Development and application of quasi-experimental methodological approaches to assess the net impacts of *agri-environmental* measures implemented in Slovakia under RDP 2014 – 2020.

A pilot project for selected regions

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Evaluation setting

o **Commissioning Institution**: Ministry of Agriculture and Rural Development (Slovakia)

o **Purpose:**

- Evaluation of net impacts of *agri-environmental* measures implemented in Slovakia under RDP 2014-2020

- Testing the recently developed advanced evaluation methodology based on a combination of a quasi-experimental approach with area-based (GIS) data

o **Timeline:** March – November 2018

Evaluation elements

Evaluated RDP measures: **M10:** Agroenvironmental Climate Action (Art.28)
M11: Organic Farming

Evaluation questions	Indicators
Common evaluation questions n. 26 or 28: To what extent has the RDP contributed to improving the environment and to achieving the EU biodiversity strategy target of halting the loss of biodiversity and the degradation of ecosystem services, and to restore them?	I.11 Water quality a. **Quality of surface waters** Content of oxygen O_2, Ph value, Chemical oxygen consumption, Content of NO_2, NO_3, PO_4 b. **Quality of underground waters** -See above + arsenic + zinc
Additional EQ: What other effects, including those related directly to other objectives of RDP, are linked to the implementation of these environmental measures (indirect, positive/negative effects on beneficiaries, non-beneficiaries, local level)?	Additional indicators: a) Profits of supported farms

Evaluation approach (1)

Applied quantitative methodologies

- **Binary Propensity Score Matching combined with DID** => net direct effects of M10 & M11 on water quality indicators

- **Generalised Propensity Score Matching (dose response function)** => net indirect effects of M10 & M11 on farm profits

Unit of analysis: areas/grids/cells (250m x 250 m) in 2 pilot regions (Slovakia) GIS data

Number of observations: 17860 (area based units = approx. 112 000 ha)

Evaluation approach (2) - Steps

Net direct effects on water quality (PSM-DID method + GIS data)

1. Descriptive statistical analysis of control variables and impact indicators (incl. overall trends)

2. Construction of comparable control groups (similar group of supported and non-supported areas/cells/grids)

      a. Preliminary comparison of supported and non-supported areas/grids/cells (t-test for difference in means)

      b) Application of matching techniques to find appropriate controls

      c) Assessment and testing of the covariate balance in matched groups (balancing property tests)

3. Calculation of the Average Treatment on the Treated (ATT) and net RDP effects

4. Qualitative analysis for triangulation

Evaluation approach (3) - Steps

Net indirect effects on farm profits (GPSM method + GIS data)

1. Estimation of the GPS as a conditional density of RDP support given the covariates

2. Testing the validity of the assumed normal distribution of the disturbances

3. Calculation of GPS as conditional density of support intensity given the observed covariates

4. Testing balancing property of the estimated GPS function

5. Estimation of a dose-response function

Construction of control areas (1)

Selected control variables (GIS data) → 33 model covariates:

- Land use:
    - Arable land (0 - 1)
    - Pasture (0 - 1)
    - Discontinuous urban fabric (Corine landcover)
    - Land principally occupied by agriculture (Corine landcover)
    - Broad-leaved forest (Corine landcover)
    - Natural grasslands (Corine landcover), etc.
- Climatic zone (1-6)
- National parks (0-1)
- Orchards (0-1)
- Protected areas (EEA Nationally designated areas) (0-1)
- Rivers (0-1)
- Natura 2000 (Special Protection Sites) =1; SCI (Sites of Community Importance) =2

Construction of control areas (2)

Selected specific control variables (GIS data):

◦ Distances to above variables in km (ranges), incl. to soil contamination areas, railways, dams
◦ Geological units
◦ Geo-morphological status
◦ Hypsometry
◦ Population density
◦ Potential vegetation
◦ Lithological characteristics
◦ Slope
◦ Soil type
◦ Traffic intensity
◦ River basin area

Data situation

Table 2: Data situation for collection of control variables + water quality indicators

Data description	Beneficiaries /Control Group
Data source	• **Structural characteristics of fields under AE projects and outside supported AE area**: geological, infrastructural, geographic and environmental characteristics of the areas, e.g. showing accessibility <distances> to water-resources, woodland, protected areas, Natura 2000 and HVN areas, etc. Important sources of information were existing (digital) maps, aerial photographs, geological and land quality databases, farm land surveys, Corine database, LPIS, • **Socio-economic information concerning these fields and their surroundings:** FADN, farm bookkeeping data, etc.. • **Institutional sources:** Corine landuse, State Geological Institute , Research Institute of Soil Science and Soil, Earth Remote Survey, Min of Environment; water management authorities;
Unit of analysis	250m x 250m grids/areas/cells
Time series/frequency	Collected in 2010 and 2016
Accessibility for evaluators	Publicly available data

Data situation: CEMS impact indicators

Graph 1: Slovakia, Water quality monitoring points: underground water
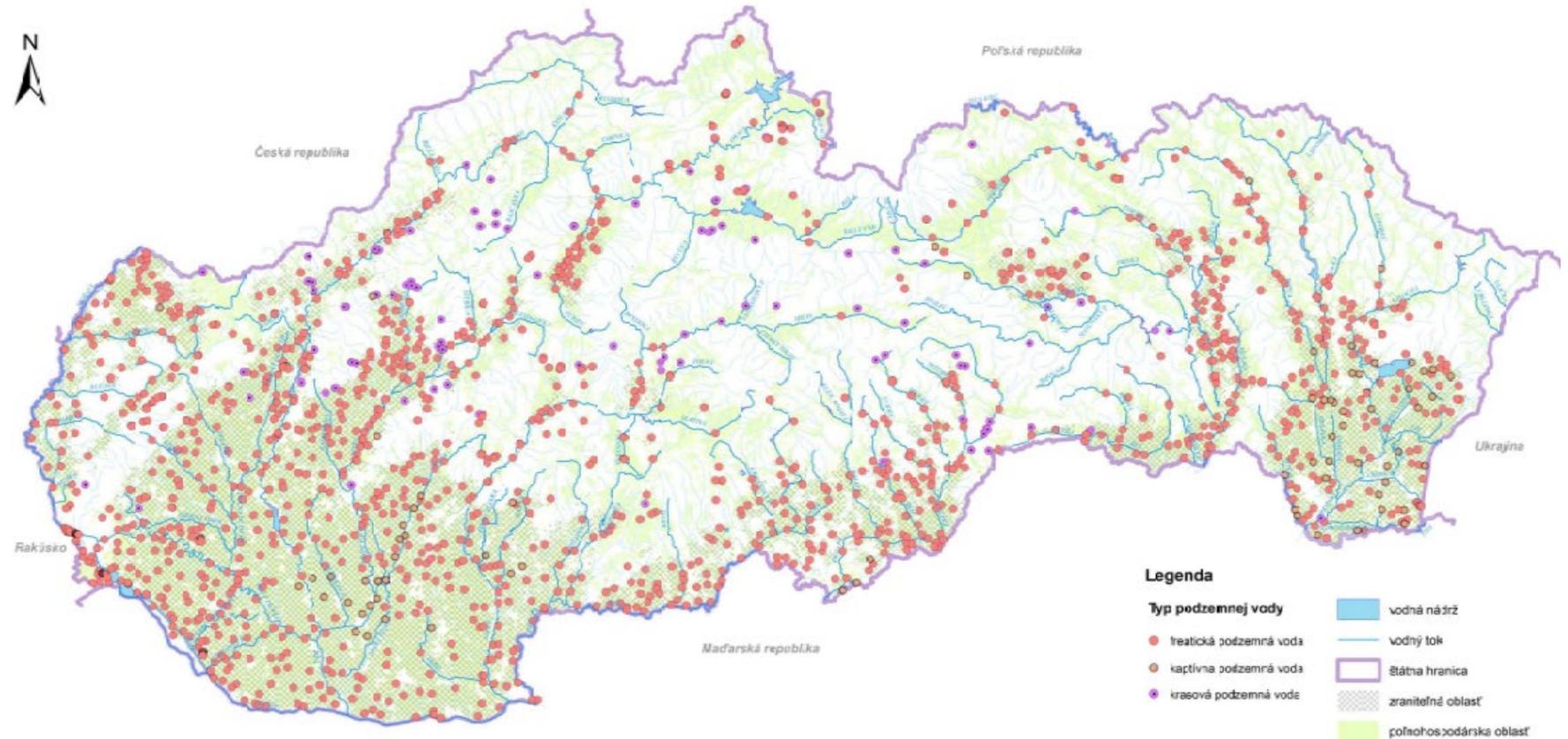
Obtained net impacts (example)

Table 3: Surface water in Slovakia

Variable	Sample		Treated	Controls	Difference	S.E.	T-stat
∧ **out_O2**	Unmatched	|	.287849472	.226887143	.060962329	.013620418	4.48
	ATT	|	.287516824	.165316271	**.122200553**	.015849657	7.71
∧ **out_NO2**	Unmatched	|	.008759129	.006981563	.001777566	.000158345	11.23
	ATT	|	.008559233	.008824259	**-.000265026**	.000235486	-1.13
∧ **out_NO3**	Unmatched	|	-.291669366	-.378982764	.087313397	.01284005	6.80
	ATT	|	-.291711069	-.382160297	**.090449228**	.015187051	5.96

O2 => positive (significant)

NO2 => slightly negative (not significant)

NO3 => negative (significant) but see: reasons

Strengths and weaknesses of the approach

Strengths	Weaknesses
• Control groups/areas fully comparable to areas/plots/grids which received support from AE measures	• The method is extremely data hungry. It needs abundant data with a large number of specific layers covering relatively large territorial areas
• More rigorous and sound, and less biased estimation of net effects of AE measures in comparison with standard approaches	• Due to a large number of GIS observations (> 10 or 100 thousands or more) a computational burden may become quite heavy and therefore time consuming
• No extrapolation of micro- results to RDP levels is required if done on appropriate territory	• A **bottleneck** is gathering enough and differentiated observations concerning a territorial distribution of specific **impact indicators** (therefore analysis covering **small areas** may be more **difficult**)
• More reliable in comparison to other techniques which merely show *an expected* impact	
• GIS data which is widely available in form of various specific digital maps (e.g. Corine landuse, satelite phothos, etc.) which can easily be translated into a raster format.	• The approach requires highly skilled experts covering fields of GIS analysis and econometrics

Lessons learnt and applicability

What are the conditions necessary for other Member States to apply this methodological approach for the AIR in 2019 or the ex post evaluation in 2024?

Duration: Approx. 3-4 months of full time equivalent

Collection of primary data through survey: Impact indicators through monitoring points

Contract the evaluator well in advance? : Yes, it may help

Structure adequately the evaluation framework? : Yes

Software: QGIS and raster tools from GRASS; STATA or R; Arcview

Agreements with data provider? Yes (for selected control variables and impact indicators)

Thank you

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Further information:

Development and Application of the Methodology for Evaluation of the Net Effects of Agro-Environmental Schemes of RDP SR 2014-2020 for selected territory (2018), final report; pp 1-67; Min of Agriculture, Projektove Sluzby Ltd.