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The governance of quality and safety in Tanzania's informal milk markets

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Despite significant economic and social transformation in Tanzania, 95% of the milk produced in Tanzania is marketed informally. Most of this is commercialized raw (unpasteurized) and distributed and sold through informal traders and vendors to low-income consumers, making it an important source of nutrition and livelihoods. While Tanzania's official dairy policy promotes pasteurization and formal industry, in practice the regulatory environment is relatively permissive of informal raw milk trade. We draw on original data from a survey with over 200 informal market actors, and insights from key informant interviews, to examine the context, perceptions and practices that affect quality and safety in the informal milk market in Tanzania. Our insights contribute to the potential for a more realistic and effective engagement with the informal sector, in Tanzania and beyond. Our results show that all informal market actors are concerned with milk quality and safety and take measures to mitigate risk. Loyalty and repeated interactions between buyers and sellers contribute to ensuring milk quality and safety in the absence of formal mechanisms such as testing. Despite this there is room for improvement. Informal actors expressed interest in training and finance to upgrade their premises and equipment and would also like to see improved communication with policymakers. Any future policy interventions should build on the indigenous practices being used by informal actors that already contribute to risk management. Efforts to better understand the informal sector and address the broader challenge of the lack of voice and representation of the informal sector in policy making in Tanzania are needed.

KEYWORDS

informal markets, milk, governance, nutrition, food safety, Tanzania

Introduction

By most metrics, Tanzania has experienced significant economic and social transformation in the last two decades, moving it from low-income to lower-middle-income country status in 2020 (World Bank, 2022). Between 2002 and 2012 it had one of Africa's fastest-rising economies, with an average annual GDP growth of 6.5% (Diao et al., 2020), though growth has slowed significantly since the COVID pandemic (World Bank, 2022). Economic growth has resulted in poverty reduction, as well as improvements in housing, education, and access to water (Arndt et al., 2017). These changes have occurred

in parallel with a doubling of population from 25 to 50 million between 1990 and 2015. Rapid urbanization has also taken place, at an annual rate of 5% in the last 20 years (Arndt et al., 2017).

Against the backdrop of these socio-economic shifts, food systems in Tanzania have also undergone significant transformations, from production to consumption. In rural areas, there is evidence of the so-called "silent revolution" observed elsewhere in Africa – the increased dynamism of and investments in the middle of the food supply chain (e.g., aggregation, wholesaling, and processing) which is bringing cash and markets deeper and deeper into the countryside (AGRA, 2019). At the same time, urbanization and rural to urban migration, and rising incomes, have been changing dietary patterns – such as the rising consumption of unhealthy processed foods – especially as a result of rising incomes (Cockx et al., 2018; Sarfo et al., 2021).

However, these transformations are uneven. Incomes have increased on average, but poverty remains widespread, particularly in rural areas (Cockx et al., 2018). Inequality has widened and hunger and malnutrition remain critical challenges; Tanzania has one of the highest chronic malnutrition rates in Africa (World Food Programme, 2022). While the agro-food economy has shown significant change, the modernization of production and retail have been very slow, with supermarkets struggling to gain market share and remain profitable (Allafrica.com, 2021). Despite government policy, the food economy–from production to marketing and retail–continues to be largely informal (Sarfo et al., 2021).

Food safety is an increasingly important aspect of food system change. One assumption is that, as incomes rise and supply chains become more complex, consumers will become more aware of food safety issues, triggering other market actors, including regulators, to move from rudimentary methods like visual inspection to regulatory standards and third-party guarantees (Ortega and Tschirley, 2017). However, this modernization agenda is unlikely to be relevant to most people and trade where informal food markets/systems continue to dominate. Evidence suggests traditional approaches to food safety persist even in the context of income rises and modernization of retail (see e.g., Wertheim-Heck et al., 2014 for Vietnam and Blackmore et al., 2021 for Kenya).

Tanzania's dairy sector exemplifies some of the unevenness of food systems transformations that are common in many low and lower-middle-income countries. Milk production has grown considerably over the past decade[1], but milk yields remain low due to the lack of improved breeds and specialized feed (CSIRO, 2022). Demand for milk has risen sharply in recent years due to population and economic growth, widening the gap between demand and local supply (See footnote 1).

Although the milk processing industry is growing, with the number of dairy processors increasing from 22 in 2001 to 83 in 2017 (Lunogela and Gray, 2020), most of the milk produced in the country is consumed directly by cattle-rearing households or traded informally, meaning that it is unprocessed (i.e., not pasteurized) and typically distributed and sold through small-scale traders and vendors, often street-based, to low-income consumers (NIRAS, 2010). The informal sector therefore remains dominant in Tanzania–with 95% of the milk produced being marketed informally. This resembles the situation in other lower-middle-income countries: raw milk accounts for up to 80% of milk sold in Kenya, and over 95% in Assam, where it is typically consumed in the form of traditionally processed products (Blackmore et al., 2020). The dominance of informal market channels poses challenges for milk quality and safety. Given milk's perishability, the general lack of refrigeration throughout the supply chain, use of non-sterile plastic containers (Gwandu et al., 2018) and the absence of pasteurization or heat treatment create conditions for public health risks (Häsler et al., 2019). The total bacterial count and *Escherichia coli* load, two commonly used hygiene indicators, have been repeatedly found to be high in milk samples in the informal sector in Tanzania (Kilango et al., 2012; Schoder et al., 2013). While boiling–a common practice among consumers–makes milk generally safer, there is still a risk of exposure to pathogenic bacteria due to possible re-contamination, depending on storage practices. Moreover, other chemical hazards such as aflatoxins or antimicrobial residues—which have been found to be common (Gwandu et al., 2018)–cannot be removed *via* heat treatment.

As modernization and food safety become a growing priority of countries in Africa, governments throughout the continent are revisiting their approaches to monitoring and regulating milk quality and safety. Despite their contribution to food security and livelihoods, informal markets are often marginalized from policy and harassed by regulators (Skinner, 2019). Much of this adversarial approach is justified by real or imagined concerns about food safety (Resnick, 2017; Mwango et al., 2019). These negative perceptions and discourses are often based on unfounded perceptions that modern food systems are better, although evidence suggests that the safety performance of informal markets is often no worse than that of modern supply chains (Roesel and Grace, 2015; Skinner, 2019). Urban food governance in Africa–defined not just as the actions of Government, but as decision-making of all involved stakeholders and institutions – has therefore focussed "too much on what should be rather than helping understand what is" (Smit, 2016, p. 80; Wegerif and Kissoly, 2022).

The Tanzanian government has promoted the dairy industry in policy, but has remained pragmatic with regard to regulation and enforcement. This means that, while official support

1 ILRI (International Livestock Research Institute) and GAIN (Global Alliance for Improved Nutrition) (2019). *Food Safety Landscape Analysis for the Dairy Value Chain in Tanzania*.

focuses on the modernization of the dairy sector, including the formalization of the industry and the sale of pasteurized milk, the regulatory approach to informal milk trade is still relatively permissive (Mbwambo et al., 2017). Regulations are interpreted differently by different government actors, and those that could feasibly be used to criminalize informal milk traders are not enforced. Yet, as seen in other low- and middle-income countries, there may be a growing push for stringent formalization of the sector on the grounds of food safety (Blackmore et al., 2021).

This paper explores the tensions between the official vision of modernity in food systems and the reality of informal trade through the lens of milk quality and safety in Tanzania. We show that actors in the informal dairy market in Tanzania–from producers to traders and consumers–place significant importance on food safety and quality, and take measures to ensure them, and that they do so despite rather than due to government support. The consequences of policies governing informal milk trade can have enormous impacts on the services informal markets currently offer to the country in terms of livelihoods, economy and health. Evidence like the one presented in this article can help guide policy-making so it is based on an adequate understanding of the operations and needs of the sector.

In this paper we examine how milk quality and safety are understood, managed and contested in informal markets in Tanzania, in a context of a rapidly transforming food system. We draw on primary data obtained from a survey with over 200 informal market actors in Arusha, and insights from key informant interviews, to better understand how milk trading chains operate, the policy environment in which those chains are situated, the incentives and capacities of sector stakeholders to ensure milk quality and safety, and the effectiveness of policy interventions–such as training–to improve milk safety.

Methods

We used mixed methods and both qualitative and quantitative data sources, including a survey among market actors in the informal sector, and interviews with key sector stakeholders. The survey sample size was 208: 20 producers, 24 intermediaries, 82 vendors (retailers), and 82 consumers Intermediaries were defined as those who purchase milk from producers and transport and sells it to vendors. Transport is typically *via* a motorbike or small van. Vendors are typically immobile, with fixed premises from which they sell milk to consumers. In a few cases vendors may be mobile, without premises, selling milk to consumers from the roadside in urban or peri-urban centers. The survey took place in and around Arusha city, including the districts of Arusha, Meru and Monduli in September 2019. These areas were chosen based on a high prevalence of milk trade, and where previous efforts to improve milk safety through training and certification of informal milk vendors had been piloted. The survey was intended to be illustrative rather than statistically representative and aimed to obtain a diverse range of opinions and perspectives from market actors about market linkages and milk quality and safety. Questionnaires combined closed and open questions and sought qualitative and quantitative insights. The list of survey questions in available as Supplementary material. Sampling was convenient: after initial participants were identified with the assistance of local guides, we used snowballing to recruit further respondents. Surveys were conducted in Swahili, and we obtained prior and informed consent from respondents and assured them of their anonymity. Data were collected using CSPro software. For each question the responses were tabulated and disaggregated by actor (i.e., producer, wholesaler, vendor, or consumer). As the data was assumed to be illustrative rather than representative, no further statistical analysis was performed.

In addition to the survey, we carried out 15 semi-structured interviews with key stakeholders including government officials (Tanzanian Dairy Board, Business Registrations and Licensing Agency BRELA, Tanzania Bureau of Standards, representatives from local government); private sector (processors, processor representative organization and business development service providers); and donors. These stakeholders were chosen based on their engagement in the sector and their contribution to policies and decision-making processes relevant to the sector. These interviews were used to capture a range of opinions on how the sector is working, specifically in relation to the capacities and incentives of key sector stakeholders to work with informal market actors to improve milk safety and quality. The interview guides can be made available upon request. Interviews were transcribed and coded according to themes, and then analyzed by extracting the relevant text.

Results

Policy, regulation and enforcement

Though the contribution of trade in unpasteurized milk to poverty alleviation and nutrition was acknowledged by government officials during interviews, the government's agenda and vision are of a formal, industrialized dairy sector where pasteurized milk is the norm. The National Livestock Policy of 2006, which outlines Tanzania's broad dairy policy framework, has an overall ambition to modernize and increase the productivity of the dairy sector. This policy has an emphasis on smallholder farmers, partly because of the considerable potential of smallholder dairying to reduce poverty (Ministry of Livestock Development, 2006). The National Livestock Policy is operationalized through several strategies and initiatives, including the Tanzanian Livestock Modernization Initiative (2015), the Livestock Sector Development Programme (2011), and the Agricultural Sector Development Programme (2017). These policies emphasize the need to: improve the genetic

potential of the dairy herd; strengthen technical support services and promote use of appropriate technologies; promote investments in production, processing and marketing; and promote dairy organizations and strengthen the Tanzania Dairy Board (Nell et al., 2014).

The Tanzania Livestock Master Plan of 2017 (Michael et al., 2018), which expresses the consensus of institutions and experts in the sector, prioritizes marketing and processing to support the construction of ultra-heat treatment (UHT) and powder milk processing plants. The Plan promotes the production and consumption of processed milk and dairy products; the introduction of quality-based standards and price premiums to encourage increases in the supply of high-quality milk; strengthening of the enforcement of milk and milk products quality standards; and most notably, the formalization of milk trade through the training and licensing of milk traders.

The legality of raw milk trade in Tanzania remains somewhat uncertain, even within government. According to several government representatives, the sale of raw milk is legal when a number of registration and licensing requirements, and safety standards are satisfied by those who are selling such milk. A representative from a government agency stated that: "*the sale of raw milk is legal as long as the milk passes platform tests and the traders are registered with [Tanzania Dairy Board] TDB and licensed to trade by the local government*." Another stated that "*the sale of raw milk is legal. For sale of milk from fixed premises or mobile locations without packaging, a daily levy or a business permit is required*." However, the representative of a food safety government agency declared that "*sale of raw milk is illegal but sales happen and no action is taken*." These differing perspectives may reflect differing interpretations of the key regulations governing the sector. The Dairy Industry Regulations ban sale of milk that has not been *"pasteurized, sterilized or subjected to such treatment to render it safe for human consumption*" (Dairy Industry Regulations, 2007). It is unclear whether the government considers boiling to be a treatment which would render milk safe for human consumption. If it does, then a number of informal actors–such as milk bars–which sell boiled milk to consumers – are likely in compliance with this aspect of the regulations, while others–informal shops or "*dukas*" may not be as they are selling predominantly raw milk, which the consumer then boils at home. Regardless, we found no evidence to suggest the government is interpreting these regulations in a way that promotes criminalization of informal milk traders.

The Tanzania Dairy Board (TDB) is the main body in charge of regulating and coordinating the development of the dairy industry (See footnote 1). To operate legally, milk producers, collectors, traders, transporters, processors, and traders must register with the Tanzania Dairy Board to obtain a registration certificate–as stated in the Dairy Industry (Registration of Industry Stakeholders). Regulations of 2007, which fall under the Dairy Industry Act of 2004. For milk traders to register, they must possess suitable milk handling equipment, adhere to hygienic milk handling and possess basic platform milk testing facilities, and undergo a medical examination. In addition to registration with the TBD, vendors must obtain other licenses to operate. Transporters must obtain a milk transport permit from Ministry of Livestock and Fisheries Development, Local Government Authorities and Ministry of Health (Urassa, 2014). Additionally, according to the Tanzania Dairy Board small dairy traders must obtain a general trading license issued by the local government (Blackmore et al., 2020).

TABLE 1 Number (and percentage) of surveyed milk traders who have the required licenses.

	Intermediaries	Vendors
TDB certificate (23 and 52 responses respectively)	3 (13%)	1 (2%)
Local government permit for business (23 and 79 responses respectively)	11 (48%)	51 (65%)
Medical certificate (23 and 79 responses respectively)	4 (17%)	23 (29%)

Our interviews suggest that the capacity of government to enforce dairy regulations is limited, especially due to the financial constraints of the Tanzania Dairy Board. Ninety per cent of the Board's revenue is generated from its own fees *via* registration, permits, and certificates. The TDB is understaffed and lacks assets to effectively execute its roles and responsibilities–a challenge exacerbated by the country's size and geography. In addition, it is much more difficult to register and tax the large number of informal actors that far outnumber the formal processors who–being easier to monitor and register–contribute the bulk of TDB fees. This becomes a self-reinforcing cycle–the lower the capacity to enforce relevant regulations around registration, the fewer the opportunities for revenue generation.

As a result of the constraints outlined above, there has been a recent push for government authorities, including TDB, to focus on cess collection and enforcement of laws from businesses in the informal markets–including by devolving some enforcement roles to local government–rather than capacity building to increase revenues of government agencies. According to one government official, this comes with a risk of weakening the relationship between informal agents and government representatives, undermining trust and pushing players "underground," which can decrease milk quality and safety.

Licensing levels among surveyed intermediaries and vendors were reported to be low (Table 1). Only three out of 23 intermediaries had the mandatory TDB registration certificate, and all but one of 52 vendors said they were not registered with

TDB (although more than a third of vendors declined to answer, presumably out of fear of negative repercussions). Twelve of 23 intermediaries (52%) did not have the local government permit which allows them to conduct business, while the remaining 11 (48%) did have the permit. Sixty-five per cent of vendors had the required local government permit, whereas 35% did not. Nineteen out of 23 intermediaries (83%) did not have the legally required medical clearance certificate, and similarly 56 out of 79 vendors (who answered the question) (71%) did not have the medical certificate either.

From the government's perspective, low licensing levels are linked to its own low capacity to enforce the relevant legislation. According to a government official, *"TDB is not able to access the traders for registration and inspection for compliance*." Another government stakeholder acknowledged that "*licenses are expensive for majority of the small traders,*" while a local government stakeholder stated that "*many of the licenses are individually affordable, but there are too many and consolidation is needed to reduce the number of licenses required*." In interviews, vendors and private sector processors attributed low licensing levels to the requirements being onerous. They complained that there are too many licenses, which are too expensive (either individually or in combination), and that dairy actors don't know the requirements. A representative from an international development organization explained that *"[informal traders] are not keen to formalize because they do not want to remit the fees required by the multiple regulatory agencies which amounts to huge sums of money. The time taken to obtain licenses is also disincentivizing for them*." Penalisation of those who don't comply with licensing is rare, and this has prompted calls from the formal sector for stricter enforcement.

The Tanzanian government was perceived by our interviewees as relatively supportive of the informal sector–meaning there is little harassment, confiscation of milk etc, and that trade is allowed to continue without interruption. This was partly seen as the result of an electoral calculus, as the ruling party did not want to alienate potential voters. There was also a recognition among government officials of the importance of the informal sector for income generation and food security of low-income households. However, there are differences in approach and attitude to the informal sector between government agencies. For example, some interviewees regard TDB's approach as "friendly"–to enable rather than harass–while the attitude among trade officers and public health officers is seen as more punitive.

What vendors perceive, is somewhat different, however. They perceive a policy environment defined by government indifference, with little impact on their daily life. In the survey, about a quarter of intermediaries defined the government's attitude toward them as "lack of support," and a similar proportion as "lack of harassment," with about a fifth not knowing what the attitude is. About two thirds of vendors said that there was either no conflict or no support from the government, and a quarter stated that there was no conflict if they are licensed. Few traders reported any practical impact of the government's attitude toward them. Some intermediaries and vendors stated that government presence manifests itself as inspections, especially by the Ministry of Health.

Interviews with regulators reveal that informal traders are not well represented in policy discussions in Tanzania, in part because they are not well organized into official associations, and as a result cannot be represented on, for example, the Annual Council of the Tanzania Dairy Board. In addition, many traders are reluctant to have a greater voice with government because they may not comply with all necessary regulatory requirements and fear being exposed.

In terms of changing the relationship with government, intermediaries suggest a closer relationship with government officials, who would then provide support through better communication on requirements, tax exemption, capital provision and input provision. Vendors would like to see a more consistent regulatory environment; more equipment being provided (lactometers and milk cans); subsidized inputs for dairy production; and links to processors to secure a market. Suggested changes by consumers to improve the relationship with government include promotion of practices to enhance quality, regulation of the market and increased campaigns to promote milk consumption.

Perceptions and practices of milk quality and safety

Milk quality and safety was found to be important for all actors in the supply chain, but perceptions and approaches to managing quality and safety vary. Consumers prefer to purchase unpasteurized milk (96% of those we sampled bought such milk, but this may be driven by our purposively sampled consumers purchasing milk from informal vendors in informal settlements) and believe the health risks to be manageable. Consumers who purchased raw milk cited freshness most frequently (26% of mentions), followed by availability (19% of mentions) and safety (14%), convenience of buying (13%), taste (11%) as the key reasons they prefer raw/unpackaged to unpasteurized milk. When thinking about which milk to buy the most important factors consumers consider (they could give up to three responses) is the safety of the milk (27% of all responses), followed by freshness (18%) and the cleanliness of the retail outlet (16%) (see Table 2 below). In interviews, key sector donors highlighted the availability and affordability of unpasteurized milk as a driver of its popularity. Milk is most commonly delivered to the consumers' door by mobile vendors in peri-urban and urban areas, or is collected by consumers at the farm gate in rural areas. During fieldwork we found that unpasteurized milk costs, on average, about half as much as the

TABLE 2 Most important factors considered by consumers when buying milk (157 responses).

	Number (and %) of mentions
Safety	42 (27%)
Freshness	28 (18%)
Nature of retail outlet/cleanliness	25 (16%)
Taste	18 (11%)
Convenience (of buying)	15 (10%)
Availability	12 (8%)
Price	9 (6%)
Nutrition value	3 (2%)
Packaging	3 (2%)
Fat content	2 (1%)

TABLE 3 Number (and percentage) of value chain actors reporting approximate volumes of milk spoiled each week.

	Producers (18 responses)	Intermediaries (23 responses)	Vendors (79 responses)
0%	15 (83%)	6 (26%)	22 (28%)
1–10%	3 (16%)	9 (39%)	45 (57%)
11–20%		2 (9%)	6 (8%)
21–30%		1 (4%)	4 (5%)
31–40%			
41–50%	1 (1%)	3 (13%)	1 (1%)
Above 50%		2 (9%)	1 (1%)

same volume of pasteurized milk. In addition, there are negative, perceptions among low-income consumers regarding processed milk, for example that additives are used to prolong shelf life.

Consumers overwhelmingly consume milk boiled, as part of chai (sweet tea). More than 80 percent of consumers state that drinking milk has not produced any instances of illness in their households. However, 18 per cent of respondents did link intake of milk to symptoms including diarrhea, vomiting, and "inflammation" and to specific diseases, such as brucellosis. Seventy-nine percent (or 10 people) of those who have fallen ill from milk consumption were able to link their illness to specific milk consumed, and 57 percent of these (8 consumers) changed vendor as a result. Lacking formal methods or guarantees that milk is safe and/or of high quality, consumers rely on visual checks of premises or milk.

When consumers were asked how they check the safety and quality of milk once at the vendor's premises, about three-quarters of consumers stated that they look at the milk before they buy it to ensure its quality and safety; others look at the milk after they boil it (6 percent) or taste it (5 percent). Over 70 percent of consumers associated milk safety with the cleanliness of the vendor, the premises and/or the containers, followed by 16 percent who mentioned trust in the vendor's milk or absence of problems with the milk purchased from that vendor in the past. Consumers tend to buy from a small number of vendors (80%), rather than shop around (20% of surveyed consumers). Only a fifth of consumers had noticed the display of legal licenses in vendors' premises, and except one respondent, all others did not associate those licenses with milk health and safety.

The survey reveals that concerns of quality and safety are not exclusive to consumers, but instead common among all actors in the supply chain. Almost all producers, intermediaries, and vendors (100 per cent (20 producers), 96 per cent (23 intermediaries) and 92 per cent (76 vendors), respectively) believe that quality is the most important characteristic customers look for when buying milk from them. Vendors mentioned milk safety as the second most important characteristic, while the cleanliness of storage containers, whether milk has been adulterated and the cleanliness of premises were also mentioned. Trading relationships are relatively stable throughout the value chain–only 4% of intermediaries (1 intermediary) and 6% (5 vendors) of vendors change their suppliers regularly–but when they do, this is due to poor quality or insufficient volumes of milk supplied.

To test for quality and safety, most surveyed intermediaries (71 per cent, or 17 respondents) and vendors (57 per cent or 46 respondents) use sight alone rather than formal testing methods, and only about a fifth of them, or slightly less in the case of vendors, use a lactometer. Despite relying mostly on visual cues, milk spoilage rates were reported by each actor to be relatively low (Table 3). Some degree of spoilage is expected as milk, a perishable product, deteriorates over time in its journey along the chain from producer to intermediary to vendor. However, vendors stated that the most common challenge faced in running their business is spoiled milk.

Traders reported facing challenges in obtaining and maintaining milk quality. A third of intermediaries (8 out of 24) and half of vendors (40 out of 81) stated that they are not always able to obtain the right quality milk due to adulteration and a lack of testing equipment. Even where safe milk or milk of high quality is obtained from farmers, 62.5% of intermediaries and many vendors (40%, or 32 out of 82 respondents) stated that they face difficulties in maintaining the quality and safety of milk. Lack of cold storage was the most cited reason (47% or 8 out of 17 intermediaries). Fluctuations in electricity supply, presumably also affecting the ability to keep milk cold for those who do have access to refrigeration, was also mentioned.

Measures to ensure and improve milk quality and safety in the informal sector

Informal actors reported taking measures to ensure milk quality and safety. Producers most commonly clean containers regularly (23%); keep milking areas clean (20% of responses)

and; ensure cattle are healthy and treated for disease (20%). Washing hands was also mentioned as an important approach (14%), as was using special containers (6%). Similarly, intermediaries and vendors typically clean their containers regularly (35% of responses for intermediaries and 41% of vendors), followed by washing hands (15% of responses for intermediaries and 14% for vendors). Keeping premises clean was also an approach used by vendors (14% of all responses).

To improve the quality and safety of the milk they sell, the majority of vendors (60%), intermediaries (75%), and producers (75%) said they needed training, and others cited the need for more money to invest in testing equipment or containers. The survey showed that most value chain actors—78% of vendors, 71% of intermediaries and 63% of producers–expect the government to help them meet these needs *via* training and provision of assets. In interviews, other sector stakeholder agreed on the need for training to improve on milk quality and safety in the informal sector. An informant from the processing industry argued that dairy sector stakeholders should make efforts to "*educate all raw milk value chain actors in appropriate milk handling approaches to ensure quality and safety.*" A representative from a farmer organization explained that "*enhancing training among producers with little or no knowledge*" can help to overcome the challenge the sector faces. A government stakeholder acknowledged the constraints in capacities–knowledge, financial and physical assets–in the informal sector, emphasizing the *"inappropriate milk handling equipment which is usually not clean"* and the lack of knowledge in handling practices. Other government stakeholders agreed on the need for training and the provisioning of appropriate equipment to improve milk safety in the informal sector.

Despite wide agreement on the need for training, actual opportunities and access to training for informal traders appear to be uncommon. According to the survey, between 2004 and 2019 only 12 of the 82 surveyed vendors and four of the 24 surveyed intermediaries had participated in training. This includes traders who were trained by several organizations including government extension workers, a private sector agency, a non-governmental organization (NGO), ILRI, TDB or by a fellow trader.

Discussion

Our results on the Tanzanian informal milk market point to some of the broader tensions arising between regulation and reality as food systems transform partially and unevenly. While changes to food systems are happening in Tanzania, and some aspects of "modernization" are emerging in response to urbanization, poverty alleviation and population growth, we have found no evidence of a clear or predictable shift toward impersonal or standardized measures to ensure safety in the milk market. Our work highlights four broad issues relevant to the governance of quality and safety in informal markets.

First, there is a disconnect between official visions of food systems modernization and the stubborn persistence of–and broad preference for–informal milk trade. Tanzania's policy environment of promoting commercialization, mechanization and standardization, which involves pasteurization, is arguably disconnected from the cultural and socio-economic realities of Tanzania's milk trade and consumption (Wegerif and Martucci, 2018). Our research shows that this persistence is explained by strong consumer demand, driven by preference and price, as well as higher perceived benefits by other market actors. Consumer preference for unpasteurized milk in many African countries is widely documented due to perceptions of this milk's freshness, availability, price and taste (Wegerif and Martucci, 2018; Blackmore et al., 2020). For producers, sale into the informal market in Tanzania–as opposed to industrial processors in the formal sector–often results in better terms including higher prices (Twine, 2016) and cash payments (Baker et al., 2013; Wegerif and Martucci, 2018). This is consistent with data on the popularity of informal milk markets in Kenya, Uganda and Mali, where the vast majority of milk is produced by smallholders and sold through informal markets (Roesel and Grace, 2015). As has been argued for Latin America, the informal sector is not a residual part of the economy to which people arrive by exclusion, but rather a "voluntary entrepreneurial small firm sector" that people actively seek because they see it as beneficial (Maloney, 2004; Perry et al., 2007).

Second, low compliance with official sanitary or licensing regulations does not mean there is a vacuum or lack of food safety. A system exists to manage quality and safety based on the practices and interpersonal relations of consumers and actors in the informal market. Our research demonstrates that quality matters to all supply chain trading partners and consumers and is a driver of trading decisions throughout the chain; these insights are consistent with evidence from other countries in sub-Saharan Africa showing that most consumers in informal markets care about food safety and respond to food safety scares by stopping or reducing purchases (Roesel and Grace, 2015). This is contrary to many widely held perceptions about the informal economy, particularly within government–that the informal food economy poses significant risks to food safety–while governments ignore their contribution to food security (Skinner and Haysom, 2016; Resnick, 2017).

Research in Ghana found that consumers prioritize cleanliness of both the vending site and the vendor when making purchasing decisions (Rheinländer, 2006). Vendors and consumers are also highly concerned with neatness, which includes aspects of cleanliness, order, aesthetic appearance as well as neat manners during social interactions (Rheinländer, 2006). Similarly, in Tanzania, consumers rely on visual checks of premises, equipment, or milk to assess safety and will remain loyal to vendors as long as milk remains safe. The

importance of loyalty between consumer trust of vendors has also been demonstrated elsewhere (Wertheim-Heck et al., 2014). Moreover, our results show that producers, intermediaries and vendors are concerned about milk safety and take measures to ensure food safety such as cleaning their containers regularly, washing their hands and keeping their premises clean. This is consistent with evidence from Kenya (Blackmore et al., 2021) and South Africa (Campbell, 2011), where street vendors were found to have adequate information regarding food safety principles and to ensure safe practices in food preparation.

For consumers in East Africa, the predominant way of consuming milk–boiled, as part of *chai* (sweet tea)–is a deliberate and effective measure to reduce health risk from germs (Grace et al., 2008), meaning that a potential hazard (e.g., pathogens or harmful substances) does not translate into a significant risk to human health (Roesel and Grace, 2014). Our research confirmed this approach by consumers in Tanzania of boiling unpackaged milk before consumption.

Third, while the informal sector takes many proactive approaches to managing milk safety and quality, there is room for and improvement. Our study has shown that, for the most part producers, vendors and consumers rely on sensory milk quality attributes to assess quality and safety of milk. These measures are an important way to mitigate risk (Roesel and Grace, 2015), but they may be insufficient. There is scope to build on the existing interests and efforts already being made by informal actors to manage health and safety to upgrade the sector. This could be achieved without criminalizing informal actors and compromising food security and livelihoods.

Research in East Africa shows that small-scale and informal traders have limited knowledge in hygienic handling of milk (Cherono et al., 2012), and this lack of knowledge has been linked to poor safety outcomes (Kilango et al., 2012). Other studies confirm a lack of food safety and hygiene knowledge as well as insufficient public services (e.g., clean water) to facilitate safe handling of food in low- and middle-income countries, such as Nigeria (Dipeolu et al., 2007; Chukuezi, 2010). The informal market actors we surveyed from across the supply chain and key informants acknowledge that there is room for improvement in milk safety and quality. Our research shows there is demand by the sector for interventions or support that enhances their ability to sell higher quality and safe milk, particularly training and access to finance for investment in equipment. While training is widely perceived as needed to improve on milk safety in informal markets (Monney et al., 2013; Ledo et al., 2021), the evidence on the impact of training on safety outcomes is mixed (Omore et al., 2005; Monney et al., 2013; Lapar et al., 2014; Alonso et al., 2018; Lindahl et al., 2018; Ledo et al., 2021). This is because while improved knowledge and awareness can lead to different practices, the pathways of change that lead to different outcomes are not always clear or guaranteed.

Fourthly, the informal sector operates in spite of, rather than due to government action or support–but there is scope for change. The current regulatory environment in Tanzania for trade in raw milk is ambiguous. Government agencies interpret regulations differently, and it is unclear whether boiling is officially considered a suitable form of treatment for milk. In addition, the government lacks capacity to enforce regulations that do exist around licensing and registration. In practice this means that informal milk trade exists and persists without government interference. This sets it apart from the adversarial relationships between regulators and informal actors found in several other low- and middle-income countries, whose contexts are defined by harassment, forced relocations, confiscation of goods, and physical abuse (Patel et al., 2014; Resnick, 2017; Grace et al., 2019; Young and Crush, 2019; Blackmore et al., 2021).

The importance of the sector for livelihoods and nutrition, and votes, is likely influencing the decision not to criminalize informal traders, though some of the government's tolerance may also stem from its lack of capacity to support or enhance food safety or informal livelihoods. Public extension services have played a significant role in improving the skills of small businesses engaged in milk marketing, but this capacity has declined in recent years, thereby adversely affecting its quality assurance services for marketed milk. The decline in capacity of government-led extension and technical assistance services in Africa is well documented, as is the general constraints on the private sector stepping in to fill that gap, especially for the low-income majority (Christoplos, 2010; Salami et al., 2010). The government's hands-off approach to managing the sector may change in the future, to be more in line with neighboring countries such as Kenya (Blackmore et al., 2021)–that may come in the form of support for upgrading or possibly greater scrutiny and criminalization. Either way, a failure to base food safety policy on evidence may jeopardize the poor who dominate and rely on informal markets and value chains (Grace et al., 2007; Roesel and Grace, 2014).

Conclusions and policy implications

Milk sold in the informal sector–unpasteurized and unpackaged–is an important source of affordable and accessible protein for low-income consumers in Tanzania. It is cheaper relative to packaged milk from the formal sector, is accessible and available in small quantities, and consumers perceive it to be of high quality (Galiè et al., 2021). Our study demonstrates that quality and safety are key factors driving trading decisions throughout the chain in Tanzania's dominant informal milk sector and shows scope for using those as drivers of upgrading the sector. Most producers, intermediaries, and vendors believe that quality is the most important characteristic buyers look for when buying milk, and for

consumers safety is one of the most important factors in determining which milk they buy (packed or unpacked), and where they buy it. We also found agreement on the need to improve milk quality and safety, as acknowledged by vendors themselves and supported by literature (Cherono et al., 2012 and Kilango et al., 2012). The sector seems to offer much potential for enhanced contribution to livelihoods, food security and the economy, though it already plays a central role in these.

The Tanzanian government has a pragmatic approach to governing informal milk trade, unlike countries such as Kenya that are more repressive (Blackmore et al., 2021). Government authorities are willing to allow for trade in unpasteurized milk so long as traders are registered, have the relevant permits, and standards are met. Though there is a simultaneous push to increase pasteurization levels in the country, current regulations are sufficiently ambiguous to allow trade in unpasteurized milk to continue. In doing so the government avoids alienating its voter base and ensures the livelihoods and food security of low-income actors. However, registration and licensing levels remain low–we found only 2% of vendors had TDB certificates–and the government faces challenges of a vicious cycle of a lack financial capacity to monitor compliance with standards and licensing and registration regulations and in turn a lack of revenue generation from licensing and registration.

Informal actors made it clear that they would like greater support to upgrade their milk testing and handling in a way that ensures its safety and quality, and they felt that this support should come from government. While training schemes in Tanzania that focus on improving the safety of milk in informal market positively impacted those who participated, these schemes have not been scaled or their effects sustained overtime. Our research showed that this is likely due to the lack of incentives and barriers such as the time taken to participate, the business losses incurred in that time, and direct costs and the lack of consumer "pull."

Our research offers a more detailed understanding of the priorities, needs and concerns of informal market actors. In the absence of this understanding, initiatives and interventions to enhance food safety in the informal sector are unlikely to be well designed, scaled or sustained. Any policy interventions need to begin with genuine efforts to understand the informal sector, including its strengths. As part of these efforts to better understand the informal sector, the broader challenge of the lack of voice and representation of the informal sector in policy making in Tanzania should be urgently addressed.

The challenge to researchers and policy makers is to recognize and enable the positive norms, values and practices around which socially embedded economic actors govern urban food markets (Wegerif and Kissoly, 2022), some of which have been documented in this research. Interventions should build on the indigenous practices being used by the entire chain of informal actors that already contribute to risk management, as well addressing informal actors' needs for finance to invest in equipment, and capacity building, to improve on milk quality and safety.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by ILRI Research Ethics Committee. The patients/participants provided their written informed consent to participate in this study.

Author contributions

EB developed research tools, conducted data analysis, and drafted and adapted the manuscript based on feedback from other experts in the field and the co-authors. AG provided strategic oversight to the research and helped draft the first manuscript and revise it after initial reviews. CK lead primary research in the field and conducted some preliminary data analysis. WV, SA, and DG contributed to conception and design of the research. All authors contributed to manuscript revision, read, and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fsufs.2022.971961/full#supplementary-material

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