



## Research report

# Balancing virtual land imports by a shift in the diet. Using a land balance approach to assess the sustainability of food consumption. Germany as an example <sup>☆</sup>



Toni Meier <sup>a,\*</sup>, Olaf Christen <sup>a</sup>, Edmund Semler <sup>a</sup>, Gerhard Jahreis <sup>b</sup>, Lieske Voget-Kleschin <sup>c</sup>, Alexander Schrode <sup>d</sup>, Martina Artmann <sup>e</sup>

<sup>a</sup> Institute of Agricultural and Nutritional Sciences, University Halle-Wittenberg, Betty-Heimann-Str. 5, 06120 Halle (Saale), Germany

<sup>b</sup> Institute of Nutritional Sciences, University Jena, 07743 Jena, Germany

<sup>c</sup> Department of Philosophy, University Kiel, 24118 Kiel, Germany

<sup>d</sup> Environmental Policy Research Center (FFU), University Berlin (FU), 14195 Berlin, Germany

<sup>e</sup> Department Geography and Geology, University Salzburg, 5020 Salzburg, Austria

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## ABSTRACT

Nutrition is considered as one of the main drivers of global environmental change. Dietary patterns in particular, embedded in the international trade of foods and other biomass based commodities, determine the dimension of beneficial or harmful environmental impacts of the agri-food sector – both domestically and abroad. In this study we analysed different dietary scenarios from a virtual land flow perspective, based on representative consumption data for Germany in the years 2006 and 1985–89. Further we identified the consumer groups that would have to adapt most to balance Germany's virtual land import and analysed the impact reduced food wastage. For the study, official data sets concerning production, trade and consumption were used. We derived land use data from environmentally extended input–output data sets and FAO statistics. The conversion of agricultural raw products to consumed commodities is based on official processing and composition data. Subgroup-specific intake data from the last representative National Nutrition Survey in Germany were used. We analysed 42 commodities, aggregated into 23 product groups, seven land use types and six nutrition scenarios. The results show that in the baseline scenario the average nutrition in the year 2006 leads to a virtual land import of 707 m<sup>2</sup> p<sup>-1</sup> a<sup>-1</sup>, which represents 30% of the total nutrition-induced land demand of 2365 m<sup>2</sup> p<sup>-1</sup> a<sup>-1</sup>. On the other hand, the German agri-food sector exports virtual land, in the form of commodities, equivalent to 262 m<sup>2</sup> p<sup>-1</sup> a<sup>-1</sup>. In this paper we calculate that the resulting net import of virtual land could be balanced by way of a shift to an officially recommended diet and a reduction in the consumption of stimulants (cocoa, coffee, green/black tea, wine). A shift to an ovo-lacto-vegetarian or vegan diet would even lead to a positive virtual land balance (even with maintained consumption of stimulants). Moreover, we demonstrate that a shift in the average diet profile could lead to maintained or even expanded export competitiveness and simultaneously enable environmental benefits. Since such a diet shift complies with official dietary recommendations, it follows that public health benefits may well result. We show further that a reduction of avoidable food losses/wastage would not be sufficient to level out the virtual land balance of the average nutrition in Germany. Regarding the dietary developments in the last 20 years, we argue that a dietary shift resulting in a zero land balance is within reach. The population groups that would have to be addressed most are younger and middle-aged men. Nevertheless, women's land saving potentials should not be ignored neither. Due to the fact that a western-style diet prevails in Germany, we argue that our basic findings are applicable to other industrialised and densely populated countries.

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\* Corresponding author.

E-mail address: [toni.meier@landw.uni-halle.de](mailto:toni.meier@landw.uni-halle.de) (T. Meier).

URLs: <http://www.nutrition-impacts.org>, <http://www.landw.uni-halle.de> (T. Meier).

## Introduction

In the current debate concerning land competition and large scale foreign land acquisitions (informally known as land grabbing), international trade and thus trade in virtual land, in particular trade flows to industrialised countries, are discussed as

influencing factors on environmental degradation and societal disturbance in developing nations (EC, 2013; Lenzen et al., 2012; Pearce, 2012; Smith, Gorrdard, House, McIntyre, & Prober, 2012). In the EU several proposals have been put forward to include in the reform of the Common Agricultural Policy (CAP, 2014–2020) also measures to decrease Europe's import dependency from crops with a high land occupation abroad, mainly leguminous protein plants (ARC, 2012; EP, 2011; WWF, 2011). Positive effects of reducing the virtual land import encompass less environmental pressure on deteriorating ecosystems in main producer countries – e.g., Brazil, Argentina (EC, 2013; Fearnside, 2001; Lenzen et al., 2012; Morton et al., 2006) – as well as positive equity effects in these countries, if corresponding land and nutrition policies are managed properly (Lipton, 2009; Wahlqvist, McKay, Chang, & Chiu, 2012).

Furthermore, reducing virtual land import necessitates increasing domestic production of protein crops. In Germany the Federal Ministry of Food, Agriculture and Consumer Protection launched a corresponding 'Protein crops strategy' (BMELV, 2012). This aims at stimulating the domestic production of protein plants, namely soya, beans, peas, lentils, lupines, chick peas, alfalfa/lucerne and clover, and thus at diminishing virtual land imports. Besides a reduced import dependency doing so features further environmental as well as economic benefits. In environmental terms, potential benefits result from inclusion of leguminous protein plants in crop rotation (Crews & Peoples, 2004; Deike, Pallutt, Melander, Strasse-meyer, & Christen, 2008; Köpke & Nemecek, 2010; Nemecek et al., 2008; Sinclair & Vadez, 2012). Economic benefits are linked to decreasing dependency on volatile world market prices (Richthofen et al., 2006; Schäfer & Lütke Entrup, 2009) as well as the creation of new income opportunities for European farmers through marketing of GMO-free products as part of a product quality scheme (JRC EC, 2012). However, contra these arguments industry and business associations have expressed concerns that promoting the domestic production of leguminous protein plants may push the production of established high-yield crops in Europe (mainly maize, grains and oilseed rape) aside, leading to less productivity and competitiveness on the world market due to an underutilized potential of relative cost advantages (OVID, 2012; UECBV, 2012).

Finally, in so far as domestic production of protein crops cannot completely substitute current imports, reducing virtual land imports involves replacing consumption of animal protein (e.g. meat, milk, eggs) with consumption of plant protein. This, in particular the reduction of red meat, comes along with positive health impacts, like a reduced chronic disease risk and a lower overall mortality (Aiking, Boer, & Vereijken, 2006; Belski et al., 2010; Darmadi-Blackberry et al., 2004; Fechner, Schweiggert, & Hasenkopf, 2011; Fleddermann et al., 2013; Messina, 2010; Weiße et al., 2010).

By applying a theoretical framework of sustainable development (SD) and inter-/intra-generational justice we reconsider the views mentioned from a broader perspective and present a possible solution, which combines their advantages while relativising corresponding criticism. SD globally functions as a leading role model for shaping (future) development. However, besides this general agreement it is not at all evident what claims for SD actually imply. In line with the Brundtland-definition we conceive of SD as development "that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). We understand this definition to encompass two kinds of claims (Voget-Kleschin, 2013):

- Direct claims for justice ask that all contemporary and future human beings should be able to live a decent human life.
- Indirect claims for justice encompass claims for a handling of our social and natural environment that qualifies as not undermining contemporary and future humans' ability to live such a decent human life.

Thus conceptualizing sustainability allows framing the above mentioned arguments: Positive health effects, positive equity effects as well as the economic benefits of reducing virtual land import can be framed as contributions towards meeting direct claims for justice. By contrast, a diminishment of productivity and competitiveness of European agriculture violates direct claims for justice. Similarly, environmental degradation and societal disturbance linked to virtual land ex- and imports violates indirect claims for justice. By contrast, ecological benefits correspond to demands for avoiding negative repercussions on our natural and social environment and thus to indirect claims for justice. In terms of our understanding of sustainability direct and indirect claims for justice are equally important and mutually constraining each other. This means that a certain process or measure, such as promotion of domestic protein crops or an expanded export strategy does only qualify as contributing to SD if it contributes to meeting direct and indirect claims for justice.

In the study we calculated a net import of virtual land associated with the current production and consumption patterns. Similar effects for Germany were also shown by Witzke, Noleppa, and Zhirkova (2011) and for Europe by Steger (2005) and Sleen (2009). To the best of our knowledge, this study is the first to link dietary recommendations and dietary styles with virtual land flows on the basis of a complete diet model. We propose a dietary regime allowing for a balanced trade of virtual land in Germany. Other studies with a similar scope focused either on the current nutrition regime and related environmental impacts in a particular country and abroad – for Switzerland Jungbluth, Nathani, Stucki, and Leuenberger (2011), for the Netherlands Gerbens-Leenes and Nonhebel (2005), for the Philippines Kastner and Nonhebel (2010) – or analysed additionally the possible effects of different dietary changes – for the EU Tukker et al. (2011), for the US-state New York Peters, Wilkins, and Fick (2007), for Germany Wiegmann, Eberle, Fritsche, and Hüneck (2005) and Meier and Christen (2013). In contrast to the study by Wiegmann et al. (2005), which is mainly based on environmental data from single-case studies (bottom-up), we could use statistically more reliable data from representative surveys (top-down).

In contrast to Meier and Christen (2012a,b, 2013) we were able to combine the production specific top-down data with representative and subgroup-specific intake data, which allowed for a more detailed assessment on the demand side. We show which population groups would have to adapt most to reach the land-balanced scenario in contrast to the dietary recommendations and dietary styles. Further, we included the last published data concerning food losses/wastage in the agri-food sector in Germany (Kranert et al., 2012) and investigated the corresponding impact on land requirements and the virtual land balance. Finally, we extended the diet model by adding further products (cocoa, coffee, green/black tea, herbal tea, wine) and provide detailed feed composition tables of related animal-based products (see supplementary material).

## Materials and methods

### *Virtual land versus the concept of the Ecological Footprint (EF)*

Methodologically this paper refers to the virtual land approach. Allan (1993, 1994) initially developed the concept of virtual inputs for water. The underlying concept is as follows: Any goods being produced require inputs (water, land etc.). The inputs used in production are considered as virtual inputs (virtual water, virtual land etc.). If the commodity is traded internationally, then the virtual input is also traded (Hoekstra, 2003; Witzke & Noleppa, 2012). This concept should be distinguished from that of the 'Ecological

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