, leverage, alternative use of public funds, social costs of public funds, administrative burden and transaction costs

The term "impact of the programme" is well defined. Several documents and guidelines define what "impacts" are, what characteristics "impact indicators" have and how "impacts" should be presented:

- According to the Common Monitoring and Evaluation Framework (Directorate General for Agriculture and Rural Development, 2006) "effects of an intervention lasting in medium or long-term" are *impacts of a programme*. "Some impacts appear indirectly, (e.g. turnover generated for the suppliers of assisted firms). Others can be observed at the macro-economic or macro-social level (e.g. improvement of the image of the assisted area); these are global impacts. Impacts may be positive or negative, expected or unexpected."
- *Impact indicators* "refer to the benefits of the programme beyond the immediate effects on its direct beneficiaries both at the level of the intervention but also more generally in the programme area. They are linked to the wider objectives of the programme" (Directorate General for Agriculture and Rural Development, 2006).
- Following the guidelines for the ex post evalution, "Impacts produced by a programme intervention are expressed in 'net terms' after subtracting effects that cannot be attributed to the intervention (e.g. confounding factors, double counting, deadweight), and by taking into account indirect effects (displacement and multipliers)" (European Evaluation Network of Rural Development, 2014b).

As shown in Table 1 the range of "impact indicators" is very broad and the requirements for evaluating the impact of the programme are very demanding from a methodological point of view. When the programme was established, the objectives were clearly stated and in most cases were made operational in a way to be able to measure progress, success or failure during the mid-term or final evaluation. The evaluation criteria and indicators have already been defined as well at that early stage.

However, when the programme was implemented, a decision on the methods for evaluation had not yet been made. Decisions on the design of measures and data to be collected were not made with a view on the needs for specific evaluation methods. A consequence is that the set of adequate evaluation methods is limited and / or that the validity of results is impaired compared to a best case situation.

Given that the main objective of LE 07-13 was not to make evaluation as easy as possible necessary trade-offs imply that second best approaches for evaluation had to be chosen. Some more examples highlight other relevant evaluation problems:

- An important feature of LE 07-13 is that it is a voluntary programme. Potential beneficiaries make the decision to participate or not to participate (e.g. organic farming). Self selection

therefore is immanent. Only in some cases administration gets further involved by ranking applicants and deciding about levels of support (e.g. investment support).

- Many programmes make efforts to reduce deadweight losses or windfall profits. Such losses occur if the beneficiary gets support without changing behaviour. An example: A farmer making an investment anyway does not need public support. Only in case he or she needs an incentive to invest, public funds may be seen to be necessary but such an incentive must not be too high otherwise deadweight occurs. Accounting for such effects is adequate in many cases but irrelevant in many others. Another example: A programme objective may be the maintenance of a certain practice (e.g. farming in mountain regions). In such a case the programme would fail if the beneficiary would change the behaviour by quitting farming. What is termed "deadweight" in other cases is a necessary incentive to promote maintenance of a certain behaviour.

- The total funds mobilized by a programme typically are assumed to be larger than the public funds allocated to the beneficiaries. From an operational point of view this is achieved by a co-financing agreement between the programme authority and the beneficiary. Depending on the measure the rate of co-financing ranges often between 10% and 50% which implies a leverage of 10 to 2. The figures on the financial flows of the LE 07-13 programme in *Table 2* shows the shares of the public and the beneficiaries as stated by the programme authorities. In some cases the leverage can be directly checked by comparing premiums with invoices on investment products. In other cases this is not possible because products and services in kind are involved which are not valued at market prices.

- The effects of a particular programme may be overstated because alternative uses of public funds with a better cost-effectiveness are not considered.

- Significant amounts of public funds are used to finance the programme of rural development. Taxes have to be imposed on consumers or workers or producers or firms or property owners to collect these funds. Most taxes affect the behaviour of agents in ways that reduce economic activities. An growth stimulating effect of programmes should be weighed against growth decreasing effects of raising taxes.

- Administrative burden and transactions are exhibiting hidden costs which are unavoidable when programmes are administered. The design of measures and the requirements for control and monitoring affect their volume in ways that are depending on many aspects (legal system, technology, number of applicants, skill of administrators, organisation of authority, auditing procedures, etc.).

In this evaluation study, the following assumptions were made:

- Deadweights were not accounted for. Only for investment support measures estimates about deadweights are available (European Commission, 2014; chapter 4.2). For all other measures such estimates have not yet been made. In order to avoid inconsistencies over measures, deadweights were not taken into consideration in this evaluation.

- In scenario 1 the leverage effects were assumed to be zero. Estimates to quantify leverages based on micro-data of participants of the programme are not yet available. In order to avoid over-estimations because of assumptions on inflated leverages their effect is discounted.
- A scenario on alternative use of public funds is calculated (scenario 3). For this scenario the assumption was made that funds co-financed by Austrian governments were taken away from general government consumption. The part co-financed by EU was treated as 'manna from heaven' which means that this money was assumed to be available without any trade-offs.
- Social cost of public funds were ignored in this evaluation study.
- Administrative costs and transaction costs were ignored with the exception of "technical assistance". This is a measure of the programme and it was treated as a demand for services for various sectors (mainly administration, marketing, science).

The list of explicit assumptions makes evident that many possible effects are not (yet) known by the time of evaluating the impacts of LE 07-13 programme. Exploring and quantifying them could be done using micro-econometric assessments with methods as introduced in the previous chapter. Because the necessary resources (among them data) have not been available to quantify the effects assumptions needed to be made.

Appendix 3: Tables and Figures

Table 2: Financial overview of LE 07-13

	Approved project costs	Total public funding	Of which EU funding	Degree of total funding
Axis / Measure	EUR million	EUR million	%	%
Axis 1	4,599.64	1,281.81	44%	28%
111	99.60	73.00	50%	73%
112	136.81	136.81	44%	100%
121	3,089.65	686.17	40%	22%
122	98.23	42.18	49%	43%
123	902.77	190.99	47%	21%
124	26.00	15.66	52%	60%
125	166.50	81.32	50%	49%
132	32.14	32.14	50%	100%
133	47.94	23.53	50%	49%
Axis 2	5,713.48	5,713.48	52%	100%
211/212	1,874.74	1,874.74	49%	100%
213	0.47	0.47	.	100%
214/215	3,727.09	3,727.09	54%	100%
221	1.58	1.58	72%	100%
224	0.16	0.16	.	100%
225	0.13	0.13	.	100%
226	109.31	109.31	50%	100%
Axis 3	1,551.04	813.10	49%	52%
311	318.40	91.51	47%	29%
312	38.73	17.53	55%	45%
313	92.72	92.72	50%	100%
321	708.30	320.83	49%	45%
322	70.82	21.12	57%	30%
323	246.07	208.26	50%	85%
331	61.71	50.08	50%	81%
341	14.28	11.06	55%	77%
Axis 4	212.06	116.69	51%	55%
411	14.01	5.57	49%	40%
412	0.00	0.00	.	
413	123.54	64.44	51%	52%
421	17.04	11.51	51%	68%
431	57.47	35.17	51%	61%
511	199.51	199.51	100%	100%
Grand total	12,275.73	8,124.59	52%	66%
of which:				
Predominantely urban regions	1,379.95	904.98	.	66%
Integrated regions	1,593.07	1,065.20	.	67%
Predominantely rural regions	9,303.14	6,154.42	.	66%

Source: BMLFUW, 2015.

PAMSA[grid]

The model used for the quantitative analysis is of axes 2 interventions is PASMA[grid] (Kirchner et al., 2015, in Press). It is a spatially explicit bottom-up linear optimization model for the agriculture and forestry sector. It represents in detail production choices in agriculture and forestry (e.g. fertilizer and management intensities, feeding options, livestock products …) and can simulate land use choices at a resolution of 1km². It can further account for GHG emissions related to almost all agricultural production activities which allows a mutual assessment of both adaptation and mitigation measures. A diagram of PASMA[grid] is presented in Figure 4.

Figure 4: Diagram of PASMA[grid]
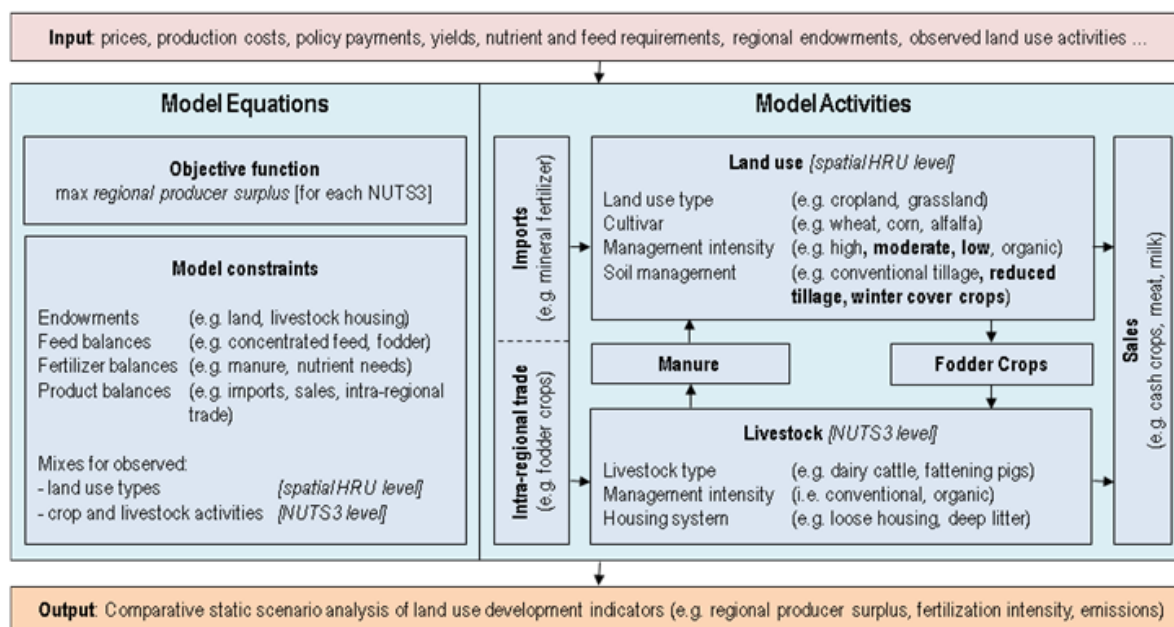
Source: own construction

BERIO-ASCANIO

Figure 5: Diagram of BERIO-ASCANIO
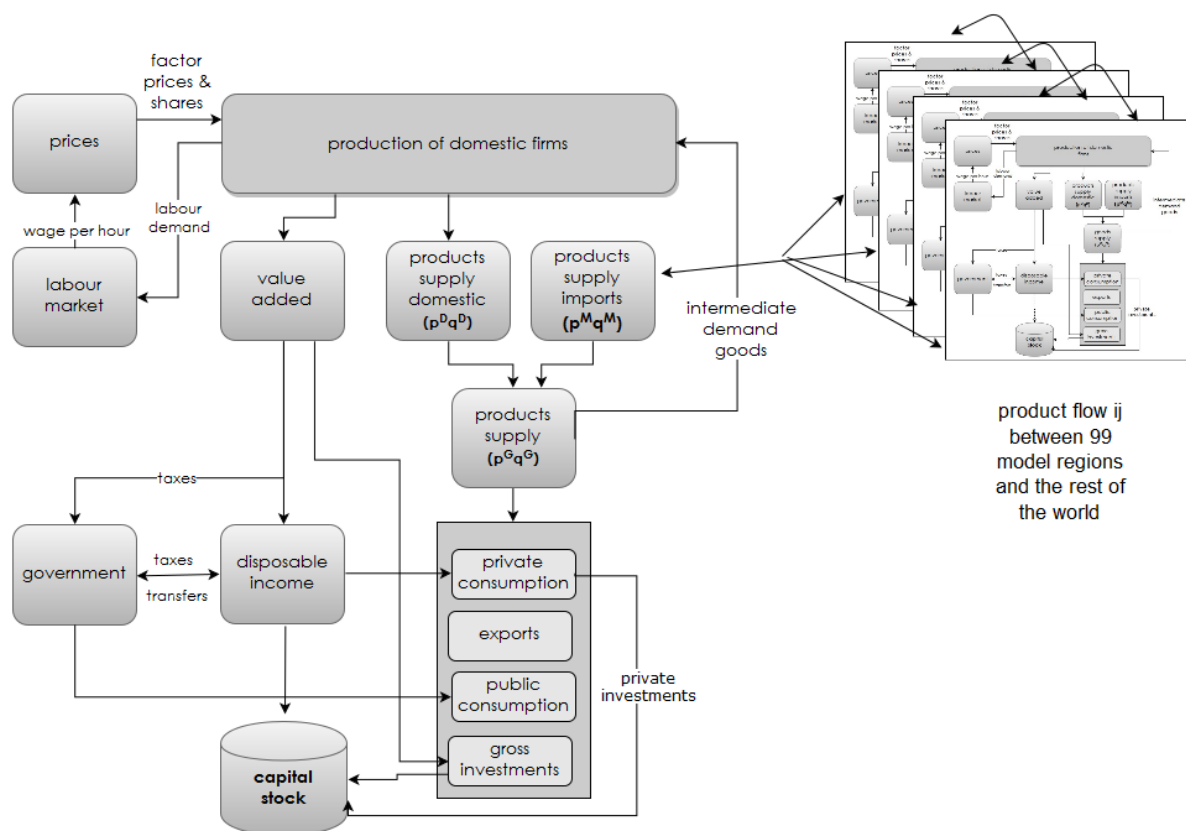
Source: Own construction. Note: flow ij = export from region i to region j = import of region j from region i

The model is used to evaluate effects on employment and value added of axis 1, axis 3 and axis 4 measures of LE 07-13. It can be used to evaluate direct, indirect and induced effects of economic impacts such as additional demand for investment products of services from the education sector:

• *Direct effects:* an example is an expansion of the demand for goods of the construction sector induces more employment and value added in this sector

• *Indirect effects:* In the example the construction sector needs inputs from other sectors to provide the additional supplies [type 1 multipliers]. This leads to a cascading effect of additional input demand accross the whole economy and increases supplies from foreign markets

- *Induced effects = total effect of a "shock"*: The growing value added affects household incomes positively. Higher incomes are used to increase consumption [type 2 multipliers]. The results presented in this study are the "total effect" of an impact.

More details on the model structure and modelling philosophy are available in chapter 3 of the model documentation (Fritz et al., 2010).

Figure 6: *Expenditures of the European Agricultural Fund for Rural Development (EAFRD) 2007-2013 (community support), EUR per person*
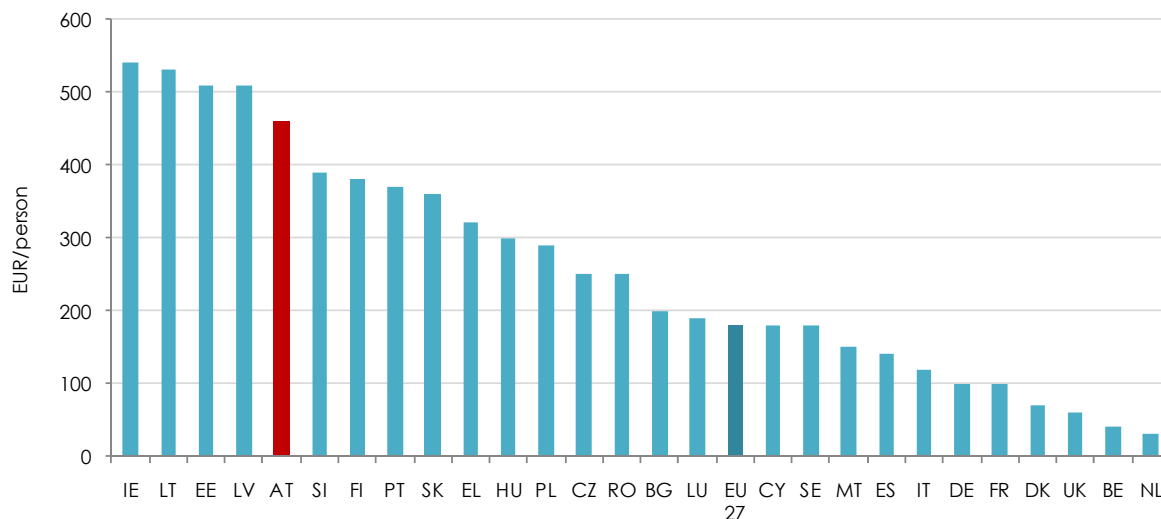
Source: EC, European Commission, Budget, Financial Report 2014 (http://ec.europa.eu/budget/financialreport/2014/foreword/index_en.html).

Figure 7: *Distribution of EAFRD expenditures by axis and measure in 2009*
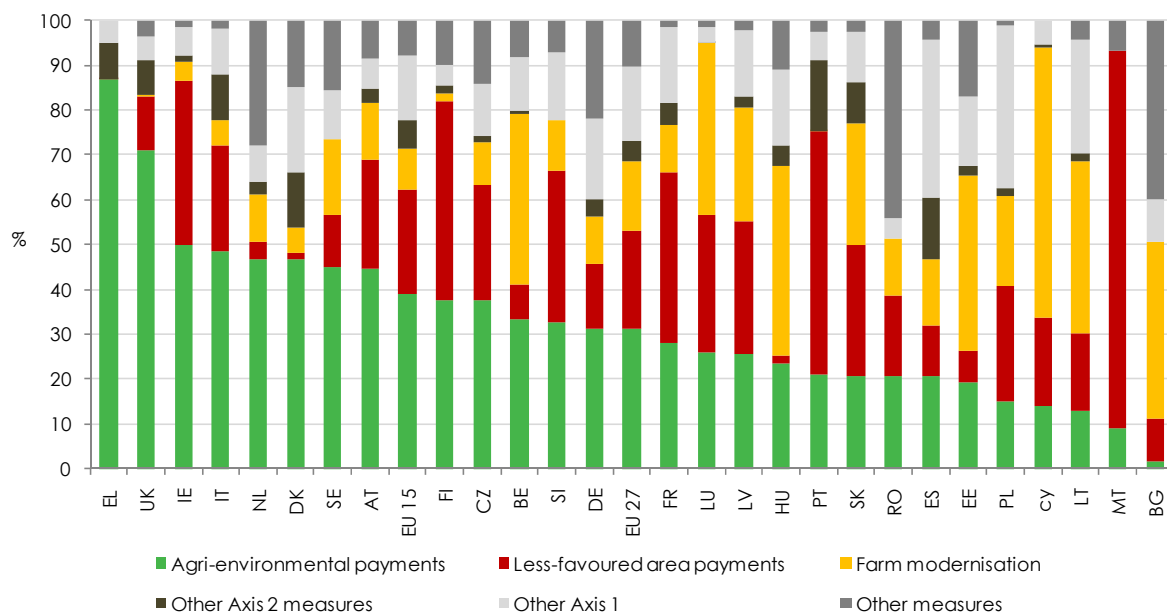

Source: OECD, Evaluation of Agricultural Policy Reforms in the European Union, 2001. EU15: the 15 member states of the EU between 1995 and 2004. EU27: the 27 members of the EU from 2007.

Figure 8: **Relative importance of the 4 thematic axes by Member State, programming period 2007-2013 (according to the Financial Plan)**
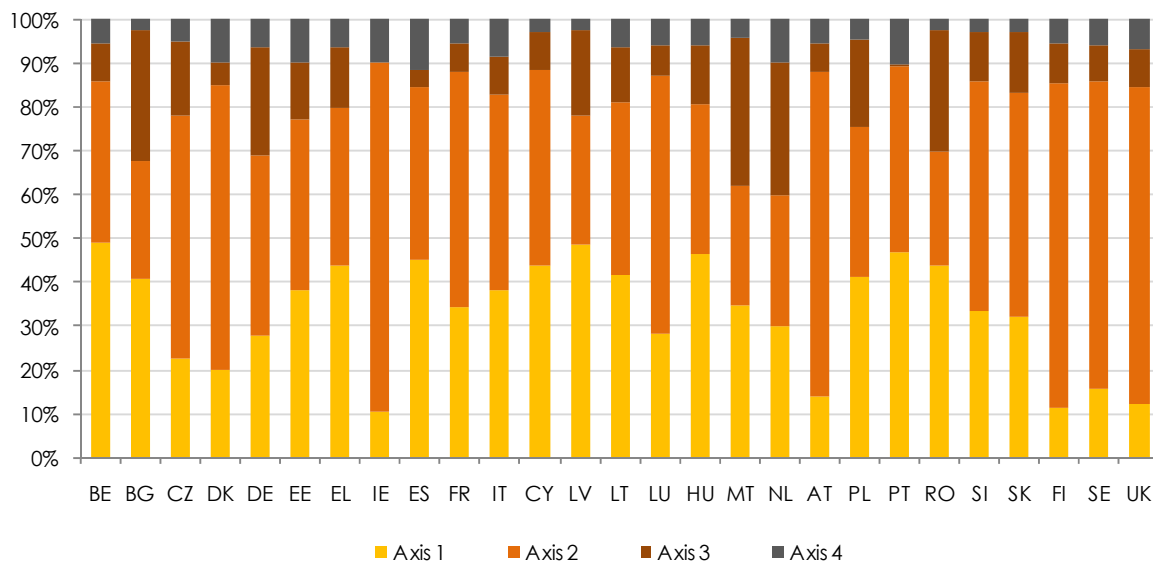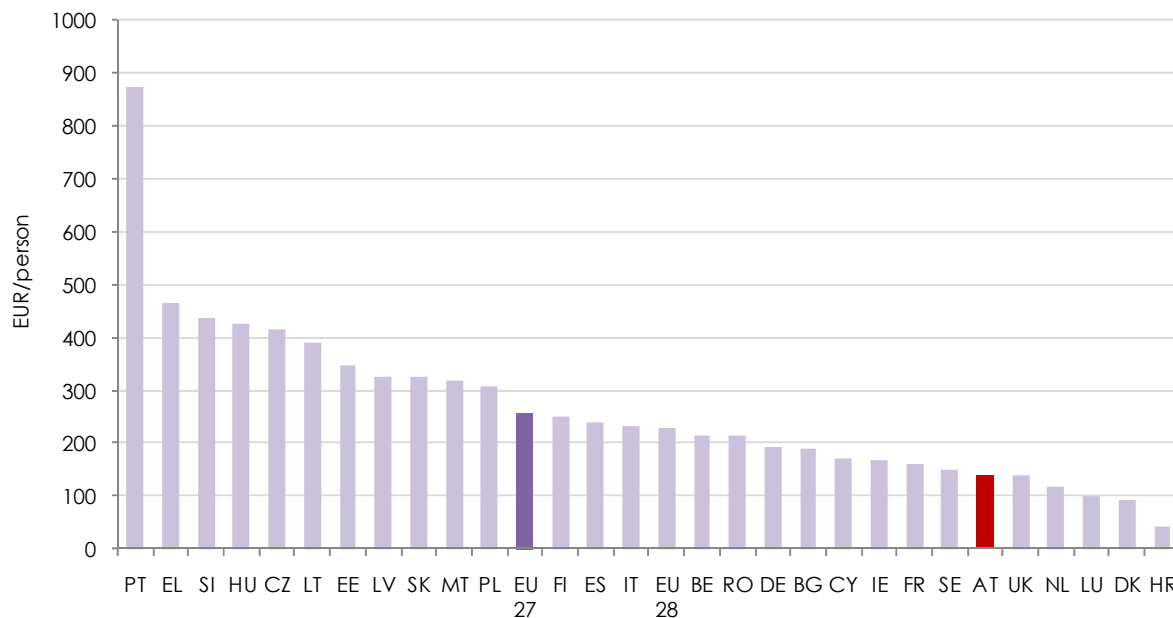

Source: EC, Rural Development in the European Union - Statistical and economic information - 2010.

Figure 9: **Total Expenditures of the European Regional Development Fund (ERDF) in Austria 2007-2013, € per Person**
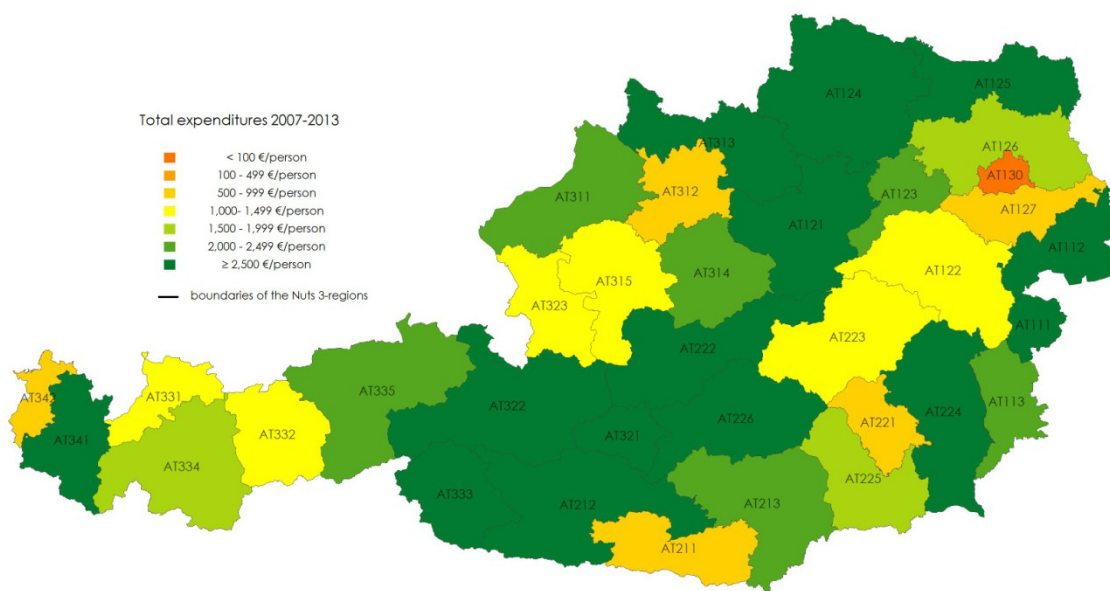

Source: ÖROK, 2015.

WIFO
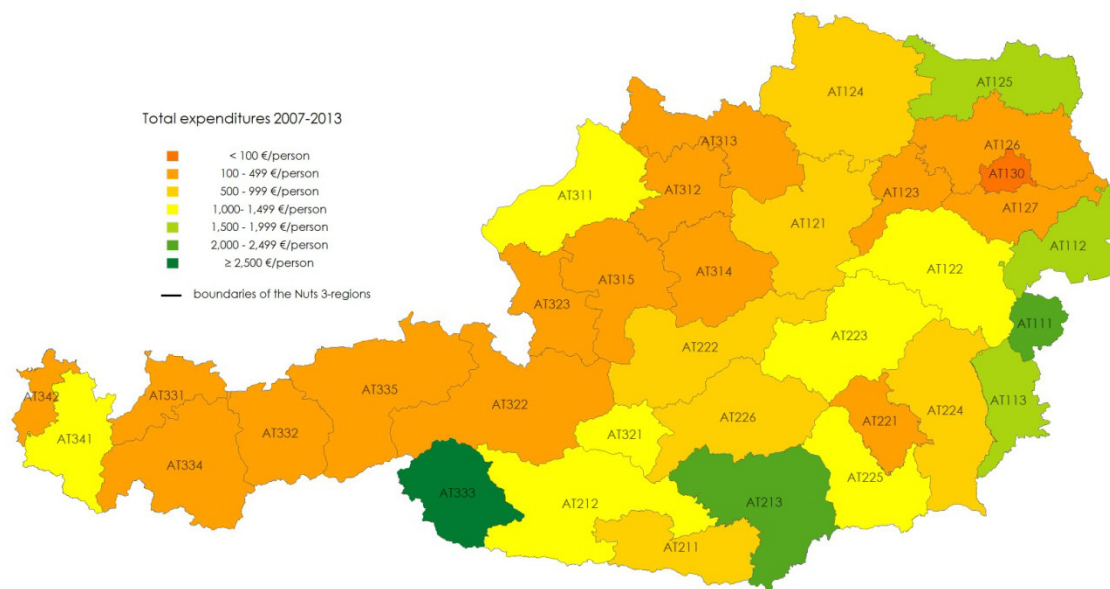
Figure 10: **Total Expenditures (EU+national+private) of the European Social Fund (ESF) by country 2007-2013**
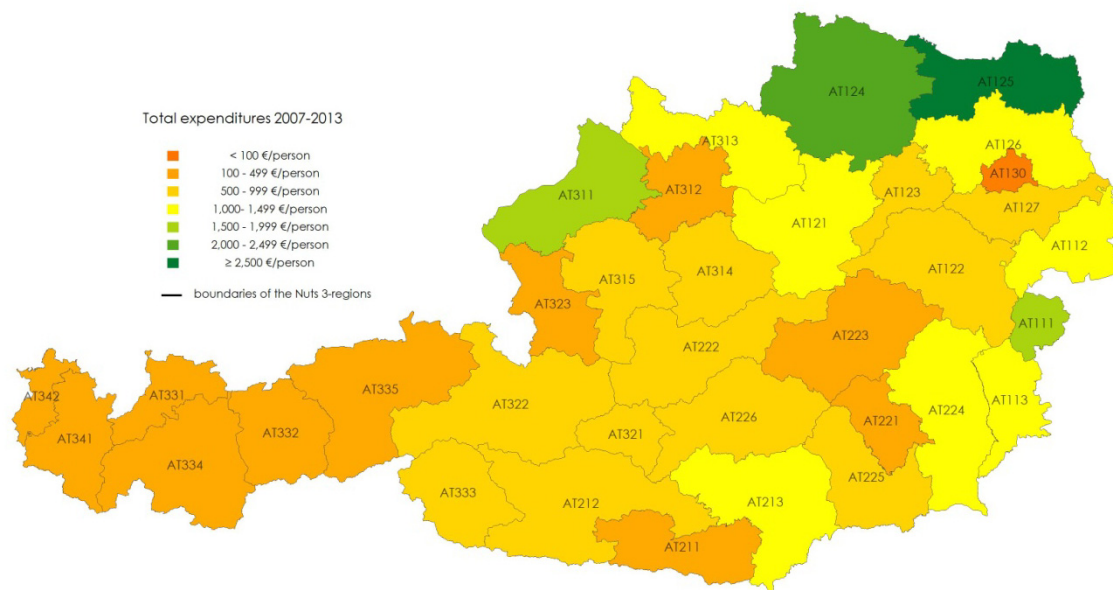

Source: European Commission (EC), Employment, Social Affairs & Inclusion, European Social Fund (ESF) budget by country 2007-2013.

Figure 11: **Total expenditures of the Rural Development Programme (RDP) in Austria 2007-2013, € per Person**
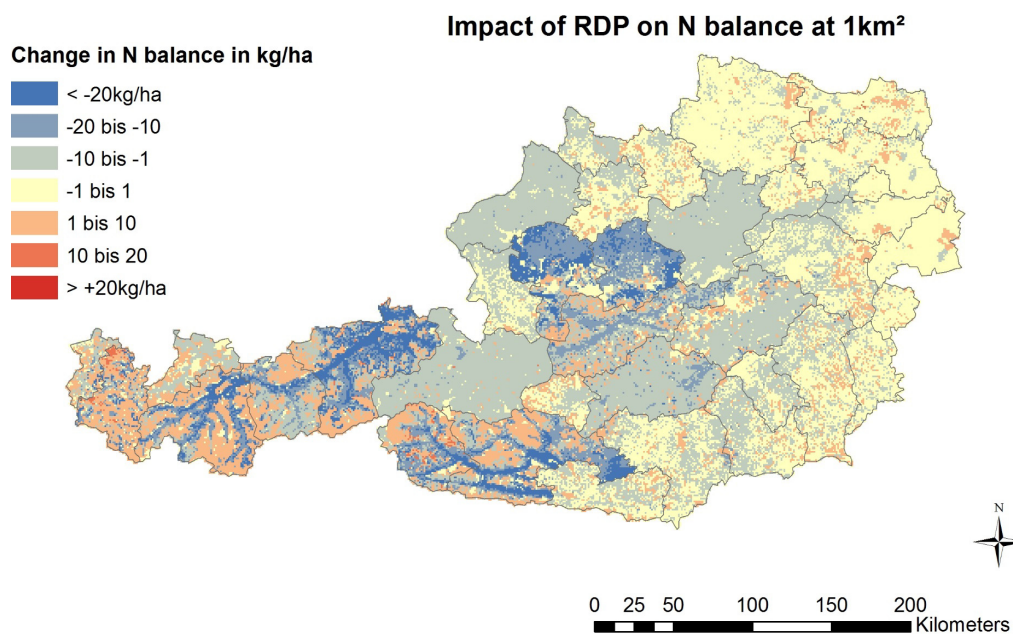

Source: BMLFUW, 2015.

Figure 12: **Expenditures under the First Pillar of the CAP in Austria 2007-2013, € per Person**

Total expenditures 2007-2013

- < 100 €/person
- 100 - 499 €/person
- 500 - 999 €/person
- 1,000- 1,499 €/person
- 1,500 - 1,999 €/person
- 2,000 - 2,499 €/person
- ≥ 2,500 €/person
- — boundaries of the Nuts 3-regions

Source: BMLFUW, 2015.

Figure 13: **Effects of the Rural Development Programme LE 07-13 on gross nitrogen surplus**

Impact of RDP on N balance at 1km²

Change in N balance in kg/ha

- < -20kg/ha
- -20 bis -10
- -10 bis -1
- -1 bis 1
- 1 bis 10
- 10 bis 20
- > +20kg/ha

Source: own results based on model PASMA[grid]. Note: Balances are calculated for NUTS3 regions separately.

WIFO

Figure 14: ***Regional effects of the Rural Development Programme LE 07-13 on gross value added***
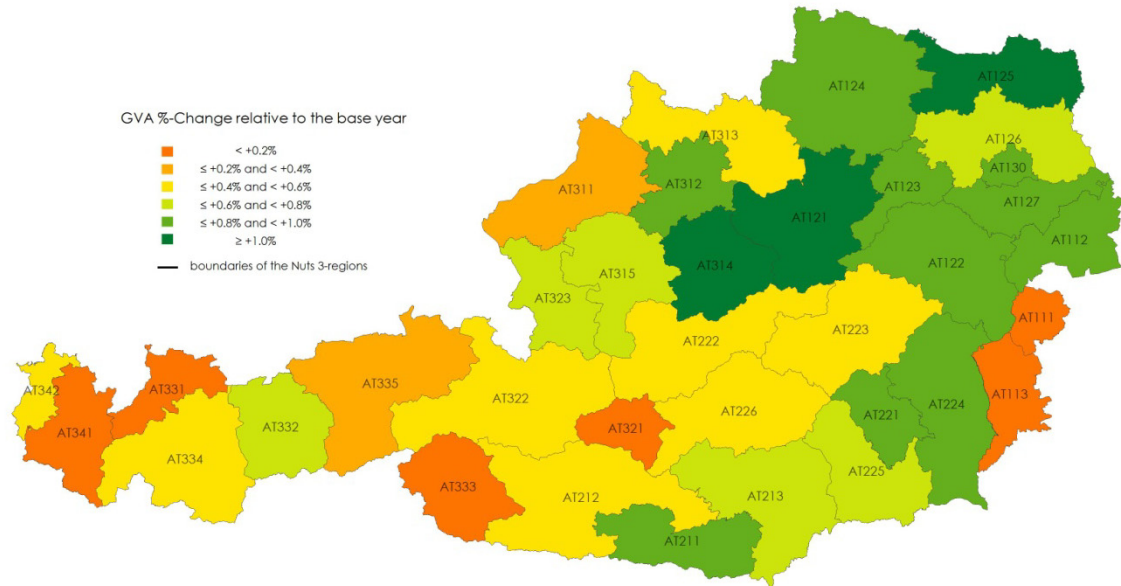
Source: own results based on model BERIO-ASCANIO 2015.