

Assessment of investment priorities for Tanzania's dairy sector: Report on activities and accomplishments

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Acronyms and abbreviations

ASDP	Agricultural Sector Development Programme
AI	artificial insemination
ANSAF	Analysis Group, Agriculture Non-State Actors Forum
BMGF	Bill & Melinda Gates Foundation
FNS	Food and nutrition security
MoLF	Ministry of Livestock and Fisheries
NGOs	Non-governmental organizations
TLMP	Tanzania Livestock Master Plan
TLSA	Tanzania Livestock Sector Analysis
LSIPT	Livestock Sector Investment and Policy Toolkit
SD	System Dynamics
TALIRI	Tanzania Livestock Research Institute

I Background

Tanzania has developed a livestock master plan with the technical support of the International Livestock Research Institute (ILRI) and funding from the Bill & Melinda Gates Foundation (BMGF). The aim of the Tanzania Livestock Master Plan (TLMP) is to contribute to the achievement of the national objectives of poverty reduction, food security and nutrition, economic growth, increased exports, and industrialization. The TLMP identifies the priority livestock value chains to drive the achievement of these goals. One of these value chains is dairy, which has been identified as having high potential to contribute to these national objectives with appropriate investments.

Tanzania is in the process of implementing the TLMP. Given its limited prior experience in implementing, monitoring, and evaluating a comprehensive livestock development plan, it recognizes the need for support of all the Tanzania livestock stakeholders and partners, to fully realize the objectives and targets set out in the TLMP. ILRI has been engaged in this process and has secured additional funding from BMGF to support the implementation of livestock master plans in selected countries, including Tanzania.

As one of the steps to implement the proposed interventions for the livestock sector, ILRI and Dalberg Implement partnered to jointly implement the 'Capacity building for the implementation and monitoring and evaluation of Tanzania livestock master plan (TLMP)' project. The overall objective of this project is to strengthen national and local capacity to conduct evidence-based policy analysis to enhance the quality of interventions, performance tracking, monitoring and evaluation, and dialogue in support of TLMP implementation. The project provides technical and capacity support to the Ministry of Livestock and Fisheries (MoLF) (Private Sector Desk, Policy and monitoring and evaluation [M&E] team) and key TLMP players to be able to implement the proposed recommendations.

The objective of this report is to describe activities and accomplishments to date and to discuss the next steps for achievement of the project's objectives.

2 Activities to date

The principal activities to date have been a review of previous analyses of Tanzania's livestock sector, a workshop to solicit stakeholder opinions about investment priorities specifically for the dairy sector, and planning for next steps, including quantitative analyses and additional engagement with stakeholders. Each of these is described below.

2.1 Review of previous analyses and planning documents

In 2017, the Tanzania Ministry of Livestock and Fisheries released the 'Tanzania Livestock Sector Analysis (TLSA) (2016/17–2031/32)'. This document was developed with input from ILRI and consultants summarizing the recent performance of the livestock sector and its projected performance for the next 15 years based on the Livestock Sector Investment and Policy Toolkit (LSIPT) modeling framework. The document identified the overarching goals of livestock sector development, which include:

- reducing poverty
- achieving food and nutritional security
- contributing to economic growth
- contributing to exports
- contributing to industrialization and employment

The analyses noted that demand for dairy products in Tanzania was likely to grow more rapidly than supply under their baseline assumptions and recommended a number of actions to accelerate the rate of milk production increases. These actions included 'artificial insemination (AI), synchronization, multiple ovulation and embryo transfer combined with improved feed and health interventions, more investment in value addition and complementary policy changes' (URT 2017). The report also recommended encouragement of private sector investment in feed production and provision of veterinary services, strengthening of dairy cooperatives, investment in milk processing plants and improvement of research and extension capacity.

Shortly following the release of the Tanzania Livestock Sector Analysis, the Tanzania Ministry of Livestock and Fisheries released the 'Tanzania Livestock Master Plan' document developed in collaboration with ILRI and a team of consultants to provide a 'investment roadmap' for livestock. This document complements and builds on the TLSA to provide 'a series of five-year development implementation plans or 'roadmaps', to be used to implement the Agricultural Sector Development Programme', the ASDP II, codified in 2016. The dairy investment roadmap identifies 'improved family dairy' and 'commercial specialized dairy' as commodity value chains of interest. Similar to the TLSA, the roadmap recommends investments to improve the productivity of dairy cows: artificial insemination (with hormone synchronization) complemented by improved feed quality and quantity and veterinary services. The TLMP projected large percentage increases (+281%) in the number of crossbred cattle and the milk production per cow (+26–42%) in Tanzania by 2022, with concomitant increases in national milk production. The document indicates required investments, return on investments (ROI) and internal rate of return (IRR) as well as complementary actions required for success.

The TLSA and dairy investment roadmap documents provide important documentation of previous performance and clearly state future priorities among a large number of potential investment options for Tanzania's dairy sector. However, there is scope for additional analyses of investment options, in part due to limitations of the previous analytical approaches. For example, the LSIPT modeling framework has at its core a national-level animal herd dynamics model. Capturing herd dynamics clearly is important, and the framework also allows specification of assumptions regarding reproduction and production rates and documentation of potential costs. However, the LSIPT has limitations in the sense that it does not appear to represent linkages between assumptions about productivity changes and resulting changes in costs or prices (Dutilly et al. 2019). The LSIPT has limited explicit representation of value chains other than herd dynamics, and thus may not fully represent required modifications or impacts in the post-farm marketing of dairy products. The TLMP provides information on rates of return but often not many details of how those values were calculated.

In addition, the previous analyses illustrate that it can be difficult to link modeled or assumed changes in the dairy value chain to the overarching development objectives noted above. For example, poverty reduction is a stated goal of livestock development and a reduction in the prevalence of poverty would thus be a desirable outcome. Analysis of the impacts of value chain interventions on the prevalence of poverty would require assumptions about the distribution of incomes by dairy-producing households and the impacts of proposed investments on that distribution. In addition, there could be multiplier effects on the incomes of households that do not own dairy cows that would affect the poverty prevalence more broadly. Similarly, impacts on food and nutrition security (FNS) are difficult to assess with only consideration of milk production increases. FNS is a complex and multi-dimensional concept that often is best measured by changes in a household's overall access to food, not only by changes in availability of one product such as milk.

2.2 Stakeholder workshop on investment priorities for Tanzania's dairy sector

Although the previous TLSA and investment roadmap documents provided priorities and road maps for future investment, given the elapsed time since the release of those documents and the potential limitations in the methods employed for analytical assessment, a process to update stakeholder assessments of investment priorities and plan additional analyses with alternative modeling approaches is appropriate.

In early October 2021, ILRI and Dalberg organized a one-day workshop that brought together key stakeholders in the livestock sector to discuss and assess investment priorities for Tanzania's dairy sector. The input from the workshop will support improving the quality of analysis in the dairy investment roadmap and support the identification of fit-for-purpose technologies for investment in the dairy value chain (a detailed report for the workshop is included in annex 1).

The objective of the workshop was to solicit input from the relevant dairy industry stakeholders about investment priorities for Tanzania's dairy sector to achieve the overarching goals and priorities for quantitative analysis. The specific objectives of the workshop were as follows:

1. Discuss and assess impacts of dairy sector intervention options on dairy sector outcomes (production and consumption) and overarching goals from the Tanzania Livestock Master Plan.
2. Discuss and rank the degree of implementation challenges for dairy sector intervention options such as cost, required expertise, and degree of change.
3. Discuss and rank the priority investments that will be used as input into quantitative ex-ante assessments with System Dynamics (SD) modeling.

The workshop was attended by representatives from the Ministry of Livestock and Fisheries (Production and Marketing Department, and Department of Policy and Planning), the President's Office, regional administration and local government, Private Sector Desk under the Ministry of Livestock and Fisheries, non-governmental organizations (NGOs), financial institutions, research institutes, investment agencies, milk producers and processors.

Participants were highly experienced stakeholders in the dairy sector with capabilities to evaluate the proposed investment priorities that involve public and private partnerships. Furthermore, having a cadre of technical persons from different institutions and organizations in the livestock sector was an added advantage because it was an avenue for information capturing about investment alternatives for Tanzania's dairy sector.

The workshop was a one-day event divided into three sessions:

Session one covered discussions on the impacts of alternative dairy sector investments on milk production, dairy product consumption, and the other overarching goals of the livestock master plan.

Session two of the workshop covered discussions around challenges that are likely to arise during the implementation of dairy sector intervention options.

Session three focused on the overall ranking of investments in the dairy sector.

In each of the sessions, participants were clustered into six working groups, which comprised a cross-section of stakeholders. Each group had a blend of local analysts (staff of the Department of Policy and Planning of MoLF), local think tanks (financial institutions and investment agencies), members of the Policy Analysis Group, Agriculture Non-State Actors Forum (ANSAF), Tanzania Livestock Research Institute (TALIRI), and milk processors and producers.

Potential dairy value chain investments were identified based on those listed in the TLSA and dairy investment roadmap and were assigned to seven different overarching categories. In each session, stakeholders were asked to discuss and assign numerical rankings to dairy value chain investments (Tables 1, 2 and 3).

Table 1. Stakeholder assessments of how alternative investments in the dairy value chain affect overarching development goals

		General Goals		Overarching Goals from Livestock Master Plan				
		Increased Milk Production	Increased Dairy Product Consumption	Reduced poverty	Food security	Economic growth	Export growth	Industrialization
	One metric to assess:	Total milk production	Total milk and dairy product consumption	#, % households below poverty threshold, producer income (by category of farms)	National availability of calories and protein in milk	Value of milk and dairy production and multiplier effects	Exports volume and value	Number dairy processing facilities and volumes processed
Category, Investment	Examples of Specific Proposed Actions							
Increase animal productivity								
Increased use of artificial insemination	Strengthen AI Centres Establish semen production center 5 Liquid N plants Train 6500 technicians Establish bull centers	4 3	3 2	3 3	3 3	3 3	2 2	4 3
Increase feed quantity and quality	Construct commercial animal feed plants "Conducive environment for investment" Land allocation and ownership policies Tax incentives and subsidies for land leasing, including under irrigation Improve quality control laboratories	4 4	3 3	3 4	3 4	3 3	2 3	2 4
Provide crossbred cows to farmers	Crossbreeding programs Dairy heifer multiplication farms Distribution of crossbred cows to farms	? 3	? 3	? 3	? 3	? 3	? 2	? 3
Reduce Dairy Cattle Mortality and Morbidity								
Improve Veterinary services	Rehabilitate veterinary centers Improve disease surveillance capacity	4 4	3 3	3 4	3 4	2 3	4 3	2 3
Increase vaccine availability	Implement vaccination campaigns	4 3	3 3	3 3	3 3	2 3	4 3	2 3
Strengthen Milk Marketing								
Support dairy cooperatives	Provide training and financing	4 4	4 3	2 3	3 4	4 4	1 4	3 4
Milk collection centres with cold chain	Establish 150 new milk collection centers with cold chain	3 4	4 4	3 4	4 4	3 4	2 4	4 4
Specify indicative prices for milk and products	List recommended prices for farm milk and dairy product prices to consumers	2 2	2 3	3 2	3 2	2 2	4 2	3 2
Increase Processing Capacity								
Increase dairy processing capacity	Provide incentives, reduce bureaucracy	4 4	4 4	4 4	3 4	4 4	3 4	4 4
Value-added processing	Establish UHT & milk powder high-capacity plants	4 4	4 4	4 4	4 4	4 3	4 3	4 4

	One metric to assess:	General Goals		Overarching Goals from Livestock Master Plan				
		Increased Milk Production	Increased Dairy Product Consumption	Reduced poverty	Food security	Economic growth	Export growth	Industrialization
		Total milk production	Total milk and dairy product consumption	#, % households below poverty threshold, producer income (by category of farms)	National availability of calories and protein in milk	Value of milk and dairy production and multiplier effects	Exports volume and value	Number dairy processing facilities and volumes processed
Category, Investment	Examples of Specific Proposed Actions							
Increase Demand (Domestic or Export)								
Promote dairy exports		4	2	3	2	4	4	4
		4	3	3	3	4	4	4
School milk feeding programs	Add 100,000 children per year five years	4	4	3	4	3	2	4
		4	4	4	3	3	3	4
Higher import tariffs for dairy products	Raise import tariffs on dairy products	3	3	3	3	3	3	4
		4	2	4	1	4	4	4
Improve Dairy Product Quality								
Improve dairy product quality	Standards and pricing, enforcement Licensing milk and dairy traders Increase capacity for quality assessment Strengthen Dairy Board to regulate quality	2 3	3 4	3 4	3 4	3 4	3 4	3 4
Improve Research and Extension								
Extension services	Train livestock keepers in husbandry, breed improvement, feeding	4	3	3	3	3	3	4
		4	4	3	3	3	4	4
Improved research capacity	Improve research capacity and funding	4	3	3	3	3	4	4
		4	4	4	4	4	4	3
	How much does investment contribute to objectives?	1	Not at all					
		2	A limited amount					
		3	A moderate amount					
		4	A large amount					

Note: The colour of numerical values above indicates the assessments by different stakeholder working groups.

Table 2. Stakeholder assessments of the challenges and costs of alternative investments in the dairy value chain

	Implementation Evaluation		
	Cost	Expertise Required	Degree of change
	What is the cost of implementation?	How much specialized expertise is required for successful implementation?	How much change to the system, knowledge or incentives is required for successful implementation?
Category, Intervention			
Increase animal productivity			
Increased use of artificial insemination	3 4	4 4	4 4
Increase feed quantity and quality	4 2	3 3	3 2
Provide crossbred cows to farmers	4 4	3 2	3 3
Reduce Mortality and Morbidity			
Improve Veterinary services	4 4	4 4	3 4
Increase vaccine availability	4 2	3 2	4 3
Strengthen Milk Marketing			
Support dairy cooperatives	4 4	4 4	4 4
Milk collection centres with cold chain	4 4	3 4	4 4
Indicative prices for milk and products	4 4	3 3	4 3
Increase Processing Capacity			
Increase dairy processing capacity	4 3	2 3	3 4
Value-added processing	4 4	3 4	4 4

	Implementation Evaluation		
	Cost	Expertise Required	Degree of change
	<i>What is the cost of implementation?</i>	<i>How much specialized expertise is required for successful implementation?</i>	<i>How much change to the system, knowledge or incentives is required for successful implementation?</i>
Category, Intervention			
Increase Demand (Domestic or Export)			
Promoting exports	?	?	?
	?	?	?
School mlk feeding programs	4	4	4
	4	4	3
Higher import tariffs	3	4	3
	3	4	3
Improve Dairy Product Quality			
Improve product quality	4	4	4
	4	4	4
Improve Research and Extension			
Extension services	3	4	3
	4	3	2
Improved research capacity	4	3	3
	4	2	2
What is the degree of implementation challenge for these investments?			
	1	None	
	2	Low	
	3	Medium	
	4	High	

Note: The colour of numerical values above indicates the assessments by different stakeholder working groups.

Table 3. Overall stakeholder assessments of priority investments in the dairy value chain

	Rank Priority	Analysis Priority	Private Investment Priority
	<i>Which investments are top 3 priorities (ranked 1-3)?</i>	<i>Which Investments require modeling analysis (ranked 1-3)</i>	<i>Which investments are most likely to attract private investments or public-private partnerships?</i>
Category, Intervention			
Increase animal productivity			
Increased use of artificial insemination	3 2	3	2 3
Increase feed quantity and quality	1 1	2 2	1 1
Provide crossbred cows to farmers		3	
Reduce Mortality and Morbidity			
Improve Veterinary services	3	1 1	2
Increase vaccine availability	2		3
Strengthen Milk Marketing			
Support dairy cooperatives	2 1	3 3	3 3
Milk collection centres with cold chain	1 2	2 2	1 2
Indicative prices for milk and products		1	
Increase Processing Capacity			
Increase dairy processing capacity	3	2 1	1
Value-added processing	3		2

	Rank Priority	Analysis Priority	Private Investment Priority
	<i>Which investments are top 3 priorities (ranked 1-3)?</i>	<i>Which Investments require modeling analysis (ranked 1-3)</i>	<i>Which investments are most likely to attract private investments or public-private partnerships?</i>
Category, Intervention			
Increase Demand (Domestic or Export)			
Promoting exports		3	1
School milk feeding programs	1	2	1
Higher import tariffs		2	3
		1	
Improve Dairy Product Quality			
Improve product quality	2 3	1	3 2
Improve Research and Extension			
Extension services	3	3	
	2		
Improved research capacity			2
	1		
	Most important	1	1
	2nd most important	2	2
	3rd most important	3	3

Note: The colour of numerical values above indicates the assessments by different stakeholder working groups.

The process of the three sessions was designed to remind stakeholders, prior to stating their priorities of a) the objectives of the investments (i.e. the development goals to be achieved) and b) the potential costs and complexity of implementing the investments. In general, stakeholders perceived that many of the investments would contribute to achievement of the TLMP goals, although the most positively perceived were related to increased milk marketing and dairy processing capacity (Table 4). The lowest costs or complexity were for improving research capacity and extension services, with the highest cost and complexity for strengthening dairy cooperatives (Table 4). In principle, investments with larger benefits and lower costs would be preferred, although this is not always reflected in the overall priorities as assessed by the stakeholders. The highest priority investment was school milk feeding programs, followed by development of milk collection centres with a cold chain. Investments focused on farm-level productivity improvement (and the priorities identified in the TLSA and TLMP documents) such as artificial insemination, improved feeding and improved veterinary services were ranked somewhat lower than the top two priorities. Additional detailed comments from the stakeholders for each of the three sessions and regarding the investment priorities were summarized in detail and are available upon request.

The stakeholder workshop provided useful information for subsequent stages of analysis (see section 3.0) and created a relevant forum for interaction and engagement with diverse stakeholders that will facilitate future interactions between them and the project team. This important stakeholder input was discussed by the ILRI-Dalberg team to identify priorities for analysis and future interaction with the stakeholders. We agreed that priorities for future assessment included investments for different components of the value chain:

- artificial insemination, improved feeding and veterinary services to improve milk per cow and reduce animal mortality¹;
- increased dairy processing and milk marketing capacity, and
- school milk feeding programs.

1. These investments more closely correspond to the innovations developed through the efforts of ILRI and other CGIAR centres.

Table 4. Summary metrics for stakeholder assessments of priority investments in the dairy value chain

	Benefit	Cost	Scale Priority	Total Priority Points
Increased use of artificial insemination	2.93	3.83	3.60	9.00
Increase feed quantity and quality	3.21	3.83	3.60	9.00
Provide crossbred cows to farmers	3.00	3.00	0.40	1.00
Improve veterinary services	3.21	3.83	3.60	9.00
Increase vaccine availability	3.00	3.00	0.40	1.00
Support dairy cooperatives	3.36	4.00	3.20	8.00
Milk collection centres with cold chain	3.64	3.83	4.00	10.00
Specify indicative prices for milk and products	2.43	3.50	1.20	3.00
Increase dairy processing capacity	3.86	3.17	3.60	9.00
Value-added processing	3.86	3.83	1.20	3.00
Promote dairy exports	3.43	Not recorded	1.60	4.00
School milk feeding programs	3.50	3.83	4.40	11.00
Higher import tariffs for dairy products	3.21	3.33	1.20	3.00
Extension services	3.43	3.17	1.60	4.00
Improved research capacity	3.64	3.00	1.20	3.00

Note: Values above are means of values reported by stakeholder working groups. 'Benefit' refers to the assessments of how the investment contributes to production, consumption or goals of the TLMP. 'Cost' refers to the investment cost, degree of expertise and degree of required systemic change for an investment. Scale priority and priority points are calculated based on the priority rankings of the stakeholder working groups. Total priority points is the sum of the values of priorities assigned by the working groups, with first priority receiving 3 points, second priority 2 points and third priority 1 point (those not in the top three priorities received zero points.). Total priority points were multiplied by 0.4. Given that the maximum value was 11, multiplying by 0.4 scales the total priority points to be roughly comparable to the 1 to 4 scaling for benefit and cost metrics.

These will be complemented by assessment of public and private investments in research, development and infrastructure and relevant policy modifications (e.g. the cess (taxes) charged on inter-regional shipments of dairy products).

These were deemed to be important potential investments aligned with the recommendations from the TLMP and stakeholder priorities expressed in the workshop, but also feasible with the analytical tools to be developed and the data required.

3 Future activities

Future activities include two key next steps:

1. Development and application of a new quantitative SD model of the Tanzanian dairy value chain to assess the impacts of the investments identified for analysis in the previous section;
2. A second workshop with stakeholders in the Tanzanian dairy value chain with the goals of evaluating the analyses from the SD model and using the results as an opportunity for discussion, learning and consensus for future action.

3.1 Development and application of a quantitative System Dynamics (SD) model

As noted above, it is relevant to consider the dynamic effects of investments from a dairy value chain perspective. The analyses intended for this stage of the project will use a SD modeling approach (Sterman 2000) that accounts for dynamic outcomes related to stock, flow and feedback effects. The modeling will build on previous SD-based dairy value chain models from Nicholson and Stephenson (2015), Dizyee et al. (2019) for Tanzania and the model by Simões et al. (2019). The model structures from these previous works can be adapted to allow consideration of farms, post-farm marketing and processing, consumer demand and international trade for Tanzania's dairy value chain. To the extent that available data allow, we intend to represent different farm types (e.g. commercial and family dairies), two product categories (fluid milk and manufactured products) and multiple geographic regions. It is also relevant to consider impacts of investments based on whether farms (or processors) adopt the technologies supported by the investments. For example, Simões et al (2019) noted that improved feeding technologies for smallholder dairy farms in Brazil can improve profitability for adopters (with offsetting effects of lower prices due to increased milk production) but that it lowered incomes for non-adopting farms.

Once the initial mathematical structure of the SD model is developed, we will assess data availability and modify the model as necessary. Consistent with SD modeling practice conventions, we intend to compare model predictions to observed outcomes as a component of model calibration and evaluation. As needed, the modeling analysis will use 'sensitivity analyses' (e.g. those in Nicholson and Monterrosa 2021) to assess the impacts of uncertainty in relevant assumptions. The impacts of investments will be evaluated relative to a *Baseline* scenario without the investments. An initial assessment with the model will assume low- or no-cost and immediate implementation of investment actions or impacts (e.g. improved milk per cow). This will provide information about whether a best-case investment scenario results in desired achievements of stated goals related to production, consumption and value chain incomes. These analyses will be complemented by additional analysis of the implementation costs and time delays likely to occur for the different investments. It is not uncommon for investments designed to improve outcomes to a) require considerable time for impact and/or b) result in outcomes that are initially worse and then improve (so-called 'worse before better behaviour'). To the extent possible, we will consider impacts on appropriate metrics for the overarching development goals. This model and these scenarios will be used to engage with dairy value chain stakeholders in a second 'learning and validation' workshop.

3.2 Learning and validation workshop with Tanzania dairy value chain stakeholders

A second workshop with stakeholders is planned for mid-December 2021. The objectives of this workshop are to 1) present the basic characteristics of the model to stakeholders, 2) use the model to facilitate real-time analysis of investment options to facilitate discussion among stakeholders about investment priorities, and 3) re-assess investment priorities of stakeholders based on the additional information about the linkages between investments and outcomes provided by the quantitative analysis. The workshop will also discuss the required actions on the part of stakeholders to implement the priority investments. The results of this workshop will be summarized in a report similar to that from the October 2021 workshop.

The ultimate goal is a clear understanding of the investment priorities in Tanzania's dairy value chain, the actions required by different stakeholders and the range of impacts on farmers, milk marketers, consumers and government.

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Annex I: Stakeholders workshop report



Dairy Stakeholders
Workshop Report.pdf