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Article

Sustainable Food Systems in the 21st Century—Considering the Natural Capital Embodied in Israeli Meat Consumption

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Abstract:
The prevailing global livestock industry relies heavily on natural capital (i.e. land, water and energy) and is responsible for high emissions of greenhouse gases (GHG). In recent years, nations have begun to take more of an active role in measuring their resource inputs and GHG outputs for various agricultural products. However, most nations record data for production, focusing on processes within their boundaries. Some recent studies have suggested the need to also consider a consumption approach. It follows that in a globalizing interconnected world, to be able to generate a sustainable food policy, a full systems approach should be embraced. The case of Israeli meat consumption is especially unique as the country does not have sufficient resources to produce enough food to support its population. Therefore, Israel relies on importing bio-capacity to meet demand, displacing the environmental impact of the system to at least a dozen other countries. This research embraces a multi-regional consumption perspective using a Life Cycle Assessment (LCA) approach, aiming to measure and compare the carbon and land footprints demanded by Israeli cattle and chicken meat consumption following both domestic production and imports of inputs and products. The results of this research show that the "virtual land" required for producing meat for consumption in Israel is almost 20% greater than the total domestic available agricultural land area. Moreover, while almost 80% of meat

consumption is provided by locally produced chicken products, the natural capital impact of this source is inconsequential compared to the cattle beef supply chain; beef imports comprise only 13% of meat consumption in Israel but are responsible for 56% of the carbon footprint and 55% of the land footprint. As the sources for Israel's meat supply contribute a profound percentage of the system's natural capital use and are currently excluded from evaluations of the environmental impact of Israeli processes, these impacts must be considered to understand the global impact of Israel's consumption habits and promote interregional sustainability.

Keywords: Meat Consumption, Sustainable Food Systems, Interregional Sustainability, Carbon and Land footprint, Life Cycle Assessment

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1. Introduction

In recent decades, the international trade of food commodities has become a central means of supplying the needs and wants of billions of consumers all over the world (Lang, 1999b; Bruinsma, 2003). In such a world, most stages in many products' lifecycles are dispersed throughout at least a dozen countries before being consumed, and production is rarely territorially specific. For countries with limited resources where domestic supply is dependent on importing bio-capacity[1], food system sustainability is also reliant on other regions; low yields or ecological damage will not only affect the country of production, but might also dramatically affect the sustainability of countries with roles farther down the commodity chain (Kissinger, Rees, & Timmer, 2011). Further, as the virtual distance between the source of production and the consumer grows longer, environmental ramifications caused by the production of a commodity becomes more difficult for the consumer to quantify (Kissinger & Rees, 2010). Although various academic research have explored the natural capital demanded by food production or processes occurring within a single country, a growing number of studies advocate for taking a full-system or consumption approach, accounting for activities taking place throughout the entire lifecycle (e.g. Jackson, 2004; Rees, 1995, 2006; Daly, 1996; Daly et al., 2007; Princen, 1999; Princen et al., 2002; Munksgaard & Pedersen, 2001; Clapp, 2002; Dauvergne, 2005, 2008; Peters, 2008; Kissinger & Rees, 2009; Kissinger, 2013).

The geographic attributes of the land of Israel, in particular, place heavy limitations on agricultural yields, making the country poorly suited for feeding its rapidly increasing population. Consequently, Israel is dependent on imports from many other countries to support domestic food supply, especially for inputs to the meat system. The international meat system has been proven to have a significant contribution to global natural capital use and greenhouse gas emissions, and the

[1] See Kissinger & Rees, 2010 and Kitzes, Piller, Goldfinger, & Wackernagel, 2007

example of cattle beef consumption in Israel compared to poultry meat presents the significance of the natural capital embodied in a globally based system (Pathak, 2010; Mogensen, Hermansen, Halberg, Dalgaard, Vis, & Smith, 2009; Steinfeld, Gerber, Wassenaar, Castel, Rosales, & de Haan, 2006; Fiala, 2008; Moss, Jouany, & Newbold, 2000). Further, these examples demonstrate how a nation's consumption influences international food security and interregional sustainability. To date, very little is known about the overall biophysical implications of the Israeli meat system and its global dependence; this study aims to calculate the greenhouse gases and land resources embodied in Israeli meat consumption, accounting for all foreign and domestic sources of supply and resources. While this analysis focuses primarily on Israeli consumption patterns, it demonstrates the need to consider interregional sustainability, and contains implications for all countries that have roles along global commodity chains. The study encourages Israel and other countries of consumption to consider ecological processes occurring in countries of import, and consider the responsibility for their role in natural capital exploitation in the global industry.

2. Background

2.1 Global Meat Commodity Chains

The global food system has undergone drastic changes in the past several decades, due in part to the availability of fossil energy, the development and increased use of artificial inputs such as fertilizers and pesticides, and transformations in shipping technologies (Pimentel & Pimentel, 2008; Ehrlich & Ehrlich, 1990; Grey, 2000; Lang, 1999b; Bruinsma, 2003). At the same time, free-trade agreements and the phasing out of food reserves, along with national food policies have fostered the increasing interconnectivity and dependency of a country on the global system (Bruins in Helsloot, Boin, Jacobs, & Comfort, 2012; Gupta, 2004). All of these transformations have contributed to shaping the current globalized food industry, one where the typical commodity chain traverses multiple continents before reaching the consumer, and consumers have access to the highest variety of products than ever before in human history (Arce & Marsden, 1993; Cribb, 2010; Lang, 1999a). Coupled with this expansion, the role of meat has emerged as a primary commodity in the typical diet, where developed countries may fill 70% of their protein consumption with animal-based products, sometimes reaching over 300 grams of meat per person daily (Pimentel & Pimentel, 2008; Martinez, 1999; Schwarzer, 2012). Since 1980, developing countries have nearly doubled their meat intake per capita as a result of growing incomes, urbanization and shifts in food preferences, and world meat exports have skyrocketed (and are projected to continue climbing) to meet demand (FAOstat, 2013; UNESCO, 2006; Fiala, 2008; Schwarzer, 2012).

The last four decades have shown an increased adoption of industrialized livestock rearing practices to accommodate growing consumption habits, including higher inputs of fossil fuels, expansion of built structures, and industrialized feed production (replacing conventional pasture-based systems) (Bouwman, Van der Hoek, Eickhout, & Soenario, 2005; Martinez, 1999). Yet these systemic changes hold substantial implications for the environment and the availability of natural resources. The global meat production system dominates as the food sector that exploits the highest quantity of GHG's, energy resources, and land area, responsible for 9% of all anthropogenic greenhouse gas emissions (Pathak, 2010; Mogensen, Hermansen, Halberg, Dalgaard, Vis, & Smith, 2009; Steinfeld, et.al., 2006; Fiala, 2008; Moss, Jouany, & Newbold, 2000). The production stages with the greatest impact on natural capital include animal digestion (CH_4 emissions), decomposition of fertilizers and animal waste (CH_4 emissions), burning of fossil fuels to create fertilizers used in feed production (CO_2 emissions), land-use changes for producing feed or grazing (land resources), and land degradation (Steinfeld, et.al., 2006).

2.2 Conventional vs. Emerging Approaches of Natural Capital Accounting

Life Cycle Assessment (LCA) is an especially useful tool for analyzing global commodity chains as it is typically used to understand complex production systems. LCA measures environmental impact by looking at a product or system throughout its lifespan accounting for all inputs and outputs, typically from "cradle to grave" (SAIC & Curran, 2006). Yet most studies using this method remain at the "cradle to gate" level, neglecting to consider sources of supply or the pre- and post-farm gate stages. Moreover, conventional approaches of LCA and other tools measuring the environmental impact of a product, process, or nation have included factors attributed only to production, accounting for environmental burdens that take place within the country's borders. These studies also typically measure the natural capital only for a single unit of analysis (i.e. one kilogram of meat), and do not present the total burden for the entire production system (a macro-scale approach). Recently, researchers acknowledge the need to consider a consumption perspective, agreeing that the ecological impact of a product lies primarily on the consumer. A growing number of studies have begun using such an approach to measure an individual or nation's impact on the environment (e.g. Jackson, 2004; Rees, 1995, 2006; Daly, 1997; Daly et al., 2007; Princen, 1999; Princen et al., 2002; Munksgaard & Pedersen, 2001; Clapp, 2002; Dauvergne, 2005, 2008; Peters, 2008; Kissinger & Rees 2009; Kissinger 2013). A small but increasing number of LCA's are now taking the consumption approach in analyzing the carbon and land impacts of a particular country's meat consumption (Weber & Matthews, 2008; Frey & Barrett, 2008; Wallén, Brandt, & Wennersten, 2004).

2.3 The Israeli Meat System

To date, very little research have used this method to explore Israel's overall food system, and none have studied the national meat system. This is especially relevant as per capita consumption of all meat products in Israel have seen a profound increase in the last two decades, with cattle and chicken meat serving as the two most highly consumed meats (OECD, 2010; FAOstat, 2013). While pork consumption is significantly lower in Israel compared to the rest of the world, Israel is still considered the world's 13th highest per capita consumer of overall meat products, as of 2009 (FAOstat, 2013).

Israel's food system is heavily reliant on foreign imports of products and supplemental resources, and while data may show that Israel is self-sufficient in certain products, it most likely does not incorporate the imported materials and energy used to create them (e.g. imported livestock feed). The Israeli chicken and cattle meat supply-chains drastically differ in scale and magnitude, with the former being primarily encompassed within Israeli borders, and the latter involving processes on over a dozen other countries. Filling in the gaps from production to consumption along the two distinctive lifecycles would show the true global warming impact and land resources required for Israeli meat consumption, identifying barriers and resolutions for achieving food security, interregional sustainability, and building a sustainable food system.

3. Methods

Our study accounts for cattle and chicken meat consumption in Israel, documenting the import of beef, calves, and feed, as well as domestic sources of production. Data sources include national and international databases, interviews with key local officials, analysis of policy documents, and peer-reviewed journal articles. The results represent activity taking place in 2010, following the most recent available data.

The four primary categories considered include: (1) beef import, (2) calf import, (3) domestic cattle beef production, and (4) domestic chicken meat production. Category 1 includes boneless beef and beef cuts that are imported from several countries, mainly Latin America, Europe, and China. Category 2 follows calves exported from Australia and Eastern Europe when they are between two and five months old, then fattened in Israeli feedlots until reaching slaughter weight. The cows produced and consumed entirely in Israel (category 3) include pastured cows, culled dairy cows, and calves born in the dairy sector that are fattened in feedlots. Finally, category 4 follows the local boiler system which is almost entirely sourced by domestic poultry production, with negligible import/export quantities of chicken meat or products.

Our analysis encompasses the following stages: a) Calculation of overall meat consumption from each source of supply; b) Measurement of the main sources of greenhouse gas emissions and land resources involved in production from each source; and c) Quantification of GHG emissions related to overseas transport to Israel.

3.1 Carbon and Land Footprints

This research estimates the carbon dioxide and methane emissions along the full commodity chain of consuming one tonne of cattle or chicken meat in Israel, accounting for all burdens resulting from the production and transport of feed, on-farm operations (animal husbandry, fertilizer application, machinery), slaughter, and overseas transport. Results are presented in CO_2 equivalent, using a factor of 1 kg CO_2/kg CO_2 and 21 kg CH_4/kg CO_2, (Hill, Walker, Choudrie, & James, 2012). The land resources considered include pastureland and cropland for cattle, and coop-land and cropland for chickens, calculating the actual area of land needed per unit of meat or feed for consumption in Israel. Overseas transportation to Israel was calculated from the nearest port of the source country to Israel using the most direct route. Tables 1-3 present the factors and data sources used for each region of analysis.

Table 1. Data Factors for Beef Import

Country	Enteric Fermentation (kg CH4/head)[a]	Manure Management (kg CH4/head)[a]	Feed Production and Farm Operations (kg CO2/kg HSCW)	Slaughter (kg CO2/kg HSCW)[e]	Shipping Distance (km)[f]	Shipping factor (kg CO2/tonne/km)[g]	Pasture Land (kg beef/hectare)	Cropland (hectares)
Rest of the World	57[c]	3[c]	4.12[c]	0.2	N/A	N/A	421[c]	N/A
Uruguay	57	1	0.3[b]	0.2	13,505	0.01605	208[h]	N/A
UK	57	6	4.04[d]	0.2	5,569	0.01605	184[i]	1,399[i]
Poland	58	6	4.98[d]	0.2	7,599	0.01605	166[k]	4,430[i]
Paraguay	56	1	0.3[b]	0.2	12,047	0.01605	208[h]	N/A
Panama	56	1	0.3[b]	0.2	11,838	0.01605	208[h]	N/A
Netherlands	57	6	2.65[d]	0.2	6,219	0.01605	1,699[i]	65[i]
France	57	7	3.99[d]	0.2	2,948	0.01605	354[i]	3,401[i]
China	188	1	4.12[c]	0.2	12,966	0.01605	Included with ROW	Included with ROW
Brazil	56	1	0.3[b]	0.2	9,304	0.01605	208[h]	N/A
Argentina	56	1	0.3[b]	0.2	13,505	0.01605	208[h]	N/A

a. FAOstat, 2013; b. Cederberg, et.al., 2007; c. Calculated average; d. Leip, et.al., 2013; e. Schroeder, Baines, & Aguiar, 2011; f. Port World, 2013; g. DEFRA, 2011; h. Carvalho, 2006; i. Calculated data using Leip, et.al., 2013

Table 2. Data Factors for Calf Import

Region	Enteric Fermentation (kg CH_4/head)[a]	Manure Management (kg CH_4/head)[a]	Shipping Distance (km)[c]	Shipping factor (kg CO_2/tonne/km)[d]	Feed Production and Shipping (kg CO_2/tonne feed)[e]	Slaughter (kg CO_2/head)[f]
Australia	43[b]	1.4[b]	17,050	0.01315	40 (maize) 64 (wheat)	69
Eastern Europe	32.75[a]	1.8[a]	2,113	0.7	40 (maize) 64 (wheat)	69

a. Calculated average using factors of Australia and Israel from FAOstat, 2013; b. Calculated average using factors of E. Europe and Israel from FAOstat, 2013; c. Port World, 2013; d. DEFRA, 2011; e. Calculated average using Kissinger & Gottleib, 2010; f. Calculated data using IEC, 2013 and Slaughterhouse (a), 2013

Table 3. Data Factors for Domestic Production

Region	Enteric Fermentation (kg CH_4/head)[a]	Manure Management (kg CH_4/head)[a]	Feed Production and Shipping (kg CO_2/tonne feed)[b]	Slaughter (kg CO_2/head)	Pasture Land (Cow-calf/hectare)[e]	Crop Land (hectare/tonne feed)[f]	Coop Land (hectares/ head)[g]
Israel (Chicken)	N/A	0.02	64 (wheat) 40 (maize)	0.75[d]	N/A	0.32	2.2×10^{-5}
Israel (Cattle)	31	1	64 (wheat) 40 (maize)	69[c]	2.5	0.32	N/A

a. FAOstat, 2013; b. Calculated average using Kissinger & Gottleib, 2010; c. Calculated data using IEC, 2013 and Slaughterhouse (a), 2013; d. Calculated data using IEC, 2013 and Slaughterhouse (b), 2013; e. Sagee, 2013; f. Calculated average using Kissinger & Gottleib, 2010; e. Haklay, 2013

3.2 Research Limitations

Due to the scope of this study and lack of data availability, certain components to the Israeli meat system are not accounted for in this study. The two sources of meat considered make up the majority of national meat consumption, therefore, other sources of meat consumption such as turkey, pig, sheep, goat, and other poultry products are not considered. These products are recommended for inclusion in future research on natural capital embedded in the Israeli meat system.

When specific figures were not available or not reliable for this study, they were either not considered or assumptions are made. Some omitted components include nitrous oxide emissions from livestock and feed production, natural capital implications of land-use change for pasture and cropland production, processes occurring within countries exporting calves prior to their overseas shipment to Israel, and transportation occurring within the country post-production, such as from the farm-gate to the port. Additionally, factors estimated for Brazil are used as a proxy for the other Latin American countries considered, and footprints are not considered for culled dairy cows in Israel, as this falls under the auspices of the dairy sector.

Finally, this study's boundaries extend until the production of one tonne of cattle or chicken meat, and do not include any subsequent stages in the lifecycle. Further research would be needed to estimate the full carbon and land footprints of consumption from cradle to grave, such steps as processing into meat products, transportation to vendor and consumer, storage, food preparation, and final waste disposal.

Given that the data used is the most updated and accessible from what is available, the limitations presented here should not impair the impact of this research. However, we do acknowledge that this study is the first step in evaluating the natural capital of Israeli meat consumption and encourage continuing to refine the data in the future to present the most accurate and reliable picture of the system.

4. Results

Figure 1 presents the displacement of the sources of Israeli meat consumption across the world.

Figure 1. Sources of Israeli Meat Consumption, by Region and Percentage Contribution

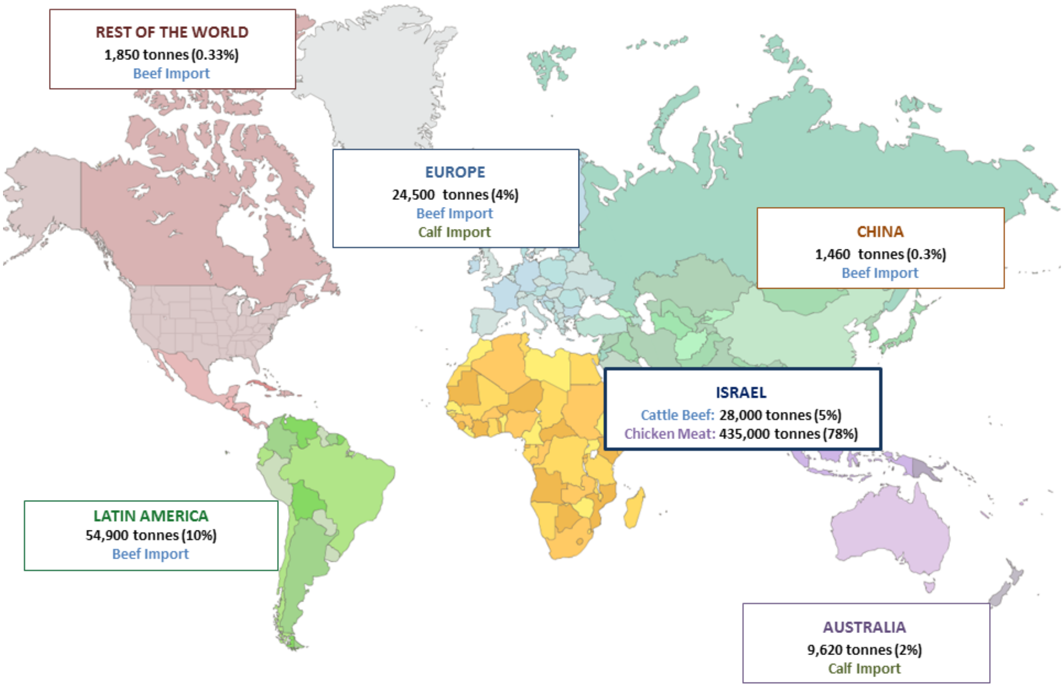


Table 4 presents the four main processes contributing to cattle and chicken meat consumption in Israel, and the quantities of consumption from each category in 2010. Appendix A details the specific countries contributing to each category and their overall burden.

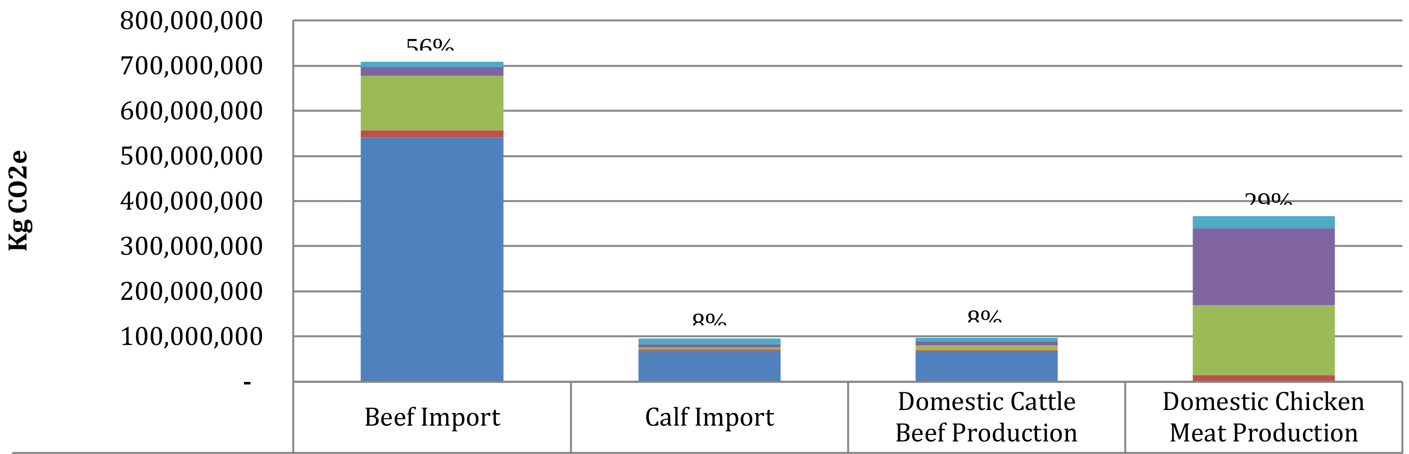
Table 4. Israeli Meat Consumption, by Category

Process	Consumption quantity (tonnes)	% of Total Meat Consumption
Beef Import	71,150	13
Calf Import	21,200	4
Domestic Cattle Meat Production	28,000	5
Domestic Chicken Meat Production	435,000	78
Total	**555,350**	**100**

4.1 Carbon Footprint

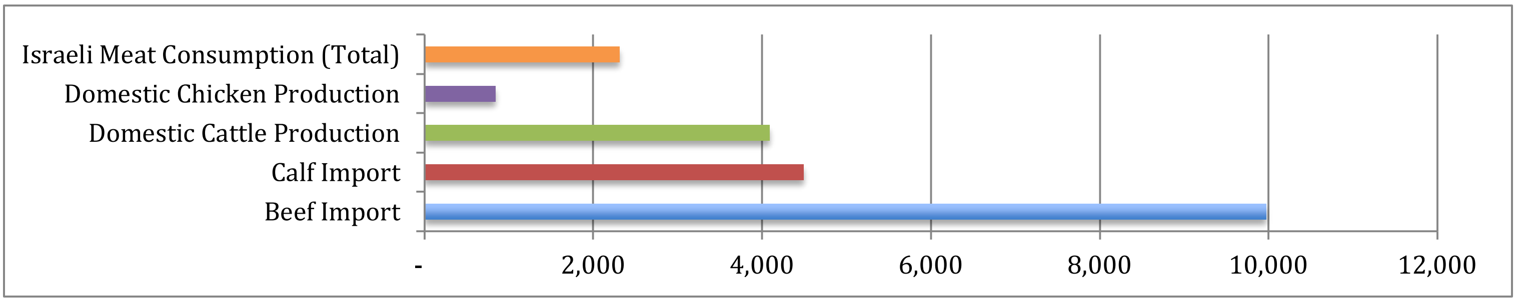
The global warming potential for the average Israeli consumption of cattle meat in 2010 measures at 902,000 tonnes CO_2e overall and 7,640 kg CO_2e per tonne. Results for chicken meat present at 367,210 tonnes CO_2e overall and 844 kg CO_2e per tonne. Factors influencing the size of the cattle beef footprint include: the quantities of meat consumed from each region of production, the type of cattle, feed, and energy sources used in each supplying region, and the distance of shipping between the source country and Israel. Relevant components in the chicken meat footprint involve quantities of consumption, quantity of feed, energy sources, and shipping of feed from overseas. The following figures break down the overall footprint into these considerations, showing the carbon footprint of each meat product by stage of production and shipping, with the share of the total GWP for each source of meat supply (Figure 2), and GWP per tonne by source (Figure 3).

Figure 2. Carbon Footprint, by Stage, Source of Supply, and Share of Burden (kg CO_2e)



	Beef Import	Calf Import	Domestic Cattle Beef Production	Domestic Chicken Meat Production
Shipping	11,907,455	13,032,102	7,444,864	27,725,231
Processing	20,325,086	6,014,023	9,349,967	169,750,374
Farm Operations	120,247,085	5,112,237	10,168,831	155,623,147
Manure Management	15,821,368	2,463,368	2,184,000	14,109,480
Enteric Fermentation	541,215,938	68,645,746	67,704,000	

Figure 3. Carbon Footprint per Unit by Source of Supply (kg CO2e/tonne meat)



The figures present that the majority of the GHG emissions are attributed to the beef import (>700,000 tonnes) through production taking place outside of the country, and the most significant process in this category is enteric fermentation. The calf import and domestic cattle beef production each account for about 8% of emissions (~100,000 tonnes). It is noteworthy that shipping emissions for the calf import are more substantial than the beef import, due to the higher weight of the calves during transport and the subsequent grain shipment needed for the duration of their rearing in Israel.

Compared to the cattle system, chicken production holds the highest burden in the categories of shipping, feed production, and slaughter and reaches nearly 370,000 tonnes CO_2e. However, as shown in Figure 2, these results are primarily attributed to the high magnitude of local poultry production (220 million chickens slaughtered/year), as this source holds low emissions per tonne compared to the other categories considered.

4.2 Land Footprint

The global land footprint for the average Israeli consumption of cattle beef in 2010 measures at 410,000 hectares overall and 3.41 hectares per tonne. Chicken meat consumption requires 202,600 hectares of land, or 0.47 hectares per tonne. The key factors impacting the size of the footprint include: the quantities of meat consumed from each region of production (presented in Table 1, above) and the type and quantity of feed used in each supplying region.

Figures 4-5 break down the overall footprint by source, land-type, and percentage contribution to the footprint. As mentioned above, land sources within calf exporting regions are not considered due to data uncertainty.

Figure 4. Land Footprint, by Source of Supply, Land Type, and Percentage of Footprint

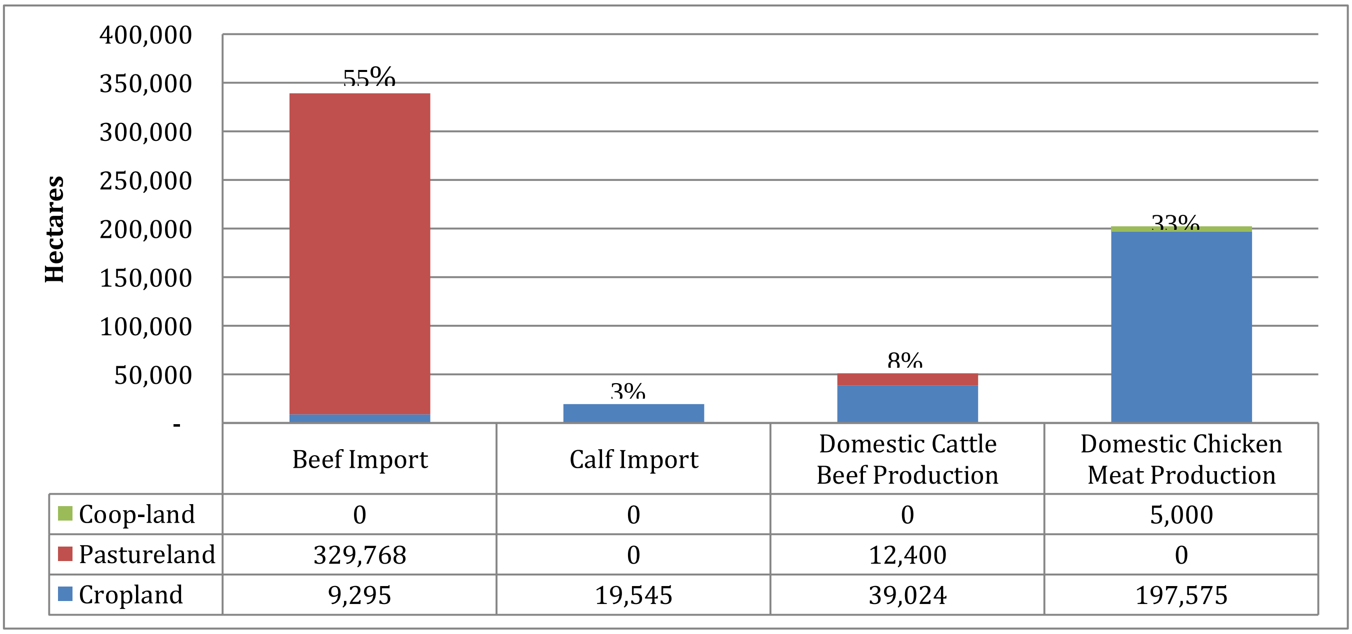
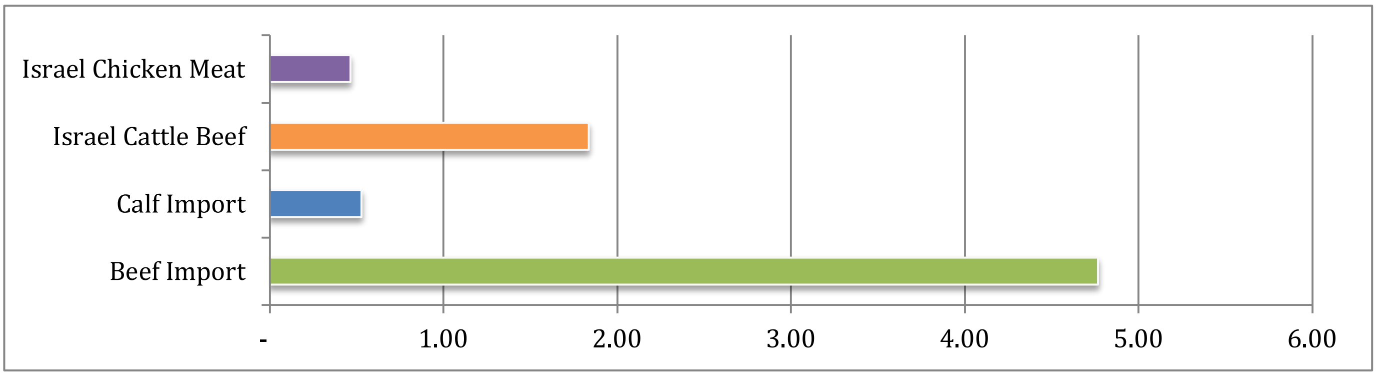


Figure 5. Land Footprint per Unit (hectares/tonne), by Source of Supply



Like GHG emissions, the greatest burden of the land footprint falls outside of Israel's borders through the beef import, both in total land resources and in hectares per capita. Figure 4 presents that domestic chicken production requires more hectares than domestic cattle beef production, and uses the greatest amount of cropland compared to the other categories. As the land impact per tonne of chicken production presents the lowest results (Figure 5), this high burden of cropland is primarily due to the significant levels of chicken meat consumption.

5. Discussion

According to 2009 data, Israel is the 13th highest per capita consumer of meat products, 18th highest per capita consumer of cattle beef, and the 5th highest consumer of poultry (FAOStat, 2013). Israeli consumption of cattle and chicken meat, both overall and per capita, has grown significantly in the past several years and has continued to rise since the year studied in this research. This study measures the population's burden of the meat system at 171 kg CO_2e emissions per capita, and land area at 0.08 hectares per capita.

The results of this research indicate that although chicken meat makes up 78% of meat consumption in Israel, it offers a low contribution to the overall carbon and land footprints attributed to Israeli meat consumption. Further, beef imports comprise only 13% of meat consumption in Israel, but are responsible for 56% of the carbon footprint and 55% of the land footprint. While cattle and poultry meat *production* within Israel require almost half of the total agricultural land in the country, the virtual land footprint of *consumption* exceeds the total area of Israeli agricultural land by nearly 20%[2]. This indicates that small increases in cattle beef imports to fill growing consumption habits would likely elevate the already significant carbon and land footprints, a great deal more than a large increase in local chicken production.

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[2] As this is the first research which studies natural capital related to Israel's meat system and is only able to cover part of the key relevant factors, future research will most likely show that natural capital estimates of Israel's meat consumption are even higher than those presented here.

The factors contributing to changes in the system's natural capital requirements undergo fluctuations between years, such as the composition of the energy mix used in Israel, more meat being imported from Latin America, or shifts in modes of international transport. Depending on the type of change, the impact on natural capital may dramatically increase or decrease. While certain shifts, such as sources of supply, are driven by purchasing decisions by producers, the consumer's choice of what type of meat to consume can have a significant impact on natural capital. If Israeli consumers reduced intake of cattle meat by 50% and replaced this quantity with chicken meat, the carbon and land footprints would decrease by 32% and 29%, respectively.

6. Conclusion

Countries with limited biophysical resources, such as Israel, have little choice but to import large quantities of food products and source materials if they wish to maintain the population's consumption levels. In light of rising meat consumption habits over the years, Israel has recognized that it is not effectual to expand domestic beef production to supply this demand, whether for reasons of economic considerations or physical limitations. While trade is typically an essential part of allowing countries access to unavailable food products and can be a cost-effective alternative to local manufacturing, the negative implications of Israel's meat system supersede the positive. This study demonstrates that the source of supply for the imported product does matter, especially for meat products, and raises questions about food system sustainability across these supply chains. Israel is essentially importing the bio-capacity from more resourceful regions, yet each source country from which Israel imports has diverse production practices with different effects on natural capital usage. When a country of import uses cattle-rearing methods that cause resource exploitation, the lines of who is responsible become blurred.

While a diversified disaggregated system of many sources of supply may protect Israel in case one region suffers from drought or low yields, the countries of import are depleting their natural capital in order for other countries to benefit, threatening interregional sustainability. Moreover, when a source country does experience ecological pressures, it may jeopardize the food systems of all regions that depend on it (Kissinger, et.al., 2011). While the majority of meat consumption in Israel is not attributed to beef imports, it is not the only country to benefit from beef products produced in the sources evaluated in this study; the regions of supply considered in this research are among the greatest beef exporters in the world. An analysis of the greenhouse gas and land efficiency of the global beef import network would most likely reveal a system where the negative externalities exceed the economic benefits. However there exists potential to turn these into positive environmental outcomes; under proper management of the commodity chain, the existing network can be used to source production from regions that are more environmentally efficient.

As illustrated by this research, the trans-boundary implications of Israeli meat consumption cannot be ignored, and will continue to grow in magnitude until they are addressed. Considering the consumption side of global food systems, such as the contribution of Israel to the global meat commodity chain, is a necessary exercise in learning to live within our ecological limits and is the first step of achieving a global sustainable food system.

Conflict of Interest

The authors declare no conflict of interest.

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Appendix

Appendix A. Makeup of Israeli Meat Consumption, by region

	Regions Considered (% of source)	**Data Sources**
Beef Import	Latin America (77%)	FAOstat, 2013; Cederberg et.al, 2007; Carvalho, 2006
	Europe (18%)	Eurostat, 2013; Leip, et.al., 2013; Cederberg et.al, 2007
	Asia (2%)	Cederberg et.al, 2007
	Rest of the World (3%)	FAOstat, 2013; Cederberg et.al, 2007

Calf Import	Australia (45%)	FAOstat, 2013, Tamir, 2013; Gavrieli, 2013; Tzuk-Bar, 2013
	Europe (55%)	FAOstat, 2013, Tamir, 2013; Gavrieli, 2013; Tzuk-Bar, 2013
Domestic Cattle Meat Production	Israel (100%)	CBS, 2013; Tamir, 2013; Gavrieli, 2013; Sagee, 2013; Tzuk-Bar, 2013; Kissinger & Gottlieb, 2010; Israeli Slaughterhouse(a), 2013; Project Bar, 2013
Domestic Chicken Meat Production	Israel (100%)	CBS, 2013; Haklay, 2013; Kissinger & Gottlieb, 2010; Adam, 2013, Israeli Slaughterhouse(b), 2013