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Intra-EU agricultural trade, virtual water flows and policy implications

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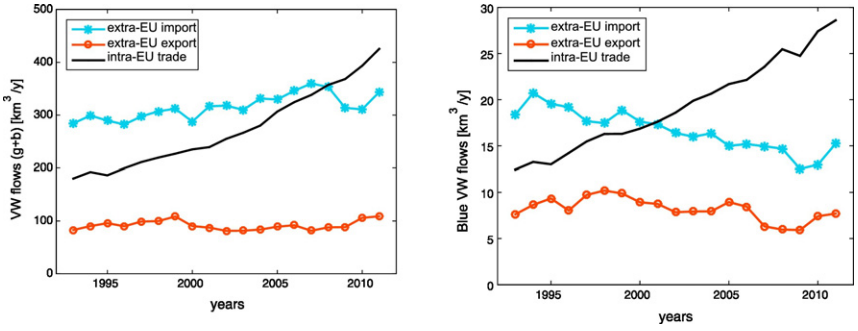
HIGHLIGHTS

- International agricultural trade influences water management.
- The EU is faced with water challenges and is a major agricultural trader in the world.
- Virtual water trade in the EU is dominated by a few countries.
- Intra-EU VWT more than doubled over the period considered
- VWT analysis can support policy-making in the water sector.

GRAPHICAL ABSTRACT



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ABSTRACT

The development of approaches to tackle the European Union (EU) water-related challenges and shift towards sustainable water management and use is one of the main objectives of Horizon 2020, the EU strategy to lead a smart, sustainable and inclusive growth. The EU is an increasingly water challenged area and is a major agricultural trader. As agricultural trade entails an exchange of water embodied in goods as a factor of production, this study investigates the region's water–food–trade nexus by analysing intra-regional virtual water trade (VWT) in agricultural products. The analysed period (1993–2011) comprises the enactment of the Water Framework Directive (WFD) in the year 2000. Aspects of the VWT that are relevant for the WFD are explored. The EU is a net importer of virtual water (VW) from the rest of the world, but intra-regional VWT represents 46% of total imports and 75% of total exports. Five countries account for 60% of total VW imports (Germany, France, Italy, The Netherlands, Belgium) and 65% of total VW exports (The Netherlands, France, Germany, Belgium and Spain). Intra-EU VWT more than doubled over the period considered, while trade with extra-EU countries did not show such a marked trend. In the same period, blue VWT increased significantly within the region and net import from the rest of the world slightly decreased. Water scarce countries, such as Spain and Italy, are major exporters of blue water in the region. The traded volumes of VW have been increasing almost monotonically over the years, and with a substantial increase after 2000. The overall trend in changes in VWT does not seem to be in accordance with the WFD goals. This study demonstrated that VWT analyses can help evaluate intertwining effects of water, agriculture and trade policies which are often made separately in respective sectors.

1. Introduction

The world's water resources are subject to increasing pressure due to growing demand for water and degradation from human activities.

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Problems related to freshwater resources use and management have, until recently, only been approached at the local, national and river basin scale. The recognition that international trade in goods entails an exchange of virtual water (VW) (Allan, 2001), i.e. the water embodied in the different products as a factor of production, between countries (a phenomenon referred to as virtual water trade, VWT) has highlighted the need to broaden the boundaries of water management and to consider the global dimension of water consumption patterns (Hoekstra and Mekonnen, 2012).

Despite the fact that the European region is generally considered to have adequate water resources, many countries of the European Union (EU) suffer from severe water scarcity and drought, and are also vulnerable to climate change (Alcamo et al., 2007; Iglesias et al., 2009; Schmidt and Benítez-Sanz, 2012). Around 20 river basins, mainly in the Mediterranean and other densely populated areas, are affected by water stress and, in summer, about 70 million inhabitants (approximately 14% of the EU population) live under water stress conditions (European Commission [EC], 2016a). Agriculture is the major water user, accounting for about 44% of total withdrawals (European Commission [EC], 2016a). This proportion reaches up to two thirds of total withdrawal in the water-challenged southern countries (e.g. Cyprus, Greece, southern-France, Italy, Portugal, and Spain), where crop production heavily relies on irrigation (European Environment Agency, 2009; European Commission on Agriculture and Rural Development, 2010). In 2013, the area equipped for irrigation was 12% of the total agricultural area and was mainly concentrated in Mediterranean countries (Eurostat, 2016). Besides competing with other water uses, agriculture also has a detrimental effect on water quality due to the input of fertilizers and pesticides. About 20% of all groundwater bodies in the EU have poor chemical status and, in 2009, only 43% of EU surface water exhibited a good ecological status (European Commission [EC], 2016b; European Environment Agency, 2012). Water protection is "one of the great challenges for the EU in the new millennium" (European Commission [EC], 2016c).

With a combined value of imports and exports amounting to €242 billion in 2015, the EU is the world's top agricultural importer and exporter (European Commission [EC], 2016d). Its share of global agricultural export value rose from 20% in the 1960s to over 40% in the 21st century, with intra-EU trade covering an important fraction of global trade (Food and Agriculture Organization of the United Nations [FAO], 2005). Such evolution of agricultural trade implies an increased VWT, thus a displacement of (virtual) water resources. Europe is also the largest importer of agricultural goods per capita, as compared to other regions of the world (Antonelli and Tamea, 2015).

Water resources and agriculture are regulated by two of the most important EU policies: the Water Framework Directive (WFD) and the Common Agricultural Policy (CAP). The WFD was established in the year 2000. It is an institutional framework for the protection and restoration of water bodies, and integrates and partly replaces the existing EU water legislation. It is one of the most ambitious pieces of EU legislation in the field of water resources (Boeuf and Fritsch, 2016). The WFD requires Member States to achieve good ecological status in surface water bodies and good chemical and quantitative status in groundwater bodies by 2015. This goal has not been achieved as hoped. The CAP is one of the EU's oldest policies and played a key role in the development of the EU in the post-war period. It is still currently the most expensive policy, absorbing about 40% of the EU budget (70% in the 1980s). It has evolved, through several reforms, from a productionist approach (leading to surplus agricultural products) to social and environmental support (post-2013 CAP). The intensification of agricultural production supported by the CAP across the EU has led to concerns about the impacts on biodiversity, land use, water resources quality and quantity, and wildlife. It is important to understand the relationship between the WFD and the CAP for an integrated water management.

To date, the intra-EU VWT associated to agricultural goods has been under-investigated by the scientific community. Previous studies have focused on the EU VWT for individual countries, river basins, cities, as well as related to different dietary patterns. VWT has been analysed at the national level (as well for specific regions) in Spain (e.g. Velázquez, 2007; Aldaya et al., 2010), Italy (Tamea et al., 2013), France (Ercin et al., 2013), The Netherlands (Van Oel et al., 2009), and for a number of cities (Vanham et al., 2016; Hoff et al., 2014). It has been shown that the EU, both at the city and country level, is very much dependent on external water resources for its food consumption and water is often not sourced from water abundant countries. For example, water-scarce areas (for instance, in Spain) produce and export water-intensive crops, despite the negative consequences to environmental sustainability (Biewald et al., 2014). The EU has been shown to be a net importer of VW (e.g. Serrano et al., 2016; Duarte et al., 2016). The impacts of EU consumption patterns on international watersheds (e.g. the Indus) and European watersheds (The Danube, Guadalquivir, and Po) have been analysed by Lutter et al. (2016). The consumption-based VWT assessment provided by Serrano et al. (2016) is, to our best knowledge, the only regional study on the intra EU-VWT. With a focus on the year 2009, it showed that 14% of the region's total water use moves within the EU as a result of intra-regional trade in goods.

Against this background, the current study presents the first comprehensive investigation of the agriculture-related intra-EU VWT from a historical perspective. It aims to understand the relationship between water resources and agricultural trade in the EU, in the attempt to provide insights for more integrated and sound water policy-making. The concept of VWT will be employed for this purpose. The analysis will focus on the major agricultural commodities traded within the EU over the timespan 1993–2011, which includes several reforms of the CAP and enlargement rounds of the EU, as well as the enactment of the WFD in the year 2000. It is of significance to investigate trends in agricultural trade in line with these policy evolvements over the years. As the different sources of water embodied in agricultural trade (namely, soil "green" water and "blue" surface and groundwater) have different externalities and opportunity costs, the analysis will be conducted both for total VWT (sum of green and blue VW flows) and for blue VWT alone. The implications of VWT for water policy will be discussed. The ultimate goal of the study is to contribute to achieving a better understanding of the potential implications of VWT for implementing the WFD and to pursuing a more effective integration of the EU water and agricultural policy.

2. Materials and methods

The present study focuses on the 32 economies that currently operate in the EU single market, which includes the EU Member States (EU28) and the countries that are part of the European Free Trade Agreement (EFTA), namely Iceland, Lichtenstein, Norway, and Switzerland. This region is hereby referred to as the "EU region". EFTA countries have been included as they are important partners for the EU. In 2012, for instance, Switzerland and Norway accounted for about 10% of the EU agricultural exports and 5% of imports (European Commission [EC], 2013). The process of enlargement of the EU over the period considered (1993–2011) included three rounds, from 12 to 27 countries. The number of countries considered here in the VW assessment is fixed to 32 over the whole timespan and also includes Croatia, which joined the EU in 2013.

The trade patterns of products were constructed by considering all agricultural products traded internationally, as reported by the Statistics Division of the Food and Agricultural Organization of the United Nations (FAOSTAT, 2013). Nine categories of agricultural products are differentiated: cereals; fruits and vegetables; animal-based products (meat, live animals, dairy and eggs); luxury foods, such as sugar and coffee (hereby referred to as lux-foods); seeds and oils; and non-edible products (such as, fibres, brans, tobacco). The international bilateral trade of EU countries and trade to/from countries in the rest of the world, for a total of 255 countries ever been active, was obtained for each year in the period 1993–2011 from FAOSTAT. Yearly trade data of goods