



# The impacts of agricultural payments on groundwater quality: Spatial analysis on the case of Slovenia



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## ABSTRACT

The European Common Agricultural Policy still follows its primary goals, i.e. quality food at affordable prices and a decent standard of living for farmers, fifty years after its adoption. Moreover, this policy adapts to the changing needs of society and the new challenges, mostly preservation of the environment, nature and biodiversity in rural areas. Although the Common Agricultural Policy receives the largest share of European budget, the funds are decreasing over time, especially direct payments, which aim to provide basic income support to farmers in the European Union. On the other hand, agri-environmental payments are gaining importance. Policy decision-makers should be interested in the question of impacts of growing eco-conditionality of agricultural spending. New insights would help them to be successful in achieving the goals of sustainable agriculture. The purpose of this paper is to estimate the impacts of production support payments and rural development payments on the quality of groundwater. We use the small EU country Slovenia as an example. The baseline indicators are the level of nitrates and pesticides in groundwater, while the impacts were estimated using spatial error model. The results show that direct payments, coupled subsidies and investment grants raise the level of pesticides in groundwater, but do not have any statistically significant impact on the level of nitrates in groundwater. Furthermore, we did not find any statistically significant effects of agri-environmental payments on decrease of groundwater pollution with nitrates. However, our findings revealed that agri-environmental payments are effective in reducing pesticides in groundwater, although only to a limited extent. These results imply a problem of insufficient targeting of agri-environmental measures on the one hand, and suggest that greening of direct payments is necessary and entirely justified.

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## 1. Introduction

The Common Agricultural Policy (CAP) of the European Union was designed in 1962 to enable good quality food at affordable prices for EU citizens and a decent standard of living for EU farmers. Fifty years later, these goals are still relevant, and the European Union adapts the CAP to the changing needs of society and the new challenges (MAFF, 2015b). Both the public and the policy makers are well aware of the fact that there are other functions of agriculture besides the supply of people with food and maintaining farmers' incomes. The agriculture preserves the countryside, together with the landscape, demographics and rural economy, as well as natural resources and biodiversity. In addressing these challenges, it is essential for the Member States to promote the

competitiveness and also the sustainability of agriculture and rural areas. With accordance to this, the CAP measures are classified in two Pillars: production support (Pillar I) and rural development (Pillar II). Still, both pillars are intertwined and integrated within the CAP.

The primary aim of the Pillar I is to provide basic income support to EU farmers by two main instruments: direct payments to farmers and market measures. In order to be eligible to receive this support, farmers must keep land in good agricultural and environmental condition and meet legislative standards covering the environment, public health, plant health and animal health (cross-compliance conditions). Therefore, direct payments should also affect the delivery of public goods, mostly those related to environment and rural vitality. While the CAP receives the largest share of the EU budget, the funds are decreasing over time, especially direct payments to farmers. In the period from 2007 to 2009, direct payments represented on average 29% of agricultural income in the EU (EC, 2011a). To be less trade distorting the main part of direct payments is decoupled from production (hereinafter referred to as

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direct payments). Only a smaller part of direct payments is still linked to the production of a particular crop or keeping a particular type of livestock. These payments are called coupled subsidies.

The measures of common rural development policy (Pillar II) are implemented within the national Rural Development Program (RDP) of the respective Member State which links European and national, local needs. Moreover, the States have to provide co-financing. Rural development measures are aimed at improving competitiveness and promoting diversification of economic activity, delivering environmental public goods and improving quality of life in rural areas (EC, 2011b). A large part of these measures represents Agri-environmental payments, like payments for organic farming, actions to maintain habitats favourable to biodiversity, management of pastures, crop rotation etc. Therefore, the support for rural development is intended for those farms, which in the management of agricultural land contribute to the conservation of biodiversity, landscape diversity and the protection of soil and water resources. Agri-environmental payments represent 30% of rural development expenditures from the EAGGF fund.<sup>1</sup> In 2009, the average share of utilised agricultural area under agri-environmental measures in EU-27 was 21%, with the highest share in Luxembourg and Finland (more than 90%) and the lowest share in Bulgaria, Poland and Netherlands (less than 6%). In terms of area covered by different types of agri-environmental measures, the most important commitments refer to management of landscape, pastures and high nature value farming (39% of the total area committed across the EU-27). This type of commitment was more popular in the new Member States (64%) than in the EU-15 (35.8%) (Eurostat, 2012).<sup>2</sup> With the new programming period (2014–2020) the environmental component is gaining even more importance as the support has extended to the field of agriculture's contribution to climate change mitigation and adaptation.

Implementation of the measures financed in the 2007–2013 period in the Member States came to an end. In the beginning of 2015, the European Commission formally confirmed the new Rural Development Program for each Member State for the period 2014–2020 which is the basis for the disbursement of EU funds in this period. Therefore, the time is right to evaluate the impacts of different types of received payments on agri-environmental contents.

Increasing the importance of environmental and safety issues for proving eligibility to receive agricultural payments as well as limited empirical evidence on environmental impacts of agricultural expenditures have motivated the present study. Hence, this study aims to numerically examine the impacts of agricultural payments (which are mostly conditional upon environmental standards) on groundwater quality. More precisely, for the EU member state Slovenia, we assess both the impacts of direct payments and coupled subsidies (Pillar I) and agri-environmental payments and investment grants (Pillar II) in the period 2007–2013 on two indicators: the level of pesticides and nitrates in groundwater.

The protection of groundwater quality in Slovenia is of utmost importance, because more than 97% of drinking water is abstracted from shallow, unconfined alluvial aquifers and fractured or karstic porosity aquifers (Krajnc et al., 2007). Moreover, more than three quarters of the surface belongs to areas with less favoured conditions for agricultural production (e.g. Alpine region). Consequently, public spending on agri-environmental measures represents the

largest share of the budget for rural development, and the same applies to Europe.

In order to avoid, prevent or reduce detrimental concentrations of harmful pollutants in groundwater, in particular the two mentioned above, the European parliament and the Council of the European Union adopted the Groundwater Directive (2006/118/EC). The major source of groundwater contamination is agricultural non-point source pollution. Agricultural pollution with nitrates and pesticides is the most common cause for failing the quality standards, and consequently poor chemical status of groundwater. For that reason, the EU legislation regulates these areas more specifically by Nitrates Directive (91/676/EEC), the Sustainable Use of Pesticides Directive (2009/128/EC) and some other directives.

The use of nitrogen fertilizers and pesticides in agriculture brings significant economic benefits to the sector but also risks to the environment and human health. The main source of nitrogen input to agricultural land is application of organic and chemical fertilizers (Korsaeth and Eltun, 2000; Sieling and Kage, 2006), while the main non-agricultural source is related to density of wastewater disposal systems (Wakida and Lerner, 2005). In Slovenia, with extremely dispersed settlement pattern, this could be an important environmental issue. Moreover, the concentration of nitrates in groundwater also depends on natural conditions such as pedological characteristics, climatic and biological factors. On the other hand, pesticides used in agriculture are plant protection products, like weed-killers and plant-growth regulators. Therefore, CAP measures are designed so as to reduce these risks as much as possible. In this paper, the impacts of agricultural payments on the level of pesticides and nitrates in groundwater are assessed with spatial panel data model.

The paper is structured as follows. Section 2 presents short literature review. In Sections 3 and 4, the article offers summary statistics of data and description of the estimation method. The results are presented in Section 5. The paper concludes with discussion and implications for policy and practice.

## 2. Short literature review

There are many CAP measures whose objective is to directly or indirectly improve or protect groundwater quality. However, to our knowledge, only a few studies have been carried out that would link individual agricultural payments to groundwater quality. The sparse findings offer a starting point for the research hypotheses on impacts' evaluation.

The CAP's most important instrument for providing basic income support to farmers and delivering basic public goods is direct payments. These payments are not related to the volume of production. As previously mentioned farmers qualify for the subsidy, if they maintain their land in a good agricultural and environmental condition and comply with the relevant statutory management requirements (Cong and Brady, 2012). The studies mainly examine the impacts of direct payments on production (e.g., Girante, 2008; Monge-Arino, 2007; Peckham, 2010; Sokolova et al., 2015) or, less frequently on the state of the environment. Those that study environmental impacts focus primarily on the type of production (intensive vs. extensive) and the structure of landscape or land abandonment in connection with diversity of habitats (e.g. Cong and Brady, 2012; Nikodemus et al., 2010; Reger et al., 2009). The study of Peckham and Kropp (2012) is related to our field of research, although indirectly. The authors found that direct payments when they were introduced in the USA in 1996, had only a small impact on the use of pesticides and nitrates, but after 2004 their impact became greater and positive (Peckham and Kropp, 2012). However, as far as we know, the problem of groundwa-

<sup>1</sup> European Agricultural Guarantee and Guidance Fund.

<sup>2</sup> Commitments referred to management of landscape, pastures and high nature value farming represent 44% of total area committed in Slovenia in 2009 (ARSE, 2011). In the total area the same area can be counted several times if several types of commitments apply on the same land (Eurostat, 2012).

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