RESEARCH ARTICLE

A multi-stakeholder participatory pilot study of the data demands of the future Ethiopian dairy sector [version 3; peer review: 3 approved]

Previous Title: A pilot study of the data demands of different stakeholders for the future Ethiopian dairy sector

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Abstract

Background: This paper describes a pilot study undertaken in 2018, to determine the key data needs of each of the different Ethiopian dairy sector stakeholder groups. The study aimed to characterise the emerging trends of dairy product production, processing, retailing and consumption in Ethiopia, and to identify and characterise current and future data needs of different stakeholders.

Methods: The study undertook a mapping of the interactions between different stakeholders in the dairy sector, and an interactive evaluation of the institutional data repository and access options. Focus group discussions and interviews were held in three regions of the country prior to a two-day workshop in the capital Addis Ababa. Data needs were characterised by type, availability, format, level of detail, methods of dissemination, uptake and use, and the institutional arrangement, including the different roles of public and private sectors in decision making processes.

Results: The study highlighted the main data needs and identified

Open Peer Review

Approval Status

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<tbody>
<tr>
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several broader institutional issues constraining the further development of the Ethiopian dairy sector. The stakeholder groups endorsed the reactivation of a national dairy board, independent of government but closely incorporating government, and with the buy-in and membership of private sector enterprises, including producers, processors, service providers and consumers, to provide clearer facilitative leadership on the dairy industry.

Conclusions: The study workshop provided a timely discussion between diverse stakeholders, including government, and several potential organisations were suggested to host and manage a national dairy database. Importantly, the reactivation of a national dairy board was strongly endorsed. It was recommended that stakeholder links be established, sector-specific data needs be elevated to higher detail, and a national roll out of herd-specific data recording schemes was called for, to allow for effective evidence-based policies and decision making.

Keywords
Ethiopia, dairy sector, stakeholders, data needs, development
Introduction

Ethiopia has a human population of around 115 million (World Bank, 2020), and as such there is the huge potential market opportunity for milk and milk products (Tegegne, 2018). The demand for milk and other dairy products is growing with population growth and urbanisation (PRECISE, 2018)(Minten et al., 2020), which has been regarded as a major investment opportunity (such as the Netherlands African Business Council (NABC)) (Zijlstra et al., 2015). The country has the largest livestock population in Africa, with a cattle population of more than 65 million (Central Statistical Agency (CSA), 2020), however, it is recognised that there are several constraints to the development of the dairy sector, including the very small population of cross bred dairy cows (estimated to be around 1.2 million, less than 2% of the cattle population)(Central Statistical Agency (CSA), 2020), the low levels of milk production, the high price of livestock feed, weak links between producers and processors, lack of a dairy board with a vision for the dairy sector, high cost of milk to the consumer, and weak links between the different stakeholders (Yilma et al., 2011). These authors concluded that the major challenges were poor infrastructure network, inadequate provision of veterinary services and lack of continuous supply of animal feeds throughout the year (Yilma et al., 2011). Guadu & Abebaw (2016) described the different production systems involved in dairying, and reviewed the challenges, opportunities and prospects for the sector. Similarly, the sector has been reviewed by Miheret et al. (2017), and Ndambi et al. (2018) examined geographical aspects of the sustainability of milk production in different regions of the country. These studies concluded that the major challenges included cattle health, lack of infrastructure, environmental issues, lack of access to credit, reproductive disorders and inadequate trained personnel, all of which contribute to the poor performance of dairy cattle in Ethiopia.

Milk is produced by 11.4 million milking cows that are kept within five different dairy systems: pastoral (traditional livestock farming); agro-pastoral (traditional lowland mixed livestock farming); mixed crop livestock (traditional highland mixed farming); urban and peri-urban (emerging smallholder dairy farming); and commercial (specialised commercial intensive dairy farming) (Zijlstra et al., 2015). Milk consumption is very low per capita at 19 litres per year (compared to 80 litres per year in Kenya and 160 litres per year in Sudan) (CDAIS, 2017). The low milk production and consumption are driven by a number of factors. In rural areas the animals used by smallholder farmers are local breeds which are not selected for milk production. Animals are managed in a traditional way, depending on natural pasture and crop bi-products with no supplementary feeds; the quantity of milk produced is low. Milk in the rural setting is mainly used for household consumption and is not widely marketed, with any surplus usually converted into butter and sold in local markets (Tegegne, 2018). The situation is different in the urban and peri-urban areas where farmers use cross-bred and exotic dairy animals, and where they have access to artificial insemination (AI), use more intensive systems, have access to commercial sources of feeds and animal health services (Tegegne, 2018). But these farmers account for only 1% of the dairy cattle population in the country. They supply milk to consumers in major urban centres, both through the collection and distribution system of dairy processors which delivers processed products to consumers, and the raw milk traders collect and distribute raw milk mainly through informal markets. The country produces around four billion litres of milk per year (Tegegne, 2018).

There are a number of challenges facing further development of Ethiopia’s dairy sector. The first is that local breeds provide about 1.5 litres of milk per day per cow. These cattle also have a short lactation length of about 150 days (Tegegne, 2018). Cross bred cattle, in comparison, produce 10–15 litres of milk per day and have a lactation period of around 300 days (Zijlstra et al., 2015). Although there is a National Artificial Insemination Centre, smallholder farmers have limited access to improved dairy genetics (Ahmed et al., 2004)(Tegegne et al., 2012) and the AI delivery system is also weak and inadequate (Dekeba et al., 2006). There are very few improved dairy animals and they are often too expensive for smallholders to purchase (Yilma et al., 2011). Feed and water are in critically short supply and livestock are mostly fed on grass hay and crop residues, most of which are poor quality (Beyu, 2016)(Ahmed et al., 2004). Supplementary feeds, such as cereal bran and oil cakes, are either too expensive or in short supply (GebreMichael et al., 2019). Dairy production requires good quality water and the availability and reliability of water is a major constraint in Ethiopia. Seasonal fluctuations in supply during the dry season, and demand (there are fasting days each week and fasting seasons by the Coptic Christian community) all affect the liquid milk chain and marketing opportunities (Yilma et al., 2011).

Despite these challenges, there are some strong and effective players operating in Ethiopia, trying to address the problems. Notably, Smart Development Works (SNV) supported dairy development initiatives (SNV, 2018), Global Affairs Canada (GAC) supported the Livestock and Irrigation Value Chains for Ethiopian Smallholders (LIVES) project (ILRI, 2018), the Bill and Melinda Gates Foundation (BMGF) supported the African Dairy Genetics Gain Programme (ADGG) (ILRI communications, 2017), and the Public Private Partnership for Artificial Insemination Delivery (PAID) programme of Land O’Lakes (Land O’Lakes, 2022). The role and position of these and other players is strengthened by the development of the

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**REVISED** Amendments from Version 2

Minor amendments have been made to Version 2 following second and third review, including clarifying the higher productivity of cross bred cattle, and confirming that the study was purposive. Some additional details have been provided to describe the roles of the foreign stakeholders in Table 2. We have also mentioned the Livestock Master Plans, with regards to data use and application elsewhere with due emphasis on LMICs, and we have highlighted the need for efficient use of data for evidence-based decisions. An additional potential bias has been described in study limitations.

Any further responses from the reviewers can be found at the end of the article.
Livestock Master Plan for Ethiopia (Shapiro et al., 2015), which brings potential cohesion to these differing initiatives, and a US $170 million World Bank development programme for livestock and fisheries (World Bank, 2018). Importantly, there is also the potential for dairying in pastoral areas, which are excluded from the current World Bank funding and also from the Livestock Master Plan. A new World Bank programme of some US $350 million is under development for the pastoral areas of the country (World Bank, 2019).

The livestock sector is viewed as a critical component of Ethiopia’s agricultural development, which is framed under the country’s Growth and Transformation Plan II (GTP II) (National Planning Commission, 2016). Ethiopia’s Livestock Master Plan (LMP) set out predicted growth opportunities, and within the LMP an ambitious programme was drawn up for the dairy sector (Shapiro et al., 2015). Within the sector, the plan included the following targets:

- Projected 93% increase in national cow milk production, a surplus of 2,501 million litres over projected domestic consumption requirements. This would make it possible to meet the milk production targets in the GTP II phase, exceeding the growing domestic demand for milk by 47%. The surplus could then be substituted for imported milk products and used domestically for new or additional industrial uses, or exported as milk powder or ultra-high temperature (UHT) to raise foreign exchange earnings
- GDP contribution from dairy will increase from Ethiopian Birr (ETB) 1.1 billion to 10.0 billion
- Adopting dairy farmers – around 1.3 million will be trained by 2020
- There will be an increase in cross-bred cattle, from 0.9 million to 5 million
- Synchronisation and AI interventions are proposed to raise Internal Rates of Return (IRR) values from 23.7 to 32.5%
- Adoption of artificial insemination (AI) and synchronisation is planned to reach 32% of the reproductive female cattle by 2020
- 20,000 public and private AI technicians will be trained
- Milk production is predicted to increase from 167 million to 1,490 million litres

In order to gain a better understanding of the feasibility of the targets, as well as monitoring and evaluation of progress in achieving the targets, there is the requirement for data. The study objective was to identify and characterise the different data needs to support effective decision making in the Ethiopian dairy sector, by building on a previous broader study ‘Landscape of Organisational Mandates and Analysis of Existing Livestock Databases in Ethiopia’ (PRECISE, 2018), supported by the Bill and Melinda Gates Foundation (BMGF). By establishing the data needs of stakeholders, priorities and recommendations could be made for how data can be generated and managed that would best support dairy sector development.

Methods

Ethics and consent

No animals were involved in this work. Initially, on conducting the study, it was felt that due to the data collection being of a relatively impersonal nature, ethical approval was not necessary. The type of data participants were expected to provide related to the performance of different components of the dairy sector in Ethiopia, and no health or otherwise sensitive personal information was collected. However, on further consideration, full details and supporting documentation of the study were submitted for retrospective ethical review on 21st February 2022 by the Human Ethical Review Committee, University of Edinburgh, the outcome of which stated that had the study been reviewed prior to commencement, ethical approval would likely have been given.

Study design

The purposive study commenced in April 2018, involving three visits to Ethiopia (9–15 May; 28 May–2 June; 5–11 August 2018) by the first author. A literature review was conducted, followed by stakeholder focus group discussions and key informant interviews, all of which helped to inform the structure of a stakeholder workshop, which was the culmination of the study. A total of 45 participants were involved.

The researchers present for the stakeholder discussions and interviews were Brian Perry and Yacob Aklilu, and for the workshop also included Getachew Legese, Solomon Hailemariam and Azage Tegegne, all Ethiopian, male scientists with long-standing experience of the Ethiopian livestock sector. Brian Perry designed and facilitated the workshop, with long-standing experience of Ethiopia and its livestock sector (he led the Independent Evaluation or the Programmes of the FAO in Ethiopia in 2010; Perry et al., 2011). Whilst all researchers were known professionally to the stakeholders, and therefore had built up trust, they were not known personally, with regards to bias.

Literature review

An extensive review of the literature was conducted, to assess past and current research and development in the Ethiopian dairy sector, however there is very little available literature on the performance of the dairy sector. Sources were multiple; initially Google scholar and PubMed electronic databases were used to search for Ethiopian dairy milk production constraints which duly led on to reports and articles, and also documents were made available to the team in Ethiopia, including non-published governmental and other grey literature reports. Findings were collated in a Microsoft Word folder. Relevant literature included research articles, government documents, including the LMP, GTP-I and II and their reports, dairy sector plans and other documents to understand development efforts and plans in the sector.

Stakeholder scoping and mapping

Stakeholder mapping and cluster identification was carried out in three regions of Ethiopia: Addis Ababa (and its surrounds); Tigray, and Southern Nations, Nationalities, and Peoples’ Region
(SNNPR). This geographical spread was undertaken in order to ensure as comprehensive engagement as possible, to pick out the key stakeholder clusters involved in dairying. Clusters were identified according to key roles undertaken by the various actors with dairy value chains in Ethiopia. Within each stakeholder cluster - government, research, feeds, genetics, health, processing, marketing, and producers - key informants were identified. Contact details were provided by the stakeholders in each of the clusters, complying with data protection legislation and ethical approval. The individuals and/or organisations operating in each cluster were identified through networking as well as the local authors provided lists of suitable participants, based on their local knowledge. Whilst there was the potential for bias, this was addressed by ensuring the widest range of participants possible.

Checklist
After consulting previous research and better understanding the sector and major stakeholders, a checklist was developed, for use in key informant interviews and focus group discussions in order to capture key issues in line with the study objectives. The checklist was developed using past research, and was supplemented extensively from discussions with the different stakeholder representatives. Checklists provided reminders of basic issues and questions, and were amplified depending on responses obtained during interviews and discussions. The checklist is included in Extended Data.

Consents and approval
Securing the consensus of relevant government officials was important in facilitating the study. The study objectives and relevance were explained to officials in relevant institutions, to aid ‘buy-in’ of the ideas, and permission to work was granted. Additionally, a clearer picture of the major actors in the dairy sector was achieved, as well as the challenges in gaining access to data for informed decision-making.

Consent was obtained from the Ministry of Agriculture and Livestock Resources (MoALR), and the Ethiopian Meat and Dairy Industry Development Institute (EMDIDI) to identify and contact key informants within stakeholder clusters. These stakeholders were involved in the scoping and mapping process and in the stakeholders’ meeting and focus group discussions. Participants were informed of the project background, research purpose, and what would be involved, in the participant invite as well as verbally at the events. Written consent was not deemed necessary as the data collected was not relating to individuals or personally sensitive, but rather was regarding the needs of a much wider group (the dairy sector). Participant willingness and voluntary choice to attend was their consent to participate.

Stakeholder focus group discussions and interviews
Focus group discussions were conducted with the identified stakeholders in the three regions identified above, and in-depth interviews were held with key informants.

In Addis Ababa a total of 17 focus group discussions and interviews were held, with one participant per interview and approximately three or four participants per focus group. A total of three discussions were held in Tigray and three were held in SNNPR. Focus groups and interviews were held at the workplaces of the relevant participants e.g. Ministry offices or at research institute premises. No participants declined to take part or dropped out. Focus groups and interviews lasted between one and two hours, with field notes taken to document the responses. Documentation and aggregation of common themes was conducted, with no further analysis at this stage. Focus group discussions and interviews were conducted in English and or Amharic. Interviews are included in Underlying data.

The purpose was to gain information on several issues:

- major constraints and opportunities in the dairy sector
- major stakeholders in the dairy sector, their current sources of data for important decision-making, and challenges they have in data availability and quality
- strengths and weaknesses of existing data and data sources, and their implication for the development of the sector
- mapping of the interaction between different stakeholders involved in collection, maintenance and dissemination of data in the sector
- coordination of activities of the different actors involved in the collection and maintenance of data in the sector
- central data storage and dissemination for dairy stakeholder issues, related data protection and property right in pooling data into a central hub and data sharing system
- existing mechanisms of the dairy sector data sharing and dissemination, strengths and weaknesses and capacity building needs for better future services
- key data needs for different dairy stakeholders
- existing government policies on the collection, maintenance and dissemination of data for the dairy sector stakeholders, policy gaps (if any) and power vested on different institutions in this regard
- existing capacity in data analysis and modelling to support informed interventions in the sector and who is doing what, and gaps in capacity

Stakeholder workshop
A two-day workshop was held at the ILRI campus, Addis Ababa on 8th and 9th August 2018, involving 37 stakeholders representing the different actors in the Ethiopian dairy value chain, to discuss data needs. The workshop was structured in order to achieve a consensus of data needs while attempting to address any biases brought by the stakeholders; an itinerary was sent out to participants in advance, and discussions were based on open questions and gathering available data. A combination of talks given by participants and participant discussions were used in the workshop sessions. The workshop itinerary and a workshop report are presented in Extended data.
As well as the initial focus group discussions, additional group discussions were integrated in the workshop, designed to build on the stakeholder mapping and scoping processes carried out in the study. The key players and key issues regarding data needs that were identified in the mapping and scoping process contributed to the design and structure of the workshop.

The focus groups were made up of between four and seven participants in each of the five stakeholder groups (see Participant invite with workshop itinerary, Allan 2022), and the discussions lasted 1–2.5 hours. Researchers present were Brian Perry, Yacob Akilu, Getachew Legese, Solomon Hailemariam and Azage Teggegne. As before, field notes were taken to document the discussions, which were conducted in English and or Amharic. The workshop intended to identify and characterise current and future data needs by types, availability formats, level of detail, methods of dissemination, uptake and use, and institutional arrangements of handling, storing and accessing data, and the different roles of public and private sectors in decision-making processes. Stakeholders were classified into five groups, identifying their different data needs (the inputs and services stakeholders - feeds, genetics and health - were clustered for organisational purposes, bringing the eight clusters to five):

1. public sector policy and regulatory systems
2. inputs and service providers (public and private sector actors and NGOs)
3. private sector milk and dairy products producers
4. private sector milk and dairy product processors and marketers
5. dairy research and extension system actors

The groups were asked to identify the different data needs, consolidating them under the following headings:

- What are the data needs?
- Why do you need the data (purpose)?
- In what format do you need the data (qualitative, quantitative or both)
- In which categories is quality essential?
- What level of resolution is required (geography, scale, region etc)
- What are the major data gaps?
- What is the time scale required for the data?

Data needs. Information on data use and application was collected; how will you use the data; who else will use the data; will there be a cost to the data; how will it be stored; where will it be stored; how will the data be accessed?

Data use and application. Information was requested about data collection, quality control and management; how is/will the data be collected; how will the data be managed; how important is quality, and how will that be managed; how important is ease of use, and how is/will this be managed; how will data be disseminated and to whom; who will access the data; are there institutional property issues?

Institutional data use. Institutional issues regarding data use, availability and access were also discussed; who will be responsible for responding to the data needs; is there adequate capacity to meet these needs, uses and access requirements; what should be the milestones for follow-up and actions following the workshop; what are the technology needs to ensure the data needs can be met; what are the communications needs required to ensure appropriate data access; what are the accountability needs?

Synthesis of outcomes

Based on the outputs of the five stakeholder discussion groups, a synthesis of data needs by the different stakeholder clusters was conducted. All stakeholders were consulted on the findings and plans. Recommendations presented are those generated by the participatory processes i.e. are those of the participants.

Results

Literature review

The review of the literature highlighted the long-standing interest in the potential for greater productivity in the Ethiopian dairy sector, and identified many of the challenges to overcome these (Guadu & Abebaw, 2016; Miheret et al., 2017; Ndambi et al., 2018; Yilma et al., 2011). Challenges included the types of cattle, the limited production capacity of these cattle types, the vegan diet of 50% of the population, the poor coordination between producers, marketers and processors, and the inadequate feed resource for dairy animals. It also illustrated the lack of attention to the role of data in development and policy interventions by the government and development partners, as well as informing planning and decision-making for the different actors in the dairy sector. It also helped to understand the opportunities and constraints in the dairy sector, the major actors in the sector, their strengths and weaknesses, and interactions between different stakeholders.

Stakeholder interactions

The process involved extensive dialogue and interaction, including travel by team participants. Stakeholder mapping and scoping identified the key players in different stakeholder categories, and the key issues regarding data needs; this helped to inform the ensuing structure and format of the workshop. Sector participants in Addis Ababa included two from government, five from research, one from feeds and two producers, amongst others. In Tigray there was one participant from the processing and two from the producer sectors, and in the SNNPR, there was one from each of the producers, feeds and processing sectors. A total of 37 participants attended the two-day stakeholder workshop. The participants included 32 males and five females.

Data needs. Based on the outputs of the discussion groups, a synthesis of data needs by the different stakeholder clusters was conducted, and categorised under headings (Table 1). A methodological approach was taken, which was refined during the workshop process.
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<th>Category</th>
<th>Sub-category</th>
<th>Data needs</th>
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<tbody>
<tr>
<td>Dairy herd data</td>
<td></td>
<td>Livestock population numbers and category of dairy animals</td>
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<tr>
<td></td>
<td></td>
<td>Dairy herd structure by species (including cattle, goats, camels), age group, blood type, location, livestock production system and agroecology</td>
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<tr>
<td></td>
<td></td>
<td>Pedigree information</td>
</tr>
<tr>
<td>Production and reproduction</td>
<td></td>
<td>Major dairy farmers, location, herd size, daily milk production</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Milk production data at national, regional, zonal, woreda, household and individual animal level by breed of animals and production system</td>
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<td>Milk yield by breed and production system</td>
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<td></td>
<td>Milk composition by breed, stage of lactation and production system</td>
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<td></td>
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<td>Lactation length</td>
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<td>Calving interval</td>
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<td></td>
<td>Service per conception</td>
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<td></td>
<td>Household milk utilization by location and production system: milk consumption at home by producers, milk processed at home, milk marketed – sold to processors and sold to raw milk distributors</td>
</tr>
<tr>
<td>Dairy input data needs</td>
<td>Feed</td>
<td>Major dairy feed producers by location and types of feed produced</td>
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<tr>
<td></td>
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<td>Type of feeds produced by different feed producers</td>
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<td>Volume of feed produced by the different actors (showing seasonality)</td>
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<td>Biomass yield of different forage species</td>
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<tr>
<td></td>
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<td>Quality – standard that different feed producers and distributors need to comply with</td>
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<tr>
<td></td>
<td></td>
<td>Feed storage conditions</td>
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<tr>
<td></td>
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<td>Quality, availability and prices of different feed/forage types (including trends)</td>
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<td></td>
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<td>Costs of transportation from points of feed production to the center/points of use</td>
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<td></td>
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<td>Demand for feed by different dairy producers</td>
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<td>Major distribution channels for the different feed producers, volume of feed distributed through each channel by geographic location and season</td>
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<td>Availability and accessibility of the required quality and quantity of feed (by seasons and location)</td>
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<td>Economic minimum and optimum sizes of operation for production, and supply of different feed products</td>
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<td>Resources (finance, land, labour) needed for economic minimum and optimum size of different feeds production and their availability by location</td>
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<td>Access to resources such as land, finance and labour for forage production, feed grain production, feed processing and similar activities in the different regions</td>
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<td>Taxes levied on the different feed ingredients and mixed ration by region</td>
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<td>Incentives to promote feed production and processing</td>
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<tr>
<td>Animal health services and veterinary drugs</td>
<td></td>
<td>History on prevalence of different diseases and parasites, by location, season and frequency of occurrence</td>
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<td>History on mortality/morbidity of animals, by location and cause</td>
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<td>Major disease diagnostic laboratories and service centers, by location</td>
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<td>Details of private and public veterinary service providers (by level of operation and location)</td>
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<td>Costs of the private and public health services</td>
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<td>Details of veterinary drugs, veterinary equipment (for clinics and laboratories) and manufacturing plants, importers, wholesalers, retailers (drug shops), by location and volume of operation</td>
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<td>Prices of veterinary services, drugs, equipment and consumables by supplier and location</td>
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<td>Incentives for veterinary service providers; vet drug, equipment and consumables manufacturers; importers; wholesalers and retailers</td>
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<td>Taxes on veterinary service providers and veterinary drug shops</td>
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<td>Genetic improvement</td>
<td>Details of public and private AI and bull service providers, by location (lists)</td>
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<td></td>
<td>Data on providers or AI services with sexed semen (their details including location, geographical coverage/capacity)</td>
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<td>Quality of AI services including services per conception</td>
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<td>Data on the semen used for AI, including: pedigree information of the semen, blood level of semen, holders of semen with different specifications</td>
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<td>Sources of liquid nitrogen by location, production capacity, prices and their areas of operation</td>
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<td></td>
<td>Capacity of the available AI service and the cost of their services</td>
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<td></td>
<td>Details of suppliers of AI equipment and disposables (manufacturers, importers, wholesalers, retailers)</td>
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<td></td>
<td>Incentive packages to promote best AI services</td>
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<td>Taxes and other obligations</td>
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<tr>
<td>Dairy technology</td>
<td>Details on importers and distributors of dairy machinery (milking machines, milk processing machines, dairy laboratory machines etc), equipment, spare parts and consumable items by location, their volume of operation, product availability, prices etc</td>
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<td>Types of dairy machinery, equipment, spare parts and consumable items, their current prices, availability and sources</td>
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<td></td>
<td>Details of companies and individual experts providing technical supports including installation and maintenance services, training and technical advises on dairy machinery and equipment</td>
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<tr>
<td>Policy decisions and directives in dairy sector</td>
<td>Number and type of different actors, volume of operation and their geographic location</td>
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<td>Input need, availability and costs for different dairy actors by location</td>
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<td></td>
<td>Economic minimum and optimum levels of feed/forage production, processing and distribution; fabrication or import, wholesale and retail of veterinary drugs; provision of animal health and AI services; milk production, processing and distribution by geographic location</td>
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<td></td>
<td>Availability of finance, land, labour and technology for dairy input producers, processors and suppliers; milk producers, processors and distributors</td>
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<td>Land use plans of area identified for dairy development and comparative advantages of the different land use options</td>
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<td>Types and volume of imported dairy products, their sources, costs and wholesale and retail prices</td>
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<td>Major importers of dairy products</td>
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<td>Drivers of importing dairy products (quality issue, consumer preference, competitiveness)</td>
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<td>Quality standards and data on important parameters with respect to consumers safety (zoonotic diseases), hygienic and product handling requirements</td>
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<td>Taxes on the products for different actors in the dairy sector and gaps in these incentive packages for dairy investment</td>
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<td>Incentive packages for different actors in the dairy sector and gaps in these incentive packages for dairy investment</td>
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<tr>
<td>Dairy marketing</td>
<td>Major milk producers and suppliers to processors and consumers (raw milk), their supply volume by location, production system and season</td>
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<td>Major milk processing plants, their production capacity, product types and volume</td>
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<td>Prices for milk and milk products by location</td>
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<td>Quantity of raw milk produced and supplied to the different market channels by different actors (by geographic location) over years showing seasonal dimensions</td>
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<td>Consumer types and size for different milk and milk products over seasons and locations</td>
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<td></td>
<td>Demand volume for milk and different milk products by consumer type, season and location</td>
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<td></td>
<td>Consumer preference for different products, consumption size, and product quality considerations</td>
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<td></td>
<td>Imported milk and milk products, their source, quality, volume, source, consumer types, market share and prices</td>
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<td></td>
<td>Major marketing channels for different milk and milk products and product flow in each channel</td>
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<td>Product quality standards and consumer safety considerations</td>
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</table>

AI = artificial insemination.
**Defining data use and application.** All stakeholder groups indicated that the use of data was to make evidence-based decisions. More specifically, data were used for production planning, marketing and investment decisions, policy formulation, system harmonisation, allocation of resources to their best use, and improving the production and productivity in the dairy sector. They were also used for proper monitoring and evaluation by the regulatory system.

Forms of access to data were discussed and included the use of websites, mobile phone text messages, printed and electronic mass media, monthly bulletins and annual reports. In discussing the high costs associated with data collection, management and dissemination, subscriptions, memberships or direct payments were considered.

**Exploring data collection, quality control and management.** It was agreed that data collection, quality control and management should follow standard procedures. The frequency of data collection depended on the types of data since some required regular collection and updating, depending on the required level of resolution (individual animal, district, zonal, regional and national levels). Some data required daily recording, for example, milk production by individual animals, whereas others only required recording on event occurrence, such as births and deaths. It was agreed that data collection required periodic updating, depending on its nature and purpose.

Different organisations were suggested as responsible for collection and management of dairy related data: Ministry of Agriculture and Livestock Resources Development; Central Statistical Agency; National Animal Genetic Resources Improvement Institute; National Dairy Board; universities; and an independent institution to be established for this purpose. Intellectual property rights would be assigned to the designated organisation and adherence to the data laws and general principles of seeking permission of owners/creators of data to acknowledge data sources in any form of use would apply.

**Exploring institutional arrangements.** It was reported that there was a lack of clarity in the institutional arrangements for generating, ownership and sustainable management of the dairy sector data, presenting a substantial challenge. A summary of the different institutions and stakeholders is shown in Table 2.

There was no current viable institutional arrangement to address the data needs in the dairy sector, which was reported to be due, in part, to poor communication and linkage between institutions, as well as due to a lack of coherence and complementarity in the data categories generated by different organisations.

Regarding the existing limitations in capacity – human, technological and institutional – participants suggested that an inventory of existing capacities be created, in order to understand and quantify the capacity requirements. A variety of initiatives had previously been tried to develop livestock information systems. Although these attempts had been unsuccessful, unused facilities existed within institutions, therefore it was suggested that a thorough inventory of the technological facilities be conducted, to help in proposing alternative capacity building interventions to address the existing gaps. It was indicated by some participants from the MoALR that there was the intention within the Ministry to establish their own livestock database, as well as a national dairy sector policy and the workshop was considered supportive and complementary to their work. The deficiencies of the Ministry, with respect to data, were acknowledged and praise was given to the pilot study and workshop for being timely and a legitimate response to the lack of appropriate and reliable data for planning, policy, investment and development activities in the dairy sector.

**Where a dairy sector database should be housed and managed.** A number of institutions were suggested to take the leading role in the hosting (development and management) of a dairy sector database, demonstrating a lack of unanimity. The National Animal Genetic Resources Improvement Institute (NAGII) was suggested, based on its experience and current responsibility in managing the database for livestock genetic resources. It was, however, suggested that the focus on livestock genetic improvement by the NAGII, may result in other issues such as input service, production, feeding, animal health, dairy production, processing and marketing, and consumption being overlooked. The MoALR was suggested, however there was concern that there may be a lack of capacity to develop and manage such datasets. Despite this concern, it was intended to establish a unit within the sector for livestock resources, to handle the dairy database.

It was suggested by the policy and regulatory stakeholders group that CSA and MoALR would be appropriate organisations for developing and handling a dairy sector database. The dairy inputs and services stakeholders group also suggested CSA, with strong technical support from MoALR. This would improve on the current sample survey data approach. The research and extension stakeholders group suggested MoALR should take sole responsibility with its regional bureaus. The dairy producers and processors suggested that a new independent organisation be established, such as a National Dairy Board, to work with government institutions to develop and handle a database.

With regards to the establishment of a National Dairy Board, it is important to note that there have been several failed attempts over more than a decade. Such an initiative has also encountered hurdles in other countries of eastern Africa, even in countries with a much higher dairy production per cow (Kurwija & Bennett, 2011). Ironically, it is thought that inadequate data for policy makers to make evidence-based decisions resulted in failure to give permission for establishment of such an organisation. It has been observed that officials have questioned the purpose of establishing a dairy board in a country where there is no milk. As such, two important points were highlighted; i) there is a lack of reliable data on the performance of the dairy sector and the needs of the sector, in order to create the appropriate organisation, and ii) a variety of factors have held back the development of the sector, namely the lack of strong associations (producers cooperatives) that promote development, and the differing views on the role of government leadership.
There is scarce literature on the data needs of the dairy sector in Ethiopia, with most literature referring to the potential for dairy enterprise and those studies highlighting the challenges facing the sector (Guadu & Abebaw, 2016; Mihret et al., 2017; Minten et al., 2020; Ndambi et al., 2018; Yilma et al., 2011). A relatively recent study described the critical knowledge gap on these challenges, confirming the lack of research conducted on the difficulties and opportunities (Didanna et al., 2019). Similarly, a recent study at the International Livestock Research Institute (ILRI) highlighted a lack of market orientation, a lack of private sector investment, limited technical and financial capacity, weak market infrastructure and linkages across the value chain, and poor input and service delivery (Gebreyohannes et al., 2021). Minten et al. (2020) highlighted the requirement for ‘good data’ in order to understand patterns of transformation in the dairy sector.

The recent development of Livestock Master Plans of different LMICs, in collaboration with ILRI, has emphasized the growing need for data, both to develop the plans, and to monitor interventions to meet targets set out (https://www.ilri.org/livestock-master-plan).

The objective of this study was to establish the data needs of dairy sector stakeholders in Ethiopia, and to characterise them by data type, use and relevance to other stakeholders, as a fundamental priority for the sector as it seeks to respond to the rapidly growing demand for dairy products in Ethiopia.

Table 2. Summary of institutions and stakeholders in the dairy sector.

<table>
<thead>
<tr>
<th>Stakeholder / role player in dairy sector</th>
<th>Directorate / Institute</th>
<th>Centre</th>
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<tbody>
<tr>
<td>Ministry of livestock/agriculture</td>
<td>Dairy development directorate</td>
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<td></td>
<td>National Institute of Livestock Production (artificial insemination)</td>
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<td></td>
<td>Directorate of veterinary services</td>
<td>National animal health diagnostic centre</td>
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<td></td>
<td>Ethiopian Institute of Agricultural Research</td>
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<td></td>
<td>Regional Livestock Bureau</td>
<td>Regional veterinary laboratories</td>
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<td></td>
<td>Agricultural Transformation Agency (catalysing the GTP II and Livestock Master Plan transformative agenda)</td>
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<tr>
<td>Ministry of Health</td>
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<td>Ministry of Trade</td>
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<td>Ministry of Industry</td>
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<tr>
<td>Ethiopian Investment Commission</td>
<td>Ethiopian meat and dairy industry development institute</td>
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<tr>
<td>Ethiopian dairy producers association</td>
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<tr>
<td>Ethiopian milk processors association</td>
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<tr>
<td>Ethiopian animal feed industry association (EAPIA)</td>
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<td>Ethiopian veterinary association (EVA)</td>
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<td>Ethiopian Society of Animal Production (ESAP)</td>
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<tr>
<td>World Bank</td>
<td>Partnership for Artificial Insemination Delivery (PAID) project, via Land O’Lakes</td>
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<td></td>
<td>African Dairy Genetic Gains (ADGG) project</td>
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<tr>
<td>Smart Development Works (SNV) (International development agency engaged in Ethiopian dairy development)</td>
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<tr>
<td>USAID (International development agency engaged in Ethiopian dairy development)</td>
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<tr>
<td>Animal Health Research Institute (AHRI) (Ethiopian research institute)</td>
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<tr>
<td>New Zealand Government Diary Development project (International agency engaged in dairy product development)</td>
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</table>
It is important to ensure efficient use of data for evidence-based decisions, and as such there is the necessity of the public good nature of the collected data.

An initial stakeholder scoping and mapping process was conducted in order to identify the dairy value chain actors. Focus group discussions and key informant interviews were held. A two-day workshop followed, with focus group discussions, building on the mapping process, to allow identification and characterisation of both current and future data needs by types, availability, formats, level of detail, methods of dissemination, uptake and use, and different roles of public and private sectors in decision-making processes.

The methodology used in this study involved a process of deep engagement with the sector as a whole, and with representatives of different stakeholder clusters. This methodology could be adapted and utilised for similar undertakings in other countries, depending on existing realities on the ground. The methodology recognised the background of the team leader, as a facilitator with a long-standing understanding of Ethiopia’s agriculture and development, and the expertise of the Ethiopian scientists engaged in the study leadership team, and the focus on the needs of the Ethiopian dairy sector. It was important for local scientists to be involved, with robust understanding of the sector, the network of colleagues and institutions, and to give the study maximum ownership by Ethiopia; this was considered a key factor behind the success of the methodology used. All stakeholder groups indicated the requirement for both quantitative and qualitative data. Quantitative data were needed for planning and prioritisation, and qualitative data to provide indicators of trends. The groups indicated different methods of data collection to collect demand-driven and user-friendly data, available for use by different stakeholders in the dairy sector. Entrepreneurs (dairy input suppliers, service providers, producers, processors, distributors) required data for planning and timely decision making, in order to make their enterprises profitable. Researchers, investors, government and non-government development actors, academics, planners, policy-makers and the regulatory system required disaggregated data in the dairy sector, to accomplish their tasks. Overall, the needs across the different groups were found to be relatively homogenous, i.e. there was significant overlap across the groups. Some of the constraints and data needs (Table 1) had been reported previously by Beyu (2016), including inadequate animal health services and high drug costs, inadequate quality feed supplies, poor productivity and genetics, and weak development of dairy co-operatives. Tschopp et al. (2021) also recently highlighted the lack of dairy productivity data in Ethiopia. It was generally accepted that quality data had monetary value, and access to it could incur a cost; however, many believed, at this stage of development, that as much data as possible should be made freely available.

Huge data gaps were identified, in terms of sufficiency and consistency. There was a lack of disaggregation of breed information and a lack of clear productivity data. Animal health and disease data were considered to be poorly captured. Bottlenecks were discussed and included who should own and manage the data, linkages and communications between different data producers, coherence and complementarity amongst data producers, and accessibility of data. It was felt that the workshop provided a unique opportunity for stakeholder groups to discuss who could best serve as the designated body to address the data needs of the varying actors in the dairy sector.

It was thought that existing cooperatives are not effectively supporting the activity of their members. There is political motivation in cooperatives, with strong interference of government actors and challenges in the sector have not been addressed. Land access for the establishment of dairy farms was also discussed, with the acquisition of unoccupied land for dairying extremely challenging; government cannot provide enough land for dairy sector investment in agro-ecologically suitable, and economically feasible locations. As a result, shareholder agreements with smallholder farmers are often the only available option, converting land into dairy farming, or an out-grower scheme for forage production and related activities. Such challenges are constraining development of the sector and contributing to the bottlenecks in the realization of a National Dairy Board. Such a Board, however, could serve as a catalyst to explore some of the major challenges and develop viable solutions.

Sector-specific needs were identified and should be elevated in detail as they are currently somewhat generic, requiring further shaping within each stakeholder group. A proposal for the drafting of a national dairy sector policy was put forward by the dairy value chain office in the MoALR. It was recommended that this be followed up, ideally with funding to support the development, and to build on the products of this pilot study, in line with the Livestock Master Plan for Ethiopia.

Overall, based on the discussions, four alternative institutions were suggested to host (generate, manage, coordinate and communicate) the dairy database in Ethiopia, namely the National Animal Genetic Resources Improvement Institute (NAGII), the sector for livestock development under the MoALR, the Central Statistical Agency (CSA), and a proposed newly established National Dairy Board. Further study of these institutions is required, to understand in more detail their capacity and suitability to store, manage and dispense data to meet the different requirements in the country. Further data analyses and modelling could be of value in supporting evidence-based decision making for dairy sector development and will be explored by Livestock Data for Decisions (LD4D) data scientists, as one-off strategic technical support on design options.

It was recommended that every effort be put in to following up on the major outputs from the workshop, and that greater attention must be paid to building both horizontal and vertical links between stakeholder groups. There is, at present, a disconnect between the stakeholders, with no clear national leadership. It was proposed that the call for a National Dairy Board be reactivated and that such a body, independent of government but closely incorporating government, with the buy-in of private sector enterprises, would be likely to be seen as highly acceptable in the current political climate of Ethiopia. However, it
would be useful to mitigate the risks of lack of political will and government capture, and overcome previous failures in the establishment of a National Dairy Board; this would likely entail some political economic analysis and recommended engagement with key actors based on the findings. The output from this study should form a sound base on which to develop a new submission to government for the creation of such a board. The dairy value chain office in the MoALR proposed the drafting of a national dairy sector policy and it is recommended that this suggestion be followed up, ideally with funding to support this development, and to build on the products of this study, in line with the Livestock Master Plan for Ethiopia.

It was recommended that all stakeholder groups should provide relevant and specific information to their constituents for informed decision making, to increase output, streamline operations, and minimise cost. Greater attention should be paid to the roles that different data play in informing and influencing proactive policies for the dairy sector. A national roll out of herd-specific data recording schemes for the emerging dairy sector was recommended, considering the example provided by the NAGII in the genetics component, and expanding it to encompass health, feed, and other input services to provide effective evidence-based extension services to dairy farmers.

Limitations

The under-representation of women in the workshop resulted in the dominance of male participants in the discussions, which does not help to redress the balance in establishing the priorities of both male and female dairy farmers. There was also the potential for the most well-known/articulated stakeholders to dominate discussions. Attempts to mitigate this potential bias were made by recruiting as wide a range of participants and stakeholders as possible.

Conclusion

The study provided a timely discussion with and between diverse stakeholder groups involved in the dairy industry in Ethiopia, including policy makers, producers, processors, service providers, and researchers. The products on data needs represented a broad set of groups within each of these categories, including regional perspectives in Tigray and SNNPR.

From the study, several potential organisations were suggested to host and manage a national dairy database. Importantly, the establishment of a National Dairy Board was strongly endorsed. The long-term sustainability of any new institutional arrangements need to be considered in addition to the functionality and business approach advocated by many of the stakeholders. It would be worth conducting a SWOT analysis on the establishment of a Dairy Board, to clearly identify the strengths, weaknesses, opportunities and threats, and engaging multiple stakeholders in this process. It was recommended that stakeholder links be established, sector-specific data needs be elevated to higher detail, and a national roll out of herd-specific data recording schemes was called for, to allow for effective evidence-based policies and decision making.

Data availability

Underlying data
Harvard Dataverse: Replication Data for: A pilot study of the data demands of different stakeholders for the future Ethiopian dairy sector https://doi.org/10.7910/DVN/PMKXOQ”
https://doi.org/10.7910/DVN/PMKXOQ (Allan, 2022)

This project contains the following underlying data:

- FINAL_Interviews with Stakeholders.pdf

Due to the full data containing identifiable information, it has not been made publicly available. Researchers in a similar field can request further details of the interviews and discussions from the corresponding author, prof.brianperry@gmail.com.

Extended data
Harvard Dataverse: Replication Data for: A pilot study of the data demands of different stakeholders for the future Ethiopian dairy sector https://doi.org/10.7910/DVN/PMKXOQ”
https://doi.org/10.7910/DVN/PMKXOQ (Allan, 2022)

This project contains the following extended data:

- Participant invite with workshop itinerary.pdf
- Checklist for Ethiopian Dairy Sector Needs Workshop.pptx
- Anonymous_Report_Dairy data needs workshop.pdf

Data are available under the terms of the Creative Commons Zero “No rights reserved” data waiver (CC0 1.0 Public domain dedication).

Acknowledgements

This study was undertaken with the support of the Bill and Melinda Gates Foundation (BMGF) and Supporting Evidence-Based Interventions (SEBI) at the University of Edinburgh, and in collaboration with the Ethiopian Ministry of Agriculture and Livestock, and the Ethiopian Agricultural Transformations Agency (ATA).

We acknowledge the substantial contributions made by Ethiopian government and private sector stakeholder representatives during the course of the study, and in the workshop process.

Author contributions

Conceptualisation: BP, KS, AP

Methodology: BP, YA, SH, GL, AP, AT

Formal analysis and investigation: BP, YA, AT, SH, GL, FA

Writing - original draft preparation: BP, YA, SH, GL, KS, FA

Writing - review and editing: BP, YA, SH, GL, KS, AP, FA

Funding acquisition: KS, AP
References

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Open Peer Review

Current Peer Review Status: ✔️ ✔️ ✔️

Version 3

Reviewer Report 04 August 2022

https://doi.org/10.21956/gatesopenres.15035.r32351

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✔️ Ulf Magnusson
Department of Clinical Science, Swedish University of Agricultural Science, Uppsala, Sweden

I appreciate the responses from the authors.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Veterinary medicine - infectious diseases and reproduction, sustainable livestock production in LMICs

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Version 2

Reviewer Report 19 July 2022

https://doi.org/10.21956/gatesopenres.14943.r32208

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✔️ Gizat Almaw
1 Animal Health Institute, Sebeta, Ethiopia
2 Animal Health Institute, Sebeta, Ethiopia

Overall the study is sound and relevant in that it has identified an important gap/s in the dairy sector of Ethiopia. However, suggestions are forwarded to improve the paper.
Introduction

The argument/hypothesis for conducting this study needs to be stronger. The authors have provided adequate background on the challenges Ethiopia’s dairy sector is facing. However, how the data need and application fit into these challenges is not detailed/addressed. Also good the authors provide background on the experiences of data use and application elsewhere with due emphasis on LMICs and present this in perspective with the Ethiopia dairy sector. The CSA of Ethiopia every year conducts an agricultural sample survey including livestock and the data is freely available. The limitation/s of this database with regard to the dairy sector needs to be also highlighted. The scope of the study needs to be clear. Does it apply to all dairy farming systems including the pastoral production system? From the identified clusters it looks pastoral system was not part.

Study design

The approach for stakeholder mapping and cluster identification needs additional clarification. Was it purposive or convenient? Was the geographic spread following the milk sheds or other criteria? Only two regional states were represented. What was the reason for this? Good authors provide additional information for the readers about how stakeholders/areas were selected.

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Not applicable

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Bovine Tuberculosis

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.
Dear Reviewer,

We sincerely thank you for your time and effort in providing expert assessment of our manuscript. There are constructive points raised which we have considered and hope that we have addressed suitably. Responses to comments are listed in italic font below, with additions and amendments highlighted in bold.

1. Introduction: The argument/hypothesis for conducting this study needs to be stronger. The authors have provided adequate background on the challenges Ethiopia’s dairy sector is facing. However, how the data need and application fit into these challenges is not detailed/addressed.

   The data needs role is stated with regard to the multiple targets set by the Livestock Development plan (last paragraph of Introduction).

2. Also, could the authors provide background on the experiences of data use and application elsewhere with due emphasis on LMICs and present this in perspective with the Ethiopia dairy sector.

   We will add to the manuscript, at the end of the first paragraph of the Discussion: The recent development of Livestock Master Plans of different LMICs, in collaboration with ILRI, has emphasized the growing need for data, both to develop the plans, and to monitor interventions to meet targets set out (https://www.ilri.org/livestock-master-plans).

3. The CSA of Ethiopia every year conducts an agricultural sample survey including livestock and the data is freely available. The limitation/s of this database with regard to the dairy sector needs to be also highlighted.

   We will add to the manuscript, in paragraph 2 of ‘Where a dairy sector database should be housed and managed’, after ‘...also suggested CSA: This would improve on the current sample survey data approach.

4. The scope of the study needs to be clear. Does it apply to all dairy farming systems including the pastoral production system? From the identified clusters it looks pastoral system was not part.

   While the study reviews the national needs, the available time and funds limited the geographical scope of the in-depth analysis. Pastoral systems were not visited specifically. This was potentially compensated by the wide range of stakeholder engagement in the discussions and workshop. One of the authors (Yacob) has extensive experience in pastoral systems, and brought that knowledge (and institutional connections) to the table.

5. Study design: The approach for stakeholder mapping and cluster identification needs additional clarification. Was it purposive or convenient? Was the geographic spread
following the milk sheds or other criteria? Only two regional states were represented. What was the reason for this? Good authors provide additional information for the readers about how stakeholders/areas were selected.

_The study was purposive, as set out in the methodology. The geographic spread covered a) the major consumption centre, the Addis Ababa region, b) one of the recognised production areas (SNNPR), and c) Tigray, an example of regional differences in demand and production_  

_We will add to the manuscript, in Study Design: “The purposive study....”_

**Competing Interests:** No competing interests were disclosed.
Under “Literature review”: the documents made available in Ethiopia; what kind? Governmental reports, other grey literature – is it possible to specify?

“Stakeholder scoping and mapping”: The list of stakeholder cluster seems to be a mix of kinds of stakeholders (e.g. Gov) and topics (e.g. feed) – is it possible to make this more systematic/consistent?

Likely it would be helpful for the reader to have a diagram that provides an overview of the flow of the information and discussions feeding into the conclusions of the study. That is; literature review, focus group discussions, interviews, and the stakeholder workshop including the number and categories of persons approached/involved.

Results:

- Literature review, aren’t the challenges already presented in the very first paragraph of the MS (i.e. the references Yilma and Gaudu & Abebaw)? It becomes a kind of circular writing.
- Stakeholder interaction: is the travel by the team relevant to state – isn’t it the face-to face dialogues that are important?
- Data needs: What does the “methodological approach” mean?
- Table 1. “stakeholder clusters”, again this seems to be a mix of topics/issues and other aspects in the columns “Category” and “Subcategory”, not really stakeholders like Gov, NGOs, farmers organisations, commercial suppliers… Moreover, it is doubtful that the shading of every second row adds clarity to the table.
- Table 2. Several of the stakeholders’ names are very descriptive regarding their role, however, others – the foreign – are not. It would be helpful if the latter could be given some explanation of their role (like for BMGF).

Discussion

- 3rd paragraph, isn’t this very much a repetition of the result and material and methods section?
- Rightly, data management and availability are elaborated on by the authors in several parts of the discussion. Based on the experience from other countries this might be a bottleneck for efficient use of data for evidence-based decisions, so it is recommended that the authors stress the necessity of the public goods nature of the collected data.

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Partly
If applicable, is the statistical analysis and its interpretation appropriate?  
Not applicable

Are all the source data underlying the results available to ensure full reproducibility?  
Yes

Are the conclusions drawn adequately supported by the results?  
Yes

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Veterinary medicine - infectious diseases and reproduction, sustainable livestock production in LMICs

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

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Author Response 22 Jul 2022

Fiona Allan

Dear Reviewer,

We sincerely thank you for your time and effort in providing expert assessment of our manuscript. There are constructive points raised which we have considered and hope that we have addressed suitably.

Responses to comments are listed in italic font below, with additions and amendments highlighted in bold.

1. Studies like the current one – a multi-stakeholder approach to identify data demands for development of the livestock sector in low-income countries – are dearly needed and applaudable. Given the inherited qualitative aspect of such studies, they are however at risk for biases, particularly “the usual-suspect-syndrome” in which the most well-known/articulated stakeholders dominate. In the current study have the authors, however, made reasonable efforts to mitigate this bias. Still, it would be appropriate to mention this risk under the “Limitations“-heading together with the gender bias.

*This comment is understood, and yes, the authors made considerable efforts to mitigate this potential bias. We will add to the manuscript, in the Limitations paragraph:*

*There was also the potential for the most well-known/articulated stakeholders to dominate discussions. Attempts to mitigate this potential bias were made by recruiting as wide a range of participants and stakeholders as possible.*

2. It might not be understood for all readers of the introduction that cross-bred dairy cows are more productive (if appropriately fed and kept healthy) than the indigenous
breeds.

We will add to the manuscript, in the Introduction paragraph 3, after 'These cattle also have a short lactation length of about 150 days (Tegenge, 2018).

**Cross bred cattle, in comparison, produce 10-15 litres per day and have a lactation period of around 300 days (Zilsta et al., 2015).**

3. In the last sentence of the first paragraph, consider replacing “reproductive challenges” with “reproductive disorders” to avoid repeating “challenges”.

We will amend this in the manuscript

4. Under “Study design”, is it relevant to tell about the first author’s 50 years of experience in Ethiopia as the team is a mix of Ethiopian and UK nationals

Interesting question! The other UK nationals are from SEBI, specialising in data needs, the first author was responsible for study design and interaction with different institutions, for which a long-standing knowledge of the country was seen to be an advantage, and endorse credibility.

We will replace 50 years with long-standing experience.

5. Under “Literature review”: the documents made available in Ethiopia; what kind? Governmental reports, other grey literature – is it possible to specify?

We will add to the manuscript ‘documents were made available to the team in Ethiopia, including non-published governmental and grey literature reports

6. “Stakeholder scoping and mapping”: The list of stakeholder cluster seems to be a mix of kinds of stakeholders (e.g. Gov) and topics (e.g. feed) – is it possible to make this more systematic/consistent?

We believe the manuscript does list in a clear systematic manner; Producers, processers, services (health, feed, breeding), government agencies, etc.

7. Likely it would be helpful for the reader to have a diagram that provides an overview of the flow of the information and discussions feeding into the conclusions of the study. That is; literature review, focus group discussions, interviews, and the stakeholder workshop including the number and categories of persons approached/involved.

As above, we feel this information is already presented in a systematic manner

8. Results: Literature review, aren’t the challenges already presented in the very first paragraph of the MS (i.e. the references Yilma and Gaudu & Abebaw)? It becomes a kind of circular writing.
We were advised by an editor to cite some of the literature as findings/results of the literature review.

9. Stakeholder interaction: is the travel by the team relevant to state – isn't it the face-to-face dialogues that are important?

Travel is relevant in that it describes regional differences in stakeholder categories, and in regional differences in importance of the dairy sector. Travel was required in order to establish the face-to-face dialogues.

10. Data needs: What does the “methodological approach” mean?

This was in response to Reviewer #1 who asked for clarification on whether the synthesis was part of methods or impromptu i.e. the approach was methodological, with refinement.

11. Table 1. “stakeholder clusters”, again this seems to be a mix of topics/issues and other aspects in the columns “Category” and “Subcategory”, not really stakeholders like Gov, NGOs, farmers organisations, commercial suppliers... Moreover, it is doubtful that the shading of every second row adds clarity to the table.

We will add to table caption, “…different stakeholder clusters and data categories…”. We can request the shading be removed (this was added by the journal).

12. Table 2. Several of the stakeholders’ names are very descriptive regarding their role, however, others – the foreign – are not. It would be helpful if the latter could be given some explanation of their role (like for BMGF).

We will add a basic description to the stakeholders:

SNV (International development agency engaged in Ethiopian dairy development)

USAID (International development agency engaged in Ethiopian dairy development)

AHRI (Ethiopian research institute)

New Zealand Government Dairy Development project (International agency engaged in dairy product development)

13. Discussion: 3rd paragraph, isn't this very much a repetition of the result and material and methods section?

This was intended as a brief reminder/summary of the study.

14. Rightly, data management and availability are elaborated on by the authors in several parts of the discussion. Based on the experience from other countries this
might be a bottleneck for efficient use of data for evidence-based decisions, so it is recommended that the authors stress the necessity of the public goods nature of the collected data.

This can be stressed. We will add to the end of the second paragraph of the discussion: It is important to ensure efficient use of data for evidence-based decisions, and as such, there is a necessity of the public good nature of the collected data.

**Competing Interests:** No competing interests were disclosed.
Yes

**Are all the source data underlying the results available to ensure full reproducibility?**
Yes

**Are the conclusions drawn adequately supported by the results?**
Yes

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Randolph: Animal health and policy economics; Omore: Veterinary epidemiology and economics

We confirm that we have read this submission and believe that we have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

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**Version 1**

Reviewer Report 09 May 2022

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Review of A pilot study of the data demands of different stakeholders for the future Ethiopian dairy sector. Perry et al.

**Approved with Suggestions:** The reviewers believe the paper has academic merit but have asked for a number of small changes to the article, or specific, sometimes more significant revisions.

Questions specific to a research article:
  - Is the work clearly and accurately presented and does it cite the current literature?  
  Partly. The article includes a review of the literature that cites what is currently available regarding
the sector, including unpublished reports that are relevant. However, it would benefit by acknowledging literature regarding the methodology in the context of information sciences. An additional reference to cite is the 2011 FAO report on ‘Dairy Development Institutions in East Africa - Lessons learnt and options’ with experiences on roles of dairy boards in the region that may be relevant as benchmarks in facilitating dairy knowledge and information systems. The authors could perhaps go further to look at performance of dairy boards in other LMICs in this respect (e.g., India?). The experiences might help the authors to re-evaluate the risk associated with the key recommendation of (re-) establishing a dairy board in Ethiopia to play similar roles. I guess the report is available from FAO’s repository.

- Is the study design appropriate and does the work have academic merit?
  Yes, on both counts. The article describes a participatory process for assessing data needs that is appropriate for the objective of strengthening sectoral capacity within a country. It has academic merit in terms of describing a process relevant elsewhere, providing a novel focus on an information sciences issue relevant to development. It could be strengthened from an academic perspective in terms of (1) establishing its fit in information sciences; (2) evaluation of strengths and weaknesses – as noted in the methods section, but not followed up in the results or discussion sections – or lessons learned during the study, beyond the results achieved specific to the Ethiopian context; and (3) displaying more fully the results consistent with the study objective, especially with respect to relevance of different types of data to the various stakeholders.

- Are sufficient details of methods and analysis provided to allow replication by others?
  Yes, the method in terms of process is well described, including the development of the data collection instrument in the form of an interview check-list. The study basically stops at the collection of data and the participatory review and could offer more in terms of how the data can be effectively analysed to inform next steps and what principles to apply to such an analysis.

- If applicable, is the statistical analysis and its interpretation appropriate?
  Not applicable.

- Are all the source data underlying the results available to ensure full reproducibility?
  Yes, the interview check-list and stakeholder workshop invitation are provided. Could be strengthened by: (1) a more detailed description of how the individual workshop sessions were conducted; and (2) referencing a workshop report that would serve as confirmation and a record of the recommendations agreed by the participants.

- Are the conclusions drawn adequately supported by the results?
  Partly. The conclusions report the general recommendations emerging from the participatory process and are consistent with the account provided by the study authors. It is not clear, though, whether the recommendations represent the explicit recommendations representing the consensus of the workshop participants – which would benefit from reference to a workshop report – or also the recommendations of the study authors: it would be useful to clarify this point. Also, importantly, the discussion and conclusions do not address risks associated with the recommendations especially in terms of repeating previous failures, including ‘who pays, who benefits?’ and potential for un-intended consequences (as have occurred in neighbouring Kenya). In particular, the risk of lack of political will – often a threat – merits highlighting going by the experiences from Tanzania and Kenya. The stakeholder ambition to have a strong autonomous dairy board in Tanzania that could play this role was thwarted at the last minute without further reference to them. Clauses in the dairy bill that envisaged autonomy and a stakeholder driven dairy board were quashed by the government before its enactment, resulting in a body that is essentially a government agency. This is the reason stakeholders started to pursue a different private sector driven approach – the Dairy Development Forum - to fulfil their initial ambitions.
More attention should be given to why the proposed ambitious data collection systems would be expected to achieve wider uptake and be sustained.

**Review**
This study addresses the critical need for data to inform dairy development in Ethiopia by describing a process for assessing those needs and related capacities across the range of relevant actors in the dairy sector. In addition to confirming stakeholder recognition of the need for such data, the process facilitated stakeholder identification of a strategy to begin addressing the needs by establishing a national dairy board that could offer a role in taking responsibility for coordinating the various interests and capacities across the sector, recognizing the risk that it could be captured by government interests. The contribution of the study is therefore to provide a methodology and an example of its application as a participatory process to strengthen sectoral data generation and management that can be replicated for other contexts, whether geographically or for other sectors.

The study would be further strengthened from addressing four key areas:
- The study approaches the data issue as a development problem, using a review of literature to justify the data issue as a major constraint to dairy development in Ethiopia. It should also recognize that the data issue falls into the domain of information sciences – not necessarily to do an extensive literature review, but to at least acknowledge there is a relevant literature there, too.

- The objective of the study is “to establish the data needs of dairy sector stakeholders in Ethiopia, and to characterize them by data type, use and relevance to other stakeholders, as a fundamental priority for the sector as it seeks to respond to the rapidly growing demand for dairy products in Ethiopia.” Data presented in the article is limited to a list of data needs and a list of dairy sector stakeholders. These are very useful as baseline information but do not cover the more specific data that appears to have been collected regarding data type, use and relevance to the various stakeholders. A summary of these findings would be expected to be presented as part of the article to serve as a critical starting point for the follow-up analysis and actions recommended by the study. If this information was indeed collected, either Table 1 or Table 2 could be expanded to provide more detail about the type of data (scope or resolution, frequency) and relevance to each stakeholder group. Also consider elaborating the purpose bullets in the methods section on a) ‘strengths and weaknesses of existing data and data sources’, and b) ‘capacity building needs for better future services’ where it appears the role of the dairy board is envisaged.

- The Results section of the article mentions that “there have been several failed attempts” presumably referring to establishing a national dairy board. One of the reviewers is familiar with such a failed attempt a decade earlier as part of the USAID funded ILRI/ASARECA work to harmonize dairy policies in eastern Africa. Ethiopia was dropped half-way through the process because stakeholders could not hold a national meeting to consider proposals if such a consultation was not driven by government. This suggests that there is a significant risk of history repeating itself if the recommendation to reactivate a national dairy board is followed blindly. It would therefore be important to characterize this risk more fully and consider the factors that could undermine or strengthen the sustainability of both the dairy board and the various data collection efforts proposed. There would be value to some additional discussion of the costs and benefits of the dairy board and the data collection
efforts from the perspectives of the different stakeholder groups to qualify what otherwise might be viewed as a high-risk recommendation. An additional reference to cite in this regard is the 2011 FAO report on ‘Dairy Development Institutions in East Africa - Lessons learnt and options’ with experiences on roles of dairy boards in the region that may be relevant as benchmarks in facilitating dairy knowledge and information systems. The authors could perhaps go further to look at performance of dairy boards in other LMICs in this respect (e.g., India?). The experiences might help the authors to re-evaluate the risk associated with the key recommendation of (re-) establishing a dairy board in Ethiopia to play similar roles.

- It would be useful if to clarify which analyses and recommendations were generated by the participatory process during the workshop and which were provided by the authors themselves.

More specific suggestions:

Title
The authors may want to consider having the participatory process dimension of the study captured more explicitly in the title and objectives.

Introduction
It would be helpful to explain apparent inconsistencies in bullets in the Introduction and later text between:

- “Milk production is predicted to increase from 167 million to 1,490 million litres” and “Combined interventions are predicted to result in a 93% increase in milk production, from 4,132 to 7,967 million litres”
- “GDP contribution from dairy will increase from Ethiopian Birr (ETB) 1.1 billion to 10.0 billion” and “Increased contribution of cow milk to GDP from ETB 28 billion to 52.9 billion”

Would help to clarify what is meant by “Combined interventions” in the sentence quoted in the preceding bullet.

The initial Purpose statement “By establishing the data needs of stakeholders, priorities and recommendations could be made for how best to develop the dairy sector of Ethiopia” looks to be more about priorities and recommendations for how data can be generated and managed that would best support dairy sector development rather than directly deciding the development strategy.

Constraints from Yilma et al 2011 are cited in one sentence, then the following sentence cites the FAO (Yilma et al 2011) study as if it is a new reference being introduced. It would make sense to consolidate the information from the FAO study in one sentence.

Methods
For “Clusters were identified by defining the dairy value chains in Ethiopia”, suggest something like “stakeholder clusters were identified according to key roles undertaken by the various actors with dairy value chains in Ethiopia.”

“Contact details were provided by the stakeholders in each of the clusters” could be interpreted as raising an ethics concern, especially given the subsequent GDPR requirements. Could perhaps add that as an issue to help justify the appropriateness of the ethics approval.
“Local authors provided lists of suitable participants, based on their local knowledge.” Consistent with other statements about potential bias, it would be useful to explain whether there was potential for bias to be introduced here.

Eight clusters listed initially, but workshop refers to five stakeholder groups: would be helpful to note and explain the change.

The structure is a bit confusing after “The groups were asked to identify the different data needs, consolidating them under the following headings”: some of the bullets are repeated in the following paragraphs, some are not. Would be useful to clarify the distinction between the bullets and three subsequent paragraphs.

“Synthesis of outcomes: .... Relevant policy makers were consulted on the findings and plans.” Merits brief explanation why policy makers were targeted rather than all stakeholders.

**Results**

Stakeholder interactions: starts by repeating information relevant to the methods section, which could be reduced. Would benefit from more evaluation of how it was implemented compared to the design/plan, e.g., adaptations, challenges.

Composition data are presented for the pre-workshop interviews; it would be useful to have workshop participant numbers also presented by cluster/stakeholder group.

Data needs: not clear if synthesis was part of methods or impromptu; it would be useful to have more clarity of any changes made in the method and what the results revealed. Alignment of this and subsequent paragraphs with the headings and the bullets in the methods section may also improve clarity.

Table 1: It is stated in the text that “The objective of this study was to establish the data needs of dairy sector stakeholders in Ethiopia, and to characterize them by data type, use and relevance to other stakeholders, as a fundamental priority for the sector as it seeks to respond to the rapidly growing demand for dairy products in Ethiopia.” Results are not presented, though, regarding the “relevance to other stakeholders”. Table 1 could be expanded to include this information with extra columns noting which stakeholder group may have expressed the need and which other stakeholder groups find it relevant – as critical information when designing data collection/coordination mechanisms. Or in Table 2, indicated which data categories were considered a priority for each stakeholder.

If any information was collected on how to overcome weaknesses in the institutions in playing their roles, this should also be reported.

Would be useful to cite some examples of “evidence-based decisions” and by which stakeholder.

Data use: “They were also used for proper monitoring and evaluation by the regulatory system” Would be useful to cite a couple of examples of what this might refer to.

Data collection: “... and general principles of seeking permission of owners/creators of data to acknowledge data sources in any form of use.” Incomplete, missing something like ‘would apply’
or ‘would need to be respected’.

Institutional arrangements Table 2: While the actors are listed, it would be useful to have a sense of the role they seem themselves or others see them playing within the sector (and were these the same?), and possibly clustering them in the table accordingly. Presumably, this type of information would have been collected and validated during the workshop. It would also be useful to report in the table any relevant strengths and weaknesses for the individual institutions identified by the stakeholders.

There appears to be repetition between the paragraph entitled Where a dairy sector database should be housed and managed and the second paragraph preceding it: both discuss candidate institutions for housing the database and so should be merged.

Housing a database: “…it was intended to establish a unit within the sector for livestock resources, to handle the dairy database.” Would be good to clarify who has the intention and if the MoALR, would they establish it within the ministry or just somewhere ‘within the sector’?

“… there have been several failed attempts” Presumably refers to establishing some type of a national dairy board, but would be good to specify for sake of clarity. Also would be useful to clarify who made the attempts.

“… a variety of factors have held back the development of the sector, namely strong associations (producers cooperatives) that support development, and challenges in access to land.” Suggests strong associations have held back development; or was it meant to be ‘lack of strong associations’?

Discussion

“Sector-specific needs were identified and should be elevated in detail as they are currently somewhat generic, requiring further shaping within each stakeholder group” Not sure what ‘elevated in detail’ means.

“… the sector for livestock development under the MoALR” What is a sector under a ministry? Sounds like a unit or equivalent to the other agencies.

“… a newly established National Dairy Board” implies it already exists. Should it be: ‘proposed’?

“Further data analyses and modelling could be of value in supporting evidence-based decision making for dairy sector development and will be explored by Livestock Data for Decisions (LD4D) data scientists.” Would be useful to clarify how this fits with the focus on creating sustainable domestic institutional capacity – should it be more explicitly framed as a one-off strategic technical support or input for designing?

Some of the workshop recommendations might be interpreted as ‘wishlist’ expressions of ‘want’ as sometimes come out of such workshops. The Discussion is meant to be more analytical, so is it possible to help the reader distinguish?

Focus in the Discussion is on establishing a new entity, but with little attention or analysis of its potential to be sustained. It would benefit from more discussion around the information
collected/results and action needed that would support addressing sustainability issues during the design, especially given the comment made about previous failed attempts.

**Conclusion**

“... reactivation of a national dairy board was strongly endorsed.” This implies one had existed; it would be useful to clarify whether one previously established that was being reactivated, or whether it was the proposal for one that was being reactivated.

While the recommendation to re-establish a national dairy board is ‘likely to be seen as acceptable in the current political climate’ as noted by the authors, it would be useful to consider a recommendation that would mitigate the risks of lack of political will and government capture and overcome previous failures to establish such a body. This might entail some political economy analysis and recommended engagement with key actors based on the findings.

Again, the Conclusion seems to assume ‘build it and they will come’, i.e. assuming roll-out will automatically ensure uptake and sustainability. It would be useful to flag any risks and highlight what is needed to avoid repeating earlier failed attempts.

**References**


**Is the work clearly and accurately presented and does it cite the current literature?**

Partly

**Is the study design appropriate and is the work technically sound?**

Yes

**Are sufficient details of methods and analysis provided to allow replication by others?**

Yes

**If applicable, is the statistical analysis and its interpretation appropriate?**

Not applicable

**Are all the source data underlying the results available to ensure full reproducibility?**

Yes

**Are the conclusions drawn adequately supported by the results?**

Partly

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Randolph: Animal health and policy economics; Omore: Veterinary epidemiology and economics

We confirm that we have read this submission and believe that we have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however we have
significant reservations, as outlined above.

Fiona Allan

20th May 2022

Dear Reviewers,

We sincerely thank you for your time and effort in providing an expert assessment of our manuscript. There are many constructive points raised that we have considered and hope that we have addressed suitably.

Response to comments are listed in italic font below, with additions and amendments highlighted in bold.

Review of A pilot study of the data demands of different stakeholders for the future Ethiopian dairy sector. Perry et al.

Approved with Suggestions: The reviewers believe the paper has academic merit but have asked for a number of small changes to the article, or specific, sometimes more significant revisions.

Questions specific to a research article:

○ Is the work clearly and accurately presented and does it cite the current literature?

Partly. The article includes a review of the literature that cites what is currently available regarding the sector, including unpublished reports that are relevant. However, it would benefit by acknowledging literature regarding the methodology in the context of information sciences. An additional reference to cite is the 2011 FAO report on ‘Dairy Development Institutions in East Africa - Lessons learnt and options’ with experiences on roles of dairy boards in the region that may be relevant as benchmarks in facilitating dairy knowledge and information systems.¹ The authors could perhaps go further to look at performance of dairy boards in other LMICs in this respect (e.g., India?). The experiences might help the authors to re-evaluate the risk associated with the key recommendation of (re-) establishing a dairy board in Ethiopia to play similar roles. I guess the report is available from FAO’s repository.

○ Is the study design appropriate and does the work have academic merit?

Yes, on both counts. The article describes a participatory process for assessing data needs that is appropriate for the objective of strengthening sectoral capacity within a country. It has academic merit in terms of describing a process relevant elsewhere, providing a novel focus on an information sciences issue relevant to development. It could be strengthened from an academic perspective in terms of (1) establishing its fit in information sciences; (2) evaluation of strengths and weaknesses – as noted in the methods section, but not followed up in the results or discussion sections – or lessons learned during the study, beyond the results achieved specific to the Ethiopian context; and (3) displaying more fully the results consistent with the study objective, especially with respect to relevance of different types of data to the various stakeholders.

○ Are sufficient details of methods and analysis provided to allow replication by others?
Yes, the method in terms of process is well described, including the development of the data collection instrument in the form of an interview check-list. The study basically stops at the collection of data and the participatory review and could offer more in terms of how the data can be effectively analysed to inform next steps and what principles to apply to such an analysis.

- If applicable, is the statistical analysis and its interpretation appropriate?
  - Not applicable.
- Are all the source data underlying the results available to ensure full reproducibility?
  - Yes, the interview check-list and stakeholder workshop invitation are provided. Could be strengthened by: (1) a more detailed description of how the individual workshop sessions were conducted; and (2) referencing a workshop report that would serve as confirmation and a record of the recommendations agreed by the participants.

**We can provide an anonymised workshop report if required.**

- Are the conclusions drawn adequately supported by the results?
  - Partly. The conclusions report the general recommendations emerging from the participatory process and are consistent with the account provided by the study authors. It is not clear, though, whether the recommendations represent the explicit recommendations representing the consensus of the workshop participants – which would benefit from reference to a workshop report – or also the recommendations of the study authors: it would be useful to clarify this point. Also, importantly, the discussion and conclusions do not address risks associated with the recommendations especially in terms of repeating previous failures, including 'who pays, who benefits?' and potential for unintended consequences (as have occurred in neighbouring Kenya). In particular, the risk of lack of political will – often a threat – merits highlighting going by the experiences from Tanzania and Kenya. The stakeholder ambition to have a strong autonomous dairy board in Tanzania that could play this role was thwarted at the last minute without further reference to them. Clauses in the dairy bill that envisaged autonomy and a stakeholder driven dairy board were quashed by the government before its enactment, resulting in a body that is essentially a government agency. This is the reason stakeholders started to pursue a different private sector driven approach – the Dairy Development Forum - to fulfil their initial ambitions. More attention should be given to why the proposed ambitious data collection systems would be expected to achieve wider uptake and be sustained.

**Review**

This study addresses the critical need for data to inform dairy development in Ethiopia by describing a process for assessing those needs and related capacities across the range of relevant actors in the dairy sector. In addition to confirming stakeholder recognition of the need for such data, the process facilitated stakeholder identification of a strategy to begin addressing the needs by establishing a national dairy board that could offer a role in taking responsibility for coordinating the various interests and capacities across the sector, recognizing the risk that it could be captured by government interests. The contribution of the study is therefore to provide a methodology and an example of its application as a participatory process to strengthen sectoral data generation and management that can be replicated for other contexts, whether geographically or for other sectors.
The study would be further strengthened from addressing four key areas:

- The study approaches the data issue as a development problem, using a review of literature to justify the data issue as a major constraint to dairy development in Ethiopia. It should also recognize that the data issue falls into the domain of information sciences – not necessarily to do an extensive literature review, but to at least acknowledge there is a relevant literature there, too.

- The objective of the study is “to establish the data needs of dairy sector stakeholders in Ethiopia, and to characterize them by data type, use and relevance to other stakeholders, as a fundamental priority for the sector as it seeks to respond to the rapidly growing demand for dairy products in Ethiopia.” Data presented in the article is limited to a list of data needs and a list of dairy sector stakeholders. These are very useful as baseline information but do not cover the more specific data that appears to have been collected regarding data type, use and relevance to the various stakeholders. A summary of these findings would be expected to be presented as part of the article to serve as a critical starting point for the follow-up analysis and actions recommended by the study. If this information was indeed collected, either Table 1 or Table 2 could be expanded to provide more detail about the type of data (scope or resolution, frequency) and relevance to each stakeholder group. Also consider elaborating the purpose bullets in the methods section on a) ‘strengths and weaknesses of existing data and data sources’, and b) ‘capacity building needs for better future services’ where it appears the role of the dairy board is envisaged.

- The Results section of the article mentions that “there have been several failed attempts” presumably referring to establishing a national dairy board. One of the reviewers is familiar with such a failed attempt a decade earlier as part of the USAID funded ILRI/ASARECA work to harmonize dairy policies in eastern Africa. Ethiopia was dropped half-way through the process because stakeholders could not hold a national meeting to consider proposals if such a consultation was not driven by government. This suggests that there is a significant risk of history repeating itself if the recommendation to reactivate a national dairy board is followed blindly. It would therefore be important to characterize this risk more fully and consider the factors that could undermine or strengthen the sustainability of both the dairy board and the various data collection efforts proposed. There would be value to some additional discussion of the costs and benefits of the dairy board and the data collection efforts from the perspectives of the different stakeholder groups to qualify what otherwise might be viewed as a high-risk recommendation. An additional reference to cite in this regard is the 2011 FAO report on ‘Dairy Development Institutions in East Africa - Lessons learnt and options’ with experiences on roles of dairy boards in the region that may be relevant as benchmarks in facilitating dairy knowledge and information systems. The authors could perhaps go further to look at performance of dairy boards in other LMICs in this respect (e.g., India?). The experiences might help the authors to re-evaluate the risk associated with the key recommendation of (re-) establishing a dairy board in Ethiopia to play similar roles.

- It would be useful if to clarify which analyses and recommendations were generated by the participatory process during the workshop and which were provided by the authors themselves.

*Recommendations were those of participants.*
More specific suggestions:

**Title**
The authors may want to consider having the participatory process dimension of the study captured more explicitly in the title and objectives. 
*We will change the manuscript title to “A multi-stakeholder participatory pilot study of the data demands of the future Ethiopian dairy sector”.*

**Introduction**
It would be helpful to explain apparent inconsistencies in bullets in the Introduction and later text between:

- We will change the manuscript to keep “Milk production is predicted to increase from 167 million to 1,490 million litres” and remove “Combined interventions are predicted to result in a 93% increase in milk production, from 4,132 to 7,967 million litres”
- We will change the manuscript to keep “GDP contribution from dairy will increase from Ethiopian Birr (ETB) 1.1 billion to 10.0 billion” and remove “Increased contribution of cow milk to GDP from ETB 28 billion to 52.9 billion”.

Would help to clarify what is meant by “Combined interventions” in the sentence quoted in the preceding bullet. 
*We will delete this from the manuscript (as above).*

The initial Purpose statement “By establishing the data needs of stakeholders, priorities and recommendations could be made for how best to develop the dairy sector of Ethiopia” looks to be more about priorities and recommendations for how data can be generated and managed that would best support dairy sector development rather than directly deciding the development strategy.

*We will change the manuscript to “By establishing the data needs of stakeholders, priorities and recommendations could be made for how data can be generated and managed that would best support dairy sector development”.*

Constraints from Yilma *et al* 2011 are cited in one sentence, then the following sentence cites the FAO (Yilma *et al* 2011) study as if it is a new reference being introduced. It would make sense to consolidate the information from the FAO study in one sentence.

*At the end of the first sentence (which cites Yilma *et al*.), we will add “These authors concluded that the major challenges were poor infrastructure network, inadequate provision of veterinary services and lack of continuous supply of animal feeds throughout the year (Yilma *et al.* 2011).*

**Methods**
For “Clusters were identified by defining the dairy value chains in Ethiopia”, suggest something like “stakeholder clusters were identified according to key roles undertaken by the various actors with dairy value chains in Ethiopia.”

*We will change the manuscript to “Clusters were identified according to key roles undertaken by the various actors with dairy value chains in Ethiopia”.*
“Contact details were provided by the stakeholders in each of the clusters” could be interpreted as raising an ethics concern, especially given the subsequent GDPR requirements. Could perhaps add that as an issue to help justify the appropriateness of the ethics approval.

We agree and will change the manuscript to “Contact details were provided by the stakeholders in each of the clusters, complying with data protection legislation and ethical approval”.

“Local authors provided lists of suitable participants, based on their local knowledge.” Consistent with other statements about potential bias, it would be useful to explain whether there was potential for bias to be introduced here.

We will add to the manuscript “...local authors provided lists of suitable participants, based on their local knowledge. Whilst there was the potential for bias, this was addressed by ensuring the widest range of participants possible”.

Eight clusters listed initially, but workshop refers to five stakeholder groups: would be helpful to note and explain the change.

For the workshop, the inputs and services stakeholders (feeds, genetics and health) were clustered for organisational purposes, bringing the eight clusters to five. We can add this to the manuscript at the end of the third paragraph of section ‘Stakeholder workshop’.

The structure is a bit confusing after “The groups were asked to identify the different data needs, consolidating them under the following headings”: some of the bullets are repeated in the following paragraphs, some are not. Would be useful to clarify the distinction between the bullets and three subsequent paragraphs.

The bullets provide the overall framework, the ensuing paragraphs add detail to certain bullets.

“Synthesis of outcomes: .... Relevant policy makers were consulted on the findings and plans.” Merits brief explanation why policy makers were targeted rather than all stakeholders.

This was a mistake – we will change the manuscript to “All stakeholders were consulted on the findings and plans”.

Results
Stakeholder interactions: starts by repeating information relevant to the methods section, which could be reduced. Would benefit from more evaluation of how it was implemented compared to the design/plan, e.g., adaptations, challenges.

We believe that the initial information merits repeating; this is the results section, and we are reporting synthesised products.
Composition data are presented for the pre-workshop interviews; it would be useful to have workshop participant numbers also presented by cluster/stakeholder group.

Apologies, but this information is no longer available.

Data needs: not clear if synthesis was part of methods or impromptu; it would be useful to have more clarity of any changes made in the method and what the results revealed. Alignment of this and subsequent paragraphs with the headings and the bullets in the methods section may also improve clarity

We will add to the manuscript: “...a synthesis of data needs by the different stakeholder clusters was conducted, and categorised under headings (Table 1). A methodological approach was taken, which was refined during the workshop process”.

Table 1: It is stated in the text that “The objective of this study was to establish the data needs of dairy sector stakeholders in Ethiopia, and to characterize them by data type, use and relevance to other stakeholders, as a fundamental priority for the sector as it seeks to respond to the rapidly growing demand for dairy products in Ethiopia.” Results are not presented, though, regarding the “relevance to other stakeholders”. Table 1 could be expanded to include this information with extra columns noting which stakeholder group may have expressed the need and which other stakeholder groups find it relevant – as critical information when designing data collection/coordination mechanisms. Or in Table 2, indicated which data categories were considered a priority for each stakeholder.

We do not have this level of detail; all implications of inter-stakeholder relevance to each other were stated. If relevance was not brought up, it was not noted. The objective statement was indeed the target, but certain components were not identified by the groups.

If any information was collected on how to overcome weaknesses in the institutions in playing their roles, this should also be reported.

Within-institutional weakness were not made explicit, for obvious political reasons.

Would be useful to cite some examples of “evidence-based decisions” and by which stakeholder.

We did not record greater detail. We already state that data were used for production planning, marketing and investment decisions, policy formulation, system harmonisation, allocation of resources to their best use, and improving the production and productivity in the dairy sector. They were also used for proper monitoring and evaluation by the regulatory system.

Data use: “They were also used for proper monitoring and evaluation by the regulatory system” Would be useful to cite a couple of examples of what this might refer to.

We do not have any recorded details.

Data collection: “... and general principles of seeking permission of owners/creators of data
to acknowledge data sources in any form of use." Incomplete, missing something like ‘would apply’ or ‘would need to be respected’.

*We will change the manuscript to “and general principles of seeking permission of owners/creators of data to acknowledge data sources in any form of use would apply”.*

Institutional arrangements Table 2: While the actors are listed, it would be useful to have a sense of the role they seem themselves or others see them playing within the sector (and were these the same?), and possibly clustering them in the table accordingly. Presumably, this type of information would have been collected and validated during the workshop. It would also be useful to report in the table any relevant strengths and weaknesses for the individual institutions identified by the stakeholders.

*This detail was beyond the scope of the study, and also the political sensitivity of publishing individual institutional strengths and weaknesses.*

There appears to be repetition between the paragraph entitled *Where a dairy sector database should be housed and managed* and the second paragraph preceding it: both discuss candidate institutions for housing the database and so should be merged.

*We will merge these paragraphs, adding the paragraph “It was suggested by the policy and regulatory stakeholders group that CSA and MoALR...” to follow on from the ‘Where a dairy sector database should be housed and managed’.*

Housing a database: “...it was intended to establish a unit within the sector for livestock resources, to handle the dairy database.” Would be good to clarify who has the intention and if the MoALR, would they establish it within the ministry or just somewhere ‘within the sector’?

*This section already states that the MoALR was suggested, however there was concern that there may be a lack of capacity to develop and manage such datasets. Despite this concern, it was intended to establish a unit within the sector for livestock resources, to handle the dairy database.*

“... there have been several failed attempts” Presumably refers to establishing some type of a national dairy board, but would be good to specify for sake of clarity. Also would be useful to clarify who made the attempts.

*The issues regarding previous attempts to establish a dairy board are presented, and some of the associated issues. We could add “such an initiative has also encountered hurdles in other countries of eastern Africa, even in countries with a much higher dairy production per cow (Kurwijila L.R., Bennett A.; Dairy development institutions in East Africa – Lessons learned and options. Food and Agriculture Organization of the United Nations. 2011).”*
to land.” Suggests strong associations have held back development; or was it meant to be ‘lack of strong associations’?

We will change the manuscript to “the lack of strong associations that promote development, and the differing views on the role of government leadership”.

**Discussion**

“Sector-specific needs were identified and should be elevated in detail as they are currently somewhat generic, requiring further shaping within each stakeholder group” Not sure what ‘elevated in detail’ means.

We believe that we have made and discussed this statement adequately.

“… the sector for livestock development under the MoALR” What is a sector under a ministry? Sounds like a unit or equivalent to the other agencies. We are unclear on this query.

“… a newly established National Dairy Board” implies it already exists. Should it be: ‘proposed’?

Agreed, we will change the manuscript to “and a proposed newly established Dairy Board”.

“Further data analyses and modelling could be of value in supporting evidence-based decision making for dairy sector development and will be explored by Livestock Data for Decisions (LD4D) data scientists.” Would be useful to clarify how this fits with the focus on creating sustainable domestic institutional capacity – should it be more explicitly framed as a one-off strategic technical support or input for designing?

We would agree and will change the manuscript, in the conclusion, to say the value of seeking one-off strategic technical support on design options.

Some of the workshop recommendations might be interpreted as ‘wishlist’ expressions of ‘want’ as sometimes come out of such workshops. The Discussion is meant to be more analytical, so is it possible to help the reader distinguish?

Part of the process was for stakeholder groups to provide specific relevant suggestions and ideas, but the value of “thinking out of the box” was welcomed.

Focus in the Discussion is on establishing a new entity, but with little attention or analysis of its potential to be sustained. It would benefit from more discussion around the information collected/results and action needed that would support addressing sustainability issues during the design, especially given the comment made about previous failed attempts.

We agree and will add to the conclusion “The long-term sustainability of any new institutional arrangements need to be considered in addition to the functionality and business approach advocated by many of the stakeholders”.

**Conclusion**
“... reactivation of a national dairy board was strongly endorsed.” This implies one had existed; it would be useful to clarify whether one previously established that was being reactivated, or whether it was the proposal for one that was being reactivated.

The old Board was during a previous era, under Haile Selassie. We could remove the word ‘reactivation’.

While the recommendation to re-establish a national dairy board is ‘likely to be seen as acceptable in the current political climate’ as noted by the authors, it would be useful to consider a recommendation that would mitigate the risks of lack of political will and government capture and overcome previous failures to establish such a body. This might entail some political economy analysis and recommended engagement with key actors based on the findings.

We agree and will add “However, it would be useful to mitigate the risks of lack of political will and government capture, and overcome previous failures in the establishment of a National Dairy Board; this would likely entail some political economy analysis and recommended engagement with key actors based on the findings”.

Again, the Conclusion seems to assume ‘build it and they will come’, i.e. assuming roll-out will automatically ensure uptake and sustainability. It would be useful to flag any risks and highlight what is needed to avoid repeating earlier failed attempts.

Agreed, we will add “It would be worth conducting a SWOT analysis on the establishment of a Dairy Board, clearly identifying the strengths, weaknesses, opportunities and threats, and engaging multiple stakeholders in this process”.

Competing Interests: No competing interests were disclosed.