

## Article

# Challenges and Obstacles to Dairy Consumption in Iran from Stakeholders' Perspectives Using a Food System Approach

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**Abstract:** Background: Despite the potential benefits of increased dairy consumption for a sustainable diet among Iranians, low levels of dairy consumption and its decreasing trend have raised serious concerns. This study used the food systems approach to identify macro-level factors contributing to low dairy consumption in Iran. Materials and methods: In-depth interviews with 39 key informants and stakeholders from various sub-systems of the dairy food system were conducted from December 2021 to November 2022. The data analysis was conducted simultaneously with data collection, using a deductive–inductive content analysis approach. Results: The main challenges identified in the production and processing subsystems included the unsustainable development of a milk and dairy production system, high production and distribution costs, and an inconsistent quality of products. In the consumption subsystem, challenges were a reduced purchasing power of consumers, doubts about the necessity of dairy consumption, and concerns about safety risks. These challenges were further compounded by some other challenges in the dairy food system and contextual challenges such as economic instability, government sectoral policies, and Iran's hot and semi-arid climate. Conclusion: Policy makers must revise the dairy industry's structure, policies, and activities, and consider utilizing local livestock and feed production systems. Pricing policies should be reformed, subsidies provided for low-income groups, and promotion programs developed to enhance the public awareness of dairy's nutritional value and safety. Independent quality control agencies should be established, and a comprehensive approach to promote good governance and improve the policy-making process should be adopted.

**Keywords:** supply chain; production; processing; consumption; sustainable development policy; dairy



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## 1. Introduction

Milk and dairy products have a long history of consumption [1,2] and are important sources of macro- and micronutrients, particularly in developing countries where access to animal-based food resources is limited [3]. Milk is a complex food that contains a variety of nutrients, some of which are involved in multiple biological processes with conflicting effects on health [3]. While milk consumption is associated with a decreased

risk of some non-communicable diseases, i.e., osteoporosis, cardiovascular disease, stroke, hypertension, colorectal cancer, and type 2 diabetes, concerns have been raised about the potential association between high dairy consumption and an increased risk of some other non-communicable diseases, including prostate cancer and Parkinson's Disease (PD) [3–6]. These concerns may be due to hormonal irregularities caused by growth factors and dairy compounds such as fat that exacerbate some types of cancer [7]. One possible explanation for the link between certain dairy products and an increased risk of PD is that milk proteins and intact milk can lower serum urate levels, which may counteract the protective effect of urate against PD [8].

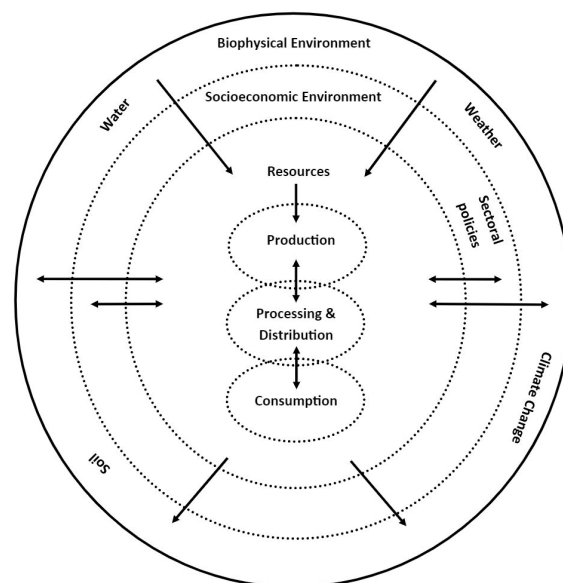
Additionally, the consumption of raw milk has also sparked considerable public debate regarding its possible benefits [9] and drawbacks [10,11]. Some proponents of raw milk support that pasteurization destroys important nutritional components in milk and therapeutic properties such as the reduction in allergies and asthma [9]. It is also claimed that raw milk can prevent lactose intolerance and contains “good” bacteria that are beneficial for health, although it has not been proven. However, the potential risks associated with consuming raw milk, such as the risk of bacterial contamination, cannot be ignored. Such discrepancies have created a complex and confusing environment for consumers [11–13]. Despite the increased scrutiny, milk and dairy products are recommended as an essential part of a healthy and balanced diet in almost all countries' food-based dietary guidelines (FBDG) and by health-related organizations [3].

Iran is a Middle Eastern country with a very low average consumption of dairy products, specifically milk [14]. An inadequate consumption of milk and dairy products increases the risk of non-communicable diseases such as osteoporosis or diabetes, which not only reduce the quality of life and increase the burden of diseases in society but also impose a substantial cost on the health system and families that is much higher than prevention costs [15]. In the second edition of “Iranian FBDG”, a daily consumption of 2–3 servings of the dairy food group is also recommended [16]. The “Desirable Food Basket for the Iranian population” [17] also recommends a daily per capita consumption of 250 g of dairy (91 kg per year). However, according to data from the “Iranian household income and expenditure survey” in 2017, the per capita consumption of dairy in the country was only around 53.5 kg per year, reaching 39.6, based on the author's calculations. The very low level of dairy consumption has prompted recommendations to increase dairy intake in order to move towards a more sustainable diet in the country, unlike the recommendations of the EAT-Lancet Commission, which generally suggest reducing dairy consumption [18].

Therefore, identifying factors that contribute to the low consumption of dairy products in the country is considered a priority in policy making. Food consumption, including milk and dairy products, is influenced by a range of factors including food availability, access, and individual preferences, which in turn are influenced by several other factors beyond personal decisions [19]. Studies conducted to evaluate determinants of milk and dairy consumption in Iran have mainly been quantitative studies focused on personal or socioeconomic factors with little consideration given to macro-level factors, including government policies, macroeconomic characteristics, climate characteristics, and economic sanctions [20,21]. On the other hand, some studies have evaluated the dairy food chain without assessing its impact on consumption [22,23]. Therefore, the present study, using a food systems approach, aims to assess the effect of macro-level factors from stakeholders' perspective on milk and dairy consumption in Iran. Food and nutrition systems determine the quantity, quality, diversity, and nutritional content of the diet that is consumed as the end product of the performance of these systems. In fact, addressing food and nutrition problems and striving to solve them evolved conceptually in recent decades with a growing emphasis on a comprehensive and holistic approach to food and nutrition issues such as food security or planning and policy making for food and nutrition using the concept of food systems [24].

### Conceptual framework:

The current study employs a food systems approach to investigate the barriers to dairy consumption among Iranian consumers through qualitative research. The food system is a complex set of functions and processes that involves the conversion of raw materials into food, operating as a system within the biophysical and socio-cultural domains. As shown in Figure 1, the food system comprises three subsystems: (1) production, (2) processing and distribution, and (3) consumption, each consisting of three stages of input, transformation, and output. Raw materials obtained from agricultural production in a biophysical environment are processed and transformed into food products, which are then distributed among consumers under economic, social, and cultural factors. This system encompasses all processes and structures involved in the nutrition of society, including cultivation, harvesting, processing, packaging, transportation, marketing, consumption, and access to food [25].



**Figure 1.** The theoretical framework of the study. Adapted with permission from Ref. [25]. 2023, Elsevier.

The concept of a “system” is a broad one that has been incorporated into the food system, meaning that the constituent parts work together and are in a dynamic relationship with each other. Thus, changes in one part of the food system can help the entire system move towards better support for healthy food choices and improved nutrition and health. However, changes in one aspect of the food system can also lead to unintended or unexpected consequences in other parts of the system, and these factors should be taken into account in the analysis of the food system for policy making [26].

Using this systemic and holistic approach, the present study aims to identify deficiencies and issues within the entire food system that affects dairy consumption. The study examines the impacts of various factors on the food subsystems, as well as the mutual effects of subsystems on each other and the consequences of changes in each of them, in terms of dairy consumption. For example, changes in agricultural production patterns and technological developments throughout the food chain and food processing, better resource management and capacity, and consequently increasing the supply (in terms of quantity, quality, and diversity) and availability can have significant effects on the consumption of the dairy food group at a macro level. However, on the other hand, economic problems can lead to a reduction in access to and consumption of these products at the household level [27].

## 2. Materials and Methods

This qualitative study used semi-structured in-depth interviews with key informants and experts to identify the challenges of Iran's dairy food system and its possible relationship with decreased dairy consumption.

**Sampling:** The research team created a primary list of different stakeholder groups and identified key governmental organizations and private sector societies in each group. The stakeholders were recruited from various sub-systems of the dairy food system and its related organizations, including the Ministry of Agriculture (Deputies of Livestock Affairs and commercial development), Secretariat for the Supreme Council of Health and Food Security, Consumers and Producers Protection Organization (eight interviews), Institute of Planning Research, Agricultural Economy and Rural Development, National Nutrition and Food Technology Research Institute, Faculty of Agriculture and Natural Resources of Tehran University (seven interviews), Iran Veterinary Organization, Iran Food and Drug Administration (four interviews), livestock feed importer/producer (three interviews), milk producers (four interviews), dairy producer, including traditional (four interviews), industrial producers (five interviews), dairy product distribution companies, and retail sector (four interviews).

Through purposive sampling, some of the informants were contacted and asked to participate in the study, after informing them regarding the purpose of the study. Sampling continued using the snowball method, considering maximum diversity. Interviews continued until data saturation. Twelve people who were contacted did not respond or refused to participate in the study. Three of them were senior managers of a governmental livestock farm, a governmental dairy factory, and a previous senior manager in the Ministry of Jihad Agriculture. Two were managers of small dairy factories and others were mid-level managers or experts from private or governmental sectors in the food system. No monetary exchange was received by participants.

**Instrument Design and Data Collection:** The research team developed a series of semi-structured interview guides with open-ended questions and probing questions for different stakeholder groups to understand dairy food system challenges. The interview guide included questions about participants' experience within the dairy food system; their opinions about the current status of their subsystem; the policies of each subsystem and related challenges; challenges resulting from macro policies such as sanctions and macro-economic status; challenges of providing raw materials and the sales market in production, processing, and distribution subsystems; and quality and safety challenges of milk and dairy products. The interview guide was the first pilot tested. The interviews were conducted from December 2021 to October 2022. To improve data consistency and avoid potential bias, all interviews were conducted by only one researcher (R.R., who had no previous relationship with the participants). Two interviews were conducted by telephone, and four were conducted via Skype due to distance. Other interviews were conducted face-to-face at the interviewees' workplaces. In three cases, a colleague accompanied the interviewee while interviewing. Interviews lasted between 35 and 105 min, and all except one that the researcher was not permitted to record were audio recorded, and notes were taken.

**Data Management and Analysis:** A data analysis was performed simultaneously with data collection. After each interview, the recorded voice was transcribed word by word, as soon as possible, and all transcripts were compared with the voices. The accuracy of the transcripts was also checked by comparing them with field notes. Then, transcripts were returned to the interviewees, and after their confirmation, they were analyzed using MAXQDA software (ver. 20). For the data analysis, a deductive-inductive content analysis was used. The main themes were derived based on the conceptual framework. The first researcher read the transcripts several times to identify key thoughts and concepts and capture their main essence. Words, phrases, and larger segments of text were then assigned codes, which were closely associated with the original data. The open codes obtained were then organized into themes. Based on the similarities and differences between the

open codes, categories or sub-themes were formed. The categories formed using the open codes were continuously compared, and axial concepts were developed based on their commonalities. During axial coding, the relationships and links between codes became apparent. After completing the axial coding process, it was found that some of the extracted codes from the analysis units did not fit into any of the primary categories. Therefore, based on the underlying meanings in these open codes, a new inductive conceptualization was performed, and a new theme was formed. Of the interviews, 40% were coded by a second researcher, separately. Codes and generated sub-themes were compared and discussed with the research team to reach a consensus. To report the study design and data analysis, the consolidated criteria for Reporting Qualitative research (COREQ) were used [28].

### 3. Results

In the present study, 39 stakeholders from various organizations were interviewed. A list of the organizations is presented in Appendix A.

According to the participants, the majority of milk produced in Iran (more than 90%) comes from cows and buffaloes, and production can be divided into two main categories: industrial and traditional (rural) livestock. The share of traditional livestock production has decreased over the years, and currently, industrial livestock accounts for 50–60% of the total milk production in the country.

According to statistics from the Ministry of Agriculture, the population of purebred, crossbred, and native cattle and calves in 2021 was 1607, 4234, and 1142 thousand heads, respectively. Additionally, the Statistical Center of Iran reported that there were 17,389 units of industrial livestock farms for milk production in 2022. Based on the present study, the total amount of milk production in Iran is estimated to be around 10–11 million tons per year. Of this, 7–8 million tons are used in the production of industrial dairy products, while 3–3.5 million tons are used for the traditional dairy product retail sector, industrial milk powder production, and self-consumption.

The Deputy of Public Industries of the Ministry of Industry, Mine, and Trade recently reported that approximately 575 small and large dairy industries are active in Iran, with a registered nominal capacity of 13 million tons. However, only 6.5 million tons of this capacity are currently active [29].

The study identified a range of challenges facing Iran's dairy food system and dairy consumption, which can be categorized into four main themes, based on the food system model:

- supply chain challenges;
- consumption challenges;
- sectoral policy challenges;
- contextual challenges.

Additionally, governance and policy-making challenges were identified as a new theme. The challenges of the milk and dairy supply chain are shown in Table 1.

**Table 1.** Challenges of milk and dairy supply chain according to the participants' perspectives.

Theme	Sub-Theme	Open Code
Unsustainable development of milk and dairy industries	Unsustainable development of the livestock and dairy industry	Desultory development of industrial farms Neglecting the water resources in the development of the livestock industry Excess capacity building in the livestock sector Excess capacity building in dairy processing Neglecting smallholder livestock production
	Dependency in the milk and dairy industry	Dependence on import for livestock feeding supply Absence of any plan to reduce import dependency Difficulties in importing equipment and technology for the dairy industry Dependency of the dairy industry on foreign countries for their technologies Decreased commercial interactions due to sanctions
Existence of monopoly in the dairy chain		Granting import and distribution licenses of livestock feeds to specific groups The limitation of the number of importers due to the increased capital requirement The monopoly of dairy industries in the domestic and international markets Main shares of dairy production with large producers
Inadequacy of government livestock feed supplies due to inappropriate distribution		The livestock farmers, mainly traditional ones, receive insufficient livestock feed from the government. The receipt of livestock feed by some units at prices higher than the government prices
High final price of milk and dairy	High cost of milk and dairy production	Intermittent shortages of imported livestock feeds Increase in global prices of imported livestock feeds Higher fixed price of governmental imported livestock feeds in comparison with global prices Increasing the price of domestic livestock feeds High cost of milk and dairy production inputs, other than feeds
	The high cost of transporting dairy products to the market	Reduction in production efficiency due to the use of low-quality livestock feeds Low efficiency of milk production in hot and dry weather Increase in the governmental exchange rate of the Rial Vs US Dollar Economic sanctions Inflation Decrease in per capita dairy consumption The not dedicated and unorganized market for distributing dairy products Disruption of dairy products' distribution due to the desultory development of chain stores The high cost of distributing dairy products

Table 1. Cont.

Lack of economic justification for milk and dairy production	Very low-profit margins for milk and dairy production	<p>Not providing sufficient profit margins for livestock farmers</p> <p>Non-profitability of smallholder livestock</p> <p>Non-profitability of the dairy industry</p> <p>Profitability of powdered milk</p> <p>Lack of investment in the milk and dairy industry due to insufficient profit</p> <p>The low financial return on investment in the dairy industry</p>
	<p>Lack of the same financial benefit for different parts of the chain</p> <p>Unsustainable financial support for production</p>	<p>Asymmetrical distribution of profits through the supply chain</p> <p>Unsustainable government financial support</p> <p>Banks not providing financial sources</p>
Inconsistent quality of livestock feed, milk, and dairy products	Low-quality domestic and imported livestock feeds	<p>Low quality of imported livestock feeds due to the sanctions</p> <p>Quality reduction or spoilage of livestock feeds during storage and transportation (while importing)</p> <p>Lower quality of domestic fodder in comparison with international standards</p> <p>Inadequate access to high-quality livestock feed for raw milk production</p> <p>Inadequate access to medicine and vaccines for livestock</p>
	Low-quality raw milk	<p>Low quality and safety of produced milk in traditional livestock farms</p> <p>Carrying out the cycle of milking, transporting, and processing traditional milk in an unfavorable way</p> <p>The source of raw milk for traditional dairy shops is not verified</p> <p>The possibility of using low-quality raw milk in traditional dairy shops</p> <p>Lack of sufficient training regarding compliance with hygienic principles in traditional processing</p>
	Low safety and quality of milk collected from traditional livestock farms	<p>High cost of raw milk quality control tests</p> <p>High cost of livestock mechanization</p> <p>High cost of implementing hygienic regulations for factories</p> <p>The high cost of repairing refrigerated cars</p> <p>Absence of the economic justification for keeping dairy products in a refrigerator in shops</p>
	Uncertain safety and quality of traditional dairy products	<p>The storage of dairy products outside of refrigeration by shopkeepers</p> <p>The lack of proper training in the storage of dairy products during distribution</p> <p>The possibility of refrigerators being turned off in rented distribution vehicles</p>
	The unaffordability of implementing hygienic requirements in different parts	
	Decreasing the quality or spoilage of dairy products during transportation and distribution	

Table 1. Cont.

Poor monitoring system/quality control of milk and dairy	Inadequate supervision of raw milk production and transportation cycle	Lack of supervision of the veterinary organization on traditional livestock farms Not evaluating raw milk delivered to brokers Lack of veterinary supervision of milk discharge in the factory The possibility of factories not returning contaminated milk and buying it at a lower price Lack of serious and systematic monitoring of the safety of dairy products Absence of independent and non-governmental organizations for quality monitoring Poor inspection of traditional dairy units Inability to identify all chemical contaminants Concern about the presence of chemical pollutants in industrial dairy Concern about microbial contamination of traditional dairy units
Propaganda regarding the quality of industrialized dairy products	Rumors about the dairy industry  Existing false statements regarding dairy products  Inadequate utilization of scientific evidence	Spreading of rumors about the safety risks of dairy products due to the conflict of interest between rival groups Neglect and defaming of traditional dairy industries by the industry and universities Destruction of the cultural value of traditional products with industrial production Rumors against industrial dairy products Rumors about the poor quality of milk Non-expert false opinion in the field of dairy The unaccountability of individuals regarding non-expert opinions in the food industry Speaking without evidence among experts and doctors The acceptance of statements without evidence by experts, educated individuals, and the public
Limited export of dairy products		Most dairy products cannot be exported The difficulty of obtaining new export markets for producers Lack of diversification of export markets due to sanctions
Inefficient trade unions		The existence of a large number of unions/associations The weakness of associations to influence government decisions

As shown in Table 1, according to the stakeholders interviewed, the unsustainable development of the milk and dairy food system is one of the challenges of this system in Iran. The desultory development of livestock industries without considering water resources and neglecting smallholder livestock was mentioned as a factor contributing to this instability. An interviewee said the following:

“Our dairy farms now do not have water to give to their cows. They have to buy water and bring it in a container. We should have had planning for our dairy farm... but unfortunately, this has not happened and many governmental farms are still developing”

(A member of an industrial association).



Also, based on the interviewee's perspectives, the dependency on foreign countries for livestock feeding supply, as well as equipment and technology for the dairy industry, is another cause of unsustainability in the dairy food system, particularly in light of decreasing commercial interactions due to sanctions. The uncertainty of continuous and adequate imports was highlighted as a concern by some of the participants. In addition, some participants in the study pointed out the existence of monopolies in the dairy food system, which has resulted in the limited number of livestock feed importers and/or the main shares of dairy production owned by large producers.

The majority of participants emphasized the high cost of milk and dairy production as the main obstacle to the dairy food system. They cited issues such as limited access to livestock feed due to the inappropriate provision and distribution of livestock feeds and its high price as contributing factors to the high cost of production. Other factors they mentioned related to production's high cost were the high prices of other production inputs, low efficiency, and economic dilemmas such as inflation and increasing exchange rates. Also, according to the interviews, there is currently no economic justification for milk and dairy production in Iran, due to the very low-profit margins that discourage investment in the sector. A member of the dairy industry claims: "Iran's dairy industry is a failing one in its nature". This threatens dairy accessibility for consumers.

The challenges related to the quality of livestock feed, raw milk, and dairy products are significant issues faced by the dairy industry in Iran. The low quality of imported or domestic livestock feeds, as well as the limited access to medicine and vaccines for livestock, contribute to the inconsistent quality of raw milk. Furthermore, unfavorable conditions during milking and transportation, such as hand milking without proper hygiene measures, inadequate cooling of milk immediately after milking, and the transportation of milk without a cold chain, can compromise the safety and quality of the collected milk from traditional livestock farms. The safety and quality of traditional dairy products are also unknown, which is a concern for consumers.

Participants implied that implementing hygienic requirements in different parts of the dairy food system can be challenging due to the high cost associated with it. They mentioned the high cost of raw milk quality control tests, livestock mechanization, implementing hygienic regulations for factories, repairing refrigerated cars, and keeping dairy products refrigerated in shops can make it difficult for small-scale producers to comply with these requirements, as a member of the monitoring system said the following:

"Perhaps due to problems in the production units, they are unable to implement everything, as their costs go up. For instance, it might be necessary to make fundamental changes in their system, or they may lack the required workforce to ensure the necessary conditions due to financial issues".

According to the interviewees, the monitoring system for the quality control of milk and dairy products is also weak, with no independent and non-governmental organizations for quality monitoring. The government monitoring system is missing in some parts of the raw milk production and distribution cycle, and there is limited ability to identify all chemical contaminants of dairy products. This lack of monitoring raises concerns about the safety and quality of dairy products, which can erode consumer confidence.

Some participants stated the challenge of conflicts of interest between rival groups, which can lead to the spreading of rumors about the safety risks of dairy products. Additionally, participants from traditional dairy industries expressed their concerns about neglecting this sector and its defaming by industry and universities. On the other hand, interviewees from the industrial dairy sector expressed concern about propaganda regarding the quality of industrialized dairy products. They also pointed out that false statements by non-experts in the field of dairy can further exacerbate these issues, as these individuals are often irresponsible in their opinions. An academician and industrial dairy sector member indicated the following:

“Experts who express non-expert opinions in areas outside of their specialization can be harmful. For instance, making non-expert and non-specialized statements about the shelf life of sterile milk and preservatives can lead to criticism of the dairy industry”.

Moreover, participants stated a lack of using scientific evidence among people and professionals, which can lead to speaking without evidence among experts and doctors, and the acceptance of statements without evidence by experts, educated individuals, and the public. These challenges have created confusion among consumers regarding dairy consumption, leading to boredom and apathy toward the industry.

Some interviewees also expressed the low efficiency of the dairy transportation and distribution system as a challenge for the dairy industry. They pointed out that this inefficiency can lead to a decrease in the quality or spoilage of dairy products during transportation and distribution. Moreover, several participants highlighted the storage of dairy products outside of refrigeration by shopkeepers as an issue, which can have a detrimental effect on the quality and safety of dairy products. The lack of proper training in the storage of dairy products during distribution was also identified as a challenge by a member of a dairy distribution company:

“More important than distribution is how the retailers handle the product. When you deliver yogurt to a shopkeeper and tell him “Hey, this yogurt has no preservatives and should go in the refrigerator”, instead, he leaves it on the doorstep”.

The limited export of dairy products was identified as another significant challenge by the interviewees. They pointed out the difficulty of obtaining new export markets for producers and the lack of diversification of export markets as their challenges for export. Moreover, the difficulty of exporting dairy products due to sanctions and the fact that most dairy products are not suitable for export exacerbate these challenges from their point of view. Finally, the interviewees mentioned that the inefficient trade unions, and their weakness in influencing government decisions, are other challenges of the dairy food system.

As shown in Table 2, from the participant’s point of view, dairy consumption plays a minor role in Iranian food culture, with a low share of dairy products in traditional foods. Some interviewees even believe in the avoidance of dairy products in Iranian society. All participants mentioned a reduction in dairy consumption in the community, even in higher-income deciles. In this regard, an academician and dairy industry member said the following:

“Unfortunately, we are facing a challenge in our country regarding per capita consumption. Our per capita consumption has shown a downward trend”.

And, a member of a monitoring organization said the following:

“Nowadays, our dairy consumption as doctors with relatively good living standards compared to the general public has become more limited”.

In their opinion, one of the reasons for this is the failure to implement programs aimed at supporting the increase in per capita consumption. Additionally, they stated that people’s purchasing power for dairy products has decreased due to increasing dairy prices, which limits people’s income. This has led to the sale of cheaper dairy products and decreased demand for luxury dairy products. The participants also remarked on the high sensitivity of the public toward dairy prices and their expectation from the government to control the market prices.

**Table 2.** Challenges of consumption subsystem based on the stakeholders' perspective.

Themes	Open Codes
The insignificance of milk products in Iranian food culture	The low share of milk products in Iranian traditional foods Avoidance of dairy products in Iranian society
Reduction in dairy consumption	Decrease in per capita consumption of dairy products Decrease in per capita consumption of dairy products in higher deciles of income Not desirable taste of dairy products Failure to implement programs to support the increase in dairy consumption
The reduced purchasing power of consumers	Reduced real income due to inflation Increase in dairy price Increase the sales of more affordable dairy products Decreased demand for luxury dairy products
Expectations from the government to control the market price	Public expectation of government intervention(s) in the market. The high sensitivity of society toward the price of dairy products.
Not believing in the necessity of dairy consumption in some groups	The belief about the harmfulness of dairy consumption in some groups Not believing in the necessity of dairy consumption by some people and elites Traditional medicine's opposition to dairy consumption Discouraging the consumption of dairy by vegetarians
Consumers are concerned about the safety risks in industrial dairy	Concerns about the use of additives, preservatives, and the presence of chemicals in dairy products Lack of transparency in issues related to safety risks and making expediency a priority Providing false information about milk and dairy products

According to the participants, some groups do not believe in the necessity of dairy consumption as traditional medicine opposes dairy consumption. This has resulted in some people and elites not believing in the necessity of dairy consumption.

“In my opinion, our problem with dairy consumption is closely related to traditional medicine, which is a very big problem. We need to address this issue first; we can no longer ignore it. . . Traditional medicine is against dairy products in our country, especially industrial dairy products”  
(an academic member in the field of nutrition).

In addition, some participants expressed concern about people's belief in the safety risks associated with consuming industrial dairy products. This is mainly due to worries about the use of additives, preservatives, and chemicals in industrial dairy products. Furthermore, they stated that false information about milk and dairy products leads to people's belief in the risks associated with consuming dairy products.

Table 3 presents the multiple challenges associated with the government's intersectoral policies according to the interviews. As the participants stated, the government's decision to subsidize livestock feed by fixing the exchange rate for its import has led to continued dependence on imported livestock feed, with no plan to reduce this import dependency. Additionally, there has been a lack of investment in developing new methods for providing livestock feed due to rent-seeking behavior. Furthermore, the lower price of domestically produced feeds compared to imported ones has made it infeasible to produce alternative feeds that result in unsustainability intensification. In addition, this policy has created a heavy economic burden and resulted in the inadequate or delayed allocation of foreign currency to import livestock feed. They also mentioned that this has led to the inappropriate

provision and distribution of livestock feeds as well as compromising its quality. A member of the livestock industry union expressed their opinion on this matter:

**Table 3.** Challenges of governmental sectoral policy.

Theme	Sub-Theme	Open Codes
Subsidizing animal feed policy	Strengthening and continuing to prioritize the dependence on imported livestock feed	Absence of any plan to reduce import dependency Lack of investment in new methods of providing livestock feed due to rent Infeasibility of alternative feeds' production due to the lower price of domestically produced feeds than imported ones
	Economic burden of providing livestock feed for the government	The heavy burden of financing livestock feed for the government
	Troubles in the allocation of foreign currency	Inadequate allocation of foreign currency to supply livestock feed Delay in the allocation of foreign currency to import livestock feed
	Inappropriate provision and distribution of livestock feeds	Import of livestock feeds without specific planning Inadequate supply of some livestock feeds Delay in the supply of some livestock feeds Economic rent and distributing parts of subsidized livestock feed through the open market
	Low-quality of imported livestock feeds	compromising the quality of livestock feeds due to their lack in the market Buying lower-quality livestock feed due to the government's willingness to allocate less foreign currency The low quality of imported inputs due to the allocation of foreign currency
Elevating fixed exchange rate for animal feed import by government	Deficiency of working capital	Increase capital needed to import livestock feed Increasing livestock feed price Livestock farmers' insufficient capital to buy governmental livestock feed The need for more working capital for the dairy industry Inappropriate support for the financing of manufacturing enterprises
	Shrinkage of livestock and dairy industries	Surplus production of raw milk and dairy products due to the consumption decrease The decreasing trend of raw milk production Decrease in milk production in the short-term due to the change in livestock diet Increasing livestock elimination due to the increasing livestock feed price Shrinkage of the livestock and dairy industries The inability of dairy factories to absorb raw milk

Table 3. Cont.

	Dairy consumption reduction due to the price surge	Reducing consumption or eliminating dairy products from the household diet Decrease in per capita consumption The sharp increase in dairy products' price Non-implementation of consumption support programs
	Tendency to export dairy products, especially powdered milk	Desultory development of powdered milk production A huge increase in powdered milk production Disturbance of the market equilibrium due to the improper control of powdered milk production Increasing demand for export The focus of export on powdered milk sales Smuggling of powdered milk in banning the export
Pricing policy	Neglecting guaranteed price	Using the target price policy instead of a guaranteed price
	Complications of determining the approved price	Setting high prices to keep all production units Setting the low price for raw milk production units Late update on the approved price of raw milk
	Suppression of competition and production due to the pricing policy	Suppression of competition Reducing the incentive to update and develop companies Unsustainability and closure of small and medium companies
	Contradiction of pricing policy with the aim of consumer protection	Reduction or non-production of dairy products subject to pricing Reducing the supply of dairy products subject to pricing in stores An increase in the fixed price of dairy to the consumer due to the pricing policy Reduction in per capita dairy consumption Lack of programs to promote dairy consumption Reducing quality, infringement, and fraud to reduce production cost and fixed price Ignoring the issue of quality by the government in pricing policy
Stopping dairy consumption support programs	Discontinuation of school milk program	Eliminating school milk due to the government's budget deficit The discontinuation of the school milk program due to high costs and lack of sufficient credit
	Cut off household subsidized milk	Discontinuation of household milk subsidy after the implementation of the targeted subsidy policy

“Traders are no longer interested in importing high-quality goods. They prefer to buy low-quality livestock feed at a cheaper price because the government has to pay for it and they prefer to pay less”.

The interviewees also implied that the government removed the subsidy in 2022 and opted for market pricing to address this issue; however, participants declared that this policy change was implemented all at once, without effective programs to support production and consumption and without considering contextual issues. This led to a very

sharp increase in livestock feed prices, a deficiency of working capital for producers, a sharp increase in dairy product prices, decreased dairy consumption, a surplus supply, and the shrinkage of the livestock and dairy industries. In this regard, a rancher and livestock feed producer said the following:

“With the removal of preferential exchange rates, the prices of barley, corn, and soybean reached nearly six times higher which sharply increased the price of dairy products”.

Moreover, interviewees expressed concern regarding the government’s decision to fix the exchange rate at a higher level again. This happened when Iran’s economy experienced a shock in the exchange rate, and the government fixed the exchange rate again at around a six times higher rate. Some participants expressed an increasing willingness to export dairy products, especially powdered milk, which has resulted in the smuggling of powdered milk, while banning the export is another challenge following this policy change.

As the interviewees stated, the government adopted the policy of determining raw milk and some dairy product prices following subsidizing livestock feed and protecting consumers. According to the participants, in addition to complications of price determination, this policy has resulted in the suppression of competition in production with the closure of small and medium companies as well as reducing the incentive to update and develop. They also implied that this policy contradicts the consumer protection objective because the reduction in the supply of dairy products will result in increased prices, as well as quality reduction, infringement, and fraud by producers to reduce production costs and fixed prices. A dairy producer declared the following:

“Companies should be allowed to offer their products based on their fixed price. This way, their products’ quality will not be compromised. . . if the final price is 50 Rials, I should be allowed to offer it for 50 Rials. Since I am forced to offer it for 40 Rials, I will compromise on its quality, and quantity, or even shut it down altogether”.

Based on participants, support programs for dairy consumption have been discontinued in recent years. They mentioned that the government’s budget deficit led to the discontinuation of the school milk program, which provided milk to students. In addition, the household milk subsidy was discontinued after the implementation of a targeted subsidy policy.

As shown in Table 4, the dairy food system in the country faces a range of contextual challenges according to the perspectives shared by interviewees. Economic instability, mistrust between stakeholders, and environmental issues are among the challenges. The interviewees highlighted the limited access to financial resources, instability, and high inflation as factors contributing to economic instability. They also pointed to the mistrust among stakeholders in the milk and dairy chain, as well as between producers and consumers, and overall, a low social capital. A member of the dairy industry declared the following:

“There is a vibe of distrust that pervades all areas. When there is distrust, even if the dairy industry produces ten good products, I criticize it, just as I am distrustful of my government, and even if they do ten good things, I don’t see it at all because the principle is distrust, the principle is non-acceptance. Our most significant problem as a nation is the issue of trust”.

Some interviewees also mentioned the limited water and soil resources, low efficiency, and agricultural water pollution with sewage as environmental challenges, while drought and industrial livestock farming are further exacerbating the environmental situation. The development of industrial livestock farms has resulted in destroyed water and soil, contributing to the increased production of greenhouse gases.

**Table 4.** Contextual challenges of the dairy food system in Iran, based on stakeholders' perspectives.

Theme	Open Code
Economic Instability in the Country	Limitations and instability in accessing financial resources due to sanctions Government's macroeconomic policies Unstable macroeconomic status Continuous high inflation
Distorted interaction between industry, universities, and the people	Interrupted interaction between consumers and the dairy industry Universities' inability to establish proper interaction with industry and people
Mistrust between different stakeholders and/or low social capital	Mistrust between different levels and actors in society Consumers' distrust of the dairy industry Doubts about the authenticity of functional dairy products
Inadequate promotion of dairy consumption	Low awareness about the affordability of dairy products according to their nutritional value among people and officials Low awareness regarding lactose intolerance Non-promotion of dairy consumption by the Ministry of Health
The semi-arid climate of the country	Limited agricultural soil Limited water resources Low water efficiency Drought Deficit of rain
Environmental consequences of livestock industry development	Destruction of water and soil with the development of industrial livestock farms Increased production of greenhouse gases with the growth of industrial livestock farming

"For example, in some places where livestock farms are located, the farm owners dig wells and deepen them up to 300 m underground, extracting salty water from there, which can destroy the soil as well"

(An interviewee from a trade union).

Table 5 presents governance and policy-making challenges from the perspective of participants in the dairy food system. Many interviewees highlighted the lack of transparency and identified challenges such as vague and obscure laws and structures, the presence of many officials, the absence of decision makers specifically responsible for the milk and dairy sector, and the plurality of policy makers and decision makers. A man with an academic position in agricultural policy making expressed his opinion:

"We have different laws, and along with them, we have different institutions and ministries. . . currently, two ministries claim responsibility for the dairy industry".

The lack of comprehensive and accurate data and lack of land use plans are also stated as issues.

Some participants expressed concern regarding poor accountability such as the government's irresponsible reactions regarding policies that are adopted and its tendency to use sanctions as an excuse for its mismanagement. The following is based on a dairy factory member's statement:

"Management is also a section, but sanctions have become the main excuse for us to blame everything. Today, we blame sanctions for everything, even if it doesn't rain, we may say it's because of the sanctions"!

**Table 5.** Governance and policy-making challenges of Iran’s dairy food system according to the participants’ points of views.

Theme	Sub-Theme	Open Code
Lack of transparency	Multiplicity and obscurity of laws and structures	Multiple, not clear rules in determining structures and responsibilities Absence of a specific policy maker in the field of milk and dairy products The plurality of policy makers and decision makers Compartmentalization of intersectoral activities
	Lack of comprehensive and accurate data	Ambiguity in the amount of milk production in the country Being unable to verify the reported amounts of milk produced in the country
	Lack of land use planning	Lack of land use planning
Poor accountability	Ignorance of adopted policies’ outcomes	Not accepting responsibility for decisions by managers Using sanctions as a cover for mismanagement The macro policies of the country and the government’s decisions are not aligned with the private sector’s interests Adopting policies that create economic challenges in production and consumption
Bias in governmental decision making for the private sector	Government dominance in decision making	Government activities as an economic enterprise Government interference in the private-sector activities Ostensible participation of trade unions in governmental decision making Governmental decision making in the milk and dairy sector
	Pressures of interest groups on decision making by the government	Undue influence, pressure, and interference of unrelated institutions in decision making Making decisions based on the wishes of the beneficiaries of more power Sabotage by various groups in case of not providing their financial benefits
	Non-specialist officials	Appointing policy makers/managers based on criteria other than expertise The unfamiliarity of officials with specialized topics in their field of work Exclusion of experienced people with management change Lack of expert body in any field Ignorance of decision makers about the importance of the issues and their effects



Table 5. Cont.

Theme	Sub-Theme	Open Code
Poor policy-making process	Weakness in holistic, realistic, and evidence-based policy making	Inadequate use of evidence in policy making Oversimplification of policy making Making sectorial and non-comprehensive policies Absence of compiled programs or policies or no implementation of them in the milk and dairy production and consumption sectors Lack of long-term policy making Suspension of programs in management change Short-term solutions to the problem instead of solving the roots Absence of compiled programs or policies or no implementation of them The incongruity of expectations from the agricultural sector with existing realities and potentials Targeting of production without considering the possibility and ability of its implementation Lack of complete and accurate implementation of policies
	Weakness in implementing policies	Neglecting the right time and situation for the implementation of policies Conducting actions to show off Not informing stakeholders of existing decisions and plans Not evaluating people's activities and programs Negligence of the government to make changes in the adopted policies if necessary
	Lack of policy evaluation and improvement system	

According to participants' opinions, bias in governmental decision making for the private sector is an important issue. Interviewees mentioned the dominance of governmental decision making with the ostensible participation of trade unions in decision making in the milk and dairy sector. A rancher and livestock feed producer stated the following:

"There is a lot of bias in milk policy-making because when governments make decisions, they often do not know how to do it due to a lack of experience in this field".

In addition, the government has several economic enterprises in the milk and dairy sector. Participants also reported undue influence, pressure, and interference from unrelated institutions in decision making, resulting in decision making based on the interests of those with more power.

The participants identified challenges in the policy making and implementation process, due to not being holistic and evidence-based, and the lack of a policy evaluation and improvement system. They believe in the incongruity between expectations and existing realities and potentials and production targeting that does not take into account the feasibility and capacity for implementation. The oversimplification of the policy making process, lack of long-term policy making, and suspension of programs following management change were also identified as challenges.

"No one cares about long-term planning, especially in the food industry. . . . . Policymaking in production is like using a Band-Aid. . . As we don't have a proper foundation when the new government comes, it feels that the previous actions were wrong" (A member of a governmental monitoring system).

The lack of complete and accurate implementation of policies was also identified as a challenge. They declared that policy makers sometimes neglect the right time and situation for policy implementation, leading to ineffective policies and actions taken merely to show progress. Another challenge mentioned by participants is the lack of policy evaluation and improvement systems, failing to evaluate people's activities and programs. They expressed that the government sometimes shows negligence in changing adopted policies if necessary, preventing timely adjustment to changing circumstances.

#### 4. Discussion

The present study reveals that Iran's milk and dairy food system is facing several challenges that have affected dairy consumption. The main findings are presented in Figure 2.

Figure 2 highlights the main challenges faced by the milk and dairy production, processing, and distribution system, which include unsustainable development, high production and distribution costs, and low product quality. In the consumption subsystem, challenges such as the reduced purchasing power of consumers, doubts about the necessity of dairy consumption, and concerns about safety risks were identified. Additionally, there are other challenges in the milk and dairy food system, including the existence of propaganda, monopolies, poor monitoring systems, and a lack of economic justification for production. Resource provision problems, such as inadequate and low-quality livestock feed, also contribute to the main problems. These challenges are further compounded with socioeconomic factors such as government sectoral policies, economic instability, mistrust, and distorted interaction among stakeholders. The hot and semi-arid climate of Iran also affects the dairy food system. All of these challenges are ultimately shaped with the governance and policy-making processes in the country.

The price of a product plays a crucial role in its consumption, as determined by the demand law. This law states that, if all other factors were held constant, an increase in the price of a product will result in a decrease in demand, and vice versa. The responsiveness of demand to changes in price is often measured with Price Elasticity, which is expressed as the percentage change in demand for a product due to a percentage change in its price [30]. A study conducted by Chizari et al. analyzed the demand for dairy products in urban households in Iran, determining the short-term and long-term price elasticities of milk, yogurt, and cheese as  $-0.62$  and  $-0.84$ ,  $-0.42$  and  $-0.46$ , and  $-0.83$  and  $-0.76$ , respectively [31]. This indicates that factors affecting the price of dairy products will have a significant impact on their consumption.

The high cost of production and distribution, which results in high final prices that do not align with the low purchasing power of consumers, is a significant issue highlighted in the present study. This issue mainly stems from ongoing economic sanctions. Other studies have also confirmed the adverse effects of sanctions on increasing inflation, production costs, and consumer prices [32–34]. In addition, the government's fiscal deficit, excessive money creation, and currency depreciation have contributed to high and volatile inflation, further exacerbating the issue [35], which has led to lower consumption. Other studies have reported inflation as a significant factor affecting household food and dairy consumption, and have highlighted the role of economic issues in dairy consumption [14,21,36].

The present study identified several sectoral policies in milk and dairy production that can negatively impact final prices and consumption. To protect producers and consumers, the government has adopted various policies, including pricing policies. Since 1994, the government has been required to purchase surplus dairy products based on the "guaranteeing the purchase of basic agricultural products to support farmers" principle. Based on the findings of the present study, the government determines the market price of milk as a guaranteed price, and dairy factories are obligated to buy milk at the determined prices. However, implementing this policy has resulted in higher raw milk prices and the price difference has been passed on to consumers. A study conducted by Faryadras and

colleagues showed that implementing this policy could increase milk prices and producers' welfare but had a negative effect on consumer welfare [37].

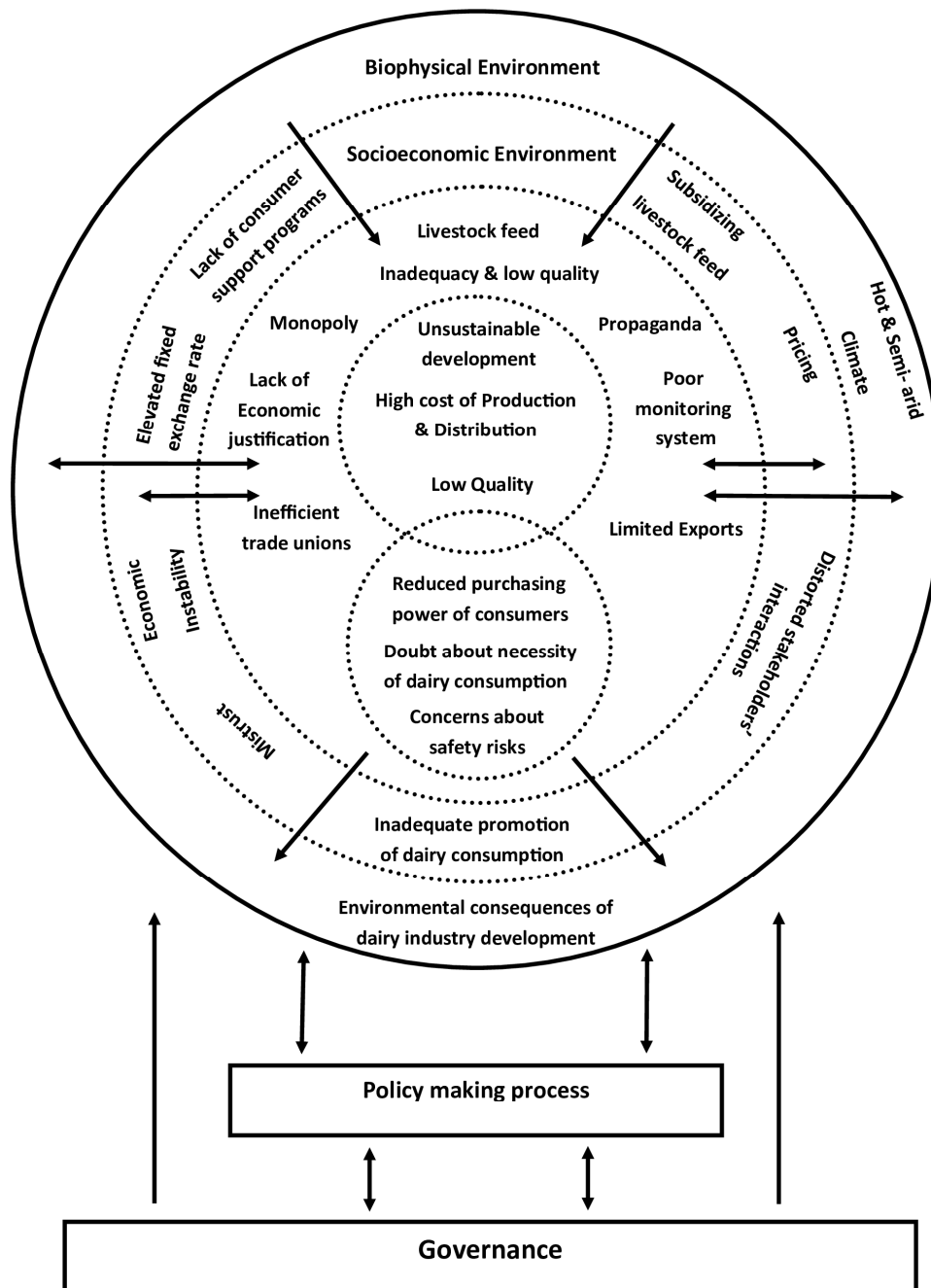


Figure 2. Justified model based on the study's findings.

Additionally, the government also subsidized milk consumption in Iran before 2011, with the government responsible for setting the price of pasteurized milk. This study has found that the elimination of milk subsidies following the passage of the Subsidy Reform Plan in December 2010 has been a significant factor in reducing dairy consumption. Several other studies have also shown that the elimination of milk subsidies and the increase in total production costs have led to a sharp increase in dairy product prices and a significant decrease in consumption [38–40]. Despite the government's attempts to control price growth, the price of milk and dairy products continued to rise due to high inflation following the implementation of the policy reform [38].

Furthermore, the government halted the school milk program, which was the only targeted subsidy program for consumer dairy consumption support until 2017, due to insufficient funding [38]. The program was launched and developed in the country in 2000 to promote a milk consumption culture and improve the health of students. Despite facing implementation problems, the program is generally considered a suitable and effective means of increasing the consumption of dairy products among school-age children [41].

In late 2017, the government implemented a preferential currency exchange rate policy to protect consumers from increasing prices caused by the currency crisis by subsidizing livestock feed. However, due to limited import resulting from the government's limited access to financial resources due to sanctions and the significant difference between governmental and market prices, the importing and distribution of livestock feed were hindered, leading to limited access for the target groups. As a consequence, some livestock farmers were forced to purchase their needed livestock feed from the market, which led to increased production costs and uncontrolled prices. As a result, consumers did not benefit from this policy as expected. For instance, Shabanzadeh et al. reported a positive but insignificant effect of this policy on household consumption [42,43]. In 2022, the government introduced a policy reform to liberalize milk and dairy production due to the heavy financial burden of subsidizing livestock feed and continuous increases in the exchange rate. However, the inappropriate implementation of this reform at an inappropriate time caused a price shock in milk and dairy production and consumption, resulting in decreasing dairy consumption and the shrinkage of the livestock and dairy industries. This also led to an increasing willingness for dairy export, especially milk powder, and the sudden and excess development of milk powder units.

The present study also found that the quality of dairy production is inconsistent, as reflected in studies on quality. Some studies have reported concerns regarding chemical, biological, or physical safety risks, or a reduction in the quality of raw milk or dairy products [44–49]; other studies reported production aligning with standards [50–53]. The inconsistency in dairy production quality is not only related to factors such as season, climate, and production methods [54] but it is also influenced by the unstable macroeconomic situation, sectoral policies, and the monitoring system's structure. This study found that the pricing policy, in general, and specifically the pricing policy for raw milk, do not consider product quality. A study on raw milk pricing in Iran revealed that variables such as protein content are not taken into account while pricing raw milk [55], while another study demonstrated that by including milk composition (quality factors) in the pricing system, the price difference between the highest- and lowest-quality milk would be more than double [56]. With quality not being reflected in the pricing, there is no motivation for producers to improve quality, and those producing high-quality milk may even suffer as they pay more for their quality product. Additionally, the lack of economic justification for producers due to government pricing policies and economic instability may result in reduced quality, infringement, and fraud to lower production costs and fixed prices. Some studies have reported the use of bicarbonate or other chemicals, powdered milk, and oil in raw milk and pasteurized milk [46,57,58]. In this context, the intensification of competition between traditional and industrial producers due to a market shrinkage has resulted in the promotion of quality-related rumors by some producers to defame their competitors. This has led to the formation of propaganda about industrialized dairy products, which raises concerns among consumers regarding their safety, which affect consumption as they create mistrust and concern among consumers about safety risks. Other studies have also shown that consumer perceived risk and mistrust can affect dairy consumption [59,60].

Based on findings, although the production quality monitoring system is controlled by the government, some parts of the production chain are missing from monitoring or are under minimum supervision. Moreover, quality control experts who work in the milk and dairy industry as representatives of government monitoring organizations are paid by the owners of the farm or factory, creating a conflict of interest and raising questions about

the efficiency of the quality monitoring system. Consequently, it appears that, except for export, production quality needs to be improved.

The present study found that the dairy food system in Iran faces a significant challenge of unsustainable development. With government support, the milk and dairy production industries have developed considerably but in a desultory manner. This development exists even though Iran's hot and semi-arid climate may negatively affect milk production [61]. Meanwhile, animal feed production has not grown alongside the development of industrial livestock farms due to inappropriate climate, limited water and soil resources, and policies such as subsidizing animal feed import. As a result, Iran's livestock industry remains dependent on imported animal feed [43]. Given the current situation, it is imperative to implement policies that promote domestic feed production, such as developing animal feed that can withstand arid and saline conditions or using innovative cultivation methods. However, non-cattle milk and dairy production may also be a promising solution. This approach has gained popularity in recent years, particularly as milk from certain species can offer higher nutritional value and better digestion and absorption compared to cattle milk [62–64]. However, this alternative approach also faces significant challenges, such as improving milk productivity and addressing obstacles in marketing and processing [64].

In addition, the dairy and livestock industries in Iran have also experienced unnecessary expansion, resulting in factories operating at less than their full capacity. Furthermore, the lack of government land use programs has led to the development of too many industrial livestock farms in warm and semi-arid provinces without consideration for ecological characteristics, particularly water resources. For example, Isfahan province in the center of Iran, with a semi-arid and desert climate, has had the highest milk production in recent years, with its share of milk production increasing from 12.19% in 2017 to 16.69% in 2021 [65]. The continuous increase in dairy product prices, decreasing domestic demand, and limited dairy exports due to sanctions exacerbate the unsustainability of the dairy food system. This unsustainability not only threatens the longevity of the milk and dairy sector but also limits consumers' physical and economic access to milk and dairy products. Additionally, a study by Ardekani et al., highlights the presence of various instabilities in the macro- and micro-institutions/organizations of the dairy industry [66].

The present study found that consumers' concern regarding the safety of milk and dairy products and doubt about the necessity of dairy consumption are among the main reasons for avoiding dairy consumption, which is consistent with the findings of other studies [67,68]. Alongside international discourse that warns against the negative consequences of dairy consumption and criticism from vegetarian groups, some fans of Iranian Traditional Medicine, a well-known branch of complementary medicine in Iran, as well as some physicians, also promote the notion that milk and dairy products are harmful to human health and advocate for their removal from the diet, particularly for those with certain diseases such as joint pain [69]. Moreover, the lack of any dairy promotion program from the government or private sector, primarily due to economic challenges, has left consumers uncertain about dairy consumption. Studies have indicated that increasing knowledge and perceived benefits are key factors in promoting dairy consumption [68,70]. Therefore, a promotional campaign that emphasizes the healthiness and nutritional benefits of milk and dairy products for different groups, particularly children and adolescents, is essential. The campaign should address current propaganda, clarify any rumors, and answer questions about the industrial process of dairy products to inform consumers about the actual risks associated with consuming dairy products, which can help to build their confidence. Additionally, re-establishing programs such as the school milk program, which not only provides milk and shapes children's taste preferences but also improves their knowledge, can be an effective tool in promoting dairy consumption.

The study also found that governance is a crucial factor in the functioning of the milk and dairy food system, which can heavily influence dairy food system practices and per capita dairy consumption. Our findings show that the milk and dairy food system in Iran struggles to meet some principles of good governance [37], including participation

transparency and accountability as well as bias in governmental decision making. For instance, decision-making processes for milk and dairy issues are often dominated by the government, and stakeholders have limited influence in determining policies. While there has been some progress in recent years to increase stakeholder participation, trade unions' power in decision making remains weak, and their presence is somewhat ostensible. This can lead to policies that do not fully address the needs of all stakeholders, particularly smallholder farmers, and producers.

Transparency is another important principle of good governance. In the milk and dairy food system, there may be a lack of transparency in the development of policies and regulations. For instance, there is a lack of comprehensive and accurate data. This can lead to confusion and conflicting reports, such as the difference of 3 million tons in reported milk production between the Ministry of Agriculture and the Statistical Center of Iran. The formation of parallel organizations with overlapping responsibilities has also resulted in ambiguity, with each organization blaming the other for the outcomes of adopted policies and programs.

Finally, accountability is an essential aspect of good governance. In the milk and dairy industry, the government may not be accountable for the outcomes of its adopted policies such as inflation, and may instead blame external factors for issues such as the greed of producers as the cause of price increases. This lack of accountability can lead to a lack of trust between stakeholders and decision makers, further exacerbating the challenges facing the industry.

In conclusion, improving governance in the milk and dairy food system is crucial for addressing the challenges facing the dairy food system and ensuring its sustainability.

## 5. Conclusions

The present study identifies several challenges faced by the milk and dairy food system in Iran that affect dairy consumption, including unsustainable development, high production and distribution costs, high consumer prices, inconsistent product quality, concerns regarding the necessity of dairy consumption, and its safety. Policy makers should consider revising the structure, policies, and activities of the dairy food system and define an optimized level and structure of milk and dairy development based on available resources, consumption patterns, and existing threats. A paradigm shift in milk production using local livestock as well as local feed production could address some of the challenges faced by the system. To address dairy-price-related problems, policy makers could consider reforming pricing policies and reducing government intervention to allow the market to determine the prices, as competition helps in pricing, quality, and accessibility, and also subsidizing dairy products for low-income and vulnerable groups. Re-establishing programs such as the school milk program could serve as a targeted subsidy and dairy promotion initiative. Policy makers should also prioritize the development of dairy promotion programs to help consumers understand the nutritional value and safety of dairy products. To address quality issues, policy makers could reform the quality monitoring system and establish independent quality control agencies. A comprehensive approach that prioritizes transparency, inclusiveness, accountability, evidence-based policies, effective implementation, and the continuous evaluation of policies is necessary for the improvement and sustainability of the dairy food system in Iran.

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## Appendix A

List of organizations and institutes that were interviewed:

1. Ministry of Agriculture Jihad (Deputies of Livestock Affairs and commercial development)
2. Institute of Planning Research, Agricultural Economy and Rural Development
3. Secretariat for the Supreme Council of Health and Food Security
4. National Nutrition and Food Technology Research Institute
5. Faculty of Agriculture and Natural Resources, Tehran University
6. Iran Veterinary Organization
7. Iran Food and Drug Administration
8. Consumers and Producers Protection Organization
9. Iran feed grain importer union
10. Livestock feed producers
11. Cattle farmers
12. Association of Industrial Milk Powder Producers
13. The Iranian Cattle Breeders' Association
14. The Iranian Dairy Industries Association
15. Dairy Products Distribution Company
16. Association of Dairy Products Retailers
17. Traditional dairy product retailers
18. Chain stores

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