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Brief 3

Uncertainty in smallholder milk production in Tanzania: implications for investment

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Key messages

- In Tanzania, cattle are considered the most economically and socially important type of livestock.
- Uncertainty and risk associated with livestock keeping are major concerns, particularly in the dairy industry—as the industry has significant potential to reduce poverty, improve nutrition and foster inclusive development in Tanzania.
- Existing and prospective dairy farm managers need to equip themselves with the knowledge and skills in animal husbandry to adequately address production-related risks.
- Dairy farm managers need to ensure they are feed self-sufficient. This could be achieved by allocating enough land to produce fodder, including maize specifically for maize bran.
- Dairy enterprises would benefit from diversifying their income sources to help them cope with sudden changes in the market.
- Dairy farm managers should adopt flexible approaches to decision making. This requires they have access to market information and knowledge of the implications of alternative production decisions.
- Attaining inclusive dairy industry development will necessitate the Tanzanian government recognize that the impacts of uncertainty vary by the gender of the producer and type of value chain.

Farmers frequently face uncertainty and risk related to the biophysical and economic environments in which they operate[1]. Both uncertainty and risk refer to randomness which tends to render risk-averse farmers without insurance incapable of making optimal production and investment decisions. Some studies have documented the existence of uncertainty and risk in livestock production in Tanzania, particularly in the dairy industry, considered as possessing the most potential to reduce poverty, improve nutrition and foster inclusive development. Ensuring the industry will be able to realize its potential will require the identification and quantification of the sources of risk and uncertainty, and the implementation of recommendations on appropriate farm management and investment strategies. This should include the identification of risk mitigation strategies and implemented through public-private investments.

Research

Undertaken under the auspices of the Netherlands Organisation for Scientific Research (NWO-WOTRO)-funded project, Local and International business collaboration for productivity and quality improvement in dairy chains in southeast Asia and East Africa (LIQUID), and the Irish Aid funded project, More Milk in Tanzania (MoreMilkiT), the research sought to identify risk factors and economic impacts associated with smallholder dairying, and determine the effect of uncertainty on milk-production investment decisions.

More specifically, the study sought to identify the sources of risk faced by milk producers, quantify their impacts and generate a single measure of risk in milk production. Researchers used a consolidated risk measure to estimate a risk-adjusted discount rate and hence the optimal producer price of milk[2] before risk-adverse

[1] Uncertainty is defined as being subjected to random events, the probability of which occurring is in part unpredictable. Risk, a concept closely related to uncertainty, refers to random events likelihood of which occurring can be quantified.

[2] The minimum price for milk needed to persuade producers, who are worried about uncertainty and irreversibility of nature of investment, to undertake investment.

producers would undertake any investment. Seeking to facilitate inclusive dairy development, measures were estimated for men, women and young milk producers operating in formal and informal dairy value chains. Unlike in the formal value chain, milk in the informal value chain does not undergo any processing before sale to the final consumer. This is means that the two value chains face different risks and levels of risk exposure.

The data for the study was collected in August 2016 at one of the MoreMilkIT project sites, Lushoto district, located in the north of the Tanga region in the eastern milk shed (see figure 1). Seventy-five percent of the district is situated in the western Usambara mountains, an area only suitable for intensive dairy cattle feeding. Lushoto district was selected because it is populated by a large number of typical smallholder dairy farmers who have historically benefited from most of Tanzania's smallholder dairy development projects. Consequently, many keep improved dairy breeds and milk production tends to be market-oriented.

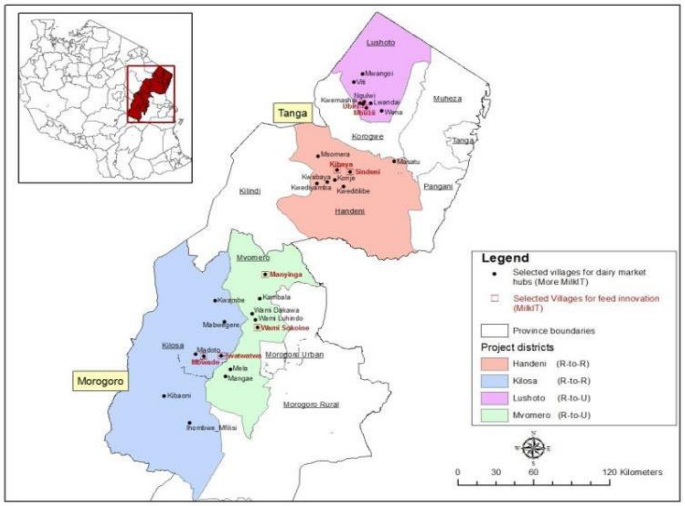

Figure 1: Study sites of the MoreMilkiT project

The study relied on representative smallholder dairy farms as study units. Farmers who undertake commercial milk production and own the dairy enterprise were the primary criteria guiding the selection of representative dairy farmers for each gender category. Farmers were also selected based on their willingness and ability to provide accurate and substantial enterprise data. Impact of risk on cash flows was examined for a single cow for one lactation period (300 days), and the impact of uncertainty on investment decisions was determined using capital budgeting methods.

Key findings

Impact of risk on cash flows

- All categories of dairy farmers, except young people in the informal value chain, generate positive cash flows every month. Young farmers working in the informal value chain generate negative cash flows in the wet season. Cash flows in the formal value chain are higher than those in the informal chain except for male milk producers in the dry season.

- Regarding the impact of risk on cash flows, losses were only observed for young people working in the informal value chain during the wet season (Table 1).

Table 1: Cash flow at risk values by gender, value chain and season

	Cash flow		**Probability of cash flow being less than their seasonal average**	
	Dry season (USD)	Wet season (USD)	Dry season	Wet season
FI	5.03	7.55	50.5%	44.5%
FF	5.66	14.15	50.5%	50.5%
MI	5.57	6.40	44.2%	44.6%
MF	4.61	20.06	55.7%	55.3%
YI	13.20	-4.37	44.9%	44.6%
YF	19.81	22.64	50.5%	50.5%

FI, FF, MI, MF, YI, and YF denote producer categories and the value chains in which they operate as follows: female informal, female formal, male informal, male formal, youth informal and youth formal, respectively.

Aggregating the impacts of risk into a single volatility measure, we see that young people operating in the informal value chain are found to face the highest annual volatility of returns to milk production of 35.15% (table 2). Overall, there is greater risk in the informal value chain than in the formal one, with average annual volatilities of 15.69% and 4.41%, respectively.

Table 2: Annual volatility of returns to milk production

	Formal value chain (%)	Informal value chain (%)
Youth	1.60	35.15
Men	10.02	7.90
Women	1.60	4.03
Combined	**4.41**	**15.69**

Impact of uncertainty on the decision to invest

If prospective milk producers are to worry about uncertainty and the irreversible nature of investment decisions, they would want to see producer prices of milk stand at USD0.33 and USD2.15 per litre of milk for the formal and informal value chains, respectively, before they invest in milk production. This is what is referred to as the optimal investment triggers in Table 3. But if they are to disregard uncertainty and irreversibility of investments, producer prices of USD0.02 and USD0.04 per litre (also known as conventional triggers) would suffice. Therefore, owing to the uncertainty that currently exists in the dairy industry, the option to wait for more and better information before investing in milk production is of value. For the formal value chain, the current price of milk of USD0.23 per litre has to increase by USD0.10 before deferring investment ceases to be optimal.

This, however, is much less than the increase in price needed to make investment in the informal value chain optimal. The current farm gate price of milk in the informal value chain, averaged across the three producer categories, is USD0.38 per litre. It would have to increase nearly six-fold to make investment in the informal value chain optimal.

Table 3. Hurdle rates, optimal and conventional investment triggers

	Formal value chain	Informal value chain
Hurdle rate	2.47	8.11
Optimal investment trigger (USD/litre)	0.33	2.15
Conventional trigger (USD/litre)	0.02	0.04

If a prospective milk producer were to disregard uncertainty and use conventional investment criterion, they would invest immediately since current farm gate prices in both value chains are a lot higher than the conventional triggers. But anecdotal evidence indicates farmers are reluctant to adhere to conventional criterion. This study was undertaken in Tanga region where the authors were involved in implementing a research-for-development project designed to facilitate greater investment in milk production. During the project implementation phase, farmers consistently described the milk prices they received as low, discouraging further investment in milk production. These results suggest the farmers are right and are perhaps aware of the risks and uncertainty they face.

Recommendations for dairy farm management and industry policy

Evidence adduced by this study suggests the level of uncertainty in smallholder dairying discourages private investment in milk production in both the formal and informal value chains, but more so in the latter. The recommendations include:

- The development of the capacity of existing and prospective smallholder dairy farm managers to become self-sufficient in the production of farm inputs, particularly animal feed, and to undertake proper dairy animal husbandry. Understanding body condition scoring as a management tool is especially important in this regard.

- Support for the diversification of incomes as a way of helping dairy enterprises cope with sudden changes in the market since there are a lack of market-based insurance products available in rural Tanzania.

- Encouragement of dairy farm managers to be flexible in decision making since it is impossible to eliminate uncertainty from the economic environment. Flexibility, however, necessitates access to market information and knowledge on the implications of alternative production decisions.

- Encouragement of the Tanzanian government in the pursuit of an inclusive dairy industry development to recognize that the impacts of uncertainty vary by gender of dairy farm manager and type of value chain. Smallholder farmers are risk averse and if government is to support implementation of risk mitigation measures, it should ensure the measures are tailored to the needs of the gender groups and value chains.

Lenders to smallholder farmers should be cognizant of the fact that risk levels vary greatly between the two value chains. Varying levels of risk exposure, in conjunction with individual producer risk profiles, should help lenders determine the appropriate risk (insurance) premiums and hence interest rates to charge on cattle and other loans. The current lender practice by those offering loans to dairy cattle farmers is to levy uniform risk premiums which neither take account of individual producer risk profiles nor the level of risk associated with the relevant value chain. Cash flow-based lenders could employ the cash flow models, such as the one developed in this study, to determine appropriate risk premiums.

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