



Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Urban consumption of meat and milk and its green and blue water footprints—Patterns in the 1980s and 2000s for Nairobi, Kenya

Caroline K. Bosire^{a,b,*}, Mats Lannerstad^b, Jan de Leeuw^c, Maarten S. Krol^a, Joseph O. Ogutu^d, Pamela A. Ochungo^b, Arjen Y. Hoekstra^{a,e}

^a University of Twente, Twente Water Centre, P.O. Box 217, 7522AE Enschede, The Netherlands

^b International Livestock Research Institute (ILRI), P.O. Box 30709, 00100 Nairobi, Kenya

^c World Agroforestry Centre (ICRAF), P.O. Box 30677, Nairobi 00100, Kenya

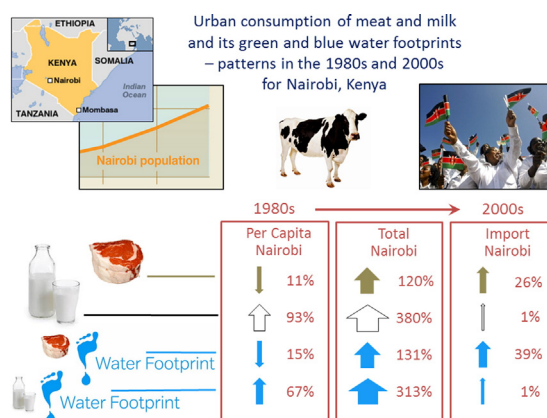
^d University of Hohenheim, Institute for Crop Science, Bioinformatics Unit, 70599 Stuttgart, Germany

^e Institute of Water Policy, Lee Kuan Yew School of Public Policy, National University of Singapore, 259770, Singapore

HIGHLIGHTS

- Consumption of meat and milk in Nairobi increased 2.2 and 5.0 times between the 1980s and 2000s.
- Total water footprints of meat and milk consumption increased 2.3 and 4.2 times, respectively.
- In the 1980s, water footprints of meat and milk consumption in Nairobi originated only from Kenya.
- In the 2000s, water footprint of meat consumption in Nairobi had a substantial foreign component.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:

Received 24 August 2016

Received in revised form 4 November 2016

Accepted 4 November 2016

Available online xxx

Editor: D. Barcelo

Keywords:

Water footprint
Consumption
Income
Meat and milk

ABSTRACT

The problem: Various studies show that the developing world experiences and will continue to experience a rise in consumption of animal proteins, particularly in cities, as a result of continued urbanization and income growth. Given the relatively large water footprint (WF) of animal products, this trend is likely to increase the pressure on already scarce water resources.

Aim: We estimate, analyse and interpret the changes in consumption of meat and milk between the 1980s and 2000s for three income classes in Nairobi, the ratio of domestic production to imports, and the WF (the volume of freshwater consumed) to produce these commodities in Kenya and abroad.

Results: Nairobi's middle-income class grew much faster than the overall population. In addition, milk consumption per capita by the middle-income group grew faster than for the city's population as a whole. Contrary to expectation, average meat consumption per capita across all income groups in Nairobi declined by 11%. Nevertheless, total meat consumption increased by a factor 2.2 as a result of population growth, while total milk consumption grew by a factor 5. As a result, the total WF of meat consumption increased by a factor 2.3

* Corresponding author.

E-mail address: kerubo.bosire@gmail.com (C.K. Bosire).

Nairobi
Kenya

and the total WF of milk consumption by a factor 4.2. The increase in milk consumption was met by increased domestic production, whereas the growth in meat consumption was partly met through imports and an enlargement of the footprint in the countries neighbouring Kenya.

Discussion and conclusion: A likely future rise in the consumption of meat and milk in Nairobi will further enlarge the city's WF. Given Kenya's looming blue water scarcity, it is anticipated that this WF will increasingly spill over the borders of the country. Accordingly, policies aimed at meeting the rise in demand for meat and milk should consider the associated environmental constraints and the economic implications both nationally and internationally.

© 2016 Elsevier B.V. All rights reserved.

1. Introduction

Urbanization is one of the three major processes driving the “livestock revolution” currently underway in many developing countries (Delgado et al., 1999). Advancing urbanization together with growing human populations and continued economic growth, engender rising food requirements and a change in dietary preferences towards more livestock intensive diets, consisting of more meat, milk and eggs (Crosson and Anderson, 1994; van der Zijpp, 1999; Ndambi et al., 2007). Not surprisingly, both the production and consumption of animal source foods (ASFs) in developing countries are projected to increase (FAO, 2016). The anticipated increase in ASF consumption will likely lower the prevailing high levels of undernutrition (FAO et al., 2015), which have been associated with inadequate consumption of protein (Ayele and Peacock, 2003; Narrod et al., 2011). Yet, despite the rising consumption of ASFs, there are major differences in consumption patterns among different income classes, with the middle and upper income classes consuming predominantly more ASFs, particularly from supermarkets (Thornton et al., 2007).

By 2014 about 54% of the global population was estimated to live in urban areas, compared to 30% in 1950. There is a huge difference in the level of urbanization between industrialized and developing countries, with around 75% living in urban areas in North America, Latin America and Europe, 48% in Asia and 40% in Africa. Up till 2050, the number of global urban dwellers is projected to increase by 2.5 billion and reach a total of 6.3 billion; 90% of this increase is projected to take place in Asia and Africa. When only the urban population in sub-Saharan Africa for the period 2015–2030 is considered, future prognoses indicate that the number of people transitioning from rural to urban life is estimated to increase by 115% in 15 years, from 170 to 360 million (UN, 2015).

Feeding urban populations requires large quantities of food to be transported into cities from surrounding areas (Liu et al., 2013). With progressing urbanization, urban centres develop tele-connectivity and a lengthening of food supply chains. Initially, agricultural products are supplied from only a few kilometres away. As urbanization continues, distances become larger, extending from local to national, to regional and finally to food imports from the global market. The highest degree of globalization is found in the most advanced countries, where urban areas are based on service and industrial sectors, which provide enough revenues to sustain long supply chains. In contrast, rural areas typically have lower population density and enough land per capita to produce food for both the rural inhabitants and adjacent and remote urban populations (Seto et al., 2012).

The environmental impacts of livestock production represent a major challenge and source of concern (Steinfeld et al., 2006; de Vries and de Boer, 2010; Gerber et al., 2013), and are expected to rise given the projected expansion of the livestock sector in developing countries in the coming decades (Alexandratos and Bruinsma, 2012b). There is thus a pressing need to safeguard ecosystems and natural resources in these countries, most of which are already experiencing considerable and varied pressures (Herrero et al., 2010; Herrero and Thornton, 2013). Following the fact that the majority of future consumers of livestock products will be urban dwellers, a deeper understanding of the link between urbanization and consumption of livestock products, on

the one hand, and natural resource use and its environmental impacts, on the other, become increasingly important.

Consumption patterns and their associated socio-economic correlates have been widely studied and form the basis for projections of future demand for food (Delgado, 2003; Narrod et al., 2011; Msangi and Rosegrant, 2012). However, the relationships of these patterns to resource use, though highly intertwined, have only recently begun to be intensively analysed (Gerbens-Leenes and Nonhebel, 2002; Rockström et al., 2007; De Fraiture et al., 2010; Falkenmark and Lannerstad, 2010; Molden et al., 2010; Fischer et al., 2011; Gerten et al., 2011; Mekonnen and Hoekstra, 2012), largely due to an increasing recognition of the growing scarcity of water and land, which severely constrains agricultural production (Costa, 2007; Molden, 2007; Hoekstra and Wiedmann, 2014). Most of these studies have mainly focused on understanding the environmental implications of food consumption in developed countries and their findings form the basis for recommendations to reduce environmental footprints. However, the results from these studies are seldom fully representative for developing countries. In Africa, studies of the relationship between resource use and consumption patterns have focused almost exclusively on crops (Chouchane et al., 2015; Pahlow et al., 2015). Consequently, there is an enhanced understanding of improved agricultural productivity of crops (Conceição et al., 2016) and its implications for natural resource demand.

An important aspect of the environmental implication of consumption that has attracted relatively little attention thus far is how urban growth and the associated increase in consumption of animal source foods (ASFs) affects natural resource appropriation in Africa. As a result, more focused studies into the relationship between resource use and consumption patterns in Africa are needed as a basis for developing sound strategies for limiting adverse environmental impacts of the rapidly expanding and changing consumption patterns.

This paper aims to contribute to advancing our understanding of consumptive water use linked to the consumption of animal sourced foods and its environmental consequences in an example developing country. More precisely, it focuses on Kenya and the linkages between the premier urban area in Kenya, Nairobi, and the use of water resources to produce the meat and milk consumed by its population. The metropolis of Nairobi functions as a financial, political and infrastructural hub for the East African region (Kearney, 2012). Its population increased from about 140,000 in 1950 to 3.9 million in 2015, raising the percentage of the total Kenyan population living in the capital city from 2.3% to 8.4% (UN, 2015). The fraction of Kenya's population living in the four largest urban areas during the same period increased from 4.3% to 12.2% (CBS, 2010), underscoring the rising importance of urban areas in Kenya (Obudho, 1997).

Nairobi City is highly segmented, with pockets of affluent neighbourhoods, with people spending at least 50 US dollars a day, surrounded by informal settlements dominated by urbanites living at, or below, the poverty line and spending about two dollars a day (Syagga et al., 2001; K'Akumu and Olima, 2007). This wealth inequality is reflected in the consumption of livestock products, with the poor households consuming far lower levels than their affluent counterparts (Gamba, 2005). Overall, about a quarter of the meat supply in Kenya is imported, with livestock from the neighbouring countries of Tanzania,

Download English Version:

<https://daneshyari.com/en/article/5751433>

Download Persian Version:

<https://daneshyari.com/article/5751433>

[Daneshyari.com](https://daneshyari.com)