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ICARDA
Science for resilient livelihoods in dry areas

SURE RESULTS
Resilient Food and Nutrition Security for Yemen through Agricultural Research Interventions and Capacity Building in the Small Ruminant Dairy and Agriculture Sector

Small Ruminants and Dairy Value Chain Analysis and Upgrading Strategy

Abyan, Aden, Lahj, and Taiz Governorates

Deliverables Report:
Component 1: Small ruminant dairy value chain analysis and “quick win” innovations

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Acronyms and Abbreviations

CAHW	Community Animal Health Worker
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
GDP	Gross Domestic Product
ICARDA	International Center for Agricultural Research in the Dry Areas
IPC	Integrated Food Security Phase Classification
IRG	Internationally Recognized Government
KII	Key Informant Interview
M&E	Monitoring and Evaluation
MIS	Market Information System
MFI	Microfinance Institution
NGO	Non-Governmental Organization
YR	Yemeni Rial

Executive Summary

This report presents an integrated analysis of the small ruminant dairy value chain across the Taiz, Aden, Lahj, and Abyan Governorates of Yemen, together with a corresponding upgrading strategy and implementation plan. Part I diagnoses the structure, economics, and constraints of the value chain on the basis of primary field data, while Part II translates that diagnosis into a coherent, prioritized program of interventions designed to strengthen the livelihoods and food security of vulnerable populations, including smallholder farmers, women-headed households, youth, and internally displaced persons.

The dairy value chain was prioritized for this in-depth assessment based on a multicriteria analysis that highlighted its potential for inclusive growth, evidenced by the high concentration of smallholders in the sector and significant opportunities for value addition. However, the investigation reveals that the regional dairy sector is significantly hampered by infrastructure deficits, restricted access to essential inputs, the prevalence of traditional, inefficient production methods, and fragmented market linkages. These factors collectively contribute to the sector's chronic underdevelopment.

To catalyze the sector's potential, this report puts forth the following key recommendations:

- **Promote climate-smart agriculture:** Implement and scale up climate-resilient practices to enhance the sustainability and productivity of dairy farming in the face of environmental pressures.
- **Invest in local agro-processing:** Encourage investment in small-scale processing facilities to increase local value capture, reduce postharvest losses, and create new economic opportunities.
- **Strengthen market integration:** Develop and strengthen market linkages between rural producers and urban consumption centers to ensure more stable, profitable outlets for dairy products.
- **Targeted capacity building:** Deliver comprehensive support – encompassing institutional, technical, financial, and marketing development – specifically tailored to empower women, youth, and internally displaced persons participating in the value chain.

Context and Rationale

Yemen's small ruminant sector plays a vital role in the agricultural economy and rural livelihoods. With approximately 9.7 million sheep and 9.5 million goats, the sector supports thousands of rural families and contributes significantly to household food security and nutrition. However, the sector faces formidable challenges including ongoing conflict, climate change impacts, water scarcity, animal diseases (particularly Peste des Petits Ruminants and Sheep and Goat Pox), limited veterinary services, and weak market linkages.

Key Statistics

- Meat production declined from 215,126 tonnes (2014) to 180,918 tonnes (2018).
- Milk production dropped from 379,564 tonnes (2014) to 316,782 tonnes (2018).
- Yemen produces only 42.6 percent of domestic milk requirements and 63.7 percent of meat demand.

- 75 percent of the rural population depends on livestock for livelihoods.
- The annual value of the small ruminant sector is approximately US$500 million.

Key Findings from Value Chain Analysis

This comprehensive assessment of the dairy and small ruminants value chain in Yemen's southern governorates reveals both significant challenges and substantial opportunities for sector development. The study covered 519 stakeholders across Lahj, Aden, Abyan, and Taiz governorates, including producers, traders, processors, and consumers.

The dairy sector in these governorates relies on small-scale systems, averaging 12–18 small ruminants per household. Milk output fluctuates seasonally by 40–60 percent, leading to significant price swings and postharvest losses of 15–25 percent due to inadequate cold storage. About 16 percent of producers consume their own milk without earning income from it.

Economic analysis reveals that producers operate on relatively thin margins (20–30 percent) for fresh milk, though value addition through processing can increase margins to 40–60 percent. Feed costs dominate production expenses at 60–70 percent of total costs, while high veterinary service costs and mortality rates (15–20 percent annually) further squeeze profitability.

Spatial variability across targeted locations leads to uneven access to resources, services, and markets for dairy and small ruminant producers. Those closer to urban centers benefit from better infrastructure and services, while remote areas face higher costs and limited support. Targeted efforts to strengthen coordination – such as producer groups and integrated service centers – are essential to address these disparities and improve overall value chain performance.

Market dynamics show strong urban demand that outstrips local supply, creating opportunities for production expansion. Consumers prioritize quality and freshness (78 percent of respondents) and demonstrate willingness to pay premium prices (10–20 percent more) for verified quality products. However, informal marketing channels dominate, with limited quality assurance systems.

Gender analysis reveals significant disparities, with women producers facing 40 percent higher barriers to financial access and limited participation in extension services (only 15 percent of producers). Despite dominating traditional processing activities (78 percent of processors), women have limited access to modern equipment and formal markets.

Critical constraints include feed scarcity and high costs (cited by 85 percent of producers), inadequate veterinary services (78 percent), water scarcity (71 percent), poor market infrastructure (72 percent), and limited access to finance (only 12 percent have accessed credit). These systemic constraints are exacerbated by the ongoing conflict, which has disrupted supply chains, damaged infrastructure, and constrained service delivery. These challenges are consistently reported across both urban and rural areas, highlighting the need for regionwide solutions to improve access to feed, markets, and essential services for all value chain actors.

The analysis identifies multiple entry points for intervention: strengthening producer organizations, investing in collection and cooling infrastructure, facilitating market linkages, providing targeted

technical support, developing appropriate financial products, and addressing gender-specific constraints. Priority investments in feed security, animal health systems, and market infrastructure could unlock significant pro-poor growth potential.

Critical Bottlenecks Across All Nodes

Production level: Limited access to quality breeding stock, inadequate animal health services, shortage of nutritious feed, declining pasture lands, and climate-related shocks significantly constrain production levels and productivity. Vaccination coverage is less than 30 percent, and disease outbreaks cause losses of 15–25 percent annually.

Processing and value addition: Minimal processing capacity exists in rural areas. Lack of hygienic facilities limited technical knowledge in dairy processing, weak quality standards, and inadequate cold chain infrastructure limit value addition opportunities. Currently, less than 10 percent of milk is processed, with most consumed fresh or wasted.

Marketing and distribution: Weak market linkages, poor infrastructure, information asymmetries, exploitative middlemen practices (capturing 40–60 percent of final value), and limited access to lucrative urban and export markets reduce producer margins and competitiveness.

Policy and institutional environment: Weak regulatory frameworks, insufficient government support services, lack of coordinated sectoral policies, minimal investment in livestock infrastructure, and fragmented governance constrain sector development.

Strategic Vision and Goals

Vision: A resilient, productive, and inclusive small ruminant sector that enhances food security, generates sustainable incomes, and improves the livelihoods of rural communities in Yemen.
To achieve this vision, the strategy is built on four key goals:

- **Enhance production and productivity:** Enhancing animal health, genetics, nutrition, and climate resilience to increase overall productivity.
- **Strengthen processing and value addition:** Developing processing capabilities to improve product quality, shelf life, and market appeal.
- **Improve market access and competitiveness:** Strengthening market linkages and lowering transaction costs to connect producers with profitable outlets.
- **Create an enabling environment:** Strengthening institutional capacity, improving policies, and promoting inclusive governance to ensure long-term sustainability.

Upgrading Strategy

This strategy and implementation roadmap presents a comprehensive plan for transforming Yemen's small ruminant sector in the four intervention regions of Taiz, Abyan, Lahj, and Aden. Developed through extensive stakeholder consultations and rigorous value chain analysis, this strategy addresses critical challenges while capitalizing on emerging opportunities for sustainable growth and livelihood improvement.

To address these constraints, the strategy proposes a coordinated set of interventions across the value chain. Key priorities include improving animal health and breeding systems, strengthening feed availability and management, expanding veterinary and advisory services, upgrading milk collection and processing facilities, and improving market linkages and value addition. The strategy also promotes stronger institutional coordination and enabling policy support while integrating cross-cutting priorities such as climate resilience, private-sector participation, gender inclusion, youth employment, and the strengthening of producer organizations.

The action plan will be implemented in phased stages between 2026 and 2030 with an estimated investment of approximately US$8.5 million. Through targeted investments, strategic partnerships, and strengthened governance mechanisms, the plan aims to enhance productivity, reduce livestock losses, expand market opportunities, and increase the participation of women and youth in the sector. Ultimately, the strategy seeks to improve incomes for smallholder livestock keepers while contributing to broader food security, economic recovery, and resilience in Yemen's livestock sector.

The strategy outlines priority interventions categorized into five key pillars:

- **Pillar A: Production Enhancement:** Improve animal health and productivity by vaccinating 1.5 million animals, deploying 100 Community Animal Health Workers (CAHWs), and training 5,000 producers in climate-smart husbandry, breeding, and resource management.
- **Pillar B: Processing and Value Addition:** Establish 12 modern dairy processing centers and train 600 women in specialized dairy production, backed by upgraded cold chains, packaging, and quality assurance systems.
- **Pillar C: Marketing and Market Access:** Connect producers to high-value markets using an SMS-based pricing system, improved collection infrastructure, contract farming, and Gulf export linkages.
- **Pillar D: Policy and Institutional Support:** Create an enabling environment by enhancing national disease surveillance, advocating for sector-friendly policies, forging university research and development partnerships, and launching livestock credit schemes.
- **Pillar E: Cross-Cutting Priorities:** Ensure environmental sustainability through climate change adaptation while driving social goals, including youth entrepreneurship and the economic empowerment of 2,000 women.

Implementation Phases

Phase I: Foundation and Pilot (2026): Backed by US$1.8 million, this phase focuses on rapid mobilization by launching a 500,000-animal vaccination campaign and establishing four pilot dairy processing centers. It also prioritizes human capital by forming 40 producer groups, training 200 women, and developing a digital market information system.

Phase II: Scaling and Market Integration (2027–2028): With a US$3.5 million investment, this high-growth stage scales annual vaccinations to 1.5 million animals and expands infrastructure to 12 processing centers and 20 collection centers. Additionally, it introduces breed improvement programs, contract farming, and strengthened policy frameworks.

Phase III: Institutionalization and Sustainability (2029–2030): Supported by US$3.2 million, the final phase ensures long-term viability by transitioning processing centers to private-sector management.

It focuses on institutionalizing veterinary services, opening high-value export channels, and scaling successful interventions to additional governorates.

Investment Summary: Five-Year Outlook
The total strategic investment of US$8.5 million is structured to front-load capacity building and infrastructure, ensuring that by 2030, the sector is self-sustaining and resilient.

Table 1. Five-year strategic investment framework (2026–2030)

Phase	Duration	Key focus	Budget (US$)
I	Year 1	Piloting and baseline	1.8 million
II	Years 2–3	Scaling and value chain	3.5 million
III	Years 4–5	Exit strategy and export	3.2 million
Total	5 years	Sector transformation	8.5 million

Stakeholder Roles

- **Government agencies (governance and regulation):** Formulate policies, enforce regulations, provide direct veterinary services, develop public infrastructure, and coordinate national priorities.
- **Private sector (commercial drivers):** Drive economic growth by investing in processing and inputs, facilitating market development and technology adoption, and leading the transition to a market-led model by 2030.
- **Development partners (technical excellence):** Agencies such as the United Nations Food and Agriculture Organization, United Nations Development Programme, International Center for Agricultural Research in the Dry Areas, and World Bank supply global expertise, technical assistance, capacity building, research, and resource mobilization.
- **Producer organizations (grassroots empowerment):** Facilitate collective action, allowing 15,000 smallholder households to access markets and services, ensure quality control, and advocate for producer interests.
- **Service providers (technical support):** Serve as the “boots on the ground” by delivering extension services, veterinary care, direct training, and technical troubleshooting for producers.

Monitoring and Evaluation

A robust monitoring and evaluation system will track progress through 30 key performance indicators:

- **Measured success and indicators:** The program tracks tangible outputs like training and facilities to achieve key outcomes: >80 percent vaccination coverage, 12 operational processing units, and the organization of 5,000 producers with a mandatory 40 percent women’s participation rate.

- **Economic and productive impact:** Projects a 40 percent boost in household income (from a US$500 baseline) and aims to generate US$12 million in additional annual sector income while creating more than 500 jobs. Productivity gains include a 30 percent increase in milk (+80,000 tonnes) and a 25 percent increase in meat yields (+52,000 tonnes).
- **Social and environmental stewardship:** Aims to halve disease-related mortality from 20 percent to 10 percent, secure food safety for 75,000 people, and economically empower 2,000 women. Environmentally, it will implement sustainable rangeland management across 50,000 hectares to reduce emissions and boost climate resilience.
- **Risk management:** Acknowledges risks like conflict, climate shocks, and market volatility. These are mitigated through conflict-sensitive programming, climate risk insurance, pre-positioned veterinary supplies, and transparent beneficiary targeting to prevent elite capture.

This strategy provides a practical and actionable blueprint for upgrading Yemen's small ruminant value chain. Its successful implementation requires commitment, collaboration, and coordinated action from all stakeholders. With sustained effort, the small ruminant sector can become a driver of rural prosperity, food security, and economic resilience in Yemen, contributing meaningfully to recovery and development in a challenging context.

Part I: Value Chain Analysis

Part I establishes the empirical foundation of the study. Drawing on a structured survey of producers, traders, processors, and service providers, complemented by focus group discussions and stakeholder consultations, it maps the small ruminant dairy value chain, quantifies its economics, and identifies the binding constraints that the upgrading strategy in Part II is designed to address.

Chapter 1: Introduction

Yemen's dairy sector, particularly small ruminant milk production from goats and sheep, plays a vital role in rural livelihoods and food security. Small ruminants are well adapted to Yemen's arid and semiarid conditions, requiring less water and feed than large ruminants, and providing a crucial source of nutrition and income for resource-poor households.

The ongoing conflict has devastated Yemen's economy and agricultural systems. Gross domestic product (GDP) has contracted by approximately 50 percent, poverty rates have soared to more than 80 percent of the population, and basic services have collapsed across much of the country. The agricultural sector, which employs about 50 percent of the workforce, has been particularly hard hit by disrupted markets, destroyed infrastructure, and displacement of rural populations.

Despite these challenges, the dairy value chain demonstrates remarkable resilience and potential for recovery. Demand for dairy products in urban centers remains strong, and traditional production knowledge persists in rural communities. The sector offers particular opportunities for women, who dominate traditional dairy processing, and for youth seeking viable livelihood options.

The dairy value chain was prioritized for this in-depth assessment based on a multicriteria analysis that highlighted its potential for inclusive growth, evidenced by the high concentration of smallholders engaged in the sector and the significant opportunities for value addition. However, the investigation reveals that the regional dairy sector is significantly hampered by infrastructural deficits, restricted access to essential inputs, the prevalence of traditional and inefficient production methodologies, and fragmented market linkages. These factors contribute to the sector's chronic underdevelopment.

Beyond direct food provision, small ruminants contribute to poverty alleviation and provide various products such as meat, milk, laban (yogurt), haqeen (sour buttermilk), ghee (clarified butter), wool, skin, and manure. While natural pastures provide a significant portion of the nutritional requirements for sheep and goats, there is a recognized limitation in their capacity to meet the full demand, indicating a need for improved feed management.

The significance of small ruminants is further amplified by the agroclimatic conditions prevalent in the region. Arid and semiarid areas, which constitute the majority of Yemen's land, are particularly suited for small ruminant production. This natural compatibility makes small ruminant farming a logical and sustainable agricultural pursuit in these environments. The sociocultural factors also contribute to a high demand for small ruminant products, further solidifying their place in the Yemeni context.

In summary, small ruminants are not merely livestock in Yemen; they are integral to food security, economic stability, and the cultural fabric of the nation. Their adaptability to the prevailing environmental conditions and their multipurpose utility make them indispensable assets for a significant portion of the Yemeni population. Addressing the challenges within their value chain is therefore paramount for enhancing overall food security and improving rural livelihoods in Yemen.

The small ruminants dairy value chain in Yemen, while not extensively detailed in a single comprehensive study, can be understood by synthesizing information from regional analyses and specific dairy sector reports. The chain generally encompasses several key stages and actors, from primary production to consumption.

While the general structure of the value chain is discernible, specific details regarding the actors, their relationships, and the flow of products within the Yemeni context require more in-depth investigation. The impact of the ongoing conflict on each stage of this value chain is also a critical area that needs further exploration.

Chapter 2: Study Purpose and Objectives

This study undertakes a comprehensive analysis of the small ruminants and dairy value chains within the four target governorates, with specific focus on identifying opportunities for pro-poor growth, women's empowerment, and resilience building.

The analysis covers all critical stages of the dairy value chain, including production systems, processing and value addition, marketing and distribution, input supply services, support services, and consumption patterns. The assessment employs both quantitative and qualitative methods to generate robust evidence for program design.

Key Objectives:

The following points are as per the project terms and references.

- **Strengthen program design:** Enhance program effectiveness by gaining detailed insights into market systems, value chain dynamics, and economic opportunities in the dairy sector. Understanding bottlenecks, inefficiencies, and leverage points for intervention.
- **Guide future interventions:** Generate evidence-based recommendations for programmatic interventions that can improve income generation, enhance food security, and foster sustainable livelihoods for small-scale producers, processors, and traders.
- **Map value chains comprehensively:** Conduct in-depth analysis of key value chains for small ruminant dairy products including fresh milk, laban, and ghee. Document product flows, actor relationships, and value distribution.
- **Identify and assess stakeholders:** Identify all key stakeholders involved in the value chain (farmers, herders, collectors, processors, traders, retailers, input suppliers, service providers, financial institutions, consumers) and assess their roles, relationships, constraints, and opportunities.
- **Map input/output flows:** At each stage of the value chain, systematically map input requirements, output quantities, associated costs, and revenue streams. Calculate value addition, profit margins, and efficiency indicators.

- **Analyze market dynamics:** Examine market dynamics including supply and demand patterns, pricing mechanisms, seasonal variations, quality requirements, consumer preferences, and competitive forces affecting value chain efficiency and equity.
- **Assess gender dimensions:** Analyze gender roles, relations, and disparities throughout the value chain. Identify gender-specific constraints, opportunities, and entry points for women's economic empowerment.
- **Identify support service gaps:** Assess availability, accessibility, and quality of critical support services including technical extension, veterinary services, financial services, business development services, and market information.
- **Evaluate governance and coordination:** Examine value chain governance structures, coordination mechanisms, power dynamics, and institutional arrangements. Identify opportunities for improving cooperation and reducing transaction costs.
- **Recommend strategic interventions:** Based on comprehensive analysis, develop specific, actionable recommendations for interventions that can strengthen the value chain, improve competitiveness, enhance inclusiveness, and contribute to sector development.

Chapter 3: Methodology, Data Collection, and Analysis

The data analysis for this value chain assessment utilized a comprehensive suite of statistical and analytical tools to process, analyze, and visualize the survey data collected from 519 respondents across the four target governorates. The analysis was performed using R Statistical Software (version 4). Domain-specific analysis was handled by packages such as value chain. The entire project was documented and presented using R statistical packages and geo-point in KoboToolbox and ArcGIS reports.

Data for the analysis was collected using the KoboToolbox platform, combining quantitative surveys with qualitative interviews to provide a comprehensive understanding of the value chain. The core of the analysis is built on four main surveys targeting different actors within the value chain:

- **Producers survey:** A detailed survey of 232 dairy producers and small ruminant breeders
- **Trader survey:** Data from 66 wholesalers and retailers on sourcing, pricing, and margins
- **Buyers survey:** A survey of 185 households focusing on consumption patterns and preferences
- **Service provider survey:** Information from 36 key support actors, including input suppliers and veterinarians

To add depth and context to the survey findings, a series of qualitative methods were also employed, with 22 focus group discussions (FGDs) and in-depth key informant interviews (KIIs) with 15 agricultural officials, 17 microfinance institutions, and 9 women's civil society organizations.

Before analysis, all datasets underwent a rigorous validation process to ensure accuracy and reliability. This included checks for completeness, consistency between related variables, data range validation, and the identification and investigation of any outliers or logical errors in the survey responses.

Comprehensive data cleaning and preparation was essential to ensure data quality and analytical integrity. From the detailed survey instruments, a wide range of variables were extracted and

organized into key analytical themes. The raw data was then rigorously cleaned, transformed, and prepared for statistical analysis.

Key Areas of Investigation

The survey was designed to capture a holistic view of the dairy value chain, focusing on the following areas:

- **Demographics and socioeconomics:** We collected foundational data on the producers and their households, including their location, household size, and key individual characteristics like age, gender, and education. We also assessed their socioeconomic status through variables like land ownership and a calculated asset index.
- **Production and inputs:** This category covers the technical aspects of dairy farming. We gathered detailed information on herd characteristics (size, breed, age), production systems (for example, intensive versus extensive), daily milk yields, and animal health practices. We also meticulously tracked all inputs, including the type and cost of feed, labor, water, and veterinary services.
- **Economics and Marketing:** To understand the business side of the operations, we tracked the flow of all outputs (milk, meat, processed goods) from production to their final destination, whether for home consumption or sale. We analyzed marketing channels, seasonal prices, and overall market access. This allowed for a thorough economic analysis of costs, revenues, and profit margins.
- **Support systems and roadblocks:** This section assesses the enabling environment. We measured producers' access to key services like agricultural extension, veterinary care, financial credit, and market information. We also specifically identified the most significant production, marketing, and financial constraints they face.
- **A gender-focused lens:** A critical component of the survey was dedicated to understanding gender dynamics. We collected data on the distinct roles of men and women in decision-making, labor, and control over resources like animals and income. We also used specific indicators to measure women's economic empowerment.

Data Collection Methods

Structured Surveys

Separate questionnaires were developed for each value chain actor category, covering the following:

- Demographic and socioeconomic characteristics
- Production systems and management practices
- Input use, costs, and sources
- Output quantities, quality, and prices
- Marketing channels and relationships
- Access to services and support
- Constraints and opportunities
- Gender roles and decision-making

Focus Group Discussions

Twenty-two gender-segregated FGDs were conducted (11 with men, 11 with women), with a total of 198 participants, to explore the following:

- Value chain mapping and actor relationships
- Seasonal variations and coping strategies
- Quality perceptions and standards
- Constraint ranking and prioritization
- Opportunities for value addition
- Gender-specific challenges and needs

Key Informant Interviews

Semi-structured interviews with 41 key informants included three groups:

- Local government agriculture officials
- Microfinance institution managers
- Non-governmental organization (NGO) program staff

Market Observations

Direct observations were made of major market sites to assess the following:

- Product quality and variety
- Pricing practices and negotiations
- Hygiene and storage conditions
- Customer-vendor interactions
- Market infrastructure and services

Study Sampling

The study utilized a cross-sectional design with stratified random sampling. The sampling frame was constructed in collaboration with local authorities, agricultural offices, and community leaders to ensure representative coverage of value chain actors.

Table 3.1 Sample size and distribution by actor category

Category	Total	Men	Women
Total respondents	519	319	200
Producers (farmers/herders)	232	119	113
Retailers	33	30	3
Wholesalers/collectors	33	21	12
Buyers	185	119	66
Dairy input suppliers	36	30	6

Table 3.2 Survey distribution by governorate

Governorate	Total	Men	Women
Lahj	123	84	39
Aden	71	57	14
Abyan	197	81	116
Taiz	128	97	31
Total	**519**	**319**	**200**

Data Collection Process

- Survey team of 12 trained enumerators and 4 supervisors
- Comprehensive five-day training on survey instruments, interview techniques, and ethics
- Use of mobile data collection tools (KoboToolbox) for real-time data capture
- Daily data review and quality checks by supervisors
- Random resurvey of 10 percent of surveys for quality assurance
- Data collection period of 8 weeks, June–August 2025

Analytical Approach

Quantitative Analysis

- Descriptive statistics (frequencies, means, medians, ranges)
- Cross-tabulations by key variables (gender, location, actor type)
- Statistical tests (RStudio) for group comparisons
- Margin and cost–benefit analysis for economic assessment
- Software used: R Statistical Software, Excel

Qualitative Analysis

- Thematic analysis of FGD transcripts and KII notes
- Participatory value chain mapping
- Constraint and opportunity matrices
- Strengths, weaknesses, opportunities, and threats (SWOT) analysis by value chain node
- Software used: RStudio for coding and analysis

Limitations and Mitigation

- **Security and access:** Some remote areas could not be accessed due to security concerns. Mitigation: Increased sampling in accessible areas with similar characteristics.
- **Seasonal timing:** Survey conducted in spring (peak production season). Mitigation: Recall questions for low season; secondary data on seasonality; plan for follow-up surveys.
- **Recall bias:** Some respondents lacked records for annual data. Mitigation: Use of multiple recall questions; triangulation with other sources; focus on recent transactions.

- **Self-reporting**: Income and cost data self-reported may have errors. Mitigation: Cross-validation across value chain actors; assessment of internal consistency; conservative estimates.
- **Conflict context:** Ongoing instability affects data reliability and generalizability. Mitigation: Clear documentation of context; conservative interpretation; focus on relative comparisons rather than absolutes.

Ethical Considerations

The study adhered to strict ethical protocols:

- Informed consent obtained from all participants
- Confidentiality and anonymity guaranteed
- No coercion or undue inducements
- Sensitive topics handled with cultural awareness
- Data stored securely with restricted access
- Results shared with participating communities
- Approval obtained from relevant local authorities

Chapter 4: Demographic Analysis

Understanding the demographic characteristics of value chain actors provides crucial context for interpreting production systems, market behaviors, and intervention design.

Geographic Distribution

The study achieved balanced coverage across the four target governorates, with slight variations based on population density and value chain activity concentration (see Table 3.2).

Survey Distribution by Governorate

- **Lahj Governorate:** 123 respondents (23.7 percent) – known for traditional dairy production in highland areas.
- **Aden Governorate:** 71 respondents (13.7 percent) – major urban market and commercial hub.
- **Abyan Governorate:** 197 respondents (37.9 percent) – mix of coastal and inland production systems.
- **Taiz Governorate:** 128 respondents (24.6 percent) – largest governorate with diverse agroecological zones.

District-Level Variation

Following consultations with the project technical coordination team, stakeholders, and field surveyors across different districts in targeted governorates, each district's Integrated Food Security Phase Classification (IPC) level was considered as reported by the IPC. The final selection of districts focused on those identified as having greater potential for dairy value chain development. The final selection of districts included Khanfar, Loder, and Zinjibar in Abyan; Al-Makatera and Tuban in Lahj; Almaafer and Saber Almoadem in Taiz; and Aden's Dar Saad and Buraiqua.

The geographic distribution reflects variation in the following:

- Population density and urbanization levels
- Concentration of value chain activities
- Accessibility and security conditions
- Presence of implementing partners
- Agro-ecological diversity

The geographic distribution of survey respondents was shaped by several critical factors. First, population density and the level of urbanization in each governorate influenced both the number of respondents and the focus of value chain activities. Areas with higher population concentrations or major urban centers, such as Aden, saw increased survey representation due to their roles as commercial hubs.

Second, the concentration of value chain activities was a guiding criterion. Districts with established or emerging dairy production, processing, and marketing operations were prioritized to ensure that the survey captured a comprehensive picture of the sector's dynamics. The study found five processing centers developed by the Food and Agriculture Organization (FAO) as part of a food security intervention, and these were the largest processing centers, if not the only. A full video case study was developed as part of this study.

Gender Distribution

The conflict has caused a massive increase in women-headed households (roughly 30 percent of displaced families), where women are now bearing primary responsibility for both household survival and resource control. The survey data reveals that Yemen's dairy value chain is highly segmented by gender, with men and women playing distinct and often unequal roles at different stages. While women are central to production and processing, they are largely excluded from the more public and profitable sectors of trade and service provision.

On the Farm: Production and Processing

At the production level, there is a men-dominated distribution, with 65 percent men and 35 percent women producers. However, men typically own and manage the livestock, while the women surveyed were often from women-headed households. These women producers reported managing smaller herds and facing greater difficulties in accessing inputs and services due to cultural barriers and limited mobility.

The role of processing milk into products like laban and ghee is overwhelmingly dominated by women (79 percent). This work is culturally defined as a woman's domain, leveraging traditional knowledge passed down through generations. Despite their critical role, women often lack control over the income generated and have little access to modern processing equipment.

The data shows that women overwhelmingly dominate traditional milk processing activities, accounting for most processors. This suggests that in many communities, there are notable clusters or groups of women engaged in processing dairy products, often leveraging shared knowledge and cultural practices.

Despite women's central role in production and processing, their representation in community leadership positions – such as presidents of cooperatives, members of local councils, or mayors – remains extremely limited. The survey found that women rarely hold formal leadership roles within producer organizations or community governance structures, reflecting broader societal norms that restrict women's public participation. Where women do serve in leadership capacities, they often face additional scrutiny and barriers, but their involvement has been shown to improve the responsiveness of cooperatives and councils to women's needs and priorities. Strengthening pathways for women to assume leadership roles – through capacity building, mentorship, and supportive policies – can help amplify women's voices in decision-making, promote more inclusive governance, and drive positive change across the value chain and the wider community.

In the Marketplace: Trading and Sales

A sharp contrast is seen in the marketplace, which is predominantly a space for men.

The retail sector is 91 percent men. Cultural norms largely restrict women from operating in public markets, so the few women retailers (9 percent) typically sell from their homes to other women within their communities.

The wholesaling and collecting sector, which requires mobility and capital, is also majority men (66 percent). Women face significant constraints that limit their participation as collectors and wholesalers.

The Broader Ecosystem: Buyers and Services

Among buyers, women are the primary decision makers (60 percent of respondents). They are typically responsible for daily dairy purchases and are more skilled at judging product quality. However, their purchasing power is often limited as men usually control the household finances.

The agricultural service sector shows the most severe gender imbalance, with 91 percent of providers being men. The near-total absence of women veterinarians, input suppliers, and extension agents creates a major barrier for women farmers, who may be unable or unwilling to interact with men service providers. Other related studies highlight time poverty due to 12–16-hour workdays with no childcare services.

Key Takeaways for Development

This gender distribution highlights women's significant yet often undervalued contributions to the dairy industry. It underscores the urgent need for targeted interventions, such as creating women-friendly service delivery models and supporting women's enterprises in processing. For any meaningful change to occur, programs must systematically address cultural barriers while actively engaging men to foster a more equitable and efficient value chain.

Age Distribution

The age profile of participants in the dairy value chain, with a mean age of 41.3 years, reveals a mature workforce and points to significant challenges regarding youth engagement and the future of farming.

A Look at the Different Generations

The average age varies significantly depending on the role an individual plays within the value chain, highlighting a clear generational divide.

- **Producers:** This is the oldest group, with a mean age of 43.2 years. A concerningly low 22 percent of producers are young people (18–30 years), raising serious questions about who will manage these farms in the future. Many youths view farming as unprofitable and laborious, preferring to seek opportunities in urban areas.
- **Traders and processors**: These roles attract a somewhat younger demographic. Traders have an average age of 38.5 years, and processors average 39.8 years. Processing, in particular, is a key income-generating activity for younger and middle-aged women.
- **Service providers:** At a mean age of 44.7 years, veterinarians and input suppliers are the most experienced cohort. The lack of young people in this sector points to a potential future shortage of skilled agricultural support professionals.

The Missing Generation: Where are the Youth?

The low participation of those aged 18–35, especially in primary production, is a major concern. Young people face numerous barriers, including limited access to start-up capital and traditional inheritance patterns that favor older family members. Furthermore, the perception of dairy farming as a low-status, low-return activity drives rural youth to migrate to cities in search of better prospects.

Looking Ahead: Challenges and Opportunities

This age dynamic presents both a significant challenge and a unique opportunity. The aging producer population means there is an urgent need for social protection, labor-saving technologies, better succession planning, and systems to ensure valuable traditional knowledge is passed down to the next generation. Tapping into this potential through targeted training and financial support is essential for the long-term sustainability and growth of the dairy industry.

The introduction of targeted safety nets, such as cash transfers, subsidized health insurance, and pension schemes for elderly producers, can help reduce vulnerability and ensure a basic standard of living. By providing a safety net and enabling environment, social protection can help retain youth in the sector, support intergenerational knowledge transfer, and promote a more resilient and inclusive value chain.

Education Level Distribution

Education levels among participants in the dairy value chain are generally low, a factor that significantly impacts business practices and the adoption of new technologies. A striking 42 percent of all respondents have no formal education, a situation worsened by conflict-related disruptions to rural schooling.

The Education Gap: A Closer Look

The data reveals significant disparities in educational attainment across different groups.

- **The Gender Gap**: There is a pronounced gender gap in education. More than 56 percent of women have no formal education, compared with 36 percent of men. This reflects cultural norms that prioritize boys' education and the disproportionate effect of school closures on girls.
- **Producers versus Professionals:** Producers have the lowest education levels, with nearly half (48 percent) having never attended school. In contrast, traders are more likely to have primary or secondary education, reflecting the need for basic literacy and numeracy in business. As expected, service providers like veterinarians are the most educated group, with more than 81 percent having completed secondary or higher education.

Does Education Make a Difference?

Formal education is strongly linked to improved business and farming practices, though it's not the only path to success. On the farm, higher education correlates with a greater willingness to adopt improved feeding practices, vaccinate animals, and keep records. However, it's crucial to note that traditional knowledge passed down through generations often compensates for a lack of formal schooling, with many highly skilled producers having no formal education. In the market, the benefits of education are even clearer. Traders with at least a secondary education are far more likely to keep business records (78 percent versus 23 percent), access formal credit, and ultimately achieve higher profit margins.

Bridging the Gap: What Can Be Done?

The low literacy levels mean that support programs must be designed to be accessible to everyone. Instead of relying on written materials, interventions should use visual aids, hands-on demonstrations, and peer-to-peer learning. Integrating adult literacy and numeracy classes with technical training can also be highly effective.

Special attention must be paid to reaching women and other groups with the lowest educational attainment. By using appropriate, low-literacy communication tools like audio-visual aids and mobile-based learning, it's possible to build skills and capacity across all segments of the value chain.

One interesting young lady was found on social media preparing homemade videos for rural women to take care of their livestock, with more than 200,000 organic followers!

Chapter 5: Value Chain Mapping and Structure

Value Chain Actors Overview

Producers: The foundation of the chain is built by small-scale livestock keepers, including farmers, herders, and peri-urban households. Typically managing small flocks of 12–18 animals with family labor, they handle animal husbandry and milk production. A significant majority (80 percent) also create basic processed goods like laban, haqeen, and ghee, selling directly to neighbors or collectors. However, they have limited access to support services and are highly vulnerable to shocks like drought and disease.

Collectors and aggregators: These intermediaries are the critical link between remote producers and urban markets. Using motorbikes or small trucks, they gather milk from numerous small farms. They operate on thin margins but handle large volumes, often building trust-based relationships and providing credit to producers.

Processors: Processing occurs at two levels. The vast majority (78 percent) is done by traditional home-based processors (mostly women) who sell locally. A smaller group (22 percent) of small commercial processors is emerging, using more modern equipment and attempting to build brands, though they face challenges with supply and capital.

Distributors and retailers: In urban centers, wholesalers purchase large quantities of fresh and processed dairy for redistribution. They operate storage facilities, set market prices, and supply various retailers. Retailers are the final point of sale and include traditional market vendors, small neighborhood shops, and a few modern supermarkets.

Buyers: The final buyers are primarily urban and rural households, along with restaurants and tea shops. Buyers show a strong preference for fresh, local products and are price-sensitive but also conscious of quality. Daily purchasing is common due to a lack of home refrigeration.

Feed producers and suppliers: Many producers struggle with access to affordable, high-quality feed due to limited local production and distribution.

Insemination service providers: Insemination services are often scarce or inaccessible in rural areas.

Veterinary shops and mobile vets: Access is often limited, especially for women and remote producers.

Equipment suppliers: Smallholders often lack the capital or market connections to acquire modern equipment.

Water suppliers: Water scarcity remains a persistent challenge for many producers.

Support Systems and Environment

The value chain relies on a wider ecosystem of support, though its effectiveness is often limited.

Suppliers and service providers: This includes shops for animal feed and medicine, as well as veterinarians and agricultural extension agents. However, their coverage in rural areas is poor, prices are high, and quality can be inconsistent.

Organizations and governance: Producer cooperatives and women's groups exist but are generally weak. Government ministries, regulatory bodies, and financial institutions that form the enabling environment are largely non-functional, offering little effective support or oversight.

Market Dynamics and Profit Distribution

The interactions between these actors are defined by several key characteristics:
Relationships: The market operates primarily on personal trust and informal credit, rather than formal contracts.

Value distribution: Producers capture 40–50 percent of the final buyer price. The highest margins are found in processing, where value addition can reach 30–40 percent, highlighting a major opportunity for producers to increase their income. Retailers typically see a 15–20 percent margin, while wholesalers and collectors earn 8–12 percent and 5–10 percent, respectively.

Producer Livestock Holdings

This analysis provides a clear picture of the scale and nature of small-scale dairy farming operations.

Herd size: The typical producer manages a herd of 12–14 goats and sheep. The majority (56 percent) fall into the medium-holder category with 10–19 animals, while about a quarter are smallholders (3–9 animals) and 17 percent are considered large holders (20+ animals).

Species mix: Goats are the dominant species (61 percent), prized for their resilience, adaptability, and higher milk yields. Most producers (73 percent) keep mixed flocks of both goats and sheep.

Herd structure: The core of the herd consists of about eight breeding females, which are the primary source of milk. To manage costs, many households do not own a breeding male, instead relying on shared community animals. A major challenge is the high mortality rate for young kids and lambs, which stands at a significant 15–20 percent.

The analysis did not reveal any significant differences in herd sizes between men and women producers. Both men and women, including those from women-headed households, typically manage herds within the same size range as the overall average – about 12–14 goats and sheep. This suggests that, despite facing different challenges in access to resources and services, women are able to maintain livestock holdings comparable to their men counterparts in the study area.

Breeding and Genetics: Quality versus Quantity

Breeding practices are foundational to herd productivity and sustainability.

Local indigenous breeds make up more than 80 percent of all animals. Producers overwhelmingly prefer these breeds (67 percent) for their hardiness and resistance to local diseases, even if their milk yields are lower than imported breeds.

For the majority of herds (58 percent), breeding is uncontrolled and unplanned. Access to quality breeding males is a key constraint, with artificial insemination being virtually non-existent. The primary breeding objective for most producers (58 percent) is to improve milk production.

The Payoff: Milk Production

Milk is the central product, providing both nutrition for the household and a vital source of income.

- **Daily yield:** A single lactating animal produces an average of 0.8–1.2 liters of milk per day. Goats generally produce slightly more than sheep.
- **Household production:** During the peak lactation season, an average household produces 4.2 liters per day. This figure can be 60 percent lower during the dry, low season.
- **Annual output**: Annually, a household produces between 450 and 650 liters of milk. Approximately 60–70 percent of this is sold, with the remaining 30–40 percent consumed at home.

Major Hurdles and Pathways to Improvement

Producers face significant obstacles but also have clear opportunities for growth.
There are four top constraints:

- **Feed and water scarcity:** Identified by 85 percent of producers, the lack of quality feed and water is the single greatest barrier to productivity, especially during the dry season.
- **Disease and health issues:** Mentioned by 78 percent of producers, common diseases and limited access to affordable veterinary care led to high mortality and economic losses.
- **Poor genetics:** More than 60 percent of producers recognize that the low productivity of local animals and a lack of access to improved breeds constrain their potential.
- **Knowledge gaps:** More than half of producers cite a need for better training in modern feeding, breeding, and health management techniques.

Key opportunities include the following:

- **Improved nutrition:** Strategic feed supplementation and cultivation of fodder crops can boost milk yields.
- **Better healthcare:** Focusing on preventive measures like vaccination can drastically reduce mortality and treatment costs.
- **Training and capital:** Access to technical training and working capital is essential for producers to invest in these improvements.

Chapter 6: Economic Analysis

Producer Cost Structure

The average annual cost for a small dairy-producing household is approximately YR301,425 (Yemeni rial), with variable costs that change with production levels making up 48 percent of this total. Fixed costs that remain relatively stable make up the other 52 percent. The exchange rate was US$1 to YR1,631 during the study period in August 2025.

The day-to-day operational expenses show that most variable costs are concentrated in a few key areas. Zakat, taxes, and fees make up the largest portion at 27 percent of these expenses, followed by feed and fodder costs such as silage, local fodder, and concentrated feed, which together account for nearly 30 percent. Overall, the cost breakdown highlights that feed, compliance, and marketing are the main drivers of daily operating expenses.

What Makes Costs Vary?

The main factors causing variation are the following:

- **Production system:** Intensive (stall-fed) systems have the highest costs but also higher productivity. Extensive (grazing-based) systems have lower costs but suffer from lower output and higher mortality.
- **Herd Size:** Larger herds have higher total costs, but economies of scale are limited because feed costs increase proportionally.
- **Geography:** Highland areas have higher feed costs, while lowland areas have higher water costs. Producers near cities face higher land costs but have better access to inputs.
- **Season:** Milk production costs per liter are higher in the dry season when milk production drops and feed prices increase by 20–30 percent.

Measuring Cost-Effectiveness

Two key metrics help assess cost-effectiveness:

- **Cost per liter of milk:** The average selling price is YR1,053 per liter.
- **Cost per animal:** The average cost to maintain one animal for a year is YR23,990.

These figures vary widely based on the producer's management skills, animal genetics, and herd health.

Key Challenges and Opportunities

The qualitative findings reveal that rural women farmers face a wide range of economic, logistical, and sociocultural challenges that significantly hinder their productivity and participation in agricultural markets. The most frequently mentioned issue was the high cost of agricultural inputs, such as plowing, seeds, and animal feed, reported by 151 participants (65 percent). Despite these difficulties, 10 participants (4 percent) identified opportunities for improvement, such as enhancing product quality, adopting better farming practices, and accessing training or organizational support.

Overall, these findings underscore how economic constraints, inadequate infrastructure, climatic stress, and restrictive social norms intersect to limit rural women's potential in agriculture. Addressing these barriers through affordable inputs, accessible financing, improved transportation, and women-centered capacity-building programs could significantly enhance their livelihoods and market participation.

Opportunities

Analysis of participants' responses revealed several prominent opportunities for advancing dairy production in their communities. The expansion of marketing outlets, including mobile caravans and nearby local markets, was identified by 63 respondents (27 percent), emphasizing the importance of accessible marketing channels for local products.

Meanwhile, increasing local demand for fresh, locally made dairy products was noted by 49 respondents (21 percent), suggesting a shift in consumer preference away from industrial goods toward village-based production. Support from donor and international organizations – including training, financial assistance, and input provision – was mentioned by 42 respondents (18 percent),

underlining the need for external backing to sustain growth. Training and capacity-building opportunities in dairy processing, animal health, and modern production methods were cited by 30 respondents (13 percent), while 18 respondents (8 percent) pointed to the use of modern equipment and solar-powered cooling systems as practical innovations to enhance quality and reduce losses.

Overall, the findings demonstrate a collective optimism toward transforming the local dairy sector from small-scale, traditional practices into a sustainable, market-oriented enterprise. The convergence of new dairy centers, expanding markets, and institutional support – combined with modern techniques and improved livestock – presents a robust foundation for rural economic growth and enhanced livelihoods among dairy producers.

Price and Margin Analysis – Producers

Table 6.1 Milk prices

Milk	Average (YR)	Median (YR)
Cost per liter	1,052.78	1,000.00
Selling price	1,860.14	1,500.00
Profit margin	**847.26**	**500.00**

The analysis of producer-level milk prices highlights a generally profitable but uneven market landscape. The average production cost for milk is YR1,052. This indicates that, on average, producers enjoy a healthy markup on their production costs. However, the median values – YR1,000 for cost, YR1,500 for selling price, and YR500 for profit margin – suggest that typical producers earn lower returns than the mean, pointing to the presence of a few higher-performing producers who raise the overall average.

This variation reflects differences in production efficiency, access to markets, and product quality across producers. Those with better infrastructure, feed management, and market linkages likely command higher selling prices, while smaller or less-efficient producers face thinner margins. Overall, while milk production remains profitable, the disparity between average and median figures underscores the need for interventions that improve productivity, reduce input costs, and strengthen market access to ensure more equitable and stable returns across all producers.

Table 6.2 Haqeen (sour buttermilk) prices

Haqeen	Average (YR)	Median (YR)
Cost per liter	1,173.68	1,200.00
Selling price	1,984.16	1,500.00
Profit margin	**810.48**	**300**

The analysis of haqeen producer prices reveals a moderately profitable segment with noticeable variability in earnings. The average production cost for milk among haqeen producers is YR1,173.68 per liter, while the average selling price reaches YR1,984.16 per liter, yielding an average profit margin of YR810.48. These figures indicate that, on average, haqeen producers achieve slightly higher profits than the overall producer average, reflecting relatively efficient production systems or stronger market positioning.

However, when considering median values – YR1,200 for cost, YR1,500 for selling price, and YR300 for profit margin – it becomes clear that typical producers earn significantly less than the top performers who raise the averages. This gap suggests heterogeneity within the haqeen producer group, likely influenced by differences in herd size, input costs, and access to high-value markets. Overall, while the haqeen segment shows solid profitability potential, targeted support to improve production efficiency and expand market access could help reduce performance disparities and strengthen profitability across the entire producer base.

Retailer Margins

At the retail level, the average purchase price of milk stands at YR1,400 per liter, while the average selling price is YR1,700 per liter. This yields a profit margin of YR300 per liter, representing a relatively modest markup of around 21 percent over the purchase price. Such a margin indicates that retailers operate within tight profitability constraints, possibly due to strong competition, consumer price sensitivity, or high operating costs such as transportation and refrigeration.

While the margin suggests efficient turnover and limited intermediary costs, it also highlights the vulnerability of retailers to price fluctuations in upstream markets. Any increase in producer or transport costs could quickly erode profits unless selling prices adjust accordingly. Therefore, maintaining stable supply chains and optimizing logistics efficiency are essential for sustaining retailer profitability in the milk value chain.

Regardless of their business model, all retailers face a similar set of challenges:

- **Perishability:** The constant risk of spoilage, especially without reliable refrigeration.
- **Market pressures:** Intense price competition from other vendors and fluctuating seasonal demand.
- **Financial strain:** Dealing with payment delays from customers who buy on credit and managing limited storage capacity.

Wholesaler Margins

For wholesalers, the average purchase price of milk is YR1,200 per liter, while the average selling price is YR1,400 per liter, resulting in a profit margin of YR200 per liter. This represents a 20 percent markup on the purchase price, reflecting a moderate return that compensates for handling, storage, and transportation costs. Compared with producers and retailers, wholesalers appear to maintain balanced margins, likely benefiting from economies of scale and bulk purchasing that reduce per-unit costs.

However, the relatively narrow margin suggests that wholesalers operate within competitive market dynamics, where price flexibility is limited by both upstream supplier costs and downstream retail pricing pressures. Sustaining profitability therefore depends on maintaining efficient distribution systems, minimizing wastage, and ensuring consistent market linkages between producers and retailers. Overall, the wholesaler segment plays a crucial intermediary role in the milk value chain, facilitating product flow while capturing modest but stable margins.

Wholesalers maintain their crucial position in the market through several key advantages:

- **Economies of scale:** They can transport and store milk far more cheaply per liter than smaller players.
- **Market power:** Their extensive networks and access to market information give them significant power in price negotiations with both producers and retailers.
- **Financial leverage:** By providing credit to retailers, they build strong, loyal customer relationships and ensure a steady demand for their products.

Value Addition Along the Chain

Based on the most recent data, milk travels through four primary actors – producers, wholesalers, retailers, and buyers – each contributing to and benefiting from the product's final market value. Using the updated average prices, the final buyer price for milk is approximately YR1,700 per liter, representing the cumulative value added across the chain.

The distribution of value along the chain shows that producers continue to capture the largest share, but downstream actors also retain meaningful margins:

- **Producer (62 percent):** The producer, who raises the animals and manages the milking process, earns approximately YR1,052 from a final price of YR1,700, capturing the majority of the value created, yet with the higher cost.
- **Wholesaler (12 percent):** The intermediary who aggregates and delivers milk from producers to markets earns around YR200 in value added, reflecting the difference between the producer price (YR1,200) and the wholesaler selling price (YR1,400).
- **Retailer (18 percent):** The shop or market vendor selling directly to buyers captures an estimated YR300 per liter, representing the difference between the purchase price (YR1,400) and the final buyer price (YR1,700).
- **Other costs and margins (8 percent):** The remaining value (around YR147) is distributed among transporters, informal collectors, storage, and miscellaneous transaction costs.

The Biggest Opportunity: Adding Value Through Processing

The findings reinforce that the greatest potential for increased profitability lies in processing milk into higher-value dairy products. For instance, transforming one liter of fresh milk (worth approximately YR1,052) into laban or cheese can significantly enhance the selling price – often reaching YR1,800–2,000, depending on quality and packaging. This represents an added-value of more than 70 percent, achieved through relatively simple on-farm or cooperative-level processing.

Although milk producers already command the largest share of total value, the margin distribution suggests that profits are uneven and sensitive to market dynamics. Strengthening producers' capacity for milk processing, cold chain management, and direct sales to buyers could meaningfully improve income stability. In short, transitioning from raw milk sales toward value-added dairy production remains the most promising pathway for boosting earnings and resilience across the Yemeni dairy value chain.

Constraints on Value Chain Actors

Both women and men in the value chain face constraints across the domains of production, marketing, finance, and infrastructure. Displacement has also disrupted traditional community support networks, further exacerbating the challenges faced by value chain actors in the sector.

The dairy sector in southern Yemen is increasingly affected by environmental stressors such as rising temperatures, prolonged droughts, soil degradation, and the spread of pests and animal diseases. These factors have led to decreased pasture availability and increased production costs. Climate change adaptation strategies – including improved water management, drought-resistant fodder crops, and integrated pest management – are urgently needed to sustain the sector.

Constraints and challenges frequently mentioned in surveys include the following:

- **Production constraints:** Feed scarcity (85 percent), limited veterinary services (78 percent), water scarcity (71 percent), and poor genetics (62 percent) are top producer constraints.
- **Marketing challenges:** Poor infrastructure (72 percent), price volatility (68 percent), lack of cold chain (65 percent), and limited information (58 percent) constrain marketing.
- **Input supply and financial constraints:** Limited input availability, high prices, and credit access (only 12 percent have formal credit) severely constrain operations.
- **Storage and quality challenges:** Lack of refrigeration, limited quality control, and high postharvest losses (15–25 percent) reduce value chain efficiency.

Chapter 7: Gender Analysis and Constraints

Women are central to Yemen's dairy sector, yet they face a web of interconnected cultural and economic barriers that systematically limit their ability to profit from their hard work. FGDs revealed that these are not isolated challenges but a systemic issue.

Economic and Financial Hurdles

Economically, women are on an unstable footing. They rarely have legal ownership of productive assets like land or livestock (only 15 percent do), which prevents them from using them as collateral for loans. This contributes to severe financial exclusion, with only 8 percent of women accessing

formal credit. This is compounded by a lack of access to business and financial literacy training, which constrains the growth of their small enterprises.

Social Norms and Restricted Access

Cultural norms present significant barriers. Restricted mobility is a major constraint for 65 percent of women, preventing them from traveling to markets, negotiating with traders, or attending training sessions. This isolation is reinforced by a men-dominated support system; agricultural extension services are overwhelmingly staffed by men, and only 15 percent of their beneficiaries are women, effectively cutting women off from crucial technical knowledge.

The Double Burden: Work Without Power

In most focus groups women in the dairy sector face extreme "time poverty," working 12–16 hours per day. They must balance all livestock and processing duties with their existing domestic responsibilities, including childcare, cooking, and water collection. This immense workload is made harder by a lack of access to modern, labor-saving processing technology.

Despite their critical labor, they have very little decision-making power. In 72 percent of households, men make all major financial decisions, even concerning the income generated by women's work. In many cases, women's dairy-related activities account for an estimated 15–25 percent of total household income. However, despite this contribution, women often have limited control over how this income is used, as major financial decisions are typically made by men.

Addressing these deep-seated constraints requires more than simple technical support. It demands a transformative approach that challenges restrictive social norms, strengthens women's legal rights, and ensures they have not only the skills but also the power to control the resources they generate.

Chapter 8: Market Analysis

Stakeholder Engagement

Stakeholder engagement was an essential component of the Small Ruminant Dairy Value Chain study. It ensured that the analysis reflected ground realities, captured diverse perspectives, validated key findings, and promoted ownership among beneficiaries, institutions, and implementing partners. The engagement process strengthened collaboration and supported evidence-based recommendations.

Stakeholders were identified based on their roles and influence within the small ruminant dairy value chain. The mapping included both field-level and institutional actors:

- **Producers and farmers:** Men and women livestock owners across the four governorates.
- **Processors and traders:** Milk collectors, processors, and retailers involved in the dairy chain.
- **Service providers:** Veterinarians, feed suppliers, financial institutions, and input dealers.
- **Government authorities:** Representatives from the Ministry of Agriculture and local livestock offices.
- **Civil society:** Women's associations, cooperatives, and local NGOs.

Engagement Methods

A combination of qualitative and participatory methods was used to engage stakeholders throughout the study. These methods ensured inclusivity, gender balance, and diverse representation across the value chain.

- **KIIs:** Conducted with representatives of government agencies, cooperatives, and the private sector.
- **FGDs:** Held separately with producers, traders, and women's groups in each governorate.
- **Validation workshop:** A consultative session organized to present preliminary findings and collect feedback.
- **Continuous coordination:** Maintained with local authorities and ICARDA technical staff to align fieldwork and data verification.

Table 8.1 Summary of stakeholder engagement activities

Activity type	Participants	Location	Key output
Key informant interviews	41 stakeholders	4 governorates	Validation of constraints and opportunities
Focus group discussions	22 groups (about 220 participants)	All sites	Gender and production insights
Workshop	Impact Consulting, ICARDA, and partners	Online and in Cairo	Consensus on key interventions
Coordination meetings	ICARDA representatives	Multiple	Validation and data alignment

Key Insights from Stakeholders

- There is strong demand for improved access to veterinary services and quality inputs.
- Small producers have limited access to finance and market information.
- Interest is high in cooperative formation and women-led processing initiatives.
- There are challenges related to feed availability and climate-induced productivity declines.
- Government institutions emphasized the need for policy coordination and investment in processing infrastructure.

Validation and Feedback Integration

Stakeholder feedback was systematically integrated into the report. The validation process led to adjustments in actor roles, geographic coverage, and recommendation priorities. Inputs from government and development partners were used to align the findings with policy frameworks and ICARDA's operational objectives.

The stakeholder engagement process ensured inclusiveness, ownership, and accuracy of findings. It enabled the study to reflect practical realities while building consensus on actionable interventions to strengthen the small ruminant dairy value chain across southern Yemen.

Market Analysis Results

Market analysis reveals strong urban demand, quality-focused buyers, and significant seasonal price variations affecting all chain actors. Limited access to veterinary services and inadequate hygiene practices in milk handling and processing pose significant health risks to both producers and consumers. Strengthening veterinary outreach, promoting good hygiene practices, and supporting the establishment of local milk collection centers with basic quality control measures are critical steps to ensure food safety and public health.

Factors influencing purchase decisions: Buyer surveys identified quality/freshness (78 percent), price (68 percent), and source/origin (54 percent) as top purchase decision factors.

Product source preferences: Urban buyers purchase 45 percent from retail shops, 30 percent from traditional markets, and 15 percent direct from producers. Rural buyers favor direct producer purchases (60 percent).

Price fluctuations and seasonality: Prices vary 20–30 percent seasonally, with lowest prices during spring peak production and highest during the summer low production period.

Support services: Support services remain weak with limited coverage, poor quality, and inadequate financing.

Input suppliers: Input suppliers are concentrated in urban areas with limited rural coverage, high prices, and quality concerns.

Microfinance services: Microfinance penetration is minimal (12 percent access), with high interest rates (20–25 percent), collateral requirements, and limited rural presence.

Agricultural extension services: Extension coverage reaches less than 20 percent of producers, with outdated methods and inadequate resourcing.

Value chain governance and linkages: Weak horizontal and vertical linkages limit coordination and efficiency gains. Producer cooperatives are weak (18 percent membership) with poor governance and limited service provision capacity.

Chapter 9: Synthesis of Diagnostic Findings and Transition to the Upgrading Strategy

This chapter consolidates the diagnostic findings of Part I and establishes the logical bridge to the upgrading strategy presented in Part II. The value chain analysis revealed a sector of substantial economic and nutritional importance that is nevertheless constrained by fragmented production, weak market linkages, limited access to finance and inputs, gender inequities, and infrastructure deficits aggravated by protracted conflict. The key findings and recommendations summarized below define the strategic agenda that the subsequent chapters operationalize into concrete interventions.

The survey of 519 respondents across four governorates reveals small-scale production (12–18 animals per household), seasonal variations (40–60 percent), and thin margins (20–30 percent for fresh milk). Women face 40 percent higher barriers to resources. Key constraints mentioned by survey respondents include feed scarcity (mentioned by 85 percent), limited veterinary access (78 percent), and weak market infrastructure (72 percent).

Growing urban demand, value addition potential (estimated at 40–100 percent increases), technology adoption opportunities, and a supportive policy environment create entry points. Women play a pivotal role in the early stages of the dairy value chain, including animal care, milking, and initial processing. Despite their significant contributions, women often lack access to training, financial resources, and decision-making opportunities. Empowering women through targeted capacity-building programs, access to microfinance, and inclusion in producer cooperatives is essential for enhancing productivity and resilience across the value chain.

Data Quality and Limitations

Data collection achieved good quality standards through trained enumerators and quality controls. Limitations include single-season coverage, self-reported financial data, limited geographic scope (four governorates), and conflict context affecting generalizability. Sample size was adequate for governorate-level analysis but limited for some actor sub-categories.

Recommendations

Boosting Production at the Farm Level

The foundation of the strategy is to make dairy farming more productive and resilient. This involves implementing climate-smart practices, such as promoting drought-resistant fodder and rainwater harvesting. Critically, it also means strengthening animal health services by establishing a network of community-based animal health workers and improving access to affordable vaccines. These actions are expected to increase productivity by more than 30 percent and cut animal mortality in half.

Building Modern and Efficient Markets

To ensure producers can sell what they produce, significant investment is needed in market systems. The plan calls for establishing milk collection centers with cooling facilities to reduce spoilage, which is a major source of loss. It also includes support for community-level processing units, allowing producers to create higher-value products like laban and cheese. These steps will help producers capture 40–60 percent more value from their milk and create hundreds of new jobs.

Strengthening Cooperatives and Financial Access

Individual small-scale farmers have little bargaining power. This strategy focuses on building strong producer organizations and cooperatives. By working together, farmers can purchase inputs more cheaply and negotiate better prices for their products. This will be paired with the development of livestock-specific financial products, such as micro-loans and insurance, to give producers the capital they need to invest in their businesses.

Part II: Value Chain Upgrading Strategy

Building directly on the diagnostic evidence of Part I, Part II sets out a coherent upgrading strategy for the small ruminant dairy value chain. It articulates the strategic context and vision, details the methodology and stakeholder process behind the strategy, and culminates in a prioritized, costed program of interventions with an implementation roadmap, monitoring framework, and risk-management plan.

Chapter 10: Strategic Context

The results are stark: Between 2014 and 2018, the overall livestock population in Yemen declined from 21.3 million head to 19.4 million. Meat production dropped by 16 percent, and milk production fell by 17 percent during the same period. Animal disease outbreaks, particularly Peste des Petits Ruminants and Sheep and Goat Pox, have caused significant stock losses. Currently, Yemen imports the majority of its livestock and dairy products, with domestic production meeting only 42.6 percent of milk demand and 63.7 percent of meat demand.

Rationale for a Value Chain Approach

- Producers operate within a complex system of market relationships, service providers, and enabling institutions.
- Constraints at any node of the chain affect the performance of the entire system.
- Sustainable upgrading requires strengthening linkages among value chain actors.
- Value addition and market development are as important as production enhancement.
- Women and youth play critical roles throughout the value chain and must be intentionally included.

Objectives of the Strategy

The overarching objective of this strategy is to design a comprehensive, actionable, and stakeholder-aligned roadmap for upgrading the small ruminant value chain in Yemen, with specific focus on the intervention regions of Taiz, Abyan, Lahj, and Aden.

Specific Objectives

Objective 1: Diagnostic and Strategic Foundation

The initial phase focuses on diagnosing value chain performance to map the intricate web of actors and functions. By identifying specific bottlenecks – from high mortality rates to fragmented market access – the program can identify upgrading opportunities. These are the strategic leverage points where small interventions can yield maximum returns in productivity and profitability. This leads to articulating a strategic vision, a collaborative framework that aligns the aspirations of thousands of producer households with national economic goals.

Objective 2: Targeted Interventions and Responsibilities

With a clear vision in place, the strategy defines priority interventions – evidence-based actions across the production, processing, and marketing nodes. To move from plan to practice, the roadmap clarifies stakeholder roles, ensuring that government, private-sector, and development partners have a clearly delineated set of responsibilities. This organizational clarity is essential for

the implementation roadmap, a sequenced five-year plan that guides the sector through its pilot, scaling, and institutionalization phases.

Objective 3: Impact, Inclusion, and Resilience

A core pillar of the strategy is establishing a monitoring and evaluation (M&E) framework. This system uses impact indicators – like the 40 percent income increase – to support adaptive management and real-time course correction. Central to this is promoting inclusive development, which intentionally integrates women and youth into dairy processing and service roles. Simultaneously, the program seeks to build resilience by embedding climate-smart husbandry and rangeland management into the daily operations of every producer group.

Objective 4: Resource Mobilization and Sustainability

Finally, the fourth objective is to catalyze investment. By providing a transparent, data-backed case for support, the strategy creates a compelling framework for resource mobilization. This ensures that the government, the private sector, and international donors see a clear path toward a self-sustaining, high-value small ruminant sector by 2030.

Geographic Scope

This strategy focuses on four primary intervention regions in southern Yemen:

Taiz: The Production Powerhouse

Taiz is characterized by its diverse agroecological zones, allowing for a high density of small ruminant populations. While the city itself remains a focal point of conflict, the rural highlands maintain relative stability, serving as a reliable engine for livestock and dairy production. The strategy here focuses on harnessing existing trade routes and improving on-farm productivity to feed the broader regional value chain.

Abyan: The Pastoral Heartland

Abyan serves as a critical production zone, defined by its traditional pastoral and agro-pastoral systems. As the region recovers from years of instability, its strong dairy traditions provide a natural foundation for value chain development. Its proximity to major transit routes makes it an ideal location for the establishment of the program's planned milk collection and processing centers.

Lahj: The Agricultural Link

Acting as a bridge between the rural interior and the coast, Lahj benefits from a mix of irrigated and rain-fed farming systems. The governorate has already seen success through previous FAO-led interventions, resulting in an emerging dairy processing sector. Its strategic market access to Aden makes it a primary candidate for scaling up commercial-grade dairy production and cooling infrastructure.

Aden: The Economic Gateway

As Yemen's economic capital, Aden is the ultimate destination for the value chain's outputs. It represents the country's largest consumption market with high demand for fresh meat and processed dairy. Beyond domestic consumption, Aden serves as the strategic export gateway to the

Gulf markets. The focus here is on high-end processing, quality assurance, and the logistics required to move Yemeni products into international trade channels.

Sectoral Scope

Upstream: Inputs and Production

The chain begins with a robust input supply network, focusing on the reliable delivery of high-quality feed, drought-tolerant fodder, and essential veterinary medicines. This foundation supports diverse production systems across the four governorates – ranging from traditional migratory pastoralism to more intensive, sedentary rearing. By professionalizing these systems, the project stabilizes the supply of sheep and goats before they ever leave the farm.

Midstream: Trading and Transformation

The transition from raw asset to marketable product occurs through organized collection and trading. This involves establishing formal milk collection points and livestock trading hubs that reduce the influence of predatory middlemen. Once collected, the processing phase adds significant value; raw milk is transformed into high-demand laban, cheese, and ghee, while livestock are managed through modern slaughter and meat processing protocols to ensure food safety and quality.

Downstream: Markets and the Consumer

The final stages focus on marketing and distribution, bridging the gap between rural producers and urban centers like Aden. This includes strengthening both wholesale and retail channels and opening the door to lucrative export markets in the Gulf. Ultimately, the success of the chain is validated at the consumption level, where increased availability of safe, nutritious animal products meets the needs of both private households and the growing food service sector.

Cross-Cutting Themes

Social inclusion: Women and Youth

The program moves beyond traditional demographics to tap into the underutilized potential of the rural workforce:

- **Youth Engagement and Employment:** To combat rural flight and unemployment, the initiative creates high-tech and service-oriented roles. This includes opportunities for young people in value chain services, such as operating digital market information systems, veterinary kiosks, and transport logistics.

Resilience: Climate and Nutrition

In an era of environmental instability, the strategy embeds “future-proofing” into every intervention:

- **Climate change adaptation:** With 50,000 hectares under sustainable management, the project prioritizes environmental sustainability. This involves promoting drought-tolerant fodder, water conservation techniques, and improved feeding practices that reduce methane emissions per unit of meat produced.

- **Nutrition and food security:** The ultimate goal of increasing milk and meat production is to improve the diets of 75,000 people. By making high-quality animal protein more available and affordable, the program directly tackles malnutrition and strengthens local food systems.

Structural Sustainability: Policy and Institutions

To ensure the project survives beyond the 2030 exit strategy, the focus remains on the "rules of the game":

- **Institutional strengthening:** This involves a heavy investment in capacity building for local veterinary departments and producer organizations. By training 100 CAHWs and reinforcing research and development partnerships, the project builds a self-reliant knowledge base.
- **Policy and regulatory environment:** The strategy advocates for a more enabling policy environment, targeting everything from export regulations to livestock credit laws. Strengthening disease surveillance at the state level ensures that the sector can defend its gains against future biological or economic shocks.

Time Frame

Phase I: Foundation and Pilot (2026)

The short-term focus is on mobilization and establishing proof of concept. Critical data gathering, including the baseline survey and the rollout of the market information system, will also be completed to ensure evidence-based management moving forward.

Phase II: Scaling and Market Integration (2027–2028)

In the medium term, the project transitions from pilot to full-scale operations. The vaccination reach will triple. By developing contract farming arrangements, the program will begin to formalize the link between smallholder producers and commercial buyers while simultaneously strengthening the national policy and institutional frameworks.

Phase III: Institutionalization and Sustainability (2029–2030)

The long-term goal is to ensure the sector's autonomy and resilience beyond the project's lifespan. By the end of 2030, the primary objective is to have established permanent sustainability mechanisms that protect the 40 percent income gains achieved by the target households.

Context Analysis

Yemen's small ruminant sector operates within a complex and challenging context shaped by multiple interconnected factors. Understanding this context is essential for designing effective and realistic upgrading interventions.

Yemen's Agricultural Sector

Yemen's agricultural sector is the backbone of the economy, contributing 15 percent to GDP and employing more than 50 percent of the workforce. The sector is characterized by the following:

- Diverse agroecological zones supporting multiple production systems
- High dependence on rain-fed and traditional irrigation systems
- Water scarcity as the most critical constraint

- Limited mechanization and low productivity
- Weak extension services and limited technology adoption
- Disruption due to ongoing conflict since 2014

Livestock production accounts for 20 percent of agricultural GDP (approximately US$1.1 billion annually). Small ruminants – sheep and goats – are the most numerous livestock after poultry, with approximately 9.7 million sheep and 9.5 million goats.

The conflict has severely weakened agricultural institutions, disrupted markets, destroyed infrastructure, and displaced populations, leading to significant declines in production.

Small Ruminant Sector Overview

Livestock Population and Productivity Trends

As of early 2026, the national flock is estimated at approximately 19.21 million head, nearly split between sheep (9.72 million) and goats (9.49 million). This represents a significant bounce-back from the 2018 low of 19.4 million, though still shy of the 21.3 million pre-conflict baseline.

While production is recovering – with meat output reaching ~207,500 tonnes and milk nearing 358,000 tonnes – a massive supply–demand gap persists. Currently, Yemen must import 57.4 percent of its milk and 36.3 percent of its meat to meet domestic needs. Closing this gap by improving local per-animal performance (averaging only 0.3–0.8 liters of milk per day) is the central objective of this strategy.

Characterizing Production Systems

The sector operates through three distinct systems, each requiring tailored interventions:

- **Pastoral systems:** These nomadic and semi-nomadic producers manage large herds (50–200 head) on natural rangelands. They are the backbone of the live animal trade but operate with minimal inputs and are highly vulnerable to climate shocks.
- **Agro-pastoral systems:** Combining crop residues with rangeland grazing, these mid-sized holders (20–50 head) focus on both meat and milk. This group is the primary target for improved veterinary inputs and fodder technology.
- **Peri-urban/intensive systems:** Located near consumption hubs like Aden, these sedentary farmers manage small herds (5–20 head) with high input use. They are the key drivers of the fresh milk and dairy market.

The Socioeconomic Safety Net

For the rural poor, sheep and goats are more than just commodities; they are a multifunctional financial instrument:

- **Income and insurance:** Generating roughly US$500 million annually, livestock act as "walking banks," providing liquid assets that can be sold to cover emergency expenses or social obligations.
- **Nutritional security:** Direct access to milk and meat provides a vital protein source for families who might otherwise struggle with food insecurity.

- **Women's empowerment:** In the Yemeni context, goats are one of the few assets women can independently own and control. Since women manage the majority of dairy activities, this sector is the most direct pathway to improving women's economic agency.

Table 10.1 Small ruminant production summary

Indicator	Sheep	Goats
Live weight	25–35 kg	20–30 kg
Reproduction rate	0.8–1.2 lambs/year	1.2–1.8 kids/year
Milk yield	Negligible	0.3–0.8 l/day
Primary value	Meat & live sale	Milk, meat, & asset ownership

Socioeconomic Context

The project operates against a backdrop of deep humanitarian need. In 2026, Yemen remains one of the world's most food insecure nations, with 60 percent of the population (17.4 million people) lacking reliable access to nutrition. Economic shocks have pushed 80 percent of citizens below the poverty line, while child stunting stands at a critical 46 percent.

For these families, small ruminants are not just livestock; they are biological bank accounts that provide life-saving protein and a buffer against the collapse of formal employment and the 45 percent contraction of the national GDP.

Demographic Shifts and the Youth Bulge

Yemen's demographic profile is characterized by a significant youth bulge, with 60 percent of the population under age 25. This creates a dual reality:

- **Urbanization:** Conflict and economic necessity have driven 4 million internally displaced persons and countless rural migrants toward cities like Aden, creating massive consumption markets but draining the rural labor force.
- **Economic opportunity:** This young, growing population represents a massive pool of potential entrepreneurs for the value chain services envisioned in our strategy (Pillar E), particularly in digital market systems and modern processing.

The Paradox of Gender Dynamics

While Yemeni society remains deeply patriarchal – reflected in women's 6 percent formal labor participation rate and restricted mobility – the small ruminant sector is a unique stronghold for women. Women perform the vast majority of daily animal care, milking, and processing; they are the "secret architects" of the dairy value chain.

Paradoxically, the absence of men due to conflict has forced many women into decision-making roles traditionally held by men. The strategy's focus on training 600 women (Pillar B) capitalizes on this shift, turning informal labor into recognized, income-generating expertise.

Social Capital: The Tribal Backbone

Despite the collapse of many formal state services, traditional social structures remain the most reliable forms of organization. These networks provide essential conflict resolution and social safety nets, often proving more resilient than government institutions.

Within the networks, much of the livestock trade in Abyan and Lahj relies on informal credit and deep-seated reputation networks. The strategy seeks to strengthen producer cooperatives (Pillar C) by building on this existing social capital rather than replacing it with unfamiliar formal models.

Political and Security Environment

The Internationally Recognized Government (IRG), based in Aden, maintains control over our four target regions (Aden, Lahj, Abyan, and Taiz). However, recent shifts in early 2026 saw rapid power struggles between the IRG and the Southern Transitional Council, necessitating a conflict-sensitive approach that works with local tribal and council leaders who often hold the most practical influence.

Regional Stability and Operational Risk

While all four intervention regions are theoretically under IRG control, the security profile varies significantly, impacting how the five-year roadmap is executed:

Table 10.2 Regional security profile and implementation considerations

Region	Current security status (2026)	Strategic implementation note
Aden	Seat of government; relatively stable	Focus on high-level processing and export logistics
Lahj	Generally stable; active production	Primary site for dairy centers and training hubs
Abyan	Improving; active recovery efforts	Requires conflict-sensitive community engagement
Taiz	Mixed; stable rural areas versus city conflict	Focus on decentralized, village-level vaccination units

The Humanitarian–Development Nexus

In a country where 18 million people face crisis levels of hunger as of February 2026, the small ruminant strategy must function as both a life-saving response and a long-term development tool. By moving from “giving food” to “building value chains,” the strategy addresses the underlying drivers of vulnerability. For example, replacing a portion of the 57 percent of imported milk with local production directly improves national food sovereignty and reduces exposure to global price spikes.

Conflict-Sensitive Programming Principles

To operate successfully in this environment, the project adheres to the following safeguards:

- **Minimizing harm:** The project will ensure that the distribution of resources (like credit or equipment) does not exacerbate local tribal tensions or favor one political group over another.
- **Adaptive flexibility:** The Year 1 (2026) budget of US$1.8 million includes scenario planning to pivot activities if specific trade routes or markets are temporarily closed due to insecurity.

Climate and Environmental Context

Yemen's highly variable geography – from the humid coastal plains to the temperate highlands – is undergoing a rapid transformation. With mean temperatures rising by 0.19°C per decade, livestock in 2026 face frequent heatwaves exceeding 45°C. This directly suppresses appetite, reduces milk yield, and increases mortality among young and weak animals.

The Water Crisis: A Terminal Constraint?

Water scarcity is the most critical threat to the small ruminant value chain. With groundwater tables dropping by 3–7 meters annually, the sector is competing for a dwindling resource.

Livestock drinking requirements increase dramatically during heatwaves, yet water sources are receding. In 2025 and 2026, the cost of trucked-in water surged, making sheep and goat rearing a financial liability for some producers in Lahj and Abyan.

Groundwater over-extraction – partially driven by the expansion of solar-powered pumping for high-value crops like qat – is draining the aquifers that once supported fodder cultivation.

Rangeland Degradation and Desertification

Rangelands cover 47 percent of Yemen and are the primary feed source for the country's 19 million small ruminants. However, these lands are under immense pressure from overgrazing.

High livestock density relative to carrying capacity has led to a loss of palatable species and severe soil erosion. The conflict has disrupted traditional migratory patterns (seasonal transhumance), leading to sedentary overgrazing in stable areas, which accelerates desertification.

Strategic Climate Adaptation Pathways

To mitigate these threats, the 2026–2030 strategy integrates several resilience-building interventions:

Table 10.3 Strategic climate adaptation pathways

Adaptation pillar	Strategic action	Expected result
Water security	Construction of rainwater harvesting cisterns & solar-powered wells	Reduced dependency on expensive trucked water
Fodder resilience	Promotion of drought-tolerant species (e.g., *Opuntia* & *Atriplex* spp.)	Stable feed supply during extended dry spells
Genetic selection	Focusing on indigenous, heat-tolerant local breeds	Lower mortality and sustained productivity under heat stress
Rangeland rehab	Community-led rotational grazing & seedling planting	Improved carrying capacity on 50,000 hectares
Early warning	SMS-based weather and drought alerts (Year 1 rollout)	Managed destocking before severe drought peaks

Chapter 11: Methodology and Approach

The development of this Small Ruminant Value Chain Upgrading Strategy employed a comprehensive, participatory, and evidence-based approach grounded in internationally recognized value chain analysis frameworks.

Conceptual Framework

The strategy development was guided by the Value Chain Development Framework, which views the value chain as a system of interconnected actors, functions, and relationships that work together to deliver products to end markets. These are among the key principles:

- **Market-driven approach:** Understanding market demand and opportunities as the starting point.
- **Systemic perspective:** Analyzing the entire value chain system rather than focusing narrowly on production.
- **Competitiveness focus:** Identifying interventions that enhance efficiency, reduce costs, and improve quality.
- **Inclusion and equity:** Ensuring smallholders, women, and marginalized groups can participate and benefit.
- **Sustainability:** Promoting economically viable, environmentally sustainable, and socially inclusive interventions.

The methodology also incorporated elements of the Making Markets Work for the Poor (M4P) approach, emphasizing understanding and addressing systemic market failures, strengthening market relationships, and facilitating sustainable change.

Phased Approach

The process followed a 10-week strategy development lifecycle.

Weeks 1–2: Preparation and Planning

The process began with a foundational "deep dive" into existing literature and secondary data. During these two weeks, the team focused on logistical mobilization, which included developing specialized data collection tools, identifying a diverse cross-section of key informants, and conducting intensive training for field researchers to ensure data integrity across all target governorates.

Weeks 3–5: Fieldwork and Data Collection

This phase represented the most intensive period of primary research. The team engaged directly with the value chain through interviews with a wide array of actors from government officials to private exporters, and FGDs to capture the nuances of producer challenges, and leveraged the value chain study conducted in livestock hubs to observe real-time pricing and trading dynamics.

Weeks 6–7: Analysis and Synthesis

Raw data was transformed into actionable intelligence during this stage. Qualitative data was transcribed and coded to reveal recurring themes, while the team engaged in detailed value chain mapping. This allowed for a precise identification of systemic constraints – such as specific disease bottlenecks – and the pinpointing of high-yield opportunities for intervention.

Weeks 8–9: Strategy Formulation

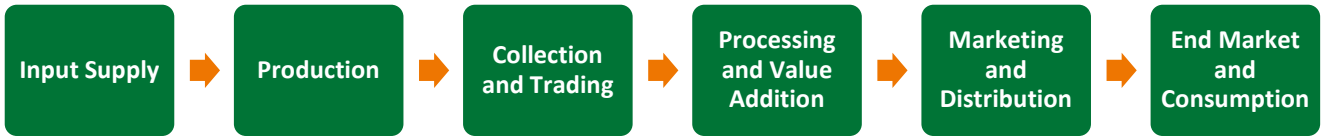
To ensure the strategy was co-created rather than imposed, the team held three consultative workshops involving 40 participants. These sessions were used to validate the field findings, articulate a shared vision, and prioritize the list of 25 interventions. It was during this phase that the five-year implementation roadmap and the M&E framework were structurally finalized.

Week 10: Finalization and Dissemination

The final week focused on refinement and formalization. After incorporating stakeholder feedback and undergoing a rigorous validation process with ICARDA, the final strategy document was produced. This phase concluded with the development of a dissemination plan to ensure all partners are aligned.

Chapter 12: Value Chain Mapping

The value chain is structured around a sequence of value-adding steps that transform raw inputs into consumable goods.



- **Input supply:** The chain begins with the provision of essentials – breeding stock, veterinary pharmaceuticals, and feed. This node is currently fragmented, often relying on informal traders rather than certified suppliers.
- **Production:** This is the core engine, operating across three distinct systems: the extensive pastoral model (low input/high mobility), the agro-pastoral mix, and the intensive peri-urban model focused on dairy.
- **Collection and trading:** This node acts as the bridge between dispersed producers and concentrated markets. It involves the aggregation of live animals for slaughter and the daily collection of milk from thousands of smallholders.
- **Processing and value addition:** Here, value is added through transformation. For meat, this occurs in slaughterhouses; for dairy, it involves the conversion of raw milk into shelf-stable laban, cheese, and ghee.
- **Marketing and distribution:** This is the logistical phase where wholesalers and retailers manage the flow of goods to final sales points, navigating physical and bureaucratic checkpoints.
- **End markets:** Here the chain has multiple destinations – domestic households and the food service sector (restaurants and hotels), alongside the high-value export channel to the Gulf States.
- **Consumption:** At this final node, value is realized by households and institutions.

The Actor Ecosystem

The chain is populated by a diverse cast of stakeholders, stratified into three layers of influence.

- **Primary actors (the "doers"):** Producers form the base, feeding into a network of village collectors and traders who aggregate volume. Processors – ranging from local butchers to industrial dairy plants – transform the raw material, while wholesalers and retailers ensure it reaches the consumer.
- **Supporting actors (the "facilitators"):** Veterinarians and Community Animal Health Workers (CAHWs) protect the primary asset (the herds), while transporters move it. Financial institutions – predominantly informal lenders and microfinance bodies – provide the necessary liquidity.
- **Enabling environment (the "rule-makers"):** The chain operates within a regulatory framework set by the Ministry of Agriculture and the Directorate General of Animal Resources. However, in the current context, development partners (FAO, United Nations Development Programme) and tribal authorities often play an equally critical role in governance and stability.

Strategic Flows: The Lifeblood of the Chain

A value chain is defined by what moves through it. In this context, two distinct flows dictate efficiency and profitability.

- **Meat chain:** The dominant pathway is from producer to village collector to market trader. From here, animals diverge; some go to local slaughterhouses for domestic retail, while high-quality males are often channeled to exporters for the Gulf market.
- **Milk chain:** This is more localized. While much stays at the household level, commercial volumes flow from producers to milk collectors to processors, eventually reaching consumers as value-added dairy products.

Information Flows

Currently, this flow is asymmetric and weak, creating a power imbalance.

- **Market data:** Price signals move efficiently among traders but rarely reach producers, leaving farmers in the dark about the true value of their stock.
- **Technical knowledge:** Vital data on animal health and weather patterns flows poorly from extension services to the field, increasing vulnerability to shocks.

Financial Flows

The economic circulatory system is characterized by informality and friction.

- **Cash is king:** Digital banking is virtually non-existent; transactions are settled in cash.
- **Informal credit:** Producers rely on traders for credit (often in the form of advance payments), creating a dependency cycle.
- **High friction:** Transaction costs are inflated by “checkpoint taxes,” transport fees, and the sheer number of middlemen required to move goods in a conflict zone.

Input Supply and Services

Feed and Fodder Security

The nutritional baseline for Yemen’s livestock is precarious, relying heavily on natural rangelands and crop residues like sorghum stalks and wheat straw. To reverse this, the strategy identifies high-potential opportunities in promoting drought-tolerant species such as pearl millet and producing feed blocks from local materials, reducing the sector’s dangerous dependence on expensive, imported concentrates.

Veterinary Health and Disease Control

The veterinary landscape is characterized by a service vacuum in rural areas. With government services weakened by conflict and private veterinarians concentrated in cities, vaccination coverage remains below 30 percent, leaving the vast majority of the national herd vulnerable. The most viable path forward involves a hybrid approach: launching mass vaccination campaigns and formally integrating CAHWs into the public–private partnership model to bridge the last-mile delivery gap.

Genetic Capital and Breeding

Genetic stagnation poses a silent threat to productivity. Without systematic breed improvement programs, producers rely on their own flocks or local markets, leading to uncontrolled breeding and significant inbreeding depression. The absence of performance recording means that superior

genetic traits are rarely identified or propagated. The strategy advocates for a community-led solution, utilizing buck exchange programs and participatory selection to improve the genetic merit of local breeds without the risks associated with importing unadapted exotic stock.

Operational and Financial Enabling Environment

The sector's growth is further stifled by a lack of technical and financial infrastructure. Extension services have largely collapsed due to budget constraints, leaving producers with little access to modern husbandry techniques outside of episodic NGO projects. To unlock capital, the strategy proposes livestock leasing programs and the introduction of mobile money platforms to facilitate secure, low-cost financial transactions.

Production Systems

The Pastoral System: Resilience on the Move

Dominated by nomadic and semi-nomadic communities in the arid zones of Abyan, Lahj, and rural Taiz, this system is the backbone of the region's live animal trade. It is characterized by high mobility and large, mixed herds averaging 80–200 head, managed with minimal external inputs. The strategy for this group focuses on mobile veterinary delivery through CAHWs and early warning systems to manage destocking before climate shocks decimate assets.

The Agro-Pastoral System: The Mixed Farming Engine

Found in the fertile highlands and wadi systems of Taiz, Lahj, and Abyan, this system integrates livestock with crop production. These semi-sedentary households manage medium-sized herds (25–50 head) and benefit from a diversified livelihood base, using crop residues for feed and manure for fertilizer. Opportunities lie in fodder crop cultivation (like alfalfa), forming cooperatives for collective marketing, and establishing small-scale dairy processing units to capture value at the farm level.

The Peri-Urban/Intensive System: Market-Oriented Dairying

Concentrated around urban consumption hubs like Aden and Taiz City, this system represents the commercial frontier. Producers here operate sedentary, intensive units with small herds (10–25 head, mostly goats) kept in confined housing. The path forward involves shortening supply chains to link producers directly to consumers, improving waste-to-energy (biogas) systems, and introducing high-yielding genetic crosses to maximize output per animal.

Cross-Cutting Systemic Considerations

- **Gender dynamics:** The sector relies heavily on women's labor for routine care and processing, yet women remain marginalized in decision-making. While they often control income from milk, men typically manage high-value live animal sales. The strategy aims to formalize women's roles through training and credit access, ensuring their labor is economically recognized.
- **Youth and employment:** Young men are often relegated to basic herding, prompting urban migration. To retain this demographic, the project creates "service-oriented" roles, positioning youth as para-veterinarians or technicians in the value chain.

Collection and Trading

Livestock Trading: The Arterial Network

The livestock trading function serves as the primary bridge between rural production and market demand. It begins at the village level, where village collectors aggregate small numbers of animals directly from farm gates. These are then funneled to market traders and commission agents operating in weekly or bi-weekly regional markets. At the apex of this system are the exporters, though their ability to access lucrative Gulf markets has been severely disrupted by conflict.

Milk Collection: The Cold Chain Gap

In contrast to the live animal trade, milk collection is a race against time and temperature. The system relies heavily on individual collectors using motorcycles or small vehicles to navigate poor road infrastructure, with organized cooperative collection remaining a rare exception.

The most critical constraint here is the lack of a functional cold chain. Without immediate cooling, milk quality deteriorates rapidly during transport over long distances, leading to hygiene issues and financial losses. This logistical fragility is compounded by seasonal supply variations – creating gluts in the wet season and scarcity in the dry – resulting in severe price fluctuations that discourage consistent production.

Processing and Value Addition

Meat Processing: A System Stuck in Tradition

The meat processing landscape is characterized by rudimentary infrastructure and minimal value addition. Operations are dominated by traditional slaughterhouses in urban centers, which often suffer from poor hygiene standards and outdated protocols. Outside of these hubs, individual butchers perform slaughter and retailing simultaneously, with no modern meat processing facilities existing in the intervention regions. Consequently, the market is overwhelmingly driven by fresh meat sales, missing the higher margins associated with processed meat products or standardized packaging.

Dairy Processing: The Frontier of Value Addition

Dairy presents a more complex picture. Currently, 70–80 percent of milk is consumed fresh, with the remainder processed at home into traditional staples like laban, cheese, and ghee for household use. Commercial capacity is virtually non-existent, save for a few small-scale women's cooperatives in Lahj supported by previous FAO interventions.

However, this underdevelopment masks a massive opportunity. The sector faces strict constraints – specifically a lack of processing equipment, cold storage, and technical knowledge regarding food safety and packaging. Yet the market drivers are strong: there is a high unmet demand for culturally preferred traditional dairy products. By empowering women – who already control this domain – to move from home-based to community-level processing centers, the strategy can simultaneously reduce postharvest waste and capture the significant markup that processed goods command over raw milk.

Marketing and Distribution

Domestic Market Architecture

The domestic market is bifurcated between traditional weekly rural markets – where price discovery is raw and localized – and a sprawling network of urban retail points in cities like Aden. Demand is not static; it surges intensely during religious peaks like Ramadan and Eid, creating seasonal pressure on a supply chain that lacks the storage or logistics to smooth out these fluctuations.

Export Potential and Barriers

Historically, Yemen served as a strategic livestock reservoir for the Gulf States, particularly Saudi Arabia. However, this lucrative channel has been severely disrupted since 2014 due to conflict and consequent import bans. While current export activity is minimal, the strategy views this not as a permanent loss, but as a recovery potential. Restoring these trade relations relies heavily on improving security and harmonizing veterinary standards to meet strict Gulf import requirements.

End Markets and Consumption

Consumption patterns in Yemen are deeply rooted in cultural tradition but constrained by economic reality. However, purchasing power is severely limited by widespread poverty, forcing many households to prioritize essential calories over protein diversity.

Despite these economic headwinds, domestic market demand remains robust. As essential food items, dairy and meat continue to see steady consumption, bolstered by a growing urban population that relies on rural production. Domestically, a burgeoning urban middle class is driving a nascent but growing demand for higher-quality, hygienic, and safe animal products.

Strategic Demographics: Women and Youth

A critical lens is applied to two specific groups:

- **Women:** They act as the backbone of daily operations – handling animal care, milking, and processing – yet often lack decision-making power and control over resources.
- **Youth:** Currently underutilized, this demographic represents the future of the sector, holding immense potential for engagement in value-added services and technical roles.

Bottlenecks and Constraints

The Market Disconnect: Lost Value

Economically, producers are disconnected from the true value of their labor. Due to weak market linkages and profound information asymmetry, middlemen capture 40–60 percent of the final product value, leaving farmers with a fraction of the profit. This extraction is exacerbated by high transaction costs – a result of poor rural roads, numerous checkpoints, and informal fees. With export channels to the Gulf disrupted by conflict and producer organizations too weak to bargain collectively, farmers lack the leverage to demand fair prices.

The Processing Gap: Dormant Potential

The sector currently operates as a raw material supplier rather than a value creator, with less than 10 percent of milk being processed. This is a direct result of an “infrastructure void” – a lack of facilities, equipment, and the cold chain logistics necessary to maintain quality. Without technical

training in processing or food safety, products cannot meet the standards required for branding or higher-tier markets, resulting in significant postharvest losses and missed revenue.

Opportunities and Leverage Points

Technological and Institutional Enablers

This technical rollout is supported by a robust institutional framework. The strong presence of international partners like FAO, ICARDA, and the World Bank provides a safety net of expertise and funding. By scaling up successful pilots – such as vaccination campaigns and cooperative dairy models – the project can leverage existing public–private partnerships to accelerate systemic change.

Strategic Leverage Points

To maximize the return on investment, the strategy targets five catalytic entry points:

- **Animal health:** Mass vaccination campaigns act as the first line of defense, delivering immediate and visible reductions in mortality.
- **Women's enterprise:** Formalizing dairy processing empowers women economically while simultaneously boosting household incomes.
- **Collective action:** Strengthening of producer organizations reduces transaction costs and increases bargaining power against traders.
- **Capacity building:** Targeted training provides the "software" needed to run the "hardware" of new processing units.
- **Information systems:** Digital market data empowers producers to make informed selling decisions, shifting the balance of power back to the farm gate.

Stakeholder Roles and Responsibilities

Public Sector: Governance and Facilitation

- **Operational support:** Facilitate community mobilization and resolve local land disputes for new facilities (for example, markets and slaughterhouses).
- **Market management:** Regulate weekly livestock markets to ensure fair trade and security.
- **Security and conflict resolution:** Coordinate with tribal leaders to secure transport routes and manage rangeland access.

Private Sector: The Engines of Growth

Private actors are responsible for driving efficiency, innovation, and investment.

Table 12.1 Private-sector roles and responsibilities

Actor	Core responsibilities
Input suppliers	Supply quality feed and medicines at competitive prices; provide embedded technical advice.
Traders & exporters	Aggregate supply efficiently; share market information; invest in transport and logistics.

Actor	Core responsibilities
Processors	Invest in processing equipment (dairy and meat); develop new value-added products; create local employment.
Financial institutions	Design livestock-specific credit products; provide loans to producers and small and medium enterprises; offer savings mechanisms.

Development Partners: Technical and Financial Anchors

International and local organizations provide the necessary capital and expertise to jumpstart the transformation.

Chapter 13: Upgrading Vision and Strategy

Vision Statement

The overarching goal is to build a resilient, productive, and inclusive small ruminant sector that serves as a pillar of national stability. This vision moves beyond simple livestock management to position the sector as a primary engine for enhancing food security, generating sustainable incomes, and fundamentally improving the livelihoods of Yemen's rural communities. It reflects a consensus that the sector must evolve from a survival mechanism into a thriving economic driver.

Operationalizing the Vision

In this transformed future, producers are no longer isolated; they operate within a system where access to quality inputs, veterinary services, and remunerative markets is the norm rather than the exception. The livestock base itself is revitalized – animals are healthy, highly productive, and bred to be resilient to climate shocks, ensuring that production continues even during environmental stress. Crucially, this growth is anchored in environmental sustainability, integrating eco-friendly practices that preserve the rangelands for future generations.

Socioeconomic Transformation

Economically, the vision sees value addition as a catalyst for employment, creating new income streams that specifically target the economic empowerment of women. Market linkages are not just strong but equitable, ensuring that smallholders capture a fair share of the final product value. Underpinned by effective institutions that provide a supportive enabling environment, the sector contributes meaningfully to national food security and nutrition, creating diversified livelihoods that are robust enough to withstand future economic and political shocks.

Strategic Goals

Goal 1: Enhance Production and Productivity

"From survival to surplus": Transition the sector from a low-input, low-output survival model to a productive, climate-resilient system.

Core Interventions

- **Health:** Roll out mass vaccination campaigns for Peste des Petits Ruminants and Sheep and Goat Pox, supported by a network of private CAHWs to bridge the veterinary service gap.

- **Nutrition:** Introduce drought-tolerant fodder crops (for example, sorghum and *Opuntia*) and lick-blocks to stabilize feed availability during the dry season.
- **Genetics:** Implement community-based breeding programs that select for local animals with superior heat tolerance and milk yield, avoiding the risks of importing unadapted exotic breeds.

Strategic Rationale

Currently, a 15–25 percent mortality rate means producers lose a quarter of their "factory" every year. By stabilizing animal health and nutrition, we effectively double the investable income of rural households without requiring them to increase herd sizes, thus protecting the rangeland.

Goal 2: Strengthen Processing and Value Addition

"Capturing value at the source": Establish a decentralized processing infrastructure that allows rural communities – specifically women – to transform raw perishables into shelf-stable, high-value products.

Core Interventions

- **Infrastructure:** Construct low-cost, village-level dairy processing units equipped with solar refrigeration and pasteurization tools.
- **Product diversification:** Train women's groups in the production of laban, ghee, and white cheese with standardized hygiene protocols to extend shelf life from hours to months.
- **Packaging:** Introduce simple, hygienic packaging to replace informal containers, allowing products to reach urban supermarkets in Aden and Taiz.

Strategic Rationale

Raw milk is a "ticking clock" – it spoils within hours, forcing producers to sell at whatever price traders offer. Processing disrupts this power dynamic. It turns a perishable liability into a stored asset (ghee or cheese), creating year-round income and empowering women who traditionally control dairy activities.

Goal 3: Improve Market Access and Competitiveness

"Breaking the information monopoly": Dismantle the information asymmetry that favors middlemen by creating direct, transparent links between rural producers and urban consumers.

Core Interventions

- **Aggregation:** Form Producer Marketing Groups to aggregate volume, allowing smallholders to negotiate bulk sales and share transport costs.
- **Digital transparency:** Deploy a low-tech, SMS/WhatsApp-based market information system (MIS) that blasts daily prices from urban markets to rural villages, empowering producers to negotiate fair prices.
- **Contract farming:** Facilitate forward contracts between peri-urban fattening units and institutional buyers (hospitals, military, hotels) to secure guaranteed demand.

Strategic Rationale

Middlemen currently capture 40–60 percent of the final value because they monopolize market data. By democratizing price information and aggregating supply, producers can reclaim this margin. This shifts the market structure from exploitative to competitive.

Goal 4: Create an Enabling Environment

"Rebuilding the rules of the game": Construct a resilient institutional framework that can function effectively even in a fragmented, conflict-affected context.

Core Interventions

- **Public–private partnerships:** Formalize the role of private CAHWs within the public veterinary surveillance system, allowing them to report disease outbreaks in real time.
- **Standardization:** Work with local councils to harmonize taxes and checkpoint fees, and establish basic food safety standards for local dairy, boosting consumer confidence.
- **Conflict resolution:** Empower traditional tribal mediation mechanisms to manage rangeland and water disputes, preventing resource conflict between pastoralists and farmers.

Strategic Rationale

In the absence of a strong central state, the enabling environment must be built from the bottom up. By aligning local authorities, private actors, and tribal leaders, we create a "governance safety net" that ensures the physical investments in Goals 1–3 are not undermined by regulatory chaos or local conflict.

Strategic Objectives

Goal 1: Enhance Production and Productivity

Operationalizing the shift from subsistence to surplus.

- **Mortality reduction:** Reduce disease-related mortality from the current 20 percent down to 10 percent by establishing a consistent mass vaccination regime and improved veterinary access.
- **Milk yield:** Increase average milk production per goat by 30 percent through the introduction of high-protein fodder and community-based genetic selection.
- **Meat yield:** Increase the average live weight of animals by 20 percent via improved fattening practices and better nutritional management.
- **Climate resilience:** Equip 10,000 producer households with climate-smart assets (for example, drought-tolerant crops and water harvesting) to withstand environmental shocks.

Goal 2: Strengthen Processing and Value Addition

Operationalizing the creation of a local dairy industry.

- **Infrastructure:** Establish 12 functional dairy processing centers (3 per governorate: Taiz, Lahj, Abyan, Aden), serving a network of 3,000 producers.
- **Processing volume:** Increase the proportion of milk processed from the current 10 percent to 40 percent by Year 5, significantly reducing seasonal spoilage.

- **Women's empowerment:** Train 600 women in hygienic processing techniques and provide start-up grants and equipment to support 200 women-led dairy enterprises.
- **Product development:** Launch 10 branded, quality-certified dairy products (for example, laban, ghee, and white cheese) into urban retail markets.

Goal 3: Improve Market Access and Competitiveness

Operationalizing fair trade and higher margins.

- **Cost efficiency:** Reduce marketing transaction costs by 30 percent through the aggregation of supply via producer organizations.
- **Producer share:** Increase the producer's share of the final consumer price from 40 percent to 60 percent by bypassing multilayered intermediary chains.
- **Information access:** Launch a digital/SMS-based MIS reaching 5,000 producers with real-time price data.
- **Market linkages:** Formalize 50 contract farming arrangements between producer groups and institutional buyers (hospitals, hotels, military).
- **Export recovery:** Pilot the re-establishment of export channels to Gulf markets for live animals, contingent on security and quarantine protocols.

Goal 4: Create an Enabling Environment

Operationalizing institutional sustainability.

- **Service coverage:** Strengthen the veterinary delivery system to ensure regular coverage for 80 percent of the target geographic areas.
- **Human capital:** Train, equip, and certify 100 CAHWs to serve as the frontline defense against disease.
- **Investment advocacy:** Successfully advocate for increased public budget allocation toward livestock infrastructure (markets, slaughterhouses).
- **Sector coordination:** Establish a functioning Multistakeholder Coordination Platform to align government, donor, and private-sector activities.
- **Financial inclusion:** Facilitate access to specialized livestock credit products for 2,000 producers.

Guiding Principles

The upgrading strategy is guided by eight key principles that inform intervention design and implementation.

1. **Market-driven:** Respond to market demand and opportunities, ensuring commercial viability and sustainability.
2. **Systemic approach:** Address constraints across the entire value chain rather than isolated nodes, strengthening linkages among actors.
3. **Inclusive development:** Intentionally target and empower marginalized groups (women, youth, poorest producers), ensuring they participate in and benefit from upgrading.
4. **Build on success:** Learn from and scale up proven interventions and successful models rather than inventing new approaches.

5. **Conflict-sensitive:** Recognize the conflict context, avoid exacerbating tensions, and adapt to changing security situations.
6. **Climate-smart:** Integrate climate adaptation and environmental sustainability into all interventions.
7. **Public–private partnerships:** Leverage complementary strengths of public-sector, private-sector, and civil society actors.
8. **Adaptive management:** Monitor, learn, and adapt interventions based on evidence and changing contexts, maintaining flexibility.

These principles ensure that the strategy is practical, context-appropriate, and likely to deliver sustainable impacts.

Chapter 14: Priority Interventions and Implementation

Based on the value chain analysis, stakeholder consultations, and strategic framework, priority interventions have been identified across five thematic pillars. These interventions address key bottlenecks, capitalize on opportunities, and work synergistically to achieve strategic goals.

Pillar A: Production Enhancement Interventions

The proposed multidimensional strategy focuses on stabilizing and enhancing the small ruminant dairy sector through a blend of immediate health interventions, long-term genetic improvement, and climate-resilient resource management. This is achieved by training 100 CAHWs and establishing cost-recovery mechanisms that ensure remote pastoralist households maintain access to essential treatments beyond the project's initial five-year lifecycle.

To drive long-term productivity gains, the intervention integrates genetic and nutritional optimization. These efforts aim to reduce producer costs by up to 30 percent while ensuring that the improved livestock have the nutritional backing to reach their higher genetic potential.

The strategy further addresses Yemen's acute environmental challenges through climate-resilient infrastructure and resource management. By constructing 50 water harvesting structures and rehabilitating existing points, the program mitigates water stress for 6,000 households. This physical infrastructure is complemented by community-led rangeland management plans covering 50,000 hectares and comprehensive climate-smart husbandry training. These measures collectively increase the carrying capacity of the land and equip producers with the skills – such as early destocking and feed conservation – necessary to withstand recurring climatic shocks.

Finally, the program ensures economic sustainability through social capital and collective action. By organizing 1,500 producers into formal groups and governorate-level federations, the intervention strengthens the bargaining power of smallholders and reduces transaction costs within the value chain. With a specific focus on gender inclusion (targeting 40 percent women), these organizational structures provide the governance and financial frameworks required to manage small grants and maintain linkages with input suppliers, ultimately transforming subsistence herding into a more resilient, market-oriented dairy sector.

Pillar B: Processing and Value Addition Interventions

The next pillar of the Yemeni dairy strategy shifts focuses from primary production to value addition and market integration, specifically targeting the transformation of raw milk into high-value, shelf-stable products. By providing the necessary hardware and initial working capital, the intervention creates a structured collection system that bridges the gap between rural producers and urban consumers.

A cornerstone of this downstream development is the economic empowerment of women, who represent 70 percent of the target milk producers. By focusing on hygiene, equipment use, and basic accounting, the program ensures that women are the primary beneficiaries of the value added during the processing stage.

To ensure these products are competitive and safe for public consumption, the strategy implements a comprehensive quality assurance and branding framework. These combined efforts – hygiene certification, cold chain integrity, and strategic branding – aim to increase producer incomes by 30 percent and establish a sophisticated, resilient dairy value chain capable of thriving in a challenging economic environment.

Pillar C: Marketing and Market Access Interventions

Another strategic layer of the Yemen dairy value chain focuses on market intelligence and commercial integration, transforming fragmented local trade into a structured, transparent, and potentially international commercial system. This begins with the eradication of information asymmetry through a mobile-based MIS. By negotiating as a unified bloc rather than as isolated individuals, smallholders can bypass predatory middlemen and secure price increases of up to 30 percent.

To facilitate these higher-volume trades, the intervention invests heavily in physical market infrastructure and contractual stability. The strategy allocates nearly US$500,000 to construct or rehabilitate 10 rural milk collection centers, five livestock markets, and three hygienic slaughterhouses. By providing legal support and mediation for these contracts, the intervention replaces volatile spot-market trading with predictable income streams and standardized quality requirements, creating a reliable pull factor for increased production.

The ultimate ambition of the strategy is the re-establishment of export channels, specifically targeting the high-premium Gulf markets. By successfully linking local producer groups to these regional hubs, the intervention aims to transition the Yemeni dairy and livestock sector from a state of crisis recovery to one of sustainable, export-led growth.

Pillar D: Policy and Institutional Interventions

Other strategic components of the Yemeni dairy intervention shift from direct field implementation to institutional strengthening and ecosystem enabling, ensuring that the gains made in production and marketing are anchored by a robust national framework. This begins with veterinary infrastructure and disease surveillance, moving beyond localized care to rehabilitate eight diagnostic laboratories across four governorates. By equipping these facilities and training 40 specialized veterinarians, the program establishes a high-level early warning system that connects frontline

CAHWs to a formal national response protocol, significantly reducing the systemic risk of livestock epidemics.

To sustain these technical improvements, the strategy incorporates policy advocacy and financial inclusion as primary drivers of sectorwide growth. Innovative financial products, including livestock leasing and credit schemes, provide 2,000 producers with the liquidity needed to invest in herd expansion and modern technology, transitioning them from subsistence to business-oriented operations.

The long-term resilience of the value chain is ultimately secured through research, development, and knowledge management. This ensures that the Yemeni dairy sector is not merely recovering from conflict but is actively evolving through a sophisticated blend of institutional support, financial empowerment, and scientific advancement.

Pillar E: Cross-Cutting Interventions

To conclude this comprehensive strategy, cross-cutting interventions address social equity and environmental resilience, ensuring the dairy value chain is inclusive, forward-looking, and capable of long-term survival in Yemen's unique socioeconomic landscape.

A robust youth engagement and entrepreneurship initiative is designed to modernize the sector and stem rural-urban migration. By training 300 youth as specialized service providers – such as artificial insemination technicians, milk collectors, and feed producers – the program creates a new tier of professional livestock services. This youth-led service layer provides the technical backbone for the processing centers and breeding programs mentioned above, turning the value chain into an attractive career path for the next generation of Yemeni entrepreneurs.

Finally, climate change adaptation is mainstreamed across the entire 25-intervention portfolio to ensure environmental sustainability. This involves a shift toward climate-resilient local breeds, the implementation of biogas production from manure management, and linking producers to global climate finance. These ecological safeguards ensure that the productivity gains achieved through health and breeding interventions are not wiped out by environmental degradation or increasing water scarcity.

The Synergistic Impact

The true strength of this plan lies in its interlocking design:

- Health and nutrition create the biological foundation for surplus production.
- Producer organizations provide the collective volume needed for processing and branding.
- Market information and infrastructure ensure that this value reaches the producer fairly.
- Policy, finance, and inclusion (women, youth, and climate) provide the structural "glue" that makes the entire system resilient to external shocks.

Implementation Roadmap

The strategy will be implemented over five years (2026–2030) in three phases, with actions sequenced based on priorities, dependencies, and capacity.

Phase I: Foundation and Quick Wins (Year 1, 2026)

Focus: Establish foundations, build capacity, and deliver quick wins to build momentum and demonstrate impact.

A total of 7,140 direct participants (40% women, 15% youth) will benefit from training programs:

Table 14.1 Detailed training programs

Target group	Training topic	Duration	Participants	Method
Producers	Improved Breeding & Genetics	5 days	1,000	Farmer Field School (FFS)
	Animal Health & Disease Prevention	3 days	2,500	FFS + Demo
	Feed & Nutrition	4 days	2,000	FFS + Labs
	Climate-Smart Practices	3 days	1,500	FFS + Field
	Business Management	2 days	1,200	Classroom
Women	Hygienic Milk Handling	5 days	300	Hands-on
	Quality Assurance & Safety	3 days	250	Lab
	Product Development	4 days	200	Workshop
	Packaging & Marketing	2 days	300	Mentoring
Community Animal Health Workers	Veterinary Service Delivery	10 days	100	Training of Trainers
Youth	Livestock Entrepreneurship	5 days	300	Workshop
Traders	Collective Marketing	2 days	150	Role Play
Extension	Value Chain Facilitation	7 days	50	Training of Trainers

Physical Infrastructure

- 4 Regional Training Centers (one per governorate) with classrooms, labs, and demo farms
- 12 upgraded community training venues
- 30 on-farm demonstration sites

Training Materials

- 15 comprehensive training manuals in Arabic
- 25 poster sets, 10 video tutorials, and 20 pictorial guides
- Mobile learning app with SMS content
- Training toolkits with thermometers, scales, and record books

Phase II: Scaling and Consolidation (Years 2–3, 2027–2028)

Focus: Scale up successful interventions, deepen impact, and strengthen systems and institutions.

Scaling Proven Success

The primary objective of the expansion phase is to leverage the successful models established in Year 1 to achieve critical mass across the sector. A major pillar of this effort is the Animal Health Shield, which seeks to shift the regional paradigm from reactive outbreak response to proactive herd immunity by doubling its reach. These 12 total hubs will form a "cold chain backbone" capable of processing 40 percent of the region's milk. Supporting this physical infrastructure is an acceleration of human capital development, with the certification of 60 additional CAHWs and the specialized training of 400 women in dairy processing.

The total cold chain investment will be US$1,280,000, or 15% of the program budget:

Table 14.2 Cold chain infrastructure investments

Infrastructure type	Units	Specifications	Locations	Unit cost (US$)	Total investment (US$)
Primary cooling centers	25	• 500 liter bulk coolers • Solar + battery • 4°C cooling	8 Taiz, 7 Lahj, 6 Abyan, 4 Aden	12,000	300,000
Processing cold rooms	12	• 15–20 m^3 capacity • Walk-in 2–8°C • Hybrid power	Integrated with processing centers	25,000	300,000
Refrigerated vehicles	20	• Collection vans • Delivery trucks • Eutectic cooling	Routes: collection to processing to markets	18,000	360,000
Retail refrigeration	40	• Display chillers for shops/outlets	Aden, Taiz, Lahj, Abyan urban areas	2,500	100,000

Infrastructure type	Units	Specifications	Locations	Unit cost (US$)	Total investment (US$)
Solar energy systems	37	• 110 kW total • 20,000 Ah storage • Backup generators	All cooling centers and processing hubs	Varied	220,000

Operational Protocols

- Standard operating procedures for collection, storage, and transport with temperature monitoring
- Temperature data loggers with real-time SMS alerts
- Mandatory milk testing for temperature, acidity, and adulteration
- Preventive maintenance schedules with trained technicians

Capacity Building

- 50 cold chain operators trained in equipment operation and hygiene
- 20 technicians trained in solar and refrigeration maintenance
- 20 drivers trained in cold chain logistics and food safety

Sustainability—Service Fees

- Collection centers: US$0.02/liter cooling fee
- Processing centers: US$0.05/liter storage fee
- Transport: US$0.08/liter for delivery
- Target: 80% cost recovery in Year 3, 100% by Year 5

Phase III: Sustainability and Institutionalization (Years 4–5, 2029–2030)

Focus: Institutionalize best practices, transition to sustainable mechanisms, and prepare for scale-up beyond intervention regions.

The final phase of the strategy marks the transition from project-driven development to market-driven sustainability. The focus shifts entirely to institutionalizing the gains made in the first three years, ensuring that systems like vaccination and dairy processing can function profitably without external subsidies, while opening high-value export frontiers.

Table 14.3 Market infrastructure

Infrastructure type	Number	Description	Investment (US$)
Livestock market yards	6	• Upgraded facilities in Taiz (2), Lahj (2), Abyan (1), and Aden (1) • Shade, water, vet checkpoints, weighbridges, and auction platforms	180,000
Rural access roads	40 km	• Rehabilitate critical roads connecting production to markets • Labor-intensive cash-for-work benefiting 800 households • Reduce transport time 40–50%, costs 25–30%	250,000
Urban retail outlets	30	• Branded retail points in urban centers • "Yemen Pure" brand emphasizing quality • Refrigeration, signage, packaging, and marketing	150,000

Quality assurance

- Develop Yemen Small Ruminant Product Quality Standards
- Grading: A (premium), B (standard), C (processing)
- "Yemen Pure" certification for traceable quality products
- Upgrade 3 regional labs with testing equipment

Institutionalization

The ultimate measure of success is the project's ability to make itself obsolete. Formal integration ensures that CAHWs are fully integrated into the national veterinary service system, recognized by the ministry as official para-veterinarians with legal standing.

Advanced Market Development

With domestic supply chains stabilized, the strategy pivots to high-value external markets. The first priority is Gulf export recovery, aiming to re-establish the lucrative trade corridor to Saudi Arabia and the Gulf by exporting 10,000 certified disease-free animals annually, leveraging the new quarantine and health certification protocols. Producer power is strengthened by establishing Producer-Owned Marketing Companies to replace traditional middlemen, giving farmers direct control over the supply chain to the end consumer.

Innovation and Future-Proofing

Looking further ahead, the strategy embraces next-generation technologies by introducing AI-driven breeding tools and mobile applications for instant milk quality testing, pushing the sector toward precision agriculture. A national Small Ruminant Center of Excellence will be established to institutionalize research and training, ensuring that knowledge generated – such as innovations in drought-resistant fodder – is preserved and widely disseminated. Finally, based on the findings of the impact evaluation, a comprehensive Scale-Up Strategy will be finalized to replicate this successful model in two additional governorates, likely Hodeidah and Hajjah, security permitting.

Resource Mobilization Strategy

To implement the full five-year strategy, a total investment of US$8.5 million is required. Financial architecture relies on a blended finance model, reducing dependency on a single donor by diversifying across development partners, government allocations, private-sector investment, and producer contributions.

The resource mobilization strategy assumes that external donors will catalyze the initial phases, with local private and public sectors gradually assuming a larger share of the operational costs.

Securing these funds requires a proactive, multipronged campaign starting immediately. Donor alignment efforts will tailor specific project proposals to match donor priorities, such as pitching "Climate-Smart Fodder" to the Green Climate Fund or "Women's Dairy Processing". The strategy explores innovative financing mechanisms such as impact bonds, where investors are repaid based on verified results like successful export volumes rather than through upfront grants.

Monitoring and Evaluation Framework

The M&E framework serves as the strategy's navigational compass. It moves beyond simple compliance auditing to function as a dynamic learning system, ensuring that the project not only tracks *what* is happening but understands *why*, allowing for rapid course correction in Yemen's volatile operating environment.

The system is designed to achieve six core functions that balance accountability with strategic learning. Operational tracking will rigorously monitor progress against the Years 1–5 targets and timelines to ensure the project stays on schedule. Stakeholder accountability ensures total transparency with funders and beneficiaries regarding how resources are used and what results are achieved. Finally, policy evidence generates the hard data needed to advocate for national policy changes and public investment.

Key Performance Indicators

The M&E framework is the dashboard for the entire strategy, translating high-level aspirations into 30 specific, trackable metrics (see Appendix G). This hierarchical system ensures that every daily activity (Output) contributes to a strategic change (Outcome), which ultimately drives the national development goals (Impact).

Impact Level: The "North Star" Indicators

Measuring the ultimate changes in human well-being and societal status, these indicators answer the question: "Are people's lives actually getting better?" Economic prosperity is measured by a target of increasing household income from small ruminants by 40 percent. Gender equity targets a 20-percentage-point increase in women's share of household decision-making.

Outcome Level: Strategic Pillar Achievements

Measuring the success of the four strategic goals, these indicators track whether the systems we built are functioning as intended. For Goal 1, Enhance Production and Productivity, success means slashing disease-related deaths from 20 percent down to 10 percent, boosting average milk production per goat by 30 percent and live animal weight by 20 percent, and achieving 80 percent vaccination coverage while having 70 percent of producers adopt climate-smart practices. For Goal 4, Create an Enabling Environment, the aim is to ensure veterinary services cover 80 percent of the target geography, train and activate 100 CAHWs, secure a 50 percent increase in public investment for the livestock sector, and facilitate credit access for 2,000 producers.

Output Level: Operational Metrics

Measuring the immediate results of activities, these indicators capture the "busy work" numbers tracked quarterly to ensure implementation is on pace. Health indicators track the number of animals vaccinated. Policy metrics track the number of policy briefs disseminated.

Cross-Cutting Indicators

Cross-cutting indicators ensure inclusion and sustainability across all activities.

- **Gender:** Women must comprise ≥40 percent of all participants.
- **Youth:** Young people must make up ≥30 percent of the engaged workforce.
- **Satisfaction:** The beneficiary satisfaction rate must remain above 80 percent.
- **Environment:** The project must maintain a positive composite Environmental Sustainability Score.

Risk Analysis and Mitigation

Table 14.4 Risk analysis and mitigation matrix

Risk category/threat	Probability & impact	Mitigation strategy
Conflict and security (escalation of armed conflict, restricted access, targeting of facilities/personnel)	High probability/high impact	**Conflict-sensitive programming:** Use "Do No Harm" frameworks. **Hyper-localization:** Rely on local partners and leaders for access negotiation. **Flexible operations:** Use mobile veterinary teams that can relocate quickly. **Strict neutrality:** Maintain transparent dialogue with all local powerbrokers.

Risk category/threat	Probability & impact	Mitigation strategy
Climate and environmental shocks (severe drought, flash floods causing mass mortality or rangeland collapse)	High probability/high impact	**Early warning systems:** Integrate meteorological data into the market information system to trigger early destocking. **Resilient assets:** Prioritize drought-resistant fodder and climate-smart breeds. **Diversification:** Promote non-farm income sources like processing to buffer shocks.
Institutional and governance challenges (weak government capacity, political interference, elite capture)	Medium probability/high impact	**Parallel systems:** Deliver services via public–private partnerships (e.g., private Community Animal Health Workers). **Transparency measures:** Publicly display beneficiary criteria and establish anonymous grievance hotlines. **Community oversight:** Empower producer groups to audit service delivery.
Financial and sustainability risks (insufficient funding, irregular disbursements, collapse after donor exit)	Medium probability/high impact	**Phased scale-up:** Structure budget so early activities deliver standalone value. **Cost-recovery models:** Introduce fee-for-service arrangements early on. **Diversification of funding:** Blend humanitarian, development, and private-sector investments.
Market and economic threats (currency depreciation, collapse in consumer purchasing power)	Medium probability/medium impact	**Localization:** Source inputs like feed and building materials locally to reduce foreign exchange exposure. **Essential goods focus:** Prioritize staple foods (laban, ghee) over luxury products.
Technical and adoption threats (low adoption rates of new tech, equipment failure)	Medium probability/medium impact	**Appropriate technology:** Select simple, low-maintenance, "ruggedized" technologies (e.g., gravity-fed water systems). **Demonstration approaches:** Use "Lead Farmers" to prove return on investment before community-wide rollout.

Sustainability and Scale-up

Financial Sustainability: The Exit Strategy

The strategy moves away from indefinite handouts toward a market-based model where value generation actively covers operational costs. Initial capital injections for producer groups will be

structured as revolving credit funds, where interest income covers administrative costs and prevents capital depletion.

Alongside revenue generation, cost reduction is pursued through localization strategies. By producing fodder locally and processing milk at the village level, the sector reduces its exposure to volatile import prices and high transport costs. Economies of scale achieved through collective purchasing via producer groups further lower the unit cost of inputs like feed and medicine, strengthening the overall financial viability of the value chain.

Institutional Sustainability: Embedding Systems

The goal is to build institutional memory so that improved practices do not disappear with the project team. Local ownership guarantees that all physical assets – including processing centers and water cisterns – are formally transferred to registered producer cooperatives or community committees, accompanied by clear bylaws for ongoing maintenance and sustained ownership.

Environmental Sustainability: Regenerative Production

The strategy acknowledges that the sector cannot grow if it destroys its natural capital. Genetic sustainability is pursued by promoting local, climate-resilient breeds, ensuring that herds can survive strictly on available local resources without heavy water and feed footprints.

Social Sustainability: Inclusion and Resilience

Sustainability is also fundamentally about social cohesion and equity. Conflict resolution is addressed through strengthening traditional tribal mechanisms for resource management, ensuring that competition for water and land does not escalate into violence and that community relationships are preserved alongside natural resources.

Conclusion and Recommendations

Yemen's small ruminant sector stands at a critical juncture. The sector faces formidable challenges – conflict, climate change, water scarcity, disease, weak institutions, and market constraints – that have severely impacted production and livelihoods. However, significant opportunities exist for recovery and growth through strategic, evidence-based interventions that address systemic constraints and leverage entry points for change.

This Small Ruminant Value Chain Upgrading Strategy provides a comprehensive roadmap for transforming the sector over the next five years (2026–2030). Grounded in rigorous value chain analysis and extensive stakeholder consultation, the strategy articulates a clear vision of a resilient, productive, and inclusive sector that enhances food security and rural livelihoods.

The strategy's four strategic goals – enhancing production and productivity, strengthening processing and value addition, improving market access, and creating an enabling environment – address the full spectrum of constraints identified. Twenty-five priority interventions, carefully sequenced and designed for synergy, provide practical pathways for achieving these goals.

Successful implementation requires sustained commitment, coordinated action, and adequate resources from diverse stakeholders – the government, the private sector, development partners,

and most importantly, producers themselves. The estimated investment of US$8.5 million over five years is modest relative to the potential impact: significantly increased incomes for 15,000 producer households, improved food security and nutrition for 75,000 people, economic empowerment of 2,000 women, and substantial increases in milk and meat production.

The strategy recognizes the challenging Yemen context and incorporates conflict sensitivity, climate adaptation, gender responsiveness, and adaptive management throughout. Sustainability is prioritized through early establishment of cost-recovery mechanisms, private-sector engagement, institutional capacity building, and integration into government systems.

Ultimately, this strategy is not just about livestock; it is about people – about the millions of rural Yemenis whose livelihoods, food security, and dignity depend on small ruminants. By upgrading the small ruminant value chain, we invest in rural prosperity, social cohesion, and resilience in one of the world's most challenging contexts.

Key Findings

- Small ruminants are critical for rural livelihoods but the sector has been severely impacted by conflict, climate change, and disease.
- Major bottlenecks exist at all value chain nodes, from production through marketing.
- Processing and value addition are severely underdeveloped, representing major missed opportunities.
- Women play critical roles but face gender-specific constraints limiting their participation and benefits.
- Proven interventions exist (vaccination, processing, collective marketing) that can be scaled.
- Strong demand for products provides market opportunities.
- Successful upgrading requires a systemic approach addressing the entire value chain.

Strategic Recommendations

To the Government

- Increase budget allocation to the livestock sector, particularly for veterinary services.
- Develop a comprehensive small ruminant sector policy.
- Strengthen the veterinary service delivery system and integrate CAHWs.
- Invest in market infrastructure and regulatory systems.
- Create an enabling environment for private-sector investment.
- Mainstream gender and youth considerations into policies and programs.

To Development Partners

- Provide sustained funding for strategy implementation.
- Coordinate interventions through a value chain coordination platform.
- Build on successful models and avoid duplication.
- Balance humanitarian and development approaches.
- Support policy advocacy and institutional strengthening.
- Invest in impact evaluation and learning.

To the Private Sector

- Invest in processing facilities and value addition.
- Develop fair and transparent market relationships with producers.
- Provide quality inputs and services.
- Partner with development actors in public–private partnerships.
- Create youth employment opportunities.
- Support sustainability through commercial viability.

To Producer Organizations

- Strengthen collective action and organizational capacity.
- Adopt improved production and marketing practices.
- Ensure inclusive participation, especially of women.
- Engage actively in coordination platforms.
- Advocate for producer interests and rights.
- Take ownership of interventions for sustainability.

To Women's Organizations

- Strengthen women's cooperatives in dairy processing.
- Advocate for women's rights to own and control livestock assets.
- Support women's access to services, credit, and markets.
- Document and share women's innovations and successes.

Way Forward – Immediate Next Steps

1. **Strategy validation:** Organize a multistakeholder validation workshop to review, endorse, and finalize the strategy.
2. **Resource mobilization:** Conduct donor roundtables, develop detailed project proposals, and secure commitments.
3. **Institutional setup:** Establish a coordination platform, recruit an implementation unit, and develop operational guidelines.
4. **Baseline and planning:** Conduct a baseline survey, establish M&E systems, and develop detailed Year 1 operational plans.
5. **Implementation launch:** Launch priority interventions: mass vaccination, producer group formation, processing centers, and training programs.

The journey from strategy to impact requires translating this comprehensive plan into concrete action. With commitment, collaboration, and sustained effort from all stakeholders, the small ruminant sector can become a driver of rural prosperity and food security in Yemen. The time to act is now.

Additional Recommendations for Enhancing Sustainability and Expanding Impact

Training on Small Ruminant Care and Health

This training should focus on improving animal health to ensure stable and increased milk production:

- Identifying common diseases in sheep and goats
- Prevention methods and vaccinations
- Managing mastitis, which is a primary cause of decreased milk yield
- Parasite management and knowing when to call a veterinarian

Training on Homemade Feed Production

Since nutrition is the most critical factor in milk production, this program suggests teaching farmers how to do the following:

- Formulating low-cost local feed rations using available agricultural waste
- Identifying ingredients that boost milk secretion
- Understanding the nutritional needs of animals during pregnancy and lactation
- Calculating the cost of feed versus the financial return

Training on Improving Home Breeding Environments and Barn Management

The physical environment directly impacts animal productivity. Recommended training topics include the following:

- Ensuring proper ventilation and reducing humidity in barns
- Maintaining cleanliness and effective manure removal
- Reducing heat stress for the animals
- Providing constant access to clean water

Training on Management of Dairy and Animal Waste

Good waste management can reduce costs and provide additional income. The training would cover the following:

- Converting manure into organic fertilizer (compost)
- Repurposing manufacturing byproducts (from dairy processing) into animal feed
- Reducing environmental pollution within the home or farm setting

Training on Quality Systems, Food Safety, and Certification

To enable formal marketing and increase consumer trust, this recommendation suggests practical training on the following:

- Health requirements for producing and preserving milk and its derivatives
- Implementing Good Manufacturing Practices (GMP) and Hazard Analysis and Critical Control Points (HACCP)
- Introduction to relevant ISO standards, such as ISO 22000 (Food Safety) and ISO 9001 (Quality Management)
- Maintaining daily records for hygiene, temperatures, and production steps
- Guidance on the application process for obtaining official certifications through accredited bodies

Appendix A: Detailed Survey Methodology and Instruments

Sampling Methodology

The value chain assessment employed a multistage stratified sampling approach designed to ensure representative coverage across geographic zones, value chain nodes, and demographic groups. The sampling framework was developed in consultation with local authorities, agricultural offices, and community leaders.

- **Stage 1: Governorate selection.** Four governorates were selected based on: (1) production potential; (2) market access; (3) security conditions; (4) concentration of vulnerable populations; and (5) presence of implementing partners.
- **Stage 2: District selection.** Within each governorate, districts were selected considering: (1) Integrated Food Security Phase Classification (IPC) level; (2) dairy production concentration; (3) accessibility; and (4) stakeholder recommendations.
- **Stage 3: Village or community selection.** Villages were randomly chosen within selected districts, stratified by production system (pastoral, agro-pastoral, or peri-urban intensive).
- **Stage 4: Actor selection.** There was purposive and random selection of value chain actors: producers (stratified by herd size and gender), traders (wholesalers and retailers), processors, input suppliers, and buyers.

Sample Size Determination

Sample sizes were calculated using standard formulas for stratified random sampling with 95 percent confidence level and 5 percent margin of error. The total sample of 519 respondents was distributed across actor categories and governorates to ensure adequate representation for statistical analysis.

Table A.1 Sample size determination by category and governorate

Category	Lahj	Aden	Abyan	Taiz	Total
Producers – men	35	18	55	42	150
Producers – women	20	12	32	18	82
Wholesalers – men	6	3	9	7	25
Wholesalers – women	2	1	3	2	8
Retailers – men	4	3	7	4	18
Retailers – women	4	2	5	4	15
Input suppliers – men	5	3	7	4	19

Category	Lahj	Aden	Abyan	Taiz	Total
Input suppliers – women	5	3	6	3	17
Buyers – men	20	13	42	25	100
Buyers – women	22	13	31	19	85
TOTAL – men	70	40	120	82	312
TOTAL – women	53	31	77	45	207

Survey Instruments

Separate questionnaires were developed for each value chain actor category using KoboToolbox for mobile data collection. All instruments underwent pre-testing, revision, and translation into local Arabic dialect. Key modules included the following:

- Producer Questionnaire: Demographics, livestock holdings, production systems, costs and revenues, marketing, constraints
- Trader Questionnaire: Business profile, sourcing patterns, volumes and prices, margins, market relationships, constraints
- Processor Questionnaire: Processing activities, input sources, products and volumes, equipment, quality control, marketing
- Input Supplier Questionnaire: Products and services, pricing, customer base, supply chains, constraints
- Consumer/Buyer Questionnaire: Purchasing patterns, preferences, quality perceptions, expenditure, satisfaction
- Focus Group Discussion Guide: Participatory value chain mapping, seasonal calendars, constraint ranking, opportunity identification
- Key Informant Interview Guide: Institutional context, policy environment, service provision, market dynamics, development priorities

Data Collection Team and Training

A team of 12 enumerators (6 men, 6 women) and 4 supervisors underwent intensive five-day training covering the following:

- Survey methodology and research ethics
- Value chain concepts and terminology
- Questionnaire content and skip logic
- Interview techniques and probing
- Mobile data collection using KoboToolbox
- Quality assurance protocols
- Safety and security procedures
- Gender-sensitive data collection

Appendix B: Detailed Economic Analysis Tables

Producer Cost Structures by Governorate

Table B.1 presents a detailed breakdown of annual production costs by major cost categories across the four target governorates.

Table B.1 Producer cost structures by governorate (YR)

Cost category	Lahj	Aden	Abyan	Taiz	Average
Concentrated feed	85,200	92,400	78,600	88,100	86,075
Zakat/taxes/fees	84,200	88,600	81,400	86,300	85,125
Marketing/sales	24,600	27,800	21,500	25,400	24,825
Transportation	21,800	24,500	19,200	22,600	22,025
Local fodder	22,500	18,700	24,800	21,300	21,825
Mineral blocks	14,500	16,100	13,200	15,300	14,775
Veterinary services	12,400	14,200	10,800	13,500	12,725
Medications/antibiotics	11,800	13,600	9,900	12,100	11,850
Packaging materials	8,400	9,800	7,200	8,900	8,575
Water	6,800	12,400	5,200	7,600	8,000
Vaccinations	5,600	6,200	4,800	5,900	5,625

Value Addition Analysis by Product Type

Table B.2 presents a detailed analysis of value addition, costs, and margins for different dairy products.

Table B.2 Value addition analysis by product type (YR per liter)

Product	Raw material cost	Processing cost	Total cost	Selling price	Margin
Fresh milk	1,050	0	1,050	1,500	30%
Laban (yogurt)	1,050	420	1,470	2,200	50%
Cheese	1,050	680	1,730	2,800	62%

Product	Raw material cost	Processing cost	Total cost	Selling price	Margin
Ghee (clarified butter)	1,050	590	1,640	2,600	59%
Haqeen (sour buttermilk)	1,050	280	1,330	1,900	43%

Seasonal Price Variation

Table B.3 reports average monthly prices for fresh milk, showing significant seasonal fluctuation.

Table B.3 Seasonal price variation for fresh milk

Month	Average price (YR per liter)	Variation from annual mean
January	1,620	+8%
February	1,580	+5%
March	1,450	−3%
April	1,320	−12%
May	1,280	−15%
June	1,350	−10%
July	1,420	−5%
August	1,480	−1%
September	1,540	+3%
October	1,590	+6%
November	1,650	+10%
December	1,680	+12%

Appendix C: Gender Analysis Detailed Findings

Gendered Division of Labor in Small Ruminant Production

Table C.1 shows task allocation by gender, based on focus group discussions and household surveys, with percentages indicating primary responsibility.

Table C.1 Gendered responsibility for labor in small ruminant production

Activity	Men	Women	Joint
Purchasing animals	78%	12%	10%
Herding/grazing	65%	25%	10%
Watering animals	42%	48%	10%
Feeding in homestead	35%	58%	7%
Milking	18%	76%	6%
Milk processing	8%	88%	4%
Cleaning shelters	25%	68%	7%
Health care (minor)	32%	54%	14%
Health care (major/vet)	72%	18%	10%
Breeding decisions	68%	14%	18%
Selling animals	82%	8%	10%
Selling milk/products	48%	42%	10%
Managing income	76%	14%	10%
Feed procurement	64%	28%	8%
Record keeping	58%	18%	24%

Gender-Specific Constraints

In Table C.2, priority constraints identified by women producers (n=194) and men producers (n=312) are ranked by frequency of mention.

Table C.2 Mentions of constraints by gender

Constraint	Women	Men
Feed scarcity/cost	92%	81%
Limited financial access	88%	62%
Lack of veterinary services	85%	74%
Water scarcity	79%	68%
Limited mobility/market access	76%	28%
Disease outbreaks	74%	81%
Lack of training/extension	71%	52%
Poor market prices	68%	72%
Limited time/labor	65%	38%
Lack of decision-making power	58%	12%

Women-Headed Households

Women-headed households constitute approximately 28 percent of the sample and face unique challenges:

- **Smaller herd sizes:** Women-headed households average 9.2 animals versus 14.3 for men-headed households.
- **Higher dependency on milk income:** 78 percent of women-headed households' income comes from dairy versus 54 percent for men-headed households.
- **Limited access to grazing land:** 62 percent of women-headed households cite restricted access versus 38 percent for men-headed households.
- **Lower vaccination rates:** 24 percent of animals are vaccinated in women-headed households versus 32 percent in men-headed households.
- **Higher vulnerability to shocks:** 84 percent of women-headed households experienced severe hardship in the past year versus 58 percent of men-headed households.
- **Limited participation in cooperatives:** 18 percent of women-headed households were cooperative members versus 34 percent of men-headed households.
- **Greater time poverty:** Women average 14.2 hours of work per day versus 10.8 for men.

Appendix D: Market Analysis and Consumer Preferences

Consumer Purchasing Patterns

Table D.1 presents an analysis of consumer (n=185) dairy purchasing behavior.

Table D.1 Consumer purchasing patterns of dairy products (milk, laban/yogurt, or haqeen/sour buttermilk)

Purchase frequency	Percentage of consumers	Average volume per purchase
Multiple times daily	12%	0.5 liters
Daily	58%	1.2 liters
Every 2–3 days	22%	2.5 liters
Weekly	6%	4.0 liters
Bi-weekly	1%	6.0 liters
Monthly	1%	8.0 liters

Quality Attributes Ranking

Consumers ranked quality attributes by importance when purchasing dairy products:

- **Freshness/recency of production:** 78 percent rated as “most important”.
- **Known/trusted producer:** 68 percent rated as “very important”.
- **Taste:** 62 percent rated as “very important”.
- **Price:** 58 percent rated as “important”.
- **Fat content/richness:** 52 percent rated as “important”.
- **Cleanliness/hygiene:** 48 percent rated as “important”.
- **Packaging:** 24 percent rated as “moderately important”.
- **Brand/label:** 12 percent rated as “less important”.

Willingness to Pay for Quality

The following results emerged from the survey of willingness to pay premium prices for verified quality improvements:

- **Certified fresh (<6 hours):** 68 percent willing to pay 10–15 percent premium.
- **Hygienically processed:** 62 percent willing to pay 15–20 percent premium.
- **Cooled/refrigerated:** 58 percent willing to pay 12–18 percent premium.
- **Veterinary-certified healthy herd:** 54 percent willing to pay 10–12 percent premium.
- **Known origin/traceability:** 48 percent willing to pay 8–10% premium.
- **Branded product:** 32% willing to pay 5–8% premium.

Appendix E: Stakeholder Consultation Summaries

Stakeholder Validation Workshop – Aden

Date: August 15, 2025
Participants: 60 stakeholders including government officials (15), private sector (18), producers (22), and non-governmental organizations (5)
Objectives: Present value chain findings, validate constraints and opportunities, and prioritize interventions
Key outcomes:

- Strong consensus on feed scarcity as primary constraint across all governorates
- Validation of high postharvest losses (15–25 percent) due to lack of cold chain
- Confirmation of gender barriers, particularly affecting women's market access
- Prioritization of processing infrastructure as highest-impact intervention
- Identification of export potential to Saudi and Emirati markets
- Agreement on need for livestock-specific credit products
- Support for gradual private-sector transition of processing centers

Strategy Formulation Workshop – Taiz

Date: September 8, 2025
Participants: 45 stakeholders including technical experts, development partners, and producer representatives
Key outcomes:

- Developed theory of change linking interventions to impact pathways
- Prioritized 25 interventions from initial list of 40+ proposals
- Designed five-pillar framework organizing interventions thematically
- Established gender targets of minimum 40 percent women in producer groups and 600 women in processing
- Set ambitious but realistic impact targets of 40 percent income increase and 30 percent production boost
- Agreed on phased implementation of piloting (Year 1), scaling (Years 2–3), and institutionalization (Years 4–5)
- Identified critical success factors of multistakeholder coordination, adaptive management, and private-sector engagement

Monitoring and Evaluation (M&E) and Planning Workshop – Lahj

Date: October 3, 2025
Participants: 35 stakeholders focused on implementation planning and monitoring
Key outcomes:

- Finalized 30 key performance indicators across output, outcome, and impact levels
- Established baseline values and targets for each indicator
- Designed M&E system with quarterly data collection and annual evaluations
- Assigned clear responsibilities for data collection to specific implementing partners
- Developed detailed Year 1 operational plan with quarterly milestones
- Created budget allocation framework across five pillars

- Identified risk mitigation strategies for conflict, climate change, and market volatility
- Established coordination mechanism with quarterly steering committee meetings

Appendix F: Detailed Budget and Resource Requirements

Five-Year Budget by Component

Table F.1 presents the detailed budget allocation (US$) across five thematic pillars over the 2026–2030 implementation period.

Table F.1 Five-year budget by component

Pillar	Year 1	Years 2–3	Years 4–5	Total	% of budget
A. Production & Health	520,000	1,280,000	920,000	2,720,000	32%
B. Processing & Value Addition	640,000	1,120,000	840,000	2,600,000	31%
C. Marketing & Access	280,000	560,000	480,000	1,320,000	15%
D. Institutional & Policy	160,000	320,000	280,000	760,000	9%
E. Cross-Cutting (Gender/Youth)	120,000	180,000	140,000	440,000	5%
M&E and Management	80,000	140,000	120,000	340,000	4%
Contingency (5%)	**0**	**0**	**340,000**	**340,000**	**4%**

Year 1 (2026) Detailed Budget Breakdown

Table F.2 presents the detailed first-year operational budget by activity line.

Table F.2 Year 1 (2026) detailed budget breakdown

Activity line	Budget (US$)	Notes
Vaccination campaign (500K animals)	180,000	Vaccines, logistics, Community Animal Health Worker training
Establish 4 pilot processing centers	320,000	Equipment, construction, initial operating
Train 200 women in dairy processing	60,000	Training, materials, start-up kits
Form 40 producer groups	48,000	Formation, training, initial support

Activity line	Budget (US$)	Notes
Baseline survey	42,000	Data collection, analysis, reporting
Market information system development	35,000	Platform development, SMS gateway
Cold chain equipment (pilot)	120,000	Cooling units, transport refrigeration
Feed production pilot	65,000	Seeds, inputs, demonstration plots
Veterinary supplies stockpiling	52,000	Medicines, equipment
Extension materials development	28,000	Manuals, videos, posters
Coordination mechanism setup	24,000	Meetings, facilitation
M&E system establishment	38,000	Database, tools, training
Gender training for staff	18,000	Workshops, materials
Youth engagement activities	22,000	Outreach, training
Policy advocacy workshops	16,000	Meetings, briefs
Research partnerships	20,000	Collaboration agreements
Staff salaries (partial)	280,000	Implementation team
Operations and logistics	145,000	Offices, vehicles, travel
Communication and visibility	24,000	Materials, events
Contingency	63,000	5% buffer

Appendix G: Detailed Monitoring and Evaluation Framework

Logical Framework (LogFrame)

Table G.1 presents a complete logical framework matrix linking inputs, activities, outputs, outcomes, and impacts.

Table G.1 Impact indicators with baseline and target values

Level	Indicator	Baseline	Target (2030)
Impact	Household income increase	US$500/year	US$700/year (+40%)
Outcome	Milk production per animal	0.8 liters/day	1.04 liters/day (+30%)
Output	Processing centers operational	0	12 centers
Activity	Animals vaccinated annually	0	1.5 million

Impact Indicators with Targets

The key impact indicators measure long-term sector transformation:

- **Household Income:** Baseline: US$500/year → Target: US$700/year (+40 percent increase).
- **Beneficiary Households:** Baseline: 0 → Target: 15,000 (75,000 people).
- **Additional Sector Income:** Baseline: 0 → Target: US$12 million/year (annual generation).
- **Jobs Created:** Baseline: 0 → Target: 500+ (processing and services).
- **Milk Production (Total):** Baseline: 358,000 tonnes → Target: 438,000 tonnes (+80,000 tonnes).
- **Meat Production (Total):** Baseline: 207,500 tonnes → Target: 259,500 tonnes (+52,000 tonnes).
- **Food Security Improvement:** Baseline: 0 → Target: 75,000 people (direct beneficiaries).
- **Women Empowered:** Baseline: 0 → Target: 2,000 (dairy enterprises).
- **Rangeland Management:** Baseline: 0 → Target: 50,000 hectares (sustainable practices).
- **Mortality Reduction:** Baseline: 20% → Target: 10% (50% reduction).

Key Performance Indicators (KPIs)

The monitoring and evaluation framework includes 30 KPIs across three levels:

Impact Level Indicators (Measuring Ultimate Goals)

1. Percentage increase in household income from small ruminants (target: +40%)
2. Percentage of households food secure (target: +25 percentage points)
3. Women's share of household decision-making (target: +20 percentage points)
4. Percentage reduction in child malnutrition (target: −15 percentage points)

Outcome Level Indicators (Measuring Strategic Goal Achievement)

Goal 1 (Production and Productivity)

5. Percentage reduction in disease-related mortality (target: from 20% to 10%)
6. Average milk production per goat per day (target: +30%)
7. Average live weight of animals (target: +20%)
8. Percentage of producers adopting climate-smart practices (target: 70%)

Goal 2 (Processing and Value Addition)

9. Number of functional processing centers (target: 12)
10. Percentage of milk processed (target: 40%)
11. Number of women-led dairy enterprises (target: 200)
12. Volume of processed products sold (target: 1,200 tonnes/year)

Goal 3 (Market Access)

13. Percentage reduction in marketing costs (target: −30%)
14. Producer share of consumer price (target: 60%)
15. Number of producers accessing market information (target: 5,000)
16. Number of contract farming agreements (target: 50)

Goal 4 (Enabling Environment)

17. Coverage of veterinary services (percentage of target areas) (target: 80%)
18. Number of trained and active Community Animal Health Workers (target: 100)
19. Public investment in livestock sector (target: +50%)
20. Number of producers accessing credit (target: 2,000)

Output Level Indicators (Measuring Intervention Implementation)

21. Number of animals vaccinated
22. Number of producers trained (disaggregated by gender, age)
23. Number of producer groups formed and functional
24. Number of Community Animal Health Workers trained and equipped
25. Number of processing centers established
26. Number of women trained in dairy processing

Cross-Cutting Indicators

27. Percentage of women participants in all activities (target: ≥40%)
28. Percentage of youth engaged (target: ≥30%)
29. Beneficiary satisfaction rate (target: ≥80%)
30. Environmental sustainability score (composite indicator)

Appendix H: References Consulted during Value Chain Analysis and Strategy Development

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