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Contributions of livestock-derived foods to nutrient supply under changing demand in low- and middle-income countries

Dolapo Enahoro[a,*], Mats Lannerstad[a], Catherine Pfeifer[a], Paula Dominguez-Salas[a,b]

[a] International Livestock Research Institute (ILRI), PO Box 30709, Nairobi 01000, Kenya
[b] The London School of Hygiene & Tropical Medicine, Keppel Street, London WC1E 7HT, United Kingdom

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ABSTRACT

The potential to use large-scale dietary transformations to meet nutritional needs of the world's poorest populations may have been largely overlooked. A case study is presented of food nutrient supplies in eight selected countries within the context of their growing demand for livestock-derived food (LDF). For almost all the countries and under a range of scenarios of economic and climatic change in 2050, we find that per capita protein supply from LDF will increase relative to that from plant sources. Survey data indicate higher LDF consumption, up to 22%, among children in households that keep livestock compared to others. However, projections that four of the selected countries will import at least 40% of their LDF protein highlight the opportunity to increase livestock sector production and the potential to develop smallholder inclusive policies.

1. Introduction

Substantial progress has been made in the past decades in addressing the most extreme forms of hunger. The share of undernourished people decreased from nearly one quarter of the global population in 1970, to about 15% in 2000, and around 11% in 2014–2016. The most recent reports however indicate that still around 815 million people remain chronically undernourished (FAO/IFAD/UNICEF/WFP/WHO, 2017), justifying a sustained focus on energy intake deficits. In parallel, the prevalence of other forms of malnutrition, including overconsumption of nutrients, and micronutrient deficiencies, lead to rising concerns about the composition of human diets, in both quantity and quality terms. This is of particular relevance in low- and middle-income countries (LMICs) where income growth, urbanization, and related factors have been driving a dietary and lifestyle shift towards increased consumption of foods high in fat and sugar content, resulting in higher rates of diet-related diseases as had been previously associated only with wealthier countries (Walker et al., 2005).

Although often linked to public health issues such as obesity and food-related non-communicable diseases, the factors driving dietary transitions may also present opportunities for increased consumption of nutrient-dense foods such as animal-source foods, fruits, and vegetables (Popkin et al., 2012). Increased intakes of animal-source foods are known to provide critical benefits to nutritionally vulnerable groups such as children, women of reproductive-age, or the elderly, in poor countries (Murphy and Allen, 2003; Randolph et al., 2007; Grace et al., 2018). Large-scale dietary transitions also contribute other significant transformations in the global food and agricultural system. To better identify intervention options for the livestock sector that meet objectives related to food security, livelihoods and nutrition, there is a need to better understand the nature and impacts of these dietary transitions.

Scenario analysis of the growing demand for animal source foods – i.e., meat, milk and eggs, as well as fish and other seafood - have indicated quite significant impacts at global level, on food prices and natural resource systems (e.g., Kobayashi et al., 2015; Rosegrant et al., 2013), as well as on rural livelihoods and incomes (Herrero et al., 2014). Not much attention has however been paid to how the dietary transition is affecting nutrient availability or intake within the countries in which demand for livestock food product types is expanding, or how these changes will transition under different macro-environments. It is also not well understood how the changing demand will impact on nutritional or livelihood outcomes of smallholder livestock producers within the affected countries. Such gaps in the knowledge have important consequences for development outcomes, and thus for the designing of relevant policy, and need to be explored. Of all animal-source food types, livestock-derived foods (LDF), i.e., meat, milk and eggs and their derived products, are known to account for about 80% of production and consumption volumes globally (FAO, 2015). These LDF are the focus of this paper.

In this paper, we assess the contribution of livestock to the food and

* Corresponding author.
E-mail address: D.Enahoro@cgiar.org (D. Enahoro).

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nutrient supply of LMICs, presenting a case study of eight countries. Using the global economic model, IMPACT, we compare alternative scenario projections of countries' food and nutrient supply in 2050 against equivalent indicators for a baseline year of 2010, and a reference scenario of moderate economic growth to 2050. To highlight potential distributional effects of the macro model outputs, we review nationally-representative household survey data on livestock ownership patterns and the consumption of LDF among children in households of different wealth categories. This latter analysis allows us to make early inferences about potential linkages between the production and demand of LDF in the future, and livelihood and nutrition improvements of smallholder households that keep livestock.

2. Livestock's contributions to nutrition and livelihoods in LMICs

LDF and fish have been described as high biological value proteins, including all nine of essential amino acids needed by humans, some of which are very limiting in plant protein sources (USDA and USDHS, 2010). Even small increases in consumption of these foods have been shown to make meaningful impacts on the health outcomes of children in developing countries, given the good quality of their protein and the content in bio-available micronutrients (e.g., iron, zinc) critical for reducing stunting and securing normal cognitive development (Murphy and Allen, 2003). In LMICs, recognition of the importance of livestock-keeping and production of LDF as instruments for addressing wide-reaching nutritional needs is further motivated by the role of the livestock sector already as a major provider of livelihoods and incomes to millions (Staal et al., 2009; Randolph et al., 2007). In addition, LDF are considered key to improved nutrition during the first 1000 days of children, from conception up to two years (Grace et al., 2018).

However, the evidence is mixed as to whether, and how, increased ownership of farm animals and household production of LDF translates to higher intakes of LDF within livestock-keeping smallholder households, or to improvements in household nutrition and health. While some studies have shown higher LDF consumption or improved child nutrition (Hoddinott et al., 2015; Dessie et al., 2003; Azzarri et al., 2015), others point to no such associations (Mosites et al., 2016, 2015). For the most part, it remains to be tested if nutrition benefits are to be expected from increased livestock production or ownership over the long-run, and under different scenarios of global change.

Starting from the seminal work by Delgado et al. (2001), quantitative scenario analysis have been used to assess the potential impacts on food security, nutrition and health, of the expanding consumption and production of livestock in LMICs (e.g., Rosegrant et al., 2013; Springmann et al., 2016). These studies have looked at changes related to kilocalorie availability and intakes, including their effects on undernutrition (e.g., measured as risk of hunger and prevalence of underweight among young children as in Rosegrant et al., 2013), and overnutrition (e.g., measured as mortality rates linked to dietary and weight-related risk factors as in Springmann et al., 2016).

The contribution of livestock to countries' supply of essential nutrients, and to the incomes and livelihoods of vulnerable populations, as well as indications of how these will fare under factors of global change, are still important elements of the international development discourse (Thornton, 2010; Thornton et al., 2009). In regions such as in the Sahel and Horn of Africa, where livestock production activities are mainstays of the economy, prospects for increasing or even maintaining current levels of LDF production in the coming decades may be increasingly hampered by threats of climate change, amongst others (McDermott et al., 2013). While international trade offers alternative channels for meeting growing nutrient requirements in LMICs (Havlík et al., 2014), trade-based strategies typically require the efficient functioning of cross-border food supply networks, a condition that does not always exist (Williams et al., 2006). In addition, net-exporting countries have been known to stem food exports during times of scarcity, posing increased threats of food unavailability to the net-importers (Puma et al., 2015). Local production is thus still considered key, in many LMICs, to meeting future demand for important food types like LDF, as well as for attaining other objectives for rural development (IFAD, 2010).

Studies such as Herrero et al. (2014) identified investments to increase livestock productivity and production in LMICs as strategic for sector development. Intervention programs such as those that promote increased milk and egg production, may be particularly favored in poorer countries, as smallholder producers can consume part of what they produce without the need to slaughter or sell a large animal (Kryger et al., 2010). However, a key question remains as to whether smallholder producers, who will be the primary targets of such pro-poor livestock sector development strategies, can compete effectively against industrial livestock producers. It is not even known if smallholders will at all remain relevant to countries' food production in the future (Collier and Dercon, 2014).

3. Framework to assess contributions of LDF to food supply: an eight-country study

The analyses in this paper has two parts, I) economic modeling of the global food and agricultural system, to generate baseline data on food supply consistent with FAO national statistics for 2010 as well as scenario projections of the same indicators in 2050; and II) assessment of household level data from the Demographic Health Surveys (DHS) to understand patterns of livestock ownership across wealth distributions, and the consumption of LDF among children in livestock-owning households. Eight countries are included in the study, namely Burkina Faso, Ethiopia, India, Kenya, Nicaragua, Tanzania, Uganda and Vietnam, representing a range of population, income, urbanization and economic growth levels (Table 1). National statistics show that protein supplies from LDF in the study countries ranged between 8 and 23 g per person per day (g/capita/day), somewhat below the global average of 27 g/capita/day, and well below the average of 60 g/capita/day in the European Union (year 2013) (FAO, 2015), presenting ample

Table 1
Population, income, urbanization and per capita protein supply from LDF in the study countries, year 2010.

	Population (millions)	Population in urban areas (%)	Urbanization growth rate (%)	GDP per capita (US dollars)	GDP, annual growth rate (%)	Proteins from LDF (g/pers/dy)
Burkina Faso	16	26	4.4	600	5.9	10.4
Ethiopia	88	17	1.8	360	8.5	8.8
India	1230	31	1.2	1320	7.1	10.2
Kenya	40	24	1.9	980	4.0	16.1
Nicaragua	5.7	57	0.5	1560	3.0	18.4
Tanzania	46	28	2.6	710	6.5	7.6
Uganda	33	15	2.0	590	7.00	8.9
Vietnam	87	30	2.5	1370	6.6	21.0

Source: Authors' collation using data from United Nations (2014), WorldBank (2016), and FAO (2017). Urbanization rate is average 2000–2010; GDP per capita is average 2009–2011. Other estimates are 2010.