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The dynamics of beef trade between Brazil and Russia and their environmental implications

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ABSTRACT

Changes in the production or consumption of agricultural commodities in one place can drastically affect land use and the environment elsewhere. We show how changes in beef production and consumption in Russia following the breakdown of the Soviet Union in 1991 contributed to the emergence of a beef trade linkage between Brazil and Russia. We argue that the decline of Russian beef production after 1991, the rebound of domestic consumption since the late 1990s, the global beef trade constellation of the early 2000s, and the booming Brazilian cattle sector during the same periods forged a strong and lasting telecoupling in the beef trade between Brazil and Russia. As a result, Russia became the largest importer of both CO_2 and non-CO_2 emissions embodied in Brazilian beef exports since the 2000s. Our review exemplifies how the combination of institutional and socioeconomic shocks along with major changes in global markets can couple food systems and redistribute environmental footprints across long distances. Incorporating telecouplings in assessments of sustainable food systems is therefore important.

1. Introduction

Places of food production and consumption are increasingly geographically separated as a result of the globalization of agricultural value chains (Meyfroidt et al., 2013), resulting in linkages and feedback loops between land systems across large distances (i.e., telecouplings) (Friis et al., 2016). Higher reliance on agricultural imports to satisfy domestic consumption may arise for various reasons. Countries may lack land resources with suitable agroclimatic conditions for satisfactory domestic production. Likewise, in open and internationalized markets, farmers in one country may be unable to compete with farmers in other countries who face lower production costs, have higher productivity, or enjoy greater support from subsidies and policies. Technological, institutional, or socioeconomic constraints on agriculture may also result in farmers being unable to realize the agricultural potential of a region or even in the temporary or complete abandonment of agricultural land (Kastner et al., 2014; Licker et al., 2010).

With about one-fifth of the global cropland area and water now being used for exported agricultural commodities (MacDonald et al., 2015), the growing spatial disconnect between production and consumption implies that the environmental impacts of agricultural production, such as carbon emissions or biodiversity loss, are increasingly offshored to countries that are exporting agricultural commodities (Henders et al., 2015; Lenzen et al., 2012). For example, the rising global demand for palm oil has been a key driver of rapid deforestation and agricultural expansion in Indonesia (Saikku et al., 2012). Likewise, an increasing demand for meat and soybeans in the European Union (EU), the United States (US), Japan, and China has stimulated an export boom that has caused deforestation in South America since the 1990s (Graesser et al., 2015; Rudel et al., 2009). Because the environmental impacts of export commodity production vary across the globe, understanding how trade patterns change is essential to assessing the environmental footprint of consumption (Kastner, 2009) and to identifying policy options for governing supply chains to support

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the transition to more sustainable agricultural production modes (Godar et al., 2016).

Beef production and consumption are important in this context for several reasons. First, meat, and in particular beef, is among the food commodities with the highest elasticity of demand to changes in prices and income (Cornelsen et al., 2015). Demand for beef is thus dynamic and has been increasing in many countries where incomes have increased (Keyzer et al., 2005). As a result of economic growth, global beef production has increased by almost 2% per year on average since 1960 (FAO, 2016). Second, beef production typically requires large areas for grazing or fodder production and is therefore a key driver of agricultural expansion into natural ecosystems, especially in South America (McAlpine et al., 2009). This makes beef production a major driver of environmental degradation, including biodiversity loss and carbon emissions from deforestation and forest degradation (Machovina et al., 2015). Over one quarter of the global carbon emissions from land-use change can be attributed to beef production in just four countries (Argentina, Brazil, Bolivia, and Paraguay) for the period 2000 to 2011 (Henders et al., 2015). Third, in beef production, non-carbon greenhouse gas (GHG) emissions from enteric fermentation contribute even more strongly to climate change than do carbon emissions (Ripple et al., 2014). The observed increases in the global beef trade therefore have strong implications for land use and environmental outcomes in beef producing countries.

Agricultural production and trade flows can reorganize particularly rapidly in response to sudden shock events (Bren d'Amour et al., 2016). Such shocks can relate to environmental changes such as extreme floods or droughts, livestock disease outbreaks (jeopardizing exports of meat and milk due to safety regulations), or industrial accidents such as nuclear disasters (Easterling et al., 2000; Hostert et al., 2011). Similarly, policy changes, such as trade agreements, land reforms, changing agricultural subsidies, market liberalization, or conservation schemes, may also impact substantially on domestic production and consumption and thus on agricultural imports. Such changes can be particularly drastic when sudden shifts in political regimes occur, which may result in a fundamental restructuring of agricultural sectors, including changes in land tenure, agricultural markets, farm structure, and trade relationships (Dearing et al., 2006; Müller et al., 2014).

The breakdown of the Soviet Union in 1991 exemplifies such a sudden shock; it caused radical political and economic changes and, in turn, deep and lasting shifts in both the production and consumption of agricultural commodities. After the breakdown, domestic cattle production plummeted because dairy and beef cattle were not competitive under the liberalized market conditions (Schierhorn et al., 2016). Beef consumption in Russia also declined rapidly after 1991, due primarily to declining incomes as well as declining state subsidies to consumers (Schierhorn et al., 2016). Beef consumption rebounded with the recovery of the Russian economy in the 2000s, but production has remained at low levels until today, which has turned Russia into a major beef importer. Meanwhile, Brazil has become a major producer and exporter of beef after 2000, including through pasture expansion into tropical forests and savannas, and also emerged as a major supplier of beef to Russia.

Here, we examine how political, institutional, and economic changes may cause the reorganization of international trade in agricultural products, and how these changes in trade flows affect land use and the associated environmental impacts. We focus on how Russia's beef production and trade relations with Brazil, the leading exporter of beef to Russia, have changed since the collapse of the Soviet Union in 1991. Specifically, we ask the following questions:

1. How did the breakdown of the Soviet Union and its subsequent economic recovery affect beef consumption and production in Russia?
2. How do changes in the global beef markets and in Brazil's livestock sector explain the changing beef trade patterns between Russia and Brazil?

Based on these questions, we discuss the possible environmental implications of these changing trade linkages.

2. Consumption, production, and trade of beef in Russia

2.1. Soviet period (1961–1991)

Since the 1960s, communist leaders subsidized meat production and consumption because the high intake of fat and protein at stable prices was seen as one of the achievements of socialism (Dronin and Bellinger, 2005). In 1990, agricultural subsidies in the Soviet Union, primarily targeted to the livestock sector, amounted to almost 12% of the gross domestic product (GDP), one of the highest subsidy rates globally (Sedik et al., 2003). As a result, per capita meat consumption in 1990 was 71.2 kg, only slightly below the United Kingdom (72 kg) where average income was double that of the Soviet Union (FAO, 2016). Beef accounted for almost half of the total meat intake in the Soviet Union (USDA, 2016), and per capita consumption of beef was one of the highest in the world in the 1980s (FAO, 2016). Within the Soviet Union, Russia had the highest beef consumption (USDA, 2016).

Because of the importance of beef for local consumption, the Soviet Union sought self-sufficiency in beef production. Between 1961 and 1991, cattle numbers increased from 76 to 116 million heads (+53%), and in 1991 the Soviet Union hosted almost 10% of all cattle in the world (FAO, 2016). Productivity in beef production also increased from 110 kg per head in 1961 to 205 kg in 1991 (+80%, FAO, 2016). Within the Soviet Union, domestic production in Russia could still not satisfy the high demand, and only 70% to 77% of the beef consumed in the Soviet Union was produced domestically (Fig. 1, USDA, 2016). Long-term import contracts were established primarily with the Soviet republics of Belarus, Ukraine, Kazakhstan, Estonia, Latvia, and Lithuania, as well as with Soviet satellite states such as Poland and Hungary (Csaki and Lerman, 1992; USDA, 2016). The Soviet Union imported large quantities of beef from France, China, and Ireland (FAO, 2016), and most of these imports were destined for Russia. A majority of all cropland in the Soviet Union was sown with fodder crops in 1990 (Schierhorn et al., 2014), but large amounts of feed grain still had to be imported, particularly from the US, Australia, and Argentina (Dronin and Bellinger, 2005). These imports peaked at 49 Mt in 1988 (FAO,

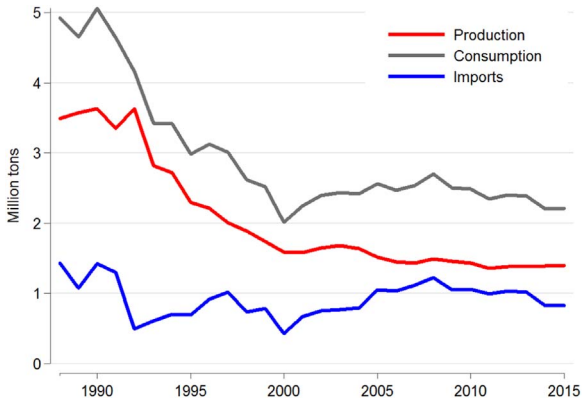

Fig. 1. Beef production, consumption, and imports in Russia. The data are from the USDA (2016).