DAIRY AND SOCIO-ECONOMIC DEVELOPMENT

What evidence does the data hold?

with the support of

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Preface

Transforming agriculture to be more sustainable is essential for achieving the Sustainable Development Goals (SDGs). In 2021, between 700 million and 830 million people faced hunger and almost 3.1 billion people could not afford a healthy diet (FAO *et al.*, 2022). At the same time, about 27 percent of the world's population is employed in agriculture, and agriculture occupies about 37 percent of the global land surface (FAO, 2022). Discussions around the sustainable transformation of agriculture, however, largely focus on its links with two global public goods: the environment, greenhouse gas emissions in particular, and human health, with an emphasis on pandemic risk. Myriad societal dimensions of agriculture are often neglected in such discussions. Yet, there is incontrovertible evidence that growth in agricultural productivity and transformation are prerequisite to economic development; potent instruments to reduce poverty, improve livelihoods, and improve food security; and support social development more generally (Barrett, 2011; Johnston & Mellor, 1961; Mellor, 2017; World Bank, 2007). Dairy production contributes close to 10 percent of agricultural value addition overall (FAOSTAT, 2023) so it is an important factor in this transformation of agricultural systems.

Under the auspices of the Global Agenda for Sustainable Livestock (GASL), the Food and Agriculture Organization of the United Nations (FAO), the International Farm Comparison Network (IFCN), the International Fund for Agricultural Development (IFAD) and the Global Dairy Platform (GDP) have joined forces to assess if, and how, the growth and transformation of the dairy cattle sector can contribute to achieving the 'people-centred' or 'social' SDGs: no poverty (SDG1), zero hunger (SDG2), healthy lives and wellbeing (SDG3), quality education (SDG4) and decent work and economic growth (SDG8). This report, based on an analysis of the performance of the dairy sectors in over 180 countries, provides new evidence that a sustainable transformation of the dairy sector can improve farmers' livelihoods, generate employment along dairy value chains, ensure the availability of affordably priced nutrients for consumers and improve governments' capacities to provide public goods and services. Societal benefits of dairy sector transformation are not necessarily linear; there are trade-offs along the way and the nature of such benefits will vary from place to place. However, there is little doubt that policies and investments that improve dairy sector sustainability and productivity can play an important role in achieving the social SDGs.

It is my hope that stakeholders representing other livestock sub-sectors will follow the example of the dairy sector to demonstrate how sustainable growth and transformation of livestock systems can improve people's livelihoods within and beyond livestock value chains, and contribute more broadly to society by helping to achieve the SDGs. ●

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Chair of the Global Agenda for Sustainable Livestock

Acknowledgements

Executive Summary

This report explores relationships between dairy sector development and several social indicators that are linked to milk and dairy from cattle. Country level indicators comprising 97 statistical variables were collected for 187 countries and territories in different world regions, with representatives from low, lower middle, upper middle, and high income economies. In a cross-sectional study with a base year of 2018, dairy sector development was approximated by average milk yield and indicators were selected that summarized aspects of dairy farmers' livelihoods, employment in milk processing plants, consumption of milk and dairy products, and benefits to governments.

The analysis showed a number of clear relationships, the most important of which can be summarized as follows.

- As national incomes grow, indicated by Gross Domestic Product (GDP), national dairy systems transform, shifting towards smaller numbers of holdings with larger herds of higher yielding cows.
- As average milk yields increase, which is indicative of dairy sector development,
  - a smaller proportion of the population lives on dairy farms and, those that do earn more income from the enterprise;
  - fewer people work on farms and more work in the dairy processing industry, and both enjoy higher incomes;
  - more milk is supplied per person, a greater proportion of people consume milk and the retail price of milk drops, both in absolute terms and in relation to average wages; and
  - more of the milk produced is channelled through formal markets, and potential tax revenues from both the production and sale of milk and dairy products increases.

These findings suggest that as dairy sectors develop there are considerable benefits to government revenues. Through these benefits the dairy sector can contribute to achieving the socially oriented Sustainable Development Goals (SDGs): no poverty (SDG1), zero hunger (SDG2), good health and well-being (SDG3), quality education (SDG4) and decent work and economic growth (SDG8). During the process of dairy sector transformation many farmers will move to other sectors as employees but for some this may be a trade-off to the benefits of sectoral transformation that needs to be managed. (see Box 2, page 13). Many jobs are created along the dairy value chain providing growing employment opportunities for the population.

If due care is not taken, the observed progression of dairy systems can be accompanied by negative externalities that would detract from the many societal benefits gained. For example, alternative employment opportunities must be created for those leaving the sector, and care must be taken to avoid environmental damage resulting from a concentration of production. It must be ensured that dairy sector development embraces all dimensions of sustainability.

This study has pulled together a substantial body of country level data on dairy cattle sector characteristics for most of the world's countries. In a detailed appendix, summaries of the dairy sector indicators are provided by wealth grouping, regional grouping and by dairy productivity (milk yield per cow per year) groupings. This comprehensive dataset is available for further investigations and will benefit from the collection and analysis of time series data for selected countries to get stronger evidence on the factors that drive the development of their dairy sectors and the direct impacts that dairy sector development has had on a range of social indicators. Further work might also explore the impact that dairy has on some social benefits for which data are less readily available, such as gender, youth, social cohesion, and education. ●

1.
Introduction

In the coming decades, population growth, urbanization, technological innovation and adoption, increased movement of people and goods, and climate change, will transform the world in which we live. Decision makers face so many uncertainties, and are pulled in so many directions, that prioritizing interventions and holding a straight course towards sustainable development becomes a daunting task indeed. In September 2015 the UN General Assembly adopted the 2030 Agenda for Sustainable Development to facilitate concerted action and investment to ensure a sustainable transformation of society by 2030. The 2030 Agenda is structured around 17 goals, the SDGs, including social (people-centred) goals, such as no poverty (SDG1), zero hunger (SDG2), healthy lives and wellbeing (SDG3), quality education (SDG4), gender equality (SDG5), and reduced inequality (SDG10); goals linked to environmental aspects of sustainability, such as affordable and clean energy (SDG7), responsible consumption and production (SDG12), climate action (SDG13), life below water (SDG14), and life on land (SDG15); and institutional goals, such as peace, justice and strong institutions (SDG16).

Action and investment in all social and productive sectors – including health, education, agriculture, industry and services – will play a role in achieving the 2030 Agenda. This report explores how the growth and transformation of the dairy sector can contribute to achieving the social goals of the 2030 Agenda. In the coming years, a growth in population from 8 billion today to 9.8 billion in 2050 as well as increased consumer purchasing power and urbanization will drive up demand for milk and dairy products. In response, global dairy production from cattle, currently contributing over 80 percent of milk production, is estimated to increase by about a quarter in the next 30 years, from 742 to over 913 million tonnes between 2020 and 2050 (FAO, 2023).

However, while there is knowledge and evidence on how to make the dairy sector more productive and sustainable (e.g. FAO, 2019; Peterson & Mitloehner, 2021) and significant investments are being made to ensure the sector contributes to achieving environment-related SDGs (e.g. DSF, 2013; GCF, 2022), there is no systematic evidence showing how the transformation of the sector will impact social SDGs. Yet, there are over 110 million farmers worldwide directly benefiting from dairy cattle farming, and the sector creates jobs and business opportunities along dairy value chains and provides nutritious milk and other dairy products to over 6 billion consumers (Dixit *et al.*, 2022; IFCN, 2023; Omore *et al.*, 2004; World Bank, 2023). Milk not only provides a variety of micronutrients essential for human development (FAO *et al.*, 2020; Murphy & Allen, 2003), but it provides these at a relatively low-cost (Chungchunlam *et al.*, 2020; Darmon & Drewnowski, 2015; Drewnowski, 2010; Hess *et al.*, 2019).

This report presents such systematic evidence, showing how the growth and transformation of the dairy cattle[1] sector can support the social SDGs. It relies on a dataset covering 187 countries and territories, including low, middle, and high income economies (Box 1, page 4). By identifying common patterns and trends across countries with different dairy production systems and value chains, the assessment allows us to appreciate the likely social impacts that growth and transformation of the

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[1] The narrative of this report focusses on dairy cattle. Globally, cattle dominate milk production (81 percent), with buffaloes (15 percent), small ruminants (3.5 percent) and camels (<0.5 percent) contributing less overall but making important contributions in some regions (FAOSTAT, 2023). For example, buffalo milk is almost as important as cattle milk in South Asia and accounts for about half of production. For this reason, estimates such as number of dairy animals or production include both cattle and buffaloes.

dairy cattle sector may bring about, and the possible trade-offs. As such, it can help policy makers and investors take informed decisions.

The next section (two) of the report presents a snapshot of the global dairy cattle sector, highlighting differences across countries at different levels of economic development. Sections three to five explore how sector development benefits dairy farmers and their families, contributes to employment generation, ensures a supply of nutritious food to families and consumers, and contributes to government revenue. Section six presents some conclusions. ●

Box 1. Data sources and dataset

To examine the contribution of the dairy cattle sector to the social SDGs, we created a dataset comprising 97 statistical variables for 187 countries and territories in different world regions, including those from low, lower middle, upper middle, and high income economies (World Bank, 2020).

The dataset includes country statistics on key characteristics of the dairy cattle sector – such as number of farms, average herd size, and milk yield – and statistics on SDG-related indicators associated with the dairy sector – such as dairy farm income, number of people employed on farms and in processing, consumers of dairy products and milk market price. All monetary values are expressed in United States dollar purchasing power parity, for 2018 (USD PPP, 2018), which allows consistent comparisons to be made. Data refer to 2018, the most recent year for which information was available for most variables. They were primarily sourced from publicly available datasets, including the World Bank Development Indicators dataset, FAOSTAT, ILOSTAT and the UNIDO Statistics Data Portal. Some data were also sourced from the IFCN dataset, which is not open access. As data were not available for all countries and variables, we used several imputation methodologies to fill gaps. The reader is referred to the appendix for details about data sources and imputation methodologies.

Figure 1. World countries by income group (2020)

Income groups
■ Low ■ Lower middle ■ Upper middle ■ High income group
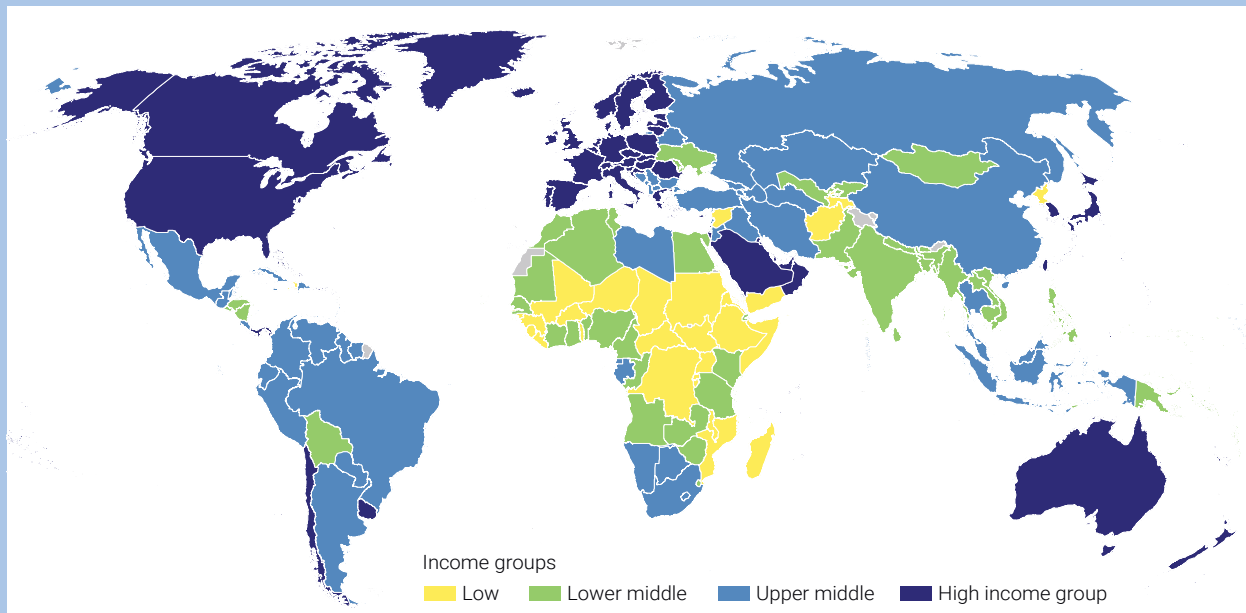
2.

The global
dairy cattle sector:
a bird's eye view

M ilk from cattle is the single most valuable agricultural commodity, with an annual production (in 2018) of around 811 billion litres. Milk and dairy products are heavily traded, with about 9 percent of the world's milk production traded, with an annual value of some 171 billion USD. Dairy production is carried out in a great diversity of production systems, reflecting different agroecological, cultural and socioeconomic contexts. Extensive dairy production occurs in pastoralist systems, in which milk is the main source of protein. Dairying is popular in labour-intensive systems, usually as part of a mixed farming system typified by the smallholder dairy producers of the East African highlands and South Asia. Dairy farming is also carried out increasingly in mechanized, capital-intensive systems.

Dairy cattle farms

There are over 110 million dairy cattle farms (with at least one dairy cow) worldwide (Table 1, see Box 2, page 13, for a broad description of the spectrum of farm types). Most dairy farms (93.5 million, or 83 percent) are concentrated in lower middle income countries and only 1.2 million (1 percent) in high-income countries. Dairy farming is popular in low and lower middle income countries, where there are about 238 and 106 dairy farms for every 10 000 people, respectively (Table 1). There are just 7.2 dairy cattle farms per 10 000 people in high income economies. Geographically, most dairy cattle farms are in South Asia (74 percent) while less than 1 percent are in North America. Central Asia boasts the highest density of dairy farms relative to the population (412 farms per 10 000 people), with North America having less than 2 per 10 000 people.

Table 1. Number of dairy cattle farms by country income group, 2018

Country income group	Million farms	%	No. farms/ 10 000 people
Low	10.2	9%	238.1
Lower middle	93.5	83%	105.9
Upper middle	7.2	6%	44.5
High	1.2	1%	7.2
World	**112**	**100%**	**32.4**

Table 2. Number of dairy cattle by country income group, 2018

Country income group	Million cattle	%	No. cattle/ 1 000 people
Low	47	14%	57.7
Lower middle	174	52%	35.2
Upper middle	70	21%	29.9
High	44	13%	28.1
World	**335**	**100%**	**32.2**

Dairy cattle

There are about 335 million dairy cattle worldwide (Table 2). The highest number of dairy cattle is found in lower middle (174 million) and upper middle (70 million) income countries, where there are about 35 and 30 head per 1 000 people, respectively. There are 47 and 44 million dairy cattle in low and high income countries, respectively, with about 58 and 28 dairy cattle per 1 000 people each (Table 2). Geographically, dairy cattle are mainly located in South Asia (136 million, 41 percent) and sub-Saharan Africa (63 million, 19 percent). North America and North Africa / Middle East are the regions with relatively few dairy cattle (about 10 million in both regions, 3 percent of world's total). Central Asia records the highest number of dairy cattle per capita (129 head per 1 000 people) while East Asia and the Pacific record the lowest 'density' of cattle per capita (3.3 head per 1 000 people).

Table 3. Farm median herd size by country income group, 2018

Country income group	Head per farm
Low	3.2
Lower middle	3.4
Upper middle	11.8
High	65.1
World	**13.0**

Herd size

Globally, the median herd size is 13 dairy cattle per farm (Table 3). The median herd size is 65 head in high income countries, 12 head in upper middle-income countries and about 3 in low and lower middle income countries. North America records the largest median herd size per farm (over 180 head), while South Asia and Central Asia have the smallest (between 2 and 3 head).

Table 4. Median milk yield by country income group, 2018

Country income group	Milk yield (kg/cow/year)
Low	421
Lower middle	1 200
Upper middle	1 776
High	6 346
World	**1 482**

Milk yield

The global median milk yield per cow is about 1 500 kg per year (Table 4). The highest yields are found in high income countries (6 346 kg per year) and the lowest in low income countries (421 kg per year). North America (7 358 kg per cow per year) has the highest median milk yield per cow, and sub-Saharan Africa the lowest (averaging 454 kg per cow per year).

Table 5. Median milk production
by country income group, 2018

Country income group	Million tonnes per year	%	Kg/person/year
Low	19	2	22
Lower middle	276	34	27
Upper middle	193	24	72
High	324	40	202
World	**811**	**100**	**55**

Table 6. Milk trade balance
by country income group, 2018

Country income group	Milk equivalent (million tonnes)
Low	-2.1
Lower middle	-11.9
Upper middle	-24.2
High	34.5
World	**–**

Milk production

The world produced about 811 million tonnes of milk in 2018 (Table 5). High income countries produced 324 million tonnes, accounting for 40 percent of global milk production. Lower middle income countries followed with 34 percent. Low income countries only contributed 19 percent to global milk production. South Asia and Europe contributed most to global milk production: 232 and 224 million tonnes, nearly a third of global production each. North America followed with 106 million tonnes (13 percent). Sub-Saharan Africa and Middle East / North Africa each accounted for only 3 percent of global milk production.

In per capita terms, the global median was some 55 kg of milk produced per person per year (Table 5). High income countries produce about 202 kg per person per year of milk and low income countries 22 kg per person per year. Per capita median milk production is highest in Central Asia (296 kg per person per year), North America (273 kg per person per year) and Europe (261 kg per person per year), and lowest in East Asia and the Pacific (5 kg per person per year) and sub-Saharan Africa (20 kg per person per year).

Milk trade

About 9 percent of the world's milk production is traded internationally, with most countries involved to some extent in trade. Dairy trade values about 171 billion USD per year. Liquid milk is expensive to transport in bulk over long distances as it is perishable and has a high volume to value ratio. The bulk of dairy trade, therefore, comprises processed dairy products, including cheese, skimmed milk powder (SMP), butter and, to a lesser extent, whole milk powder (WMP).

High income countries are net exporters of milk and dairy products, with a positive trade balance of 34.5 million tonnes of milk equivalent, while upper middle, lower middle and low income countries are, in aggregate, net importers of milk and dairy products. The five largest exporting countries (New Zealand, Germany, Netherlands, France and the United States) together account for over half of the milk exported, globally. Imports are less concentrated, with China and European Union countries being the largest milk importers. ●

3.

Growth and transformation of the dairy sector and economic development

As farms become more commercially oriented, improving milk yields shifts these beneficial impacts from the household level towards a population level, because the benefits of more affordable milk are available to all households.

The differences in the dairy sectors across low, lower middle, upper middle and high income countries suggest that, as economic development progresses, the dairy sector transforms. Clear trends are seen in several dairy sector characteristics moving from low to high income countries. The number of dairy farms per person, for example, went from 238 per 10 000 people in low income countries to 7.2 in high income countries (Table 1, page 7). The per capita number of dairy cows reduced while production increased, from 57.7 dairy cows per 1 000 people and 22 kg per capita in low income countries to 28.1 animals per 1 000 people and over 200 kg per capita in high income countries. Typical dairy median herd sizes were 65 head of cattle in high income economies but only 3.2 in low income countries (Table 3, page 8). Milk yields are 15 times greater in high income than in low income countries, and milk production per capita is 9 times higher. It is only the high income countries that are net exporters of milk and dairy products.

Box 2. Dairy sector growth and transition

Globally there is a great diversity in dairy systems. At one end of a spectrum there are many subsistence dairy farms, focusing on survival and covering the basic needs of the family (food and cash-flow). Subsistence farms have small numbers of low-yielding animals, perhaps 1 or 2 (Douphrate *et al.*, 2013). In these low-income situations the animals tend not to be specialized in dairy production but serve many additional roles such as beef production, providing a source of capital, transportation, draught power and manure (Douphrate *et al.*, 2013; Felis, 2020). This reflects the complex roles of animals as an integral part of a mixed farming household, and the diverse roles they play in household well-being (Otte *et al.*, 2012; Randolph *et al.*, 2007). At the other end of the spectrum are fully market-oriented dairy farms with large numbers of specialized dairy animals producing high milk yields entirely for sale. Such farm types are possible thanks to good access to natural resources, readily available services, and a stable market for the produce (Henriksen, 1995; van der Lee *et al.*, 2020).

These diverse systems contribute differently to delivering the 2030 agenda and its SDGs. Smaller subsistence farms focus on feeding the family, which addresses zero hunger (SDG2) and enhance health and wellbeing (SDG3) by providing nutritious milk to the family. Cash from selling any surplus contributes to reducing poverty (SDG1). Improving milk yields can have an immediate effect on family health and wellbeing (SDG3) and further contribute to zero hunger (SDG2). If dairy income increases this can strengthen progress towards no poverty (SDG1) and help towards quality education (SDG4). **As farms become more commercially oriented, improving milk yields shifts these beneficial impacts from the household level towards a population level, because the benefits of more affordable milk are available to all households.** In addition, progress towards other goals can be enhanced, as quality education (SDG4) and decent work and economic growth (SDG8).

Figure 2 of this report shows that as the wealth of countries increases (as indicated by per capita GDP) milk yields increase, herds become bigger, milk production (per capita) grows, and the number of farms drops sharply. More is produced from a

(Continued)

Box 2. Dairy sector growth and transition (continued)

smaller number of larger farms, and this represents a transition from many rural households producing milk – primarily for their own consumption but also for local sale – to a situation where the bulk of milk is bought and is produced commercially in more productive, specialized dairy farms. This is the transition from subsistence to market-oriented dairy farms. The driving forces underlying this transition are complex to unravel (Clay *et al.*, 2020) and available data do not allow for causes to be pinpointed directly, but the phenomenon can be observed in multi-country assessments such as the present study, and in time series assessments for individual countries (e.g., in a forthcoming report on the evolution of dairy systems in USA).

Several authours signal dairy development as mechanism for escaping poverty (FAO *et al.*, 2020; Heffernan, 2004; Kidoido and Korir, 2015; Omamo *et al.*, 2006). Many people in low and middle income countries are kept in subsistence farming by poor access to food, because of cost and availability, and a lack of employment opportunities (ILRI, 2003; Randolph *et al.*, 2007). Poor access to markets for small rural farms also restricts the amount of commercialisation, and therefore investment, that can take place on these farms (ILRI, 2003). As economies develop, industry, services and job opportunities grow, food becomes more abundant and affordable, and supplies become more reliable. Under such

changing conditions many will stop farming for better opportunities (Timmer, 1988). As food becomes more plentiful and people find jobs that are less demanding than farming and provide a better and more reliable income – not at risk from disruption by poor weather or disease – then they can afford to purchase food. Buffington and Reaves (1968), exploring why people in Virginia, USA, had left dairy farms, cited reasons such as finding a better job and escaping the long hours. Many leaving the sector had moved into the transportation and industrial sectors.

The phenomenon is reinforced as more people are fed from a more professional farming sector because this releases people to enter the labour force, allowing the economy to grow into industry and services, creating more job opportunities. Those that remain, or become dairy farmers, participate in a business that is increasingly lucrative as milk yields grow (Figure 4.b, page 23), and for others there are growing opportunities for gainful employment along the dairy value chain, in processing and service provision.

This transition is neither linear nor complete. At any point during it there remains a spectrum of farm types and sizes, which may also depend on characteristics, often spatial in nature, such as market access and agro-ecological conditions, as well as socio-economic, cultural, and historical factors. It is because of this that there remains such a rich diversity of dairy systems worldwide.

To better explore how the dairy sector transforms in line with economic development, charts are presented that correlate four important dimensions of the dairy sector with the level of economic development, approximated by Gross

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Domestic Product (GDP) per capita, for the study countries: (1) number of dairy farms per 10 000 people, which is a measure of the pervasiveness of the sector among the population; (2) the average farm herd size, which is a proxy for the concentration or intensification of the dairy sector; (3) milk yield per cow per year, with average productivity acting as a proxy for the level of development of the sector in a country; and (4) per capita milk production, which is an indication of the capacity of the dairy sector to contribute to food security and nutrition. The four charts suggest that, as economic development progresses, there is a transformation of the dairy sector characterized by: (1) a reduction in the relative number of dairy farms; (2) an increase in the average farm herd size; (3) an increase in milk yield; and (4) an increase in per capita milk production. ●

Figure 2. Selected dairy sector characteristics plotted against economic development
for 187 study countries in 2018

A. Number of dairy farms per 10 000 people
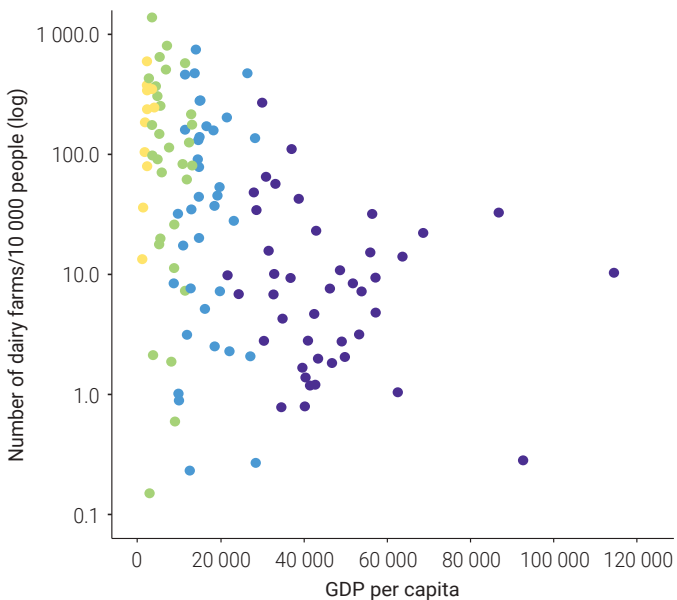
B. Average herd size
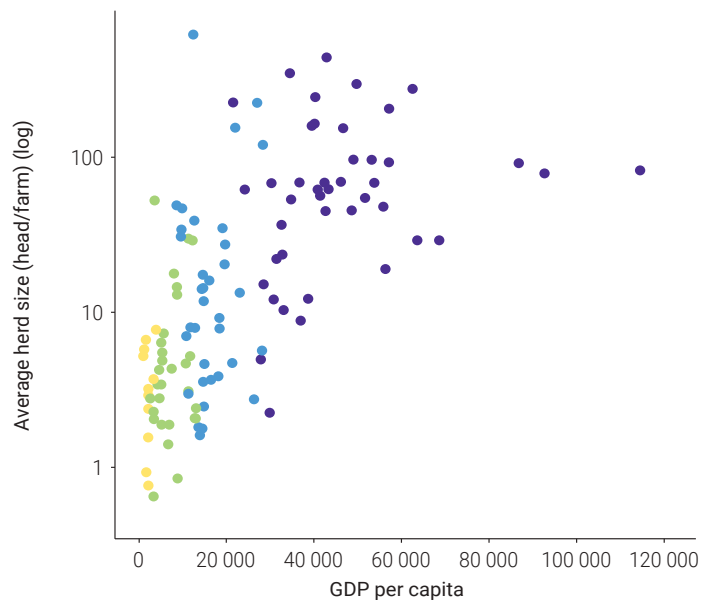
C. Milk yield
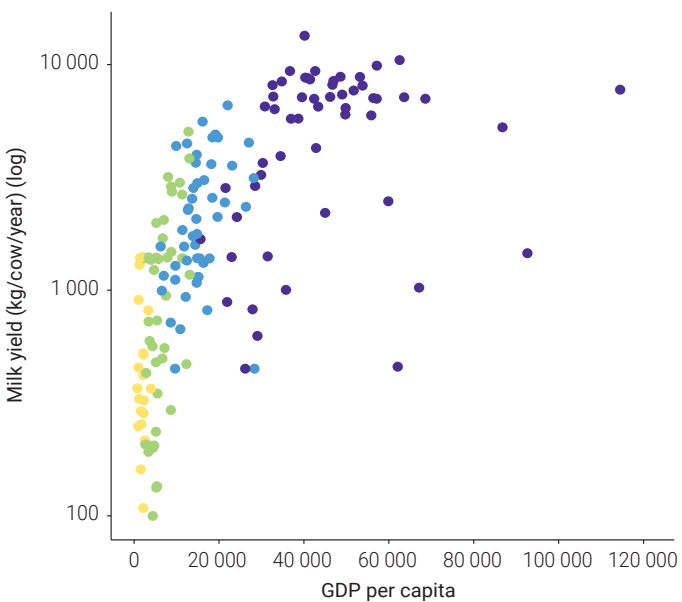
D. Per capita milk production
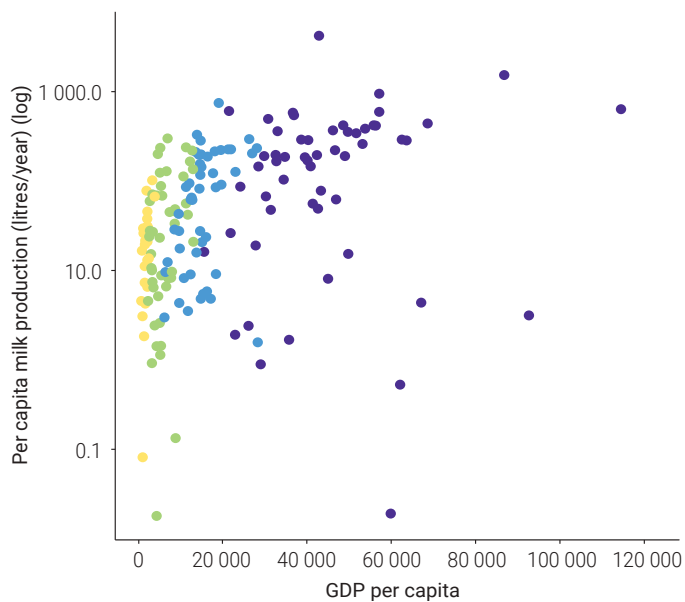
4.

Dairy sector development and its social implications

According to the OECD-FAO Agricultural Outlook 2022-2031 there are *"buoyant prospects for the dairy sector"*. [...]. "*As incomes and population increase, more dairy products are expected to be consumed over the medium term.* [...]. "*The key drivers for this are strong demand growth in India, Pakistan and Africa. In low and middle income countries, fresh dairy products comprise over two-thirds of the average per capita dairy consumption (milk solids), while consumers in high income countries tend toward processed products*" [...]. "*World milk production is projected to grow at 1.8 percent per annum over the next decade (to 1 060 Mt in 2031), faster than most other main agricultural commodities. The projected growth in the number of milk-producing animals is expected to be strong (1.1 percent per annum), especially in regions with low yields such as Sub-Saharan Africa and in major milk-producing countries such as India and Pakistan. Over the projection period, yields across the world are expected to grow steadily with the strongest growth expected in Southeast Asia and North Africa where average yield growth is around 2 percent per annum*" (OECD and FAO, 2022).

Any agricultural sector that grows and transforms will shape social development and influence the achievement of the social SDGs. As the dairy sector grows and transforms, input and output prices will change in absolute and relative terms, impacting the livelihoods of dairy farmers and their families; jobs for men or women will be created or lost, both on farms and along value chains, affecting livelihoods, gender equality and youth employment. The quantity, quality and affordability of milk and dairy products available for consumers will change, impacting on poverty levels, food security and health and wellbeing. Tax revenues from milk production and consumption will change, influencing governments' capacities to provide public goods and services. There will inevitably be losers and winners in the process of dairy sector growth and transformation. Decision-makers, both public and private, should be aware of the likely impacts of the growth and transformation of the dairy sector on the social SDGs. They should assess risks and trade-offs and formulate and implement policies and investments that steer the sector on a socially desirable development pathway.

This section investigates the likely social impacts of the anticipated growth and transformation of the dairy sector. To this end, we analyzed the relationship between milk yield per cow per year – a proxy for dairy sector development (Box 3, page 20) – and several socially relevant indicators for the 187 countries included in the study.

The 187 countries were ranked by milk yield and divided in quartiles as described in Table 7 (page 20) and shown in Figure 3 (page 21).

Milk yield is defined as the quantity of milk produced by a dairy cow in a year. Its determinants are the quantity and quality of production inputs – animal breed, diet and animal health, for example – and the efficiency of the production process, determined by the way farmers utilize and combine these production inputs within specific production systems. The latter is influenced by idiosyncratic factors, such as farm size, farmers' knowledge, education and health; and by broader environmental, institutional and economic factors, such as agroecological conditions, availability of extension services and infrastructure. Milk yield, therefore, broadly captures the micro, meso and macro factors that determine the level of development of the dairy sector. Of course, it does not fully reflect the heterogeneity of the dairy systems making up the sector, but this generally holds true for variables that summarize complex systems, such as the use of GDP per capita as a proxy for the level of development of a country. As well as being a variable for which estimates are available for most countries, milk yield per cow per year has a direct impact on social development: higher milk yields offer more potential benefits for the population, from farmers through businesses along the dairy value chain that transform and trade milk to consumers.

For each quartile of dairy producing countries, median values were estimated for selected social indicators in the domains of farm, employment, consumption and government. The median provides the best measure of central tendency given the underlying data distributions. To better appreciate the correlation between selected social indicators and milk yield, scatter plots were produced for each, based on data for the 187 countries included in the study.

By selecting social indicators linked to the farm, employment, consumption and government, a wide range of dairy stakeholders was included. For each domain, indicators were identified that were directly linked to the level of development of the dairy sector (e.g. number of dairy farmers or per capita supply of milk), and at the same time likely to support the achievement of social SDGs (e.g., no poverty, health and wellbeing, and decent work and economic growth). However, direct linkages between dairy sector development (milk yield) and the SDGs were avoided as it would be naïve to assume that, on its own, the development of the dairy sector could result in achieving any of the SDGs. Table 8 presents the list of socially relevant indicators that were considered.

The selected social indicators only capture a portion of the benefits that the dairy sector generates for society. Other potential benefits include empowerment of women, child nutrition, social cohesion in rural areas, conservation of biodiversity and genetic resources, preservation and maintenance of rural landscapes, among others. However, there are no cross-country datasets systematically capturing those and other social dimensions, and it would be difficult to assume that the dairy sector affects the level of those social indicators countrywide. Indeed, most studies that explore how the dairy sector benefits society are location and context-specific and, as such, of limited value for national studies. While this country-level analysis includes a limited set of indicators, it provides insights to decision-makers on the country-wide social benefits that the growth and transformation of the dairy sector can generate, as well as possible trade-offs.

Table 7. Country quartiles based on milk yield, 2018

Milk yield group	Milk yield (kg/cow/year)		
	Low cut-off	High cut-off	Median value
Low yield	100	774	376
Lower middle yield	775	1 482	1 239
Upper middle yield	1 483	4 126	2 574
High yield	4 127	13 412	7 106

Figure 3. World countries by milk yield per cow per year group

Milk yeld (kg/cow/year)

99.9 774 1 482   4 126   13 410
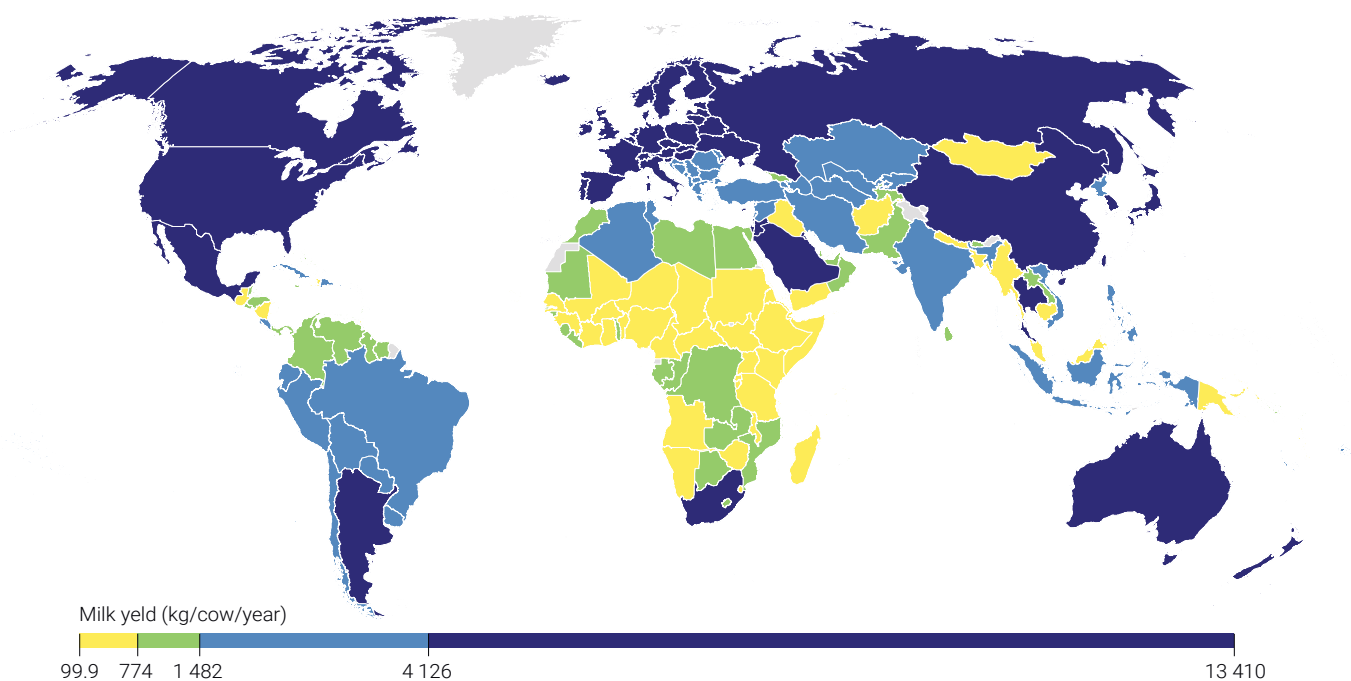
Table 8. Socially relevant dairy sector indicators

Domain	Socially relevant indicators	Relationships with SDGs
Farm	No. of people living in dairy households	These indicators assess the extent to which dairy farming is pervasive among the population and contributes to livelihoods, thereby supporting the achievement of SDG1 (no poverty) and, indirectly, SDG2 (zero hunger), SDG3 (health and wellbeing), SDG4 (quality education) and SDG10 (reduced inequalities).
Farm	Share of people living in dairy households	
Farm	Dairy farm income (from milk sales)	
Farm	Per capita income of people living in dairy households	
Farm	Per capita income of people living in dairy households relative to the international poverty line	
Employment	No. of people employed in dairy farms	These indicators assess the extent to which the dairy sector generates employment opportunities for the population and further contributes to SDG1 (no poverty), SDG 8 (decent work and economic growth) and SDG10 (reduced inequalities).
Employment	No. of people informally employed in milk processing	
Employment	No. of people formally employed in milk processing facilities	
Employment	Average wage of employees in milk processing facilities	
Consumption	No. of consumers of milk and dairy products	These indicators assess the extent to which the dairy sector contributes to SDG2 (zero hunger) and, through ensuring affordably priced milk and dairy products, to SDG1 (no poverty), SDG3 (health and wellbeing), SDG4 (quality education), SDG8 (decent work and economic growth) and SDG 10 (reduced inequalities).
Consumption	Milk supply per capita	
Consumption	Share of population consuming milk and dairy products	
Consumption	Average retail price of 1 litre of milk	
Consumption	Share of daily income necessary to purchase one litre of milk	
Government	Cattle milk production value	These indicators provide insight on the contribution of the dairy sector to agricultural economic growth, which is essential to achieving no poverty (SDG1), and to the government tax base, which is necessary for the provision of public goods and services that create an enabling environment for achieving all the SDGs.
Government	Dairy cattle contribution to agricultural value added	
Government	Milk production tax per cow	
Government	Milk consumption tax per capita	

Box 4. Methodological explanation for curve fitting in Figures 4 to 7

Figures 4 to 7 show the relationships between selected, dairy-oriented social indicators with national milk yields (per cow per year, throughout this box), as an indicator of the level of development of the dairy sector in a country (Box 3, page 20).

As national incomes (GDP) strengthen, dairy sectors develop and milk yields generally increase (Figure 2.c, page 15). However, **milk yields from countries within a particular income range are quite variable** (as shown by the scatter within each wealth grouping in Figure 2.c) **as they are also dependent on agroecological, historical, socioeconomic and cultural factors, which determine the diversity of dairy production systems that prevail.** Within certain constraints, therefore, milk yields in each country can be expected to grow as the sector develops up to a level determined by the prevailing environment. Growth in milk yields with increasing wealth is particularly strong at the lower end of the

milk yield/GDP spectrum – where small increases in milk yields are associated with larger increase in wealth.

The inferences in this report are based largely on observed country-level relationships between selected socially related variables and milk yield, as a proxy for sector development (Figures 4 to 7). To better depict these relationships, we use a 'local regression' curve fitting approach, LOESS (LOcally WEighted Scatter-plot Smoother), which helps reveal the shape of the relationship. LOESS is a non-parametric descriptive technique, originally described by Cleveland (1979), further developed by Cleveland and Devlin (1988) and adapted to the social sciences by Jacoby (2000). LOESS makes no assumptions about the underlying form of a relationship, but rather fits a local regression to reveal the structure within the data. In Figures 4 to 7 the LOESS curves are shown along with their 95 percent confidence intervals.

Milk yields from countries within a particular income range are quite variable (as shown by the scatter within each wealth grouping in Figure 2.c) as they are also dependent on agroecological, historical, socioeconomic and cultural factors, which determine the diversity of dairy production systems that prevail.

Box 5. Socially relevant dairy farm indicators

The variable 'number of people in the farm household' includes dairy farmers and their family members. It does not include on-farm employees.

The 'share of people living in dairy cattle farm households' is the number of people living in dairy farm households per 1 000 people. It gives insight on the pervasiveness of dairy farming in a country.

The indicator 'dairy farm income' is an estimate of farm income revenue from the sale of milk, net of production costs. This likely underestimates dairy farm income as it does not account for the sale of calves and older females.

The indicator 'income of people living in dairy farm households' is estimated by dividing the farm income by the number of people living in dairy farm households. It is likely to underestimate the real per-capita income because of economies of scale at family level.

The indicator 'income in relation to the poverty line' is measured by dividing the per capita income of people living in dairy farm households by the international poverty line (USD 2.15 per person per day).

Worldwide, over half a billion people, more than 7.5 percent of the world's population, live on dairy cattle farms. This number grows considerably if other dairy species are included (see footnote 1). The vast majority of dairy farmers and their families live above national poverty lines, covering their most basic needs in terms of nutrition and income. However, as the dairy sector grows and transforms, many farmers move into other sectors, with those remaining in dairy becoming increasingly better-off.

Dairy sector development and farmer livelihoods

This section investigates how the development of the dairy sector affects people's livelihoods at farm level. This includes all people in the farm household, i.e., the farm owner and family. The analysis considers how it influences the (1) absolute and (2) relative numbers of people living on dairy farms; (3) farm income; and (4) livelihoods.

Globally, about 572 million people lived in dairy farm households in 2018 – 7.5 percent of world's population at that time. Ninety-four percent lived in countries with low and lower middle milk yields, while only 6 percent lived in high yield countries. About 11 in every thousand people live in dairy farm households worldwide. Dairy farm households are most pervasive among the population in low milk yield and lower middle milk yield countries (63 and 39 people per thousand, respectively) and less so in high milk yield dairy producing countries (1.7 people per thousand).

Dairy contributes between USD 138 and USD 11 614 to the annual income of people living on dairy cattle farms. However, while milk production suffices to maintain a family out of poverty in upper middle and high milk yield countries, in low and lower middle milk yield countries it might help feed the family, but dairy farmers should rely on multiple sources of income to avoid poverty (e.g., from calf sales, mixed farming or other enterprises). In such situations, milk sales can provide a regular stream of cash that is highly appreciated by farming households (Geng *et al.*, 2017).

Figure 4 (page 24) portrays the correlation between a) the share of people living in dairy farm households and b) income per person relative to the international poverty line, and milk yield (referring to yield per cow per year here and throughout this section) for the 187 countries in the study. It shows a negative correlation between milk yield and the pervasiveness of dairy farming and a positive correlation between milk yield and income level. Farmers in countries with higher milk yields enjoy higher incomes relative to the international poverty line and, therefore, improved livelihoods and resilience to shocks.

Table 9. Number and share of people living in dairy farm households in 2018

Milk yield group	Million people	Share (per 1 000) people
Low yield	121.8 (21%)	62.5
Lower middle yield	75.7 (13%)	38.7
Upper middle yield	341.6 (60%)	32.4
High yield	31.5 (6%)	1.7
World	**571.6 (100%)**	**11.0**

Table 10. Dairy income per family member and income relative to the international poverty line among people depending on dairy farming in 2018

Milk yield group	Annual income of people living on dairy farms (USD PPP)	Income/poverty line (2.15 USD PPP)
Low yield	138	0.2
Lower middle yield	433	0.6
Upper middle yield	840	1.1
High yield	11 614	14.4
World	**1 470**	**1.8**

Figure 4. Selected livelihood indicators plotted against milk yield in 2018 for the study countries. LOESS curves have been fitted to the scatter plot, with 95 percent confidence intervals (see Box 4 for more information)

A. Share of people living in dairy farm households
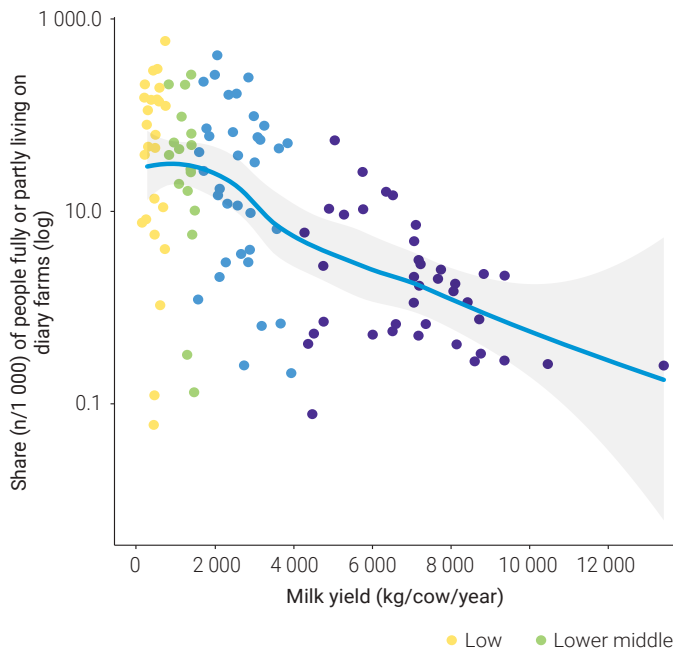
B. Dairy-farm income per family member in relation to the international poverty line

● Low ● Lower middle ● Upper middle ● High milk yield
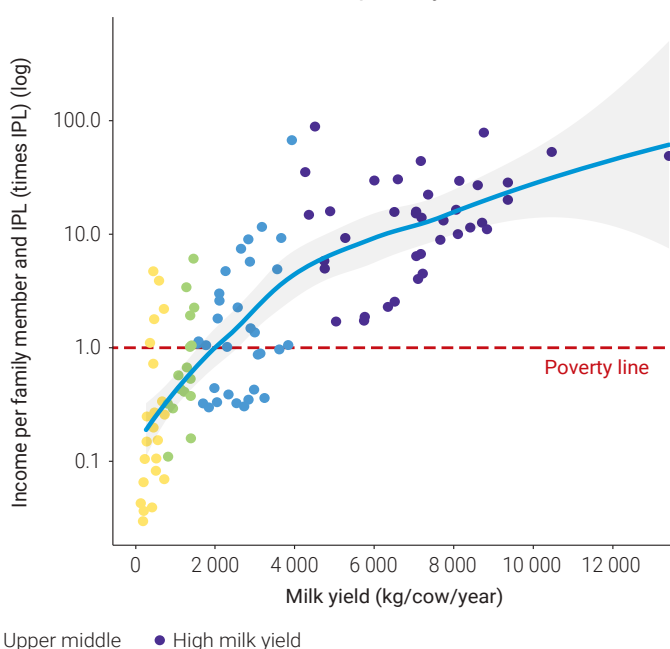
Dairy sector development and employment

The dairy sector creates jobs both on farm, and upstream and downstream of milk production. This section investigates how the dairy sector creates jobs at farm level and in milk processing facilities, and so contributes to support livelihoods, strengthen food security and provide decent work. It correlates milk yield with: (1) the number and (2) share of people working on dairy farms; (3) the number of people employed in milk processing facilities; and (4) their average wage.

Of the 35.2 million people working on dairy farms, approximately 33.5 million (95 percent) are in low, lower middle and upper middle milk yield countries and 1.7 million (5 percent) are in high milk yield countries. In low, lower middle and upper middle milk yield producing countries 3-4 people in every 1 000 raise dairy animals, but only one in every 1 000 does so in high milk yield countries. Labour productivity is higher in high milk yield countries (1.4 full time workers per tonne of milk produced per day) than in upper middle, lower middle and low milk producing countries (where it takes between 10 and 39 full time workers to produce one tonne of milk in a day).

Globally in 2018, 35.2 million people worked on dairy farms and 6.6 million in milk processing facilities, accounting together for 0.6 percent of the world's population. Seventy percent of those working in dairy farms live in upper middle milk yield countries, which also account for 51 percent of all employment in dairy processing facilities. The development of the dairy sector is characterized by a shift in employment from dairy farms to jobs in milk processing facilities.

The picture is quite different for employment in milk processing facilities (Table 12). There are about 6.6 million people worldwide working in milk processing facilities. About 4.4 million (66.5 percent) of these live in low, lower middle and upper middle milk yield countries, and 2.2 million (33 percent) are from high milk yield countries. Labour 'density' in processing is greater in high and upper middle milk yield countries (each with 1 person per 1 000) than in lower middle and low milk yield dairy producing ones (0.4 and 0.3 people per 1 000, respectively). Processing facilities in high and

The number of people working on dairy farms is measured in full-time equivalent (2 500 working hours per year) and includes both family members and employed labour.

The share of people working on dairy farms (per 1 000 people) is an indication of the capacity of the dairy sector to contribute to employment.

People employed per tonne of milk produced is an inverse indication of on-farm labour productivity.

Number of people employed in milk processing facilities, either formally or informally. This indicator does not capture all employment along dairy value chains – for example jobs created downstream in transport and retailing, or upstream in feed production and animal health service provision – but is the only indicator for which consistent data was available.

Share of people formally and informally employed in milk processing facilities. This indicator helps assess the extent to which the dairy sector supports decent work, assuming that the formal sector pays a fair income, ensures safe working conditions and ensures equal treatment for men and women.

Wage is the reported wage (USD PPP) of people employed in milk processing facilities.

Table 11. Number, share, and productivity of people working in dairy farms in 2018

Milk yield group	Million people	People working in dairy farms/1 000 people	Full-time workers/tonnes of milk produced
Low yield	4.5 (13%)	3.4	38.6
Lower middle yield	4.7 (13%)	3.2	26.0
Upper middle yield	24.3 (69%)	3.8	10.8
High yield	1.7 (5%)	1.0	1.4
World	**35.2 (100%)**	**2.0**	**8.0**

Table 12. Number of people employed in milk processing plants, formally and informally, and their median wages of formal employees

Milk yield group	Million people	Employees/1 000 people	People/tonne of milk processed per day	Formal employment (%)	Informal employment (%)	Employee's wage (USD PPP/year)
Low milk yield	0.5 (7.8%)	0.3	28.5	12.7	87.3	9 774
Lower middle yield	0.5 (7.5%)	0.4	15.8	20.0	80.0	12 859
Upper middle yield	3.4 (51.3%)	1	4.4	18.3	81.7	15 646
High yield	2.2 (33.3%)	1	1.6	59.9	40.1	44 455
World	**6.6 (100%)**	**0.7**	**3.9**	**32.0**	**68.0**	**24 158**

upper middle milk yield countries use capital intensive technologies: they employ 1.6 and 4.4 people per tonne of milk processed, respectively. Conversely, processing is more labour-intensive in low and lower middle milk yield counties, where there are 29 and 16 employees per tonne of milk processed, respectively. This explains, in part, the different wages earned by employees in processing facilities across the different milk yield groups of countries. In high yielding countries, employees earn 3 to 4.5 times more than their peers in less productive countries and most of them (60 percent) are formally employed.

Figure 5 (page 26) present scatter plots of the number of people working on dairy farms per 1 000 people and per tonne of milk produced and how employment and income in dairy processing facilities varies as country-level milk yields change. It suggests that the higher the milk yield, the lower the number of people working on dairy farms. This could be explained by the use of high-yielding

breeds and adoption of labour-saving technologies associated with dairy sector development, such as automatic cattle feeders and milking robots. The figure also shows that, as milk yields rise, more people are engaged in milk processing facilities where they increasingly earn a larger wage.

Figure 5. Selected employment related dairy sector indicators plotted against milk yield in 2018 for the study countries. LOESS curves have been fitted to the scatter plot, with 95 percent confidence intervals (see Box 4 for more information)

A. Share of people employed in dairy farms
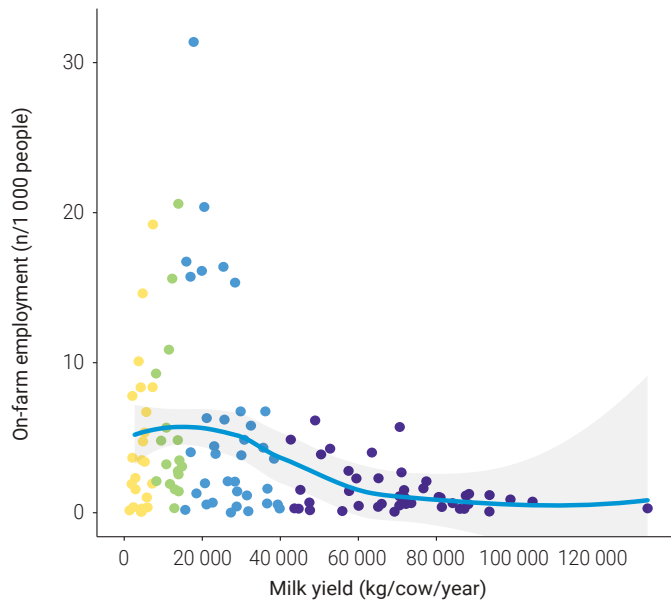
B. Number of people employed in dairy farms per tonne of milk produced
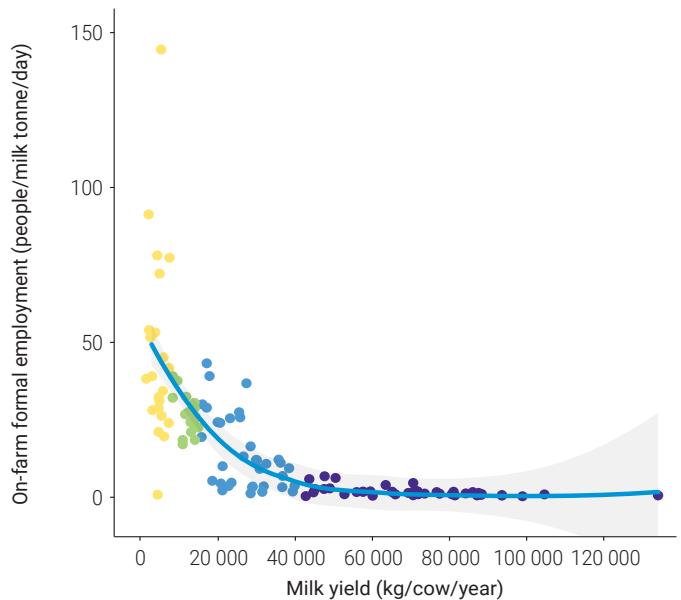
C. Formal employment in milk processing facilities
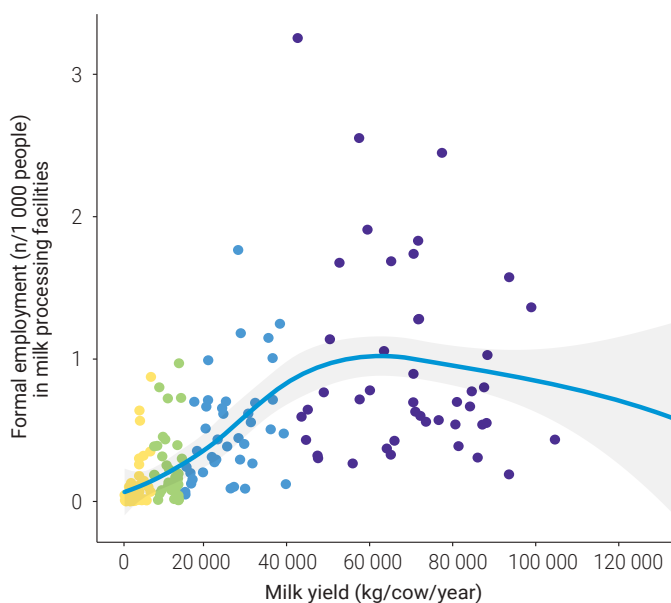
D. Employees' wages in milk processing facilities
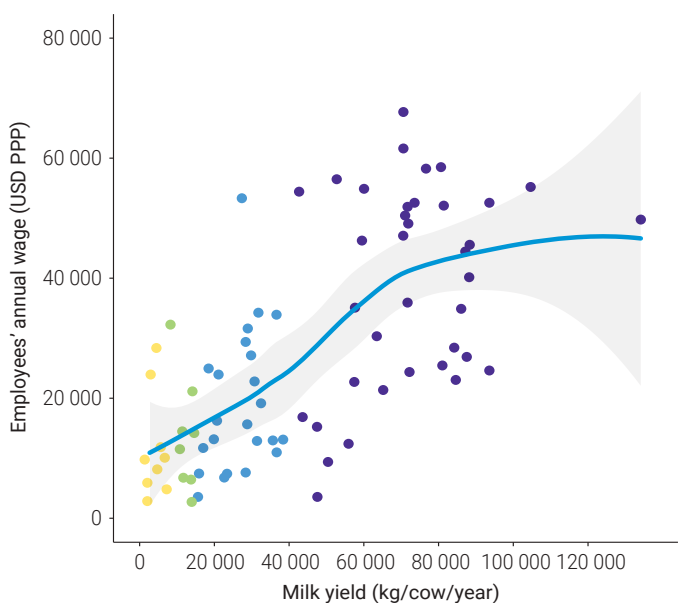
Low   Lower middle   Upper middle   High milk yield

Dairy sector development and consumption of milk and dairy products

Milk is rich in nutrients and contributes to meeting the body's needs for calcium, magnesium, selenium, riboflavin, vitamin B12 and vitamin B5. Indeed, the dietary guidelines of most countries recommend consumption of an adequate amount of milk and dairy products (FAO, 2023). This section investigates how the consumption of milk and dairy products corresponds to the development of the dairy sector, as approximate by average milk yield (per cow per year), by correlating the following variables with milk yields: (1) the number and share of people consuming milk and dairy products; (2) per capita availability of milk; and (3) affordability of milk, as measured by the price of one litre of milk and the share of daily income needed to purchase a litre of milk.

Of a global population of 7.66 billion in 2018, some 6 billion consumed milk and dairy products in 2018; more than 3 quarters of the world's population (Table 13). Nearly half of them (2.9 billion) lived in high milk yield countries, where about 98 percent of the population regularly consume milk and dairy products. The proportions of dairy consumers are much smaller in low yield countries (57 percent; 664 million people) and lower middle yield countries

About 80 percent of the world's population – some 6 billion people – regularly consume milk and dairy products. The numbers and shares of people consuming dairy products are higher in high milk yield countries than in low milk yield countries. Milk is 70 percent more expensive in low milk yield countries than it is in high milk yield countries (in comparable intl.USD).

(82 percent; 512 million people). In high milk yield countries, per capita milk supply is 242 litre per day, and one litre of milk costs USD 1.7. Conversely, in low milk yield countries, there is a low per capita supply (22.7 l per person per year) and a higher milk price of USD 2.7 per litre. Compounded by differences in income, consumers in high and low milk yielding countries need to spend, respectively, 1.5 and 21 percent of their daily income to purchase one litre of milk.

Figure 6 (page 28) presents several consumption-related variables plotted against milk yield (per cow per year): milk supply per capita; share of the population consuming dairy products; real price of one litre of milk for consumers; and share of daily income necessary to purchase one litre of milk. It suggests that the more the dairy sector develops, as implied by higher milk yields, the greater the

Table 13. Supply, consumption and affordability of milk

Milk yield group	Million consumers	Supply per capita year	Consumers/ population (%)	USD PPP of one litre of milk	% of daily income to purchase one litre of milk
Low yield	664 (11.1%)	22.7	56.5	2.8	21.0
Lower middle yield	512 (8.6%)	39.9	81.8	3.1	8.6
Upper middle yield	1 900 (31.9%)	133	89.9	2.3	4.9
High yield	2 875 (48.2%)	242	97.5	1.7	1.5
World	**5 960 (100%)**	**61.2**	**87.0**	**2.3**	**3.8**

Box 7. Socially relevant dairy consumption indicators

Milk supply per capita per year is the amount of milk potentially available to each consumer. Supply includes production and net trade.

The number of consumers of milk and dairy products and the share of people consuming milk and dairy products regularly (at least once per

week), provide an indication of the importance of milk and dairy products in the national diet.

The real price, in USD PPP, of one litre of milk and the share of personal daily income necessary to purchase one litre of milk provide an indication of the affordability of dairy products for consumers.

benefits for consumers. In particular, the lower prices that consumers pay for milk as the sector develops suggest that increased milk yield contributes to making the cost of a healthy diet more affordable: as supply increases, the price comes down and more people include milk and dairy products in their diets.

Figure 6. Selected milk and dairy product consumption related indicators plotted against milk yield in 2018 for the study countries. LOESS curves have been fitted to the scatter plot, with 95 percent confidence intervals (see Box 4 for more information)


A. Milk supply per capita
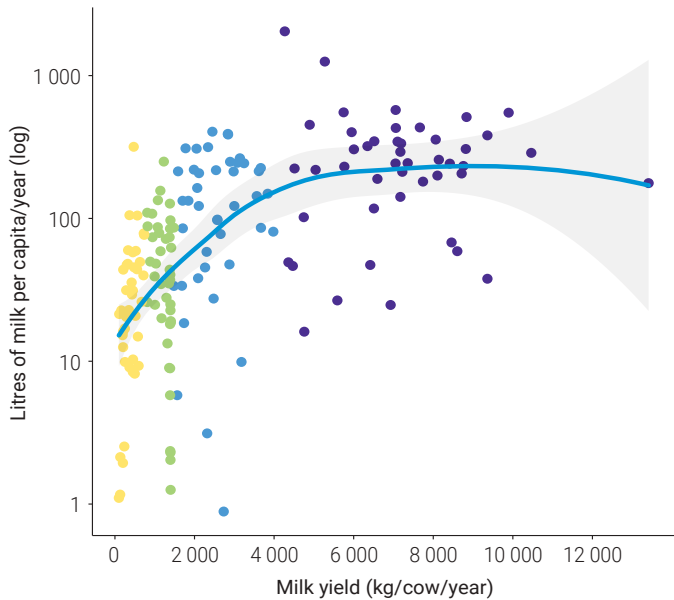
B. Share of people consuming dairy products
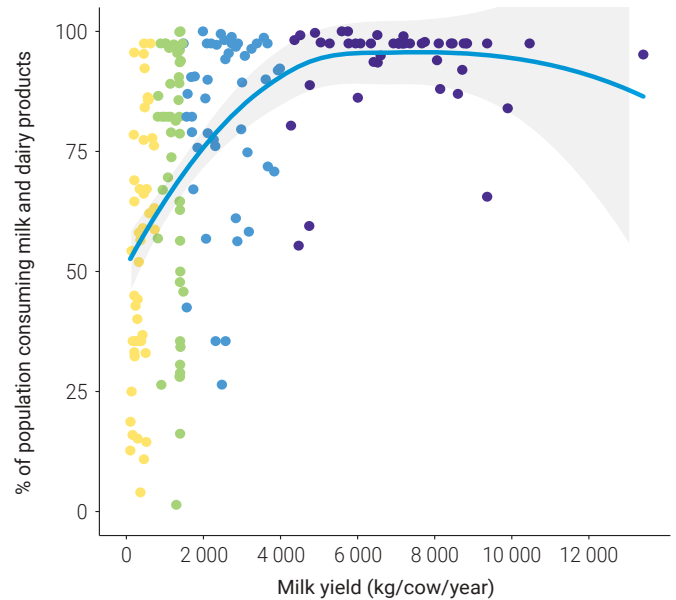
C. Milk price
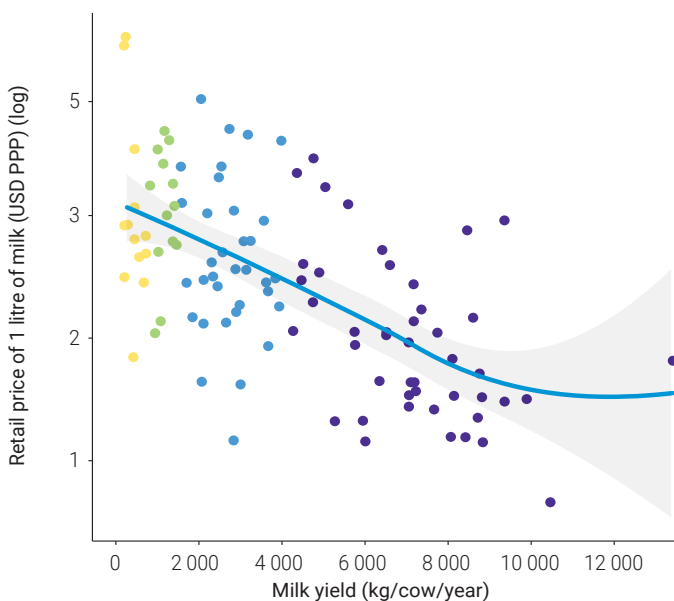
D. Share of income needed to purchase one litre of milk
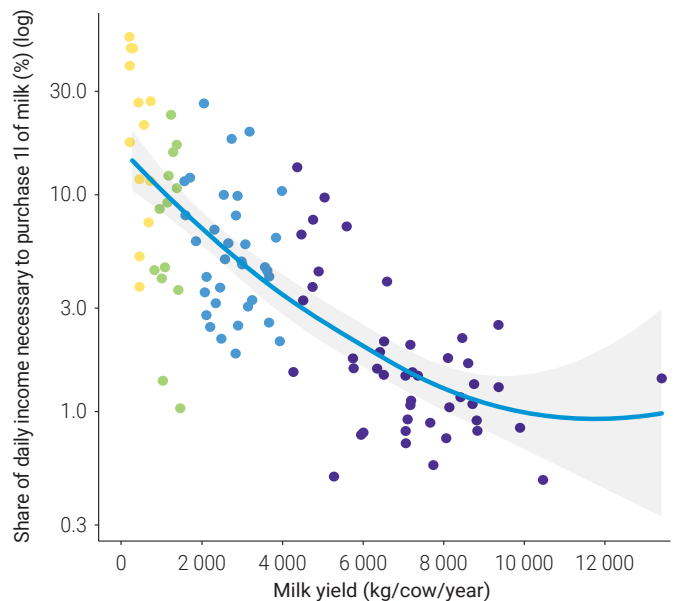
● Low ● Lower middle ● Upper middle ● High milk yield

Dairy sector development and governments' benefits

Demands on government are always pressing and public budgets often under strain. Any additional resource that governments can tap into to improve the delivery of public goods and services is essential in making progress on complex challenges, such as achieving the SDGs. This section investigates how the growth and transformation of the dairy sector improves the overall capacity of the government to deliver, by looking first at the contribution of the dairy sector to agricultural value addition, which is a key determinant of poverty reduction (FAO *et al.*, 2018), and then at the potential tax revenues from production (income) and consumption (sales) of milk and dairy products.

The value of global milk production was over USD PPP 350 billion in 2018, with high milk yield producing dairy countries making up half of that. The dairy sector contributes more to agricultural value added in high than in low milk yielding countries. Consequently, governments in high dairy producing countries can potentially generate between 50 and 90 times more revenue from taxing dairy production (income) and consumption (sales) than governments in low milk yielding countries.

The global value of milk production was over USD 350 billion (PPP 2018), which was largely contributed to by high milk yield (50 percent) and upper middle milk yield (38 percent) countries (Table 14). Low milk yield countries contributed only about 3 percent to the global value of milk production. As dairy sectors develop, their contribution to agricultural value addition increases, from 2.4 percent in low milk yield countries to 17.8 percent in countries with high milk yields, suggesting that as countries become wealthier their dairy sector grows

Table 14. The value of milk production in absolute and relative terms, and tax bases from production and consumption in 2018

Milk yield group	Milk production value (billion USD PPP 2018)	Share (%) of milk production value in agricultural production value	Production (income) tax base/farm/year (USD PPP 2018)	Consumption (sales) tax base/person/year (USD PPP 2018)	Milk trade balance (million tonnes milk equivalent)
Low yield	12.0 (3.4%)	2.4	73	6.0	-7.98
Lower middle yield	30.9 (8.8%)	3.3	211	64.1	-7.13
Upper middle yield	133.3 (37.8%)	7.9	821	145.2	-13.1
High yield	176.4 (50.0%)	17.8	18 083	292.7	25.6
World	**352.6 (100%)**	**6.4**	**1 099**	**148.6**	**–**

Box 8. Government-related dairy sector indicators

Milk production value is measured by multiplying gross production by output price (USD PPP 2018) at farm gate. Since production costs (e.g., feed and animal drugs) are not considered, the value of milk is estimated for gross production.

The percentage contribution of the dairy sector to the value of agriculture production is an indication of the importance of the dairy sector in agriculture.

Production tax per farm shows the potential tax base (income) from milk production per dairy farm.

Consumption tax per capita shows potential tax base (sales) from per capita milk consumption.

Milk trade balance is the difference between exports and imports of milk and dairy products. It is measured in milk equivalent.

Figure 7. Selected government related dairy sector indicators plotted against milk yield in 2018 for the study countries. LOESS curves have been fitted to the scatter plot, with 95 percent confidence intervals (see Box 4 for more information)

A. Share of milk production in agricultural production value
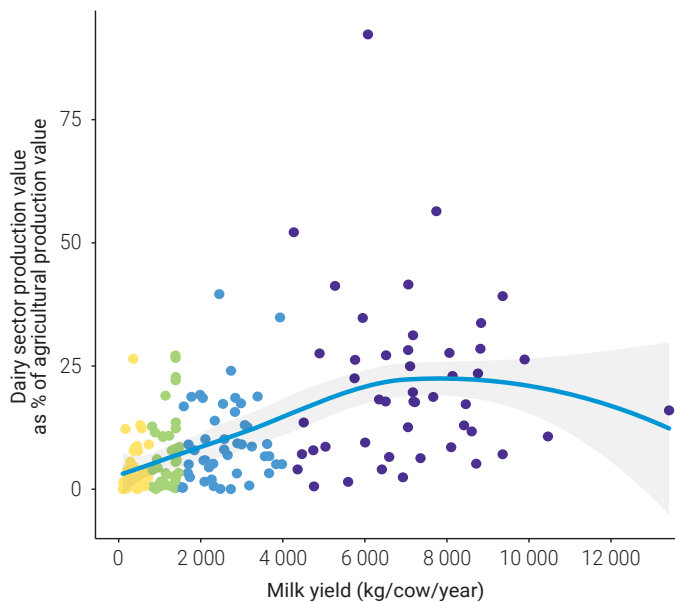
B. Tax base from production (income) of milk and dairy products, per farm
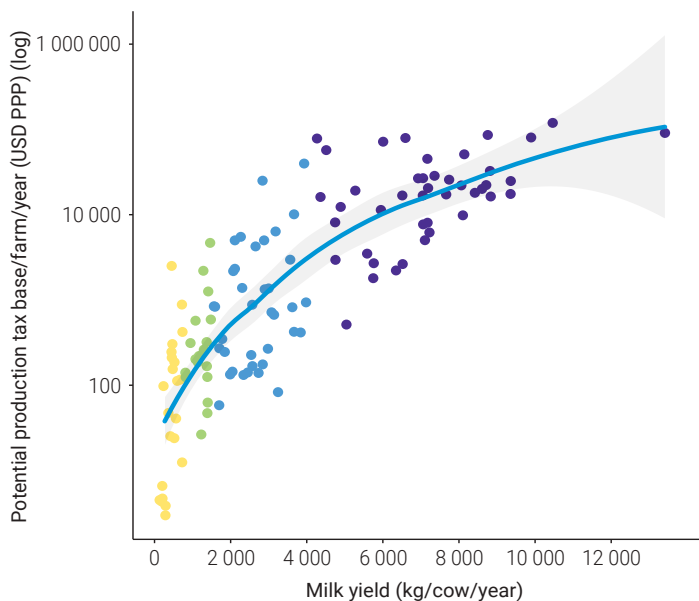
C. Tax base from milk consumption (sales) per capita
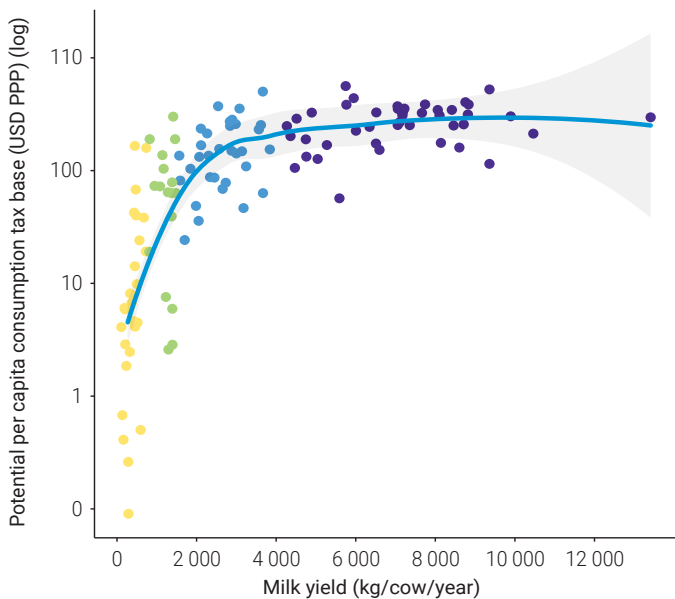
D. Proportion of milk channelled through formal markets
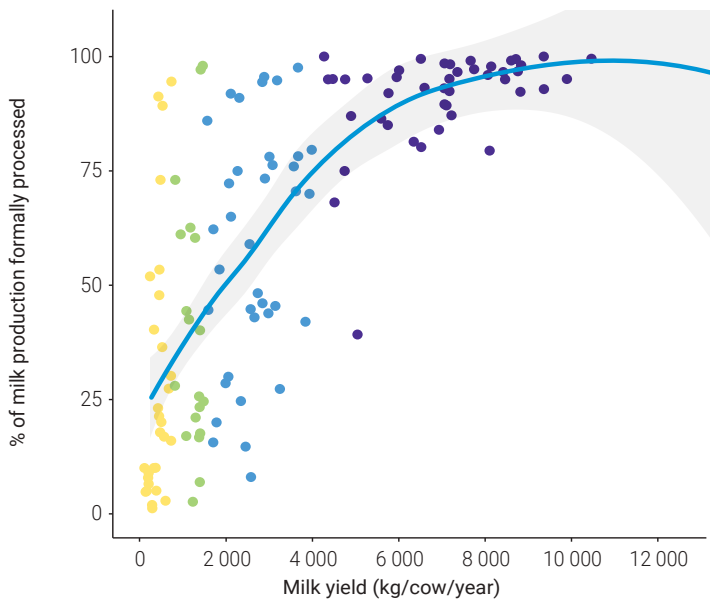
● Low ● Lower middle ● Upper middle ● High milk yield

faster than agriculture as a whole. The tax bases from the dairy sector are 250 and 50 times higher, at production and consumption levels respectively, in high than in low milk yield countries. This large increase in potential tax revenues comes not only from increased production and consumption of milk and dairy products, but also from a greater proportion of that being channelled through formal markets. High milk yielding countries tend to be net exporters of milk and dairy products while upper middle, lower middle and low milk yield producing countries tend to be net importers.

Figure 7 presents several government related indicators plotted against milk yield for the study countries: the contribution of milk production to the value of agriculture overall; tax bases from production and consumption; and the share of milk production channelled through formal markets. The observed trends suggest the development of the dairy sector contributes considerably to agricultural growth and enhances the capacities of governments to provide the public goods and services that will be necessary to achieve the SDGs. ●

5.
The social implications of dairy sector growth and transformation: a snapshot

Decision-makers have a role to play in steering the transformation of the dairy sector towards a preferred structure that best matches agroecological conditions and accounts for socioeconomic and cultural factors.

I n the previous sections we explored how dairy sector development, as approximated by average national milk yield, relates to farm livelihoods, employment along the value chain, consumption patterns, and the capacity of the governments to provide public goods and services. Whilst correlation does not imply causation, the strong correlations observed, the clear patterns and plausible explanations do provide a compelling story of how dairy sector development can contribute to achieving the social SDGs. The graphs derived from the 187 countries included in the cross-sectional study show the status of their dairy sectors in 2018, but the dairy sectors in the high yielding countries have been developing over many years to reach their current state. It is reasonable to assume that changes over time in the performance of the dairy sector in an individual country would reflect the patterns observed in the previous sections, and so be correlated similarly to the variables included in this analysis. Box 4 (page 22) explains that dairy sector performance will be constrained by exogenous factors, such as agroecological conditions, so the rate, pattern and extent of growth in performance will vary from country to country, and indeed within countries that are large and diverse. However, based on the patterns observed in Sections 3 and 4 we can expect certain changes to occur as the dairy sector develops in a country, particularly if it is starting from a low base. In this chapter we summarize the key findings by postulating the development of the dairy sector for a hypothetical country whose dairy sector transforms progressively from a low yielding to a higher yielding system, in aggregate.

As milk yields increase in line with sector development, we expect a dramatic reduction in the share of people living on dairy farms (Figure 4.a, page 24). The income generated on dairy farms increases considerably (Figure 4.b). There is also a dramatic reduction in the number of dairy farms and an increase in the average herd size (Table 16, page 45). However, there is considerable heterogeneity among high yielding dairy systems. For example, the average number of cows in dairy farms in the European Union is 21, but in the United States of America the average is almost 300; it is 30 cows in Switzerland and about 280 in Australia. This heterogeneity, due largely to different agroecological conditions and government policies, suggests that **decision-makers have a role to play in steering the transformation of the dairy sector towards a preferred structure that best matches agroecological conditions and accounts for socioeconomic and cultural factors.**

Sector development is expected to be associated with shifting employment from farm to processing facilities (Figure 5.a and Figure 5.c, page 26), and a considerable increase in wages for employees working in processing facilities (Figure 5.d) and dairy farm revenues.

Results evidence the role of dairy development in securing food access and food availability to a wider population (better nutrition at lower costs).

The growth and transformation of the dairy sector from a low yielding to a high yielding system (based on average yield per cow per year) corresponds also with a major increase in dairy consumption across the population, seen by the rising share of the population consuming milk and dairy products (Figure 6.b, page 28). This response is particularly strong as yields move from 1 000 to 4 000 kg per cow per year suggesting that considerable nutritional gains can be made at the lower end of the scale, where they are most needed. This may be in response to growing per capita supply as the sector develops (Figure 6.a), and a reduction in retail prices for milk and dairy products (Figure 6.c). At low yields (about 1 000 kg per cow per year), per capita supply is about 20 litres of milk per year and just over half of the population regularly consume milk and dairy products. Conversely, as milk yields increase to around 6 000 kg per cow per day, per capita milk supply exceeds 240 litres per year, and more than 90 percent of the population regularly consume milk and dairy products. These **results evidence the role of dairy development in securing food access and food availability to a wider population (better nutrition at lower costs).**

Increased milk productivity, associated with the growth and transformation of the dairy sector, eventually translates also into increasing potential tax revenues for governments, both in terms of income tax (production – Figure 7.b, page 30) and sales tax (consumption – Figure 7.c). These growing potential revenue streams are associated with a greater proportion of milk being channelled through formal markets (Figure 7.d). ●

6.

Discussion and conclusions

Society is expected largely to benefit from the development of the dairy sector, whose growth and transformation can contribute considerably to achieving the 2030 Agenda for Sustainable Development.

I n September 2015, the UN General Assembly (UNGA) adopted the 2030 Agenda for Sustainable Development at a summit of heads of State and Government with the objective to forge a sustainable pathway for people and the planet. The 17 SDGs, which summarize the overarching ambition of the 2030 Agenda, include people-centred, sustainability and institutional goals.

This report shows that the anticipated growth and transformation of the dairy sector can contribute to achieving the people-centred SDGs, including SDG1 (no poverty), SDG2 (zero hunger) and SDG8 (decent work and economic growth). It demonstrates positive correlations between increased milk yields and improved benefits for society: for farmers, employees and consumers, as well as for their governments.

Other reports have noted that, unlike many other types of farming, dairying provides a regular source of income (Douphrate *et al.*, 2013). This allows many groups to access cash regularly and accumulate capital, especially in the absence of formal banking facilities. Farmers sell more in local markets, in particular to buyers who pay cash immediately, at times when they are short of funds. In a study of smallholder dairy farms in Kenya, Geng *et al.* (2017) observed that households cope with health shocks by shifting the sale of milk from the cooperative to the local market, where payment is instant.

The growth and transformation of the dairy sector, however, will entail some potential trade-offs that need to be managed, particularly at the farm level. Based on patterns observed in countries with more advanced dairy sectors, there seems little doubt that some dairy farmers will move to other sectors in their transition to alternative employment and livelihoods (see Box 2, page 12) as the sectors develop in the lower yielding countries. It should be ensured that alternative employment opportunities are available for those who stop dairy farming. It is important that a transition to more formal marketing of milk and dairy products does not have detrimental effects on producers or processors – particularly those more marginalised and vulnerable. Environmental risks may arise from larger and more concentrated dairy herds, particularly pollution from manure management and fertilizer application. It is important that such risks are managed to avoid detrimental effects.

As dairy sectors develop, the reduction in numbers of dairy farmers is accompanied by an increase in income from those that remain and, as dairy farms get bigger, there is a shift in employment from farm to processing. This narrative is hardly surprising: the history of agricultural development is one of increased specialization and productivity. Not only is food security enhanced by the provision of affordable, good quality food for consumers, but a labour force is freed up to drive the development of the industrial and service sectors.

The transition of dairy systems does also come with challenges for dairy farmers, who are often in an economically vulnerable position as 'price takers' rather than 'price setters' (Douphraite *et al.*, 2013). The availability of local markets and labour are also frequent challenges, with most dairy farmers globally still being small-scale producers, with a weak and vulnerable position on the dairy market (Kardashian, 2012).

Evidence shows that sustainability in dairy transformation is possible (Engels & Jonker, 2022; Firbank *et al.*, 2013; GDP, 2023; van Zanten *et al.*, 2023). The report explored only the connection between dairy and the people-centred SDGs, but investing in dairy sector development will also positively impact environmental and public health dimensions, if properly managed, as well as resulting in better animal health and welfare. Decision-makers should take this into account when designing and implementing policies and investments to support the development of the dairy sector.

Decision-makers should also be aware that the development of the dairy sector is not linear but characterized by changes in production, processing and consumption patterns along the pathway of growth and transformation. In aggregate, **society is expected largely to benefit from the development of the dairy sector, whose growth and transformation can contribute considerably to achieving the 2030 Agenda for Sustainable Development.** ●

Appendix

Data sources

Table 15. Data sources

Variable	Data sources
Population	United Nations. Department of Economic and Social Affairs. Population Division. World Population Prospects: 2019 Revision. New York, 2019. (1)
GDP	World Bank. International Comparison Program. World Development Indicators Database. (2)
Income classification	World Bank. World Bank Country and Lending Groups. (3)
Region classification	World Bank. World Bank Country and Lending Groups. World Bank list of economies. (3)
International poverty line	World Bank. Poverty and Inequality Platform. (4)
Milk yield	FAOSTAT. Food and agriculture data. (5)
Farm numbers	International Farm Comparison Network (IFCN). IFCN Dairy Report 2020.
Dairy animals (number)	FAOSTAT. Food and agriculture data. (5)
Average herd size	Elaborated from FAOSTAT and International Farm Comparison Network (IFCN). IFCN Dairy Report 2020.
Milk production	FAOSTAT. Food and agriculture data. (5)
Milk supply per capita	FAOSTAT (5) and UN population data. (1)
People living on dairy farms	Elaborated from United Nations, Department of Economic and Social Affairs, Population Division (2022). Database on Household Size and Composition 2022 (6) and International Farm Comparison Network (IFCN). IFCN Dairy Report 2020.
Share of people living on dairy farms	Elaborated from United Nations, Department of Economic and Social Affairs, Population Division (2022). Database on Household Size and Composition 2022 (6) and International Farm Comparison Network (IFCN). IFCN Dairy Report 2020.
Average income of people living on dairy farms	Elaborated from United Nations, Department of Economic and Social Affairs, Population Division (2022). Database on Household Size and Composition 2022 (6) and International Farm Comparison Network (IFCN). IFCN Dairy Report 2020.
Poverty rate among people living on dairy farms	Elaborated from United Nations, Department of Economic and Social Affairs, Population Division (2022). Database on Household Size and Composition 2022 (6) and International Farm Comparison Network (IFCN). IFCN Dairy Report 2020 and World Bank, Poverty and Inequality Platform. (4)
On-farm number of workers	Elaborated from International Farm Comparison Network (IFCN). IFCN Dairy Report 2020.
Off-farm formal employment	Elaborated From UNIDO INDSTAT database, INDSTAT4 ISIC Revision 4 (7) and literature review.
Off-farm informal employment	Elaborated From UNIDO INDSTAT database, INDSTAT4 ISIC Revision 4 (7) and literature review.
Dairy industry average wage	Elaborated from UNIDO INDSTAT database, INDSTAT4 ISIC Revision 4. (7)
Nº of consumers of dairy products	Elaborated from World Bank. Global Consumption Database. (8)
Share of consumers of dairy products	Elaborated from World Bank. Global Consumption Database. (8)
Average retail price of 1 litre of milk	Elaborated from Numbeo. Cost of Living. (9) and World Bank. International Comparison Program. World Development Indicators database. (10)
% of daily income to purchase one litre of milk	Elaborated from Numbeo. Cost of Living. (9) and World Bank. International Comparison Program. World Development Indicators database. (10)
Milk tax base per capita	Elaborated from World Bank. Expenditure on milk, cheese and eggs (11) and FAOSTAT on production (5) and UN population data. (1)
Dairy sector's contribution to agriculture value-added	Elaborated from FAOSTAT. Value of Agricultural Production. (5)
Dairy sector's value added	FAOSTAT. Value of Agricultural Production. (5)
Milk production value-added per animal	Elaborated from FAOSTAT. (5)

Web links

(1)   https://population.un.org/dataportal
(2)   https://data.worldbank.org/indicator/NY.GDP.PCAP.PP.CD
(3)   https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-
      world-bank-country-and-lending-groups
(4)   https://pip.worldbank.org/home
(5)   www.fao.org/faostat/en/#data
(6)   https://www.un.org/development/desa/pd/data/household-size-and-composition
(7)   https://stat.unido.org/database/INDSTAT%204%202022,%20ISIC%20Revision%204
(8)   https://datatopics.worldbank.org/consumption/detail
(9)   www.numbeo.com/cost-of-living/
(10) https://data.worldbank.org/indicator/PA.NUS.PPP
(11) https://databank.worldbank.org/embed/ICP-2017-Cycle/id/4add74e?inf=n

Table 16. Dairy sector statistics

Milk yield group		Million farms		No. farms/10 000 people		Million cows		No. Cows/1 000 people		Number of dairy cows/farm		Production (million tonnes/yr)		Production (kg/capita/yr)		Milk yield (kg/cow/yr)	
		Tot	%	Me	Av	Tot	%	Me	Av	Me	Av	Tot	%	Me	Av	Me	Av
Income group	Low	10.2	9	238.1	225	46.7	14	57.7	78.3	3.2	3.6	19.0	2	22.0	32.4	421	732
	Lower middle	93.5	83	105.9	227	174	52	35.2	54.7	3.4	8.0	275.7	34	27.2	64.7	1 200	1 231
	Upper middle	7.2	6	44.5	118	69.7	21	29.9	48.4	11.8	42.8	192.6	24	71.7	121.9	1 776	2 323
	High	1.2	1	7.2	20.4	44.4	13	28.1	55.8	65.1	95.9	323.7	40	201.8	328.8	6 346	5 464
Region	Central Asia	5.5	5	412.0	425.5	16.9	5	129.9	129.3	3.2	4.6	40.5	5	295.8	263.4	2 018	2 018
	East Asia & Pacific	1.7	2	2.1	24.2	24.7	7	3.3	60.3	29.0	88.6	79.9	10	5.2	206.6	1 564	2 673
	Europe	3.1	3	22.2	96.2	37.6	11	58.8	66.7	32.0	53.4	224.1	28	260.8	351.7	6 346	5 886
	Latin America & Caribbean	2.6	2	30.3	52.6	35.5	11	29.8	41.6	26.0	49.6	78.2	10	55.3	85.1	1 399	1 830
	Middle East & North Africa	3.3	3	20.1	56.2	10.6	3	13.7	17.6	5.1	29.9	23.6	3	52.9	61.3	2 388	3 281
	North America	0.0	0	1.9	1.9	10.4	3	26.7	20.6	186.3	186.3	106.1	13	273.4	273.4	7 358	7 069
	South Asia	83.2	74	377.2	474.8	136.0	41	89.9	86.3	2.4	2.4	231.9	29	60.2	82.9	1 171	992
	Sub-Saharan Africa	12.6	11	88.8	155.6	62.5	19	40.1	62.9	5.2	44.5	26.7	3	20.2	28.9	454	771
Milk yield	Low yield	21.3	19	148.0	219	76.5	23	50.2	73.9	4.2	14.6	28.5	4	19.7	35.5	366	376
	Lower middle yield	9.2	8	74.5	126	46.1	14	19.1	35.3	5.1	12.6	65.5	8	23.9	45.1	1 368	1 239
	Upper middle yield	79.0	70	83.16	166	144.4	43	34.2	50.7	4.88	16.5	294.0	36	136.0	149.6	1 542	2 574
	High yield	2.5	2	5.2	18.05	67.7	20	35.5	67.6	62.0	102.9	422.9	52	258.6	406.5	7 059	7 106
	World	**112**	**100**	**32.4**	**120.1**	**335**	**100**	**32.2**	**57.0**	**13.0**	**49.4**	**810.9**	**100**	**55.3**	**158.2**	**1 482**	**2 832**

Me = median; Av = average

Statistical tables

Table 17. Trade statistics for the dairy sector (milk equivalent – ME)

		Net trade (ME million tonnes)	Milk export (ME kg/capita)		Milk import (ME kg/capita)	
		Aggregate	Median	Average	Median	Average
Income group	Low	-2.1	0.0	0.3	0.2	1.2
	Lower middle	-12.0	0.0	1.9	1.4	4.5
	Upper middle	-24.2	0.2	9.9	9.8	16.2
	High	34.5	30.4	138.8	49.2	70.7
Region	Central Asia	0.3	1.6	2.0	0.7	3.1
	East Asia & Pacific	-6.2	0.0	93.8	2.7	10.9
	Europe	17.3	45.9	126.1	65.0	85.2
	Latin America & Caribbean	-5.3	0.1	11.7	10.6	14.7
	Middle East & North Africa	-11.3	0.7	6.0	8.2	20.2
	North America	7.4	6.8	6.8	8.3	8.3
	South Asia	-2.4	0.0	0.0	0.1	4.2
	Sub-Saharan Africa	-3.7	0.0	0.3	1.0	5.2
Milk yield	Low yield	-8.0	0.0	1.6	0.7	5.0
	Lower middle yield	-7.1	0.0	1.4	8.1	13.9
	Upper middle yield	-13.1	1.2	12.7	7.7	21.9
	High yield	25.6	40.2	167.5	50.0	69.6
	World	**-**	**0.2**	**47.0**	**7.6**	**28.1**

Table 18. Statistics for people living on dairy farms

		People living on dairy farms (million people)		Share of people (per 1 000) living on dairy farms		Annual income/family member (USD PPP 2018)		Income/international poverty line (2.15 USD/day – PPP 2018)	
		Total	%	Median	Average	Median	Average	Median	Average
Income group	Low	80.1	14	112.6	126.9	175	259	0.2	0.3
	Lower middle	437.3	76	49.0	105.7	291	1 222	0.4	1.6
	Upper middle	50.2	9	14.7	45.7	892	8 512 (5 190*)	1.1	6.6
	High	4.0	1	2.0	6.5	8 824	13 706	11.2	17.5
Region	Central Asia	25.8	5	186.3	197.3	325	448	0.4	0.6
	East Asia & Pacific	33.1	6	0.6	10.7	3 910	10 366	5.0	13.2
	Europe	9.0	2	6.9	34.3	5 141	9 674	6.6	12.3
	Latin America & Caribbean	10.6	2	10.9	21.5	1 780	5 984	2.3	7.6
	Middle East & North Africa	15.4	3	18.3	33.0	3 146	7 609	4.0	9.7
	North America	0.1	0	0.5	0.5	29 578	29 578	37.7	37.7
	South Asia	389.0	68	243.3	270.9	168	197	0.2	0.3
	Sub-Saharan Africa	88.5	15	48.0	78.1	125	6 732 (393*)	1.2	0.5
Milk yield	Low yield	121.8	21	62.5	109.1	138	593	0.2	0.8
	Lower middle yield	75.7	13	38.7	66.6	433	963	0.6	1.2
	Upper middle yield	341.6	60	32.4	65.6	840	3 537	1.1	4.5
	High yield	31.5	6	1.7	5.0	11 614	18 135 (15 766*)	14.4	20.1
	World	**571.6**	**100**	**11.0**	**56.2**	**1 470**	**7 788**	**1.8**	**8.7**

* Excluding South Africa

Table 19. Employment statistics for the dairy sector

		People employed on dairy farms							People employed in milk processing plants							Milk yield (kg/cow/yr)	
		Million people		People working/ 1 000 people		Full-time workers/ tons of milk produced daily		Million people		Employees/ 1 000 people		People/ tonne of milk processed per day		Formal (%)	Informal (%)	Milk yield (kg/cow/yr)	
		Aggr	%	Me	Av	Me	Av	Aggr	%	Me	Av	Me	Av	%	%	Me	Av
Income group	Low	2.0	6	2.55	4.16	32.33	48.07	0.13	2	0.15	0.25	15.08	30.88	13.6	86.4	NA	NA
	Lower middle	29.4	83	3.75	6.31	27.54	31.23	3.25	49	0.38	0.81	14.65	24.38	11.3	88.7	9 774	13 752
	Upper middle	2.8	8	3.37	5.04	11.14	13.80	2.21	34	0.79	0.84	4.44	13.80	44.4	55.6	12 652	13 664
	High	1.1	3	1.05	1.57	1.41	3.14	1.00	15	0.91	1.15	1.64	2.97	75.1	24.9	40 165	40 656
Region	Central Asia	1.2	3	12.70	13.70	24.11	20.99	0.15	2	0.95	0.95	3.37	5.98	54.7	45.3	12 891	11 154
	East Asia & Pacific	0.6	2	0.18	1.98	3.54	15.16	1.39	21	0.70	0.90	8.93	14.48	40.7	59.3	34 265	32 477
	Europe	1.6	5	1.86	3.79	1.82	5.41	0.81	12	1.08	1.27	1.77	2.87	73.2	26.8	31 608	34 413
	Latin America & Caribbean	1.5	4	2.08	3.41	17.11	16.68	0.76	12	0.87	1.09	5.86	16.69	42.8	57.2	16 242	18 315
	Middle East & North Africa	0.8	2	1.60	1.77	12.02	17.21	0.45	7	0.79	0.88	8.83	14.46	31.4	68.6	15 522	20 454
	North America	0.3	1	0.69	0.69	1.04	1.04	0.20	3	0.61	0.61	0.83	0.83	81.2	18.8	53 888	53 888
	South Asia	26.6	75	8.36	10.48	31.48	33.62	2.56	39	0.73	0.81	28.50	26.01	7.9	92.1	5 782	6 533
	Sub-Saharan Africa	2.6	7	1.74	2.80	33.35	43.44	0.27	4	0.18	0.27	28.20	34.06	17.3	82.7	10 803	12 864
Milk yield	Low yield	4.5	13	3.40	4.60	38.65	46.95	0.51	8	0.25	0.51	28.50	36.35	12.7	87.3	9 774	11 750
	Lower middle yield	4.7	13	3.23	5.54	25.96	26.54	0.49	7	0.40	0.66	15.82	23.67	20.0	80.0	12 859	13 688
	Upper middle yield	24.3	69	3.84	5.94	10.76	14.00	3.38	51	0.95	1.01	4.44	8.13	18.3	81.7	15 646	19 129
	High yield	1.7	5	0.95	1.47	1.41	1.78	2.19	33	0.96	1.21	1.58	2.91	59.9	40.1	44 455	38 909
	World	**35.2**	**100**	**1.95**	**4.03**	**8.01**	**17.39**	**6.59**	**100**	**0.66**	**0.84**	**3.89**	**14.37**	**32.0**	**68.0**	**24 158**	**27 871**

Me = median; Av = average

Table 20. Consumption statistics for dairy products

		Million consumers		Milk supply/person/year (l)		Consumers population (%)		Price of one litre of milk (USD PPP 2018)		% of daily income to purchase one litre or milk	
		Total	%	Median	Average	Median	Average	Median	Average	Median	Average
Income group	Low	248.4	4	21.45	33.30	35.51	36.23	2.23	2.23	36.98	36.98
	Lower middle	2 152.4	36	29.28	63.49	64.58	64.93	2.77	3.29	17.25	19.52
	Upper middle	2 413.0	40	85.61	123.83	82.26	82.79	2.43	2.75	5.91	6.78
	High	1 146.0	19	227.95	263.14	97.47	93.43	1.75	1.90	1.47	1.67
Region	Central Asia	126.4	2	285.93	254.43	88.34	84.26	2.35	3.23	3.16	10.86
	East Asia & Pacific	2 043.9	34	18.49	115.70	82.26	74.87	3.56	3.44	5.20	10.21
	Europe	732.4	12	246.90	321.30	97.47	95.43	1.74	1.92	1.58	2.89
	Latin America & Caribbean	435.3	7	71.91	84.12	87.45	82.92	2.38	2.42	4.15	6.14
	Middle East & North Africa	385.7	6	70.86	72.23	92.27	83.31	2.56	2.53	4.34	5.12
	North America	356.7	6	265.71	265.71	97.47	97.47	1.40	1.40	0.97	0.97
	South Asia	1 424.5	24	59.34	84.27	76.40	76.86	2.53	2.88	17.47	18.41
	Sub-Saharan Africa	454.8	8	21.45	32.60	41.47	46.58	2.87	3.12	26.61	28.60
Milk yield	Low yield	664.0	11	22.70	37.74	56.50	53.83	2.74	3.27	21.01	24.58
	Lower middle yield	512.4	9	39.85	55.33	81.83	70.11	3.13	3.15	8.60	8.94
	Upper middle yield	1 899.6	32	133.03	153.40	89.94	81.88	2.32	2.62	4.85	6.78
	High yield	2 875.3	48	242.28	310.18	97.47	93.42	1.68	1.83	1.47	2.35
	World	**5 960**	**100**	**61.19**	**139.01**	**87.00**	**76.55**	**2.25**	**2.44**	**3.75**	**7.30**

Table 21. Milk production, consumption and potential tax base

		Milk production value (billion USP PPP 2018)		Share (%) of milk production in agriculture value		Production (income) tax base/farm/yr (USD PPP 2018)		Consumption (sales) tax base/person/yr (USD PPP 2018)		Formal milk processing (%)	
		Aggregate	%	Median	Average	Median	Average	Median	Average	Median	Average
Income group	Low	7.9	2	4.4	6.1	47.3	101.5	4.13	4.85	10.05	21.87
	Lower middle	129.4	37	3.9	5.9	144.5	736.6	42.41	54.40	27.14	37.57
	Upper middle	80.6	23	6.1	8.1	838.1	5 804.0	142.89	161.91	61.30	58.53
	High	134.7	38	15.7	17.6	17 798.0	25 930.0	300.74	297.49	95.24	91.25
Region	Central Asia	16.8	5	16.2	16.0	142.5	261.4	48.60	67.90	28.28	29.45
	East Asia & Pacific	33.6	10	0.7	3.9	3 498.6	17 787.5	123.83	122.68	86.41	79.18
	Europe	93.3	26	19.0	23.1	8 937.3	15 983.4	311.56	299.78	89.33	77.48
	Latin America & Caribbean	32.6	9	5.8	6.7	1 385.6	8 653.9	152.83	153.46	70.00	65.61
	Middle East & North Africa	10.1	3	4.4	6.5	938.1	10 501.1	157.71	145.96	78.16	67.98
	North America	44.1	13	10.7	11.9	74 078.6	74 078.6	232.86	232.86	98.08	98.08
	South Asia	110.9	31	9.1	9.5	58.4	90.7	21.75	39.91	16.01	31.20
	Sub-Saharan Africa	11.1	3	3.6	5.9	43.8	74.7	4.13	11.09	16.89	24.05
Milk yield	Low yield	12.0	3	2.4	4.1	72.5	246.4	5.97	24.36	17.81	28.46
	Lower middle yield	30.9	9	3.3	6.4	211.3	638.9	64.10	83.14	28.00	40.16
	Upper middle yield	133.3	38	7.9	9.7	820.8	3 293.5	145.18	168.23	62.23	58.57
	High yield	176.4	50	17.8	21.1	18 083.4	28 687.4	292.70	279.38	95.07	91.50
	World	**352.6**	**100**	**6.4**	**10.3**	**1 099.1**	**11 436.2**	**148.55**	**165.74**	**70.56**	**60.17**

Tax base estimates based on milk formally processed and consumed

Imputation methodologies

All statistics were calculated by combining data from different sources and covered the majority of the 187 countries in the sample. However, sparse data were available for four variables: (i) share of population consuming dairy products; (ii) costs and revenue for dairy farmers; (iii) people employed in dairy processing plants; and (iv) share of informal employment in dairy processing units. We used several methodologies to fill the data gaps for these variables, in each case using a model to estimate the variable value for the countries for which data were not available.

Share of population consuming dairy products

The World Bank Global Consumption dataset includes data on the share of population consuming dairy products – including fresh milk, preserved milk and other milk products, cheese, butter and margarine – for 90 countries of the 186 in the dataset. For a few other countries, we found estimates in the literature. We tested different models to explain the determinants of the share of population consuming dairy products. The best model used the following predictor variables: i) GDP per capita, ii) price of milk by region, sub-region and iii) country income level.

Cost and revenue

We retrieved data on cost and revenue for 134 dairy farm typologies in 54 countries from the IFCN 2020 Annual Report. These statistics are needed to estimate net farm income. We experimented with different models to identify the determinants of the cost/revenue ratio. The best model used the following predictor variables: 1) number of animals, and ii) GDP per capita by sub-region.

Employment in dairy processing plants

The UNIDO dataset includes data on people employed in dairy processing plants for 81 countries. As employment varies widely across regions we developed regional models to identify the major determinants for i) sub-Saharan Africa and South Asia, ii) North, Central and Southern America, iii) Middle East and North Africa, iv) Europe and Central Asia, and v) East Asia and the Pacific. Depending on the region, the predictor variables were selected from among i) GDP per capita, ii) number of dairy cows per capita, iii) milk yield, and iv) share of people employed in the informal sector.

Share of people informally employed in dairy processing units

For this variable we relied on ILO country data and used the regional statistics to fill the data gaps. For countries/regions for which data were not available, we reviewed the literature. For the few countries for which no data could be found in the literature, we used ILO statistics either for the world or for WB country income level grouping. ●

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This study has pulled together and analysed a substantial body of country level data on dairy cattle sector characteristics and social dimensions for most of the world's countries. It presents systematic evidence that the dairy sector can contribute to achieving the socially oriented Sustainable Development Goals (SDGs): no poverty (SDG1), zero hunger (SDG2), good health and well-being (SDG3), quality education (SDG4) and decent work and economic growth (SDG8).