

**PERCEIVED CHALLENGES IN BUSINESS DEVELOPMENT OF
SMALLHOLDER DAIRY FARMERS IN THREE MALAWIAN REGIONS****Baur I¹, Chiumia D², Gazzarin C¹ and M Lips^{1*}****Ivo Baur**

*Corresponding author email: markus.lips@agroscope.admin.ch

¹Agroscope, Institute for Sustainability Sciences, Tänikon, Switzerland

²ETH Zurich, Animal Physiology, Institute of Agricultural Sciences, Zurich, Switzerland



ABSTRACT

Dairy farmers face various challenges in developing their businesses. The current literature identifies several constraints towards a more efficient dairy sector that relate mostly to on-farm management practices. The available studies analyze constraints mostly from the objective viewpoint of the researcher, whereas very little is known about what farmers themselves perceive to be challenging. To better understand the farmers' perspective and what they perceive to be challenging, and how these challenges differ across regions, this paper builds on a survey of 529 dairy farmers in Malawi. In the survey, respondents were asked in an open question to name their three main challenges. Based on the responses, a three-level coding scheme was elaborated. Data were then coded by two researchers to ensure reliability of coding. Codes were then used to calculate relative frequencies for the different challenges and to perform chi-square tests to check for regional differences in frequencies. Results suggest that farmers perceive low milk price and milk yield, animal health, availability of feedstock, and the costs for drugs as the main challenges. The analysis also revealed that the challenges vary strongly between the three main regions in the country – Blantyre (south), Lilongwe (central), and Mzuzu (north). The perceived challenges reflect the different production systems in the regions. In Blantyre, dairy farming is low in intensity, and farmers thus perceive inputs, in particular the availability of fodder, as well as outputs, in particular milk yields more frequently as a challenge than farmers in Lilongwe and Mzuzu. In contrast, dairy farming in Lilongwe is the most intense. Accordingly, farmers in Lilongwe perceive costs, in particular for inputs such as mash and concentrates as major constraints. Farmers in Mzuzu, which is a rather remote region, consider a lack of assistance, in particular concerning extension services significantly more challenging than the farmers in the other two regions do. Considering these insights, development work and extensions services may be able to increase outcomes in the dairy sector by targeting the regional challenges.

Key words: Challenges, dairy production, smallholders, Malawi, qualitative study, regions



INTRODUCTION

Dairy cattle production has the potential to contribute to the livelihood of many smallholders in Malawi through income generation, increased resilience during food crises, and by strengthening social security [1]. Malawi currently has more than 8,000 smallholder dairy farmers owning about 40,500 dairy cows [2]. During the past decade, many Malawian farmers gained interest in dairy production because of its promotion through the Malawian government and non-governmental organizations. Despite these efforts, average milk yield per day remains relatively low with reported figures being 5 to 8 liters [3], 9 to 11 liters [4], and 6.5 liters [5]. Considering the whole sector, annual outputs have stagnated at 47,000 tons between 2010 and 2014, while outputs in countries such as Kenya, Tanzania, Uganda and Zimbabwe clearly increased [6].

The most frequently mentioned challenges in literature are on-farm constraints, which include land and fodder scarcity [1, 7], animal health problems [8, 9], poor infrastructural endowment and animal housing [2], breeding strategies [8, 10], low fertility [2, 11], and limited management skills [12, 13]. Furthermore, concerning the macro level, the agricultural policy report of the Malawian government identifies three major restrictions to the development of livestock production: (i) limited pasture due to population pressure; (ii) inadequate production and storage technologies in feed and breeding programmes; and (iii) insufficient animal health support infrastructure and services [14].

However, none of these insights derives from approaches elucidating the perspective of the farmers. Therefore, very little is known about what smallholders themselves perceive as challenging. The only study that inquired challenges directly from farmers was conducted by Tebug *et al.* [15] who reported for Northern Malawi that farmers felt most challenged by poor animal health and inadequate extension services with 56%, followed by inadequate artificial insemination services with 45%, poor market for milk with 39%, and feed shortage with 37%. However, this analysis was limited to the northern part of Malawi (Mzuzu), and farmers in other regions may face entirely different constraints. For example, Ecker and Qaim found strong regional differences in the performance of smallholder dairy farmers suggesting that production conditions heavily depend on regional aspects [5]. Therefore, this analysis aims at extending on the work of Tebug *et al.* [15] by investigating for the entire country what farmers perceive to be major challenges in the development of their dairy business, and whether farmers' perception of challenges differs regionally.

METHODS

Study region characteristics

Malawi is located in sub-Saharan Africa, populated by 16.7 million people and characterized by tropical climate with a rainy and a dry season. The south is more densely populated with approximately 258 people per square kilometer hosting almost 50% of the national population, whereas the central and northern regions record lower population densities with 94 and 69 people per km², respectively [15].



With regard to milk production, it was reported by Chagunda *et al.* [10] for the year 2008 that 9,600 dairy farmers kept around 36,000 dairy cows (pure and crossbreds). Most of them were kept in the southern region of Blantyre, where 22,800 dairy cows produced 23,300 tons annually. In the central region of Lilongwe and northern region of Mzuzu, the dairy sector was structurally very similar. In Lilongwe 3,800 dairy cows yielded 3,400 tons, while in Mzuzu, 3,500 dairy cows yielded 3,200 tones. Overall, however, local Zebus – which serve many other purposes than just milk supply – outnumber dairy cows by far, with only four animals out of every one hundred being dairy. Nonetheless, the share of dairy cows appeared to be much higher in the south with ten percent, compared to the one percent found in Lilongwe and Mzuzu [10].

Sampling strategy and data collection

Data used herein were derived from a baseline survey conducted in summer 2013, involving 12 assistants who helped in collecting the data [16, 17]. A total of 540 questionnaires were collected, of which 529 contained valid information with regard to the question concerning challenges to on-farm development. The questionnaire was designed in English, and whenever possible, also conducted in English. The sample was taken from the records of 15 milk bulking groups (MBGs), equally distributed among the three regions.

The sampling procedure aimed at reflecting the actual regional distribution of farmers, while still getting a reasonable sample for Mzuzu. According to Chagunda [10], much more than half of the dairy farmers are located in Blantyre (63%), followed by Lilongwe (26%), and Mzuzu (12%). Therefore, slightly more than half the questionnaires were collected in Blantyre ($n = 287$), one fourth in Lilongwe ($n = 141$), and one fifth in Mzuzu ($n = 101$). The sample was drawn from a population consisting of farmers from 15 milk bulking groups (MBGs), equally distributed across the three study regions. The majority of respondents were female ($n = 352$), and the average age was 49.4 years. In an open question, smallholders were asked to name the three major challenges they currently face in their dairy enterprise. The answers were noted as key words, which resulted in 1,183 statements that were used for further analysis. While not all questions in the survey could be answered by the farmers as expected, this question yielded 2.24 answers on average per subject and showed no indications of misunderstandings or inconsistencies.

Coding and analysis

The coding scheme was inductively developed from the data and contained three tiers. The highest tier consisted of seven categories, the second of 26, and the third of 38 categories. The seven first tier categories were inputs, outputs, animal management, household structure, social environment, market development, and the natural and infrastructural environment. These seven top-tier categories were characterized by two lower tiers as displayed in Figure 1 and briefly summarized as follows:

- Inputs included all non-market challenges relating to on-farm inputs. For instance, feedstock was an input category of the second tier and was further differentiated in the third tier including the categories concentrates, maize bran, grass, and roughage.



- Outputs contained all challenges that relate to downstream challenges.
- Animal management included all challenges that directly relate to diseases such as mastitis, mortality, and to fertility.
- Household structure comprised categories such as available family labor and skill sets, location (distance to markets, water sources, extension services, milk bulking group and pasture), and scantiness of assets (animal housing, tools, cash liquidity and capital in general).
- Social environment included problems relating to extension service like its quality in providing assistance, or the reliability of the milk-bulking group (delay of payments, breakdown of the cooling facilities, and lack of leadership).
- Market development referred to prices regarding outputs (milk prices) and inputs (prices of feed, animals, semen, veterinary services, drugs, and credits).
- The natural and infrastructural environment comprised climate, seasonal variations in fodder growth, and rainfall.

Once the developed coding system covered all statements, data were coded independently by two researchers. Whenever possible, the code from the lowest tier was assigned to the statements, but in some cases statements were so generally formulated that they had to be allocated to the first tier allowing no further specification. After the first coding round, a comparison of the resulting codes took place. At this point, 76% of the statements were identically coded. After briefly discussing the mismatches, both researchers recoded the non-matching statements and achieved a match of 94%. The remaining 6% were specifically discussed to reach an agreement on the proper code. Subsequently, the calculation of the relative frequencies for the challenges (number of answers divided by the total number of farms) in total, and separately for the three regions of Blantyre, Lilongwe, and Mzuzu down to the lowest level was carried out. For all challenges mentioned at least 15 times, a chi-square test was conducted to examine whether challenges differed at all across the three regions. Furthermore, a chi-square test for the pairwise comparison of two particular regions was applied.

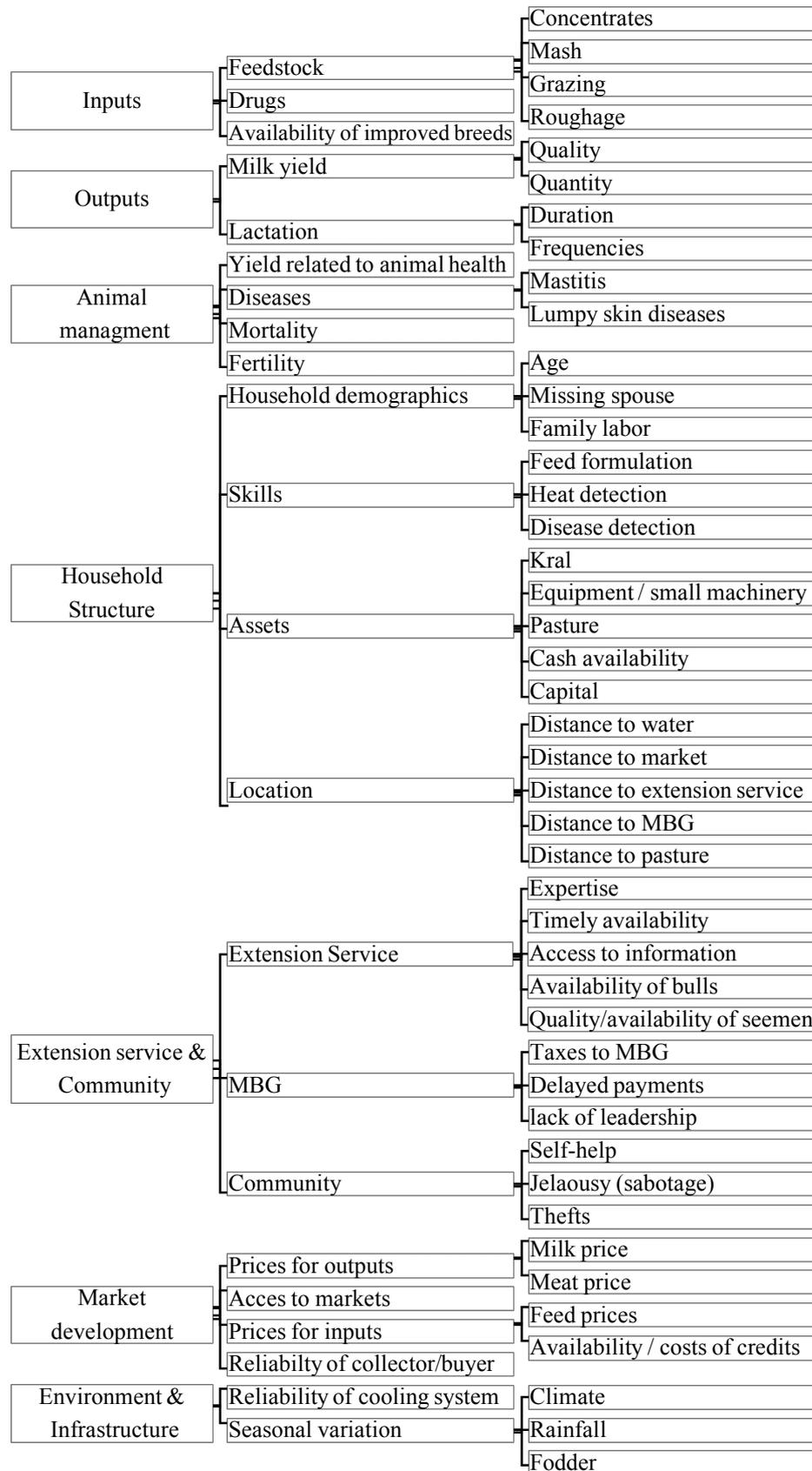


Figure 1: Coding scheme with three tiers

RESULTS

First tier regional differences

Figure 2 depicts the frequencies of reported challenges on the first tier. Overall, the most relevant challenges were clearly market forces with frequencies between 32% in Blantyre and almost 42% in Lilongwe.

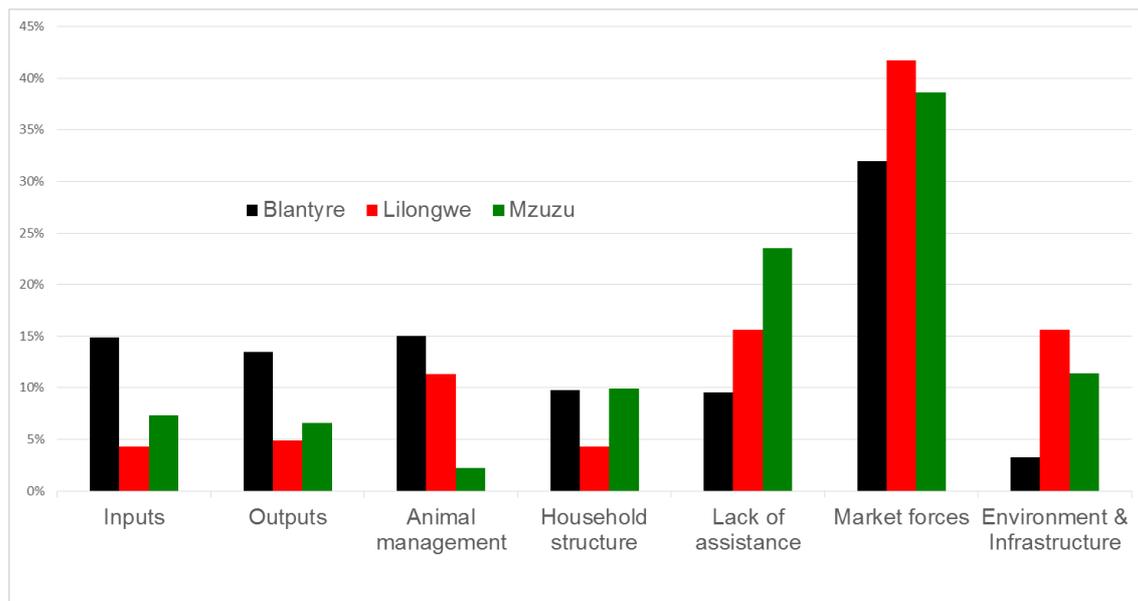
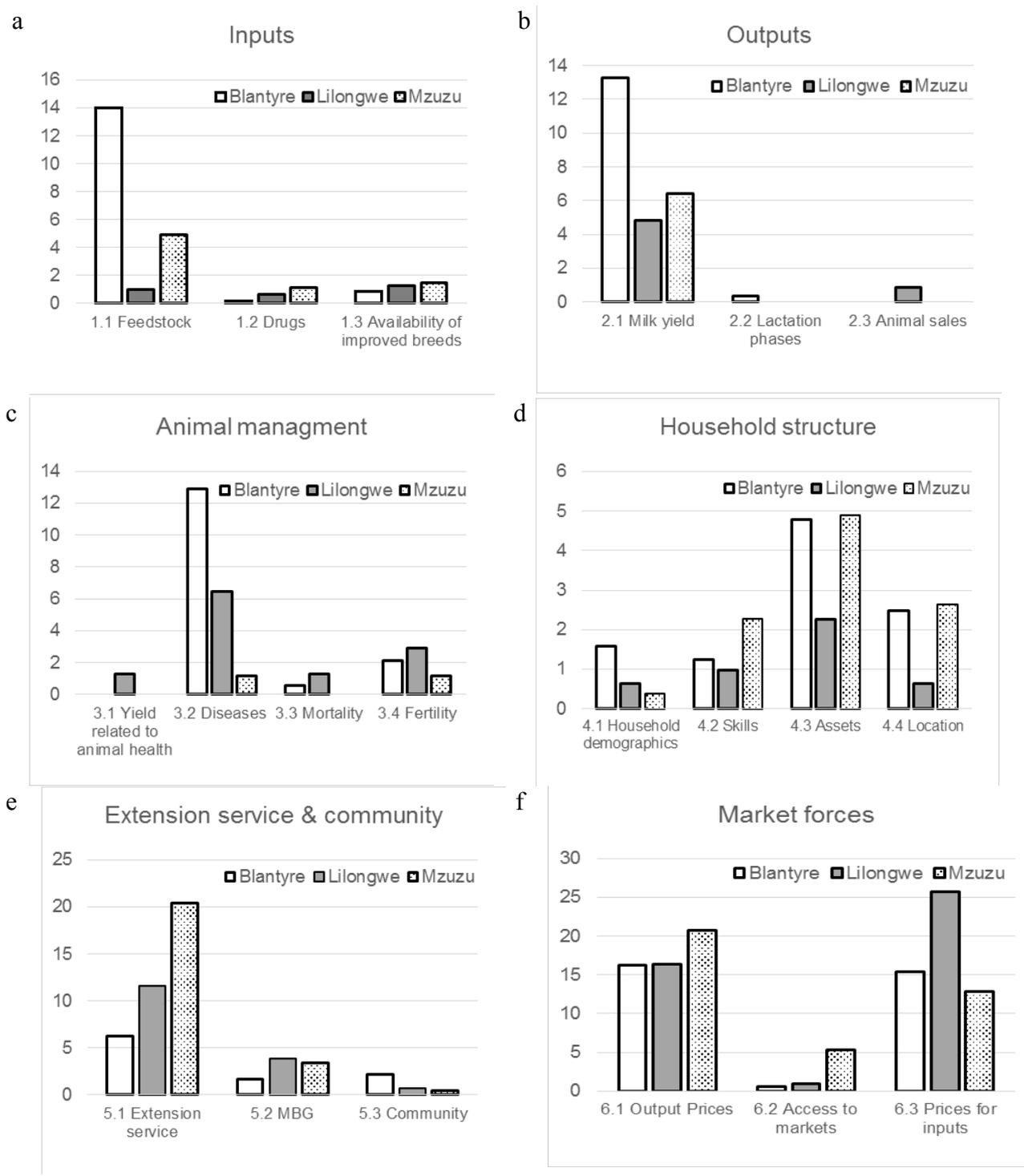


Figure 2: Relative frequencies of challenges on the highest tier by region

Inputs and outputs in general were perceived as more challenging by the farmers in Blantyre than by farmers in Lilongwe and Mzuzu. Considering animal management, the farmers in Mzuzu stated to have significantly less problems compared with the farmers in Blantyre and Lilongwe. Regarding household structure, farmers in Lilongwe were the least concerned. The social environment was a major problem for farmers in Mzuzu. Furthermore, environmental and infrastructural conditions were of little concern in Blantyre.

Second and third tier regional differences

Figures 3a-g display the highest tier challenges subdivided into the second tier.



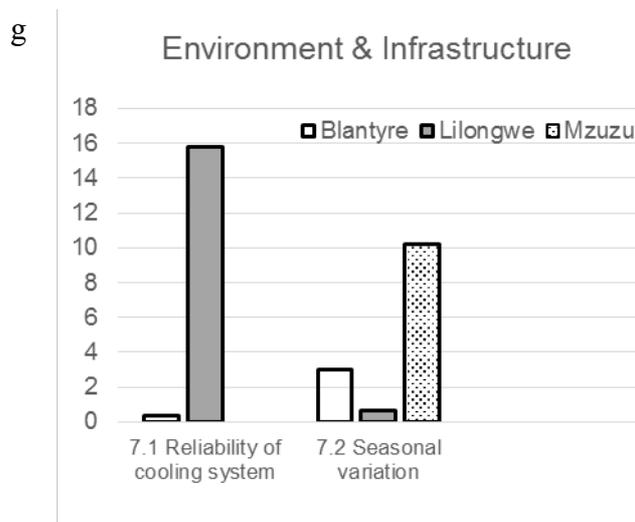


Figure 3a-g. Second tier relative frequencies of challenges by region

Most of the challenges regarding inputs (Figure 3a) concern the availability of feedstock, which farmers in Blantyre perceive significantly more often challenging than the farmers in the other two regions (Table 1). A similar constellation was found with regards to outputs (Figure 3b), where milk yield (in quantity) was significantly more frequently perceived to be a challenge by the farmers in Blantyre than by the farmers in the other regions (Table 1). Farmers in Blantyre were also highly concerned with challenges in animal management, in particular animal health (Figure 3c). For animal health, which was the third most frequently named concern across all regions, the levels of expressed concern differed significantly between the regions with the relative highest concern for farmers being in Blantyre followed by Lilongwe and very little concern in Mzuzu (Table 1). Concerning household structure, the main challenges for farmers is their lack of assets (Figure 3d). The farmers in Mzuzu perceived their infrastructural assets, in particular small machinery, to be more challenging than their colleagues in Blantyre and Lilongwe did (Table 1). Also, farmers in Blantyre were significantly less concerned by the impact of the geographical location on their business than the farmers in the other regions (Table 1). Overall, farmers in Mzuzu were also more concerned with the quality of the assistance they receive to run their business (Figure 3e), in particular the extension services and the quality of semen. Regarding the perception of market developments, farmers in all the three regions frequently named the milk price as a challenge, while regional differences existed with regard to input prices (Figure 3f). The farmers in Lilongwe felt particularly challenged by the prices for inputs (especially for drugs), whereas the farmers in Mzuzu were unsatisfied with the milk price (output price) (Table 1). Concerning environmental and infrastructural problems, the farmers in Lilongwe felt most challenged, in particular by the cooling infrastructure (Figure 3g). The resulting milk loss was perceived most problematic in Lilongwe, whereas milk cooling caused a significantly lower concern in the other two regions (Table 1).

DISCUSSION

The paper investigated qualitatively the challenges that dairy farmers in Malawi perceive as major constraints in the development of their farm business. In the survey, 529 farmers were asked to name the three main challenges they face in developing their farm business, which resulted in 1,183 statements. The statements were coded using a hierarchical coding system. On the first tier, farmers were most concerned with market developments which included prices for inputs as well as their milk price. Furthermore, farmers were concerned strongly about the quality of the extension service available for them. On the second tier, top-listed constraints were input (mainly drugs) and output prices (almost entirely milk), followed by poor extension services and disappointing milk yields, animal health problems, and the availability of feedstock. Another important obstacle to successful business development is milk cooling for the milk bulking groups.

In the overall sample, considerable difference existed between the challenges identified in the literature and the challenges that farmers considered the most constraining. The most frequently discussed constraints in the literature are on-farm issues, namely, animal health followed by milk yield and farmers' decision making such as lack of documentation [18]. From the farmers' perspective, challenges are more equally distributed including upstream problems such as cost of drugs, and downstream problems such as a low milk price. This finding suggests significant discrepancies between farmers' perception of problems and what research has identified as major constraints. Therefore, results herein are not necessarily findings that reveal the biggest obstacles for the development of the dairy sector. Instead, these results are intended to complement more objective approaches by elucidating the farmers' viewpoint.

Furthermore, the emphasis on these challenges differed regionally for Blantyre, Lilongwe, and Mzuzu. Therefore, this study also provides a detailed overview on regional constraints as perceived by farmers and thus could be used as a starting point to design measures and development programs targeting the particular regional challenges. However, the problems as perceived by the farmers do not necessarily reflect the actual most critical regional problems. Therefore, the findings on challenges need further validation with more objective approaches to achieve a more rigorously supported conclusion for designing and targeting regionally specified measures and programs. Nevertheless, despite the subject views presented herein, the authors believe that perceived challenges significantly reflect the regional differences in the production environments.

In Blantyre, which is located in the south, farmers mostly operate at low input and low output levels and accordingly perceive availability of feedstock and milk yields to be unsatisfying. Hence, the perception of farmers is very much in line with findings from regression analysis showing that yields in Blantyre are significantly lower than yields in the other two regions [5]. Consequently, farmers in Blantyre also feel that the milk price is less of a challenge because they are not so much dependent on market developments as they operate at low intensities. A major reason for reduced intensity in Blantyre is likely related to land scarcity [19], in particular land that could be allocated to fodder generation. Furthermore, farmers in Blantyre are significantly more challenged with



animal health issues than farmers in Lilongwe and Mzuzu, suggesting that Blantyre is the least favorable region for dairying in terms of fodder supply and animal welfare. Accordingly, any intervention for Blantyre should focus on forage production and potentially on providing farmers with better access to pastureland.

Lilongwe, the central region, is, with regard to the farmers' perception of many challenges, located between the southern and northern regions. In general, Lilongwe is characterized by higher intensity in production, which allows for better income from dairy farming [5]. Farmers feel less challenged to collect their inputs except for maize bran, which seems to be insufficiently available on-farm. The only challenge that was significantly more frequently named in Lilongwe than in the other two regions was the breakdown of the milk cooling system. As most milk is collected and processed by milk bulking groups which are organized as collectives, any milk loss will negatively affect the producers' receipts. Therefore, measures aimed at improving milk production in Lilongwe should target the infrastructure at the milk bulking groups by improving electrical supply.

Mzuzu is a rather remote region in the northern part of the country. As a consequence of the limited infrastructure, farmers in Mzuzu are mostly concerned with output markets as indicated by concerns about the milk prices and market access, although they achieve the highest milk price among the three regions with MWK 107.8 per liter, followed by Lilongwe with MWK 106.9 per liter and Blantyre with MWK 95.4 per liter [20]. Nevertheless, farmers in Mzuzu perceive prices to be more challenging than do the farmers in the other regions. Other challenges more pronounced in Mzuzu than in the other regions include prices for drugs, the quality of semen, and the fodder growth during the dry season. These issues relate to some extent to findings from a similar study by Tebug *et al.* [15], stating that farmers are most challenged by poor animal health and extension services, poor market opportunities, and feed shortage.

CONCLUSION

Dairy farmers in Malawi face various challenges in improving their dairy enterprise. But analyses mostly take the objective approach and potentially fail to generate an in-depth understanding of the challenges as they are perceived by farmers. Consequently, development projects or extension services may address problems that do not have highest priority in the farmers' agendas and may consequently lack acceptance and adoption. This study provides a semi-qualitative analysis of the constraints that Malawian farmers perceive to be most hindering in the development of their dairy business. The results of this study highlight significant differences in the challenges experienced by the farmers and those identified in the literature by researchers. Whereas farmers perceive the challenges to be equally distributed across the value chain, the literature identifies most potential for improvement on-farm. Furthermore, the analysis suggests that challenges differ substantially between regions. Results show that farmers perceive low milk price and milk yield, animal health, availability of feedstock, and the costs for drugs to be most challenging. The analysis also showed that the perception of challenges differs across regions, and that perceived differences reflect also different production systems and environmental constraints characterizing the regions. Consequently, it seems

beneficial that measures for improving dairy production in Malawi take into account the perceived regional differences in the challenges. Nevertheless, it should be clear that no development measure should be considered based solely on perceived challenges without further critical evaluation of the problem.

ACKNOWLEDGEMENTS

We would like to thank Léa Tabin for her contribution to coding. Furthermore, we are also grateful for two anonymous reviewers that helped improve the manuscript.



Table 1: Relative frequencies of main challenges (3 tiers possible) and regional differentiation based on chi-squared tests across regions and for pairwise comparison (Only categories considered with overall relative frequencies >1)

Challenges	Relative frequencies				Total		Blantyre–Lilongwe		Blantyre–Mzuzu		Lilongwe–Mzuzu	
	Total	Blantyre	Lilongwe	Mzuzu	χ^2	<i>p</i>	χ^2	<i>p</i>	χ^2	<i>p</i>	χ^2	<i>p</i>
Inputs	10.2%	14.9%	4.3%	7.4%	19.151	***	18.070	***	3.296	*	4.283	**
Feedstock	8.0%	13.5%	0.9%	4.8%	38.039	***	34.007	***	7.347	***	10.505	***
Outputs	9.6%	13.5%	4.9%	6.6%	13.262	***	12.040	***	3.070	*	1.842	
Milk yield	9.1%	13.0%	4.6%	6.3%	13.315	***	12.013	***	3.154	*	1.786	
Quality	2.0%	3.4%	0.0%	1.5%	10.369	***	9.981	***	1.116		5.615	**
Quantity	6.9%	9.2%	4.6%	4.8%	4.888	*	4.144	**	1.622		0.264	
Animal management	11.1%	15.0%	11.3%	2.2%	20.281	***	0.701		20.502	***	14.508	***
Diseases	8.1%	12.5%	6.1%	1.1%	23.885	***	5.938	**	20.594	***	8.041	***
Mastitis	1.4%	1.9%	0.9%	0.7%	1.373		0.850		0.774		0.006	
Animal fertility	2.0%	2.1%	2.8%	1.1%	1.711		0.950		0.287		1.405	
Household structure	8.3%	9.7%	4.3%	9.9%	10.203	***	5.951	**	1.756		10.395	***
Skills	1.4%	1.2%	0.9%	2.2%	3.576		0.040		2.765	*	2.329	
Assets	4.0%	4.6%	2.1%	4.8%	4.466		2.414		0.900		4.578	**
Small machinery	1.6%	1.0%	1.2%	3.3%	10.102	***	0.227		9.107	***	4.115	**
Location	1.9%	2.4%	0.6%	2.6%	4.585		3.065	*	0.592		4.868	**



Challenges	Relative frequencies				Total		Blantyre– Lilongwe		Blantyre– Mzuzu		Lilongwe– Mzuzu	
	Total	Blantyre	Lilongwe	Mzuzu	χ^2	<i>p</i>	χ^2	<i>p</i>	χ^2	<i>p</i>	χ^2	<i>p</i>
Social environment (lack of assistance)	14.5%	9.6%	15.6%	23.5%	50.801	***	11.449	***	51.796	***	10.883	***
Extension service	10.6%	6.0%	11.0%	19.9%	58.774	***	10.731	***	60.066	***	14.094	***
Expertise	3.2%	3.2%	4.3%	1.8%	2.364		1.378		0.344		1.908	
Timely availability	2.5%	1.4%	3.4%	3.7%	8.946	**	5.435	**	8.277	***	0.308	
Quality of semen	3.6%	0.5%	2.1%	12.1%	96.933	***	6.265	**	83.117	***	28.929	***
Milk bulking group	2.6%	1.5%	4.0%	3.3%	8.113	**	6.927	***	5.455	**	0.006	
Delayed payments	1.6%	0.7%	2.1%	2.9%	9.990	***	4.731	**	10.398	***	0.847	
Self-help	1.3%	2.1%	0.6%	0.4%	4.083		2.231		2.296		0.087	
Market development	36.2%	32.0%	41.7%	38.6%	26.901	***	16.396	***	19.953	***	0.498	
Output prices	16.7%	15.7%	15.6%	20.2%	11.536	***	0.539		11.324	***	5.260	**
Milk price	16.7%	15.7%	15.6%	20.2%	11.536	***	0.539		11.324	***	5.260	**
No established markets	1.7%	0.5%	0.9%	5.1%	34.278	***	0.794		28.422	***	11.810	***
Input prices	17.7%	15.6%	25.2%	13.2%	19.823	***	18.911	***	0.397		7.304	***
Concentrates	1.4%	1.7%	1.5%	0.4%	1.727		0.001		1.655		1.564	
Mash	2.1%	1.4%	5.2%	0.0%	23.459	***	14.184	***	2.835	*	12.469	***
Drugs	5.6%	2.4%	8.0%	9.6%	32.916	***	19.205	***	32.670	***	1.573	
Environment & Infrastructure	8.5%	3.2%	15.6%	11.4%	55.578	***	53.391	***	35.104	***	0.587	
Milk bulking group	4.6%	0.3%	15.0%	1.5%	114.405	***	95.828	***	5.172	**	27.482	***
Unreliable cooling system	4.2%	0.3%	14.7%	0.0%	127.031	***	93.640	***	0.705		36.817	***
Seasonal effects	3.9%	2.9%	0.6%	9.9%	50.371	***	4.387	**	29.648	***	32.778	***
Fodder growth	3.7%	2.6%	0.6%	9.9%	54.043	***	3.498	*	33.116	***	32.778	***
Others	1.7%	2.1%	2.1%	0.4%								
Total	100.0%	100.0%	100.0%	100.0%								

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.



REFERENCES

1. **Banda L, Gondwe T, Gausi W, Masangano C, Fatch P, Wellard K, Banda J and E Kaunda** Challenges and opportunities of smallholder dairy production systems: A case study of selected districts in Malawi. *Livestock Research for Rural Development*, 2011; **23**: 226.
2. **Banda LJ, Kamwanja LA, Chagunda MGG, Ashworth CJ and DJ Roberts** Status of dairy cow management and fertility in smallholder farms in Malawi. *Trop Anim Health Prod*, 2012; **44(4)**: 715-727.
3. **Tebug SF, Kasulo V, Chikagwa-Malunga S, Wiedemann S, Roberts DJ and MG Chagunda** Smallholder dairy production in Northern Malawi: production practices and constraints. *Trop Anim Health Prod*, 2012; **44(1)**: 55-62.
4. **USAID**. Final Evaluation of the Malawi Dairy Development Alliance, Land O'Lakes Malawi. 2012.
5. **Ecker O and M Qaim** Analyzing nutritional impacts of policies: an empirical study for Malawi. *World Dev*, 2011. **39**.
6. **Hemme T** Dairy Report 2015 for a better understanding of the dairy world, International Farm Comparison Network, Editor. 2015, Kiel.
7. **Douillet M and A Toulon** Developing a typology of agricultural holdings for improved policy design: a preliminary case study of Malawi. 2014.
8. **Kawonga BS, Chagunda MG, Gondwe TN, Gondwe SR and JW Banda** Characterisation of smallholder dairy production systems using animal welfare and milk quality. *Trop Anim Health Prod*, 2012; **44(7)**: 1429-1435.
9. **Tebug SF, Njunga GR, Chagunda MG and S Wiedemann** Health constraints and farm management factors influencing udder health of dairy cows in Malawi. *J Agric Sci*, 2012; **4(6)**: 136-141.
10. **Chagunda MGG, Gondwe TN, Banda L, Mayuni P, Mtimuni JP, Chimbaza T and A Nkwanda** Smallholder dairy production in Malawi: current status and future solutions. 2010, Scottish Agricultural College.
11. **Banda J** Evaluation of the productive and reproductive performances of Friesian X Zebu and Jersey X Zebu crossbred cattle at Bunda College farm in Malawi. *Malawi Journal of Science and Technology*, 1996; **3(1)**: 25-36.
12. **Chagunda M, Msiska A, Wollny C, Tchale H and J Banda** An analysis of smallholder farmers' willingness to adopt dairy performance recording in Malawi. *Livestock Research for Rural Development*, 2006; **18(5)**.



13. **Tebug S, Chikagwa-Malunga S and S Wiedemann** On-farm evaluation of dairy farming innovations uptake in northern Malawi. *Livestock Research for Rural Development*, 2012; **24(5)**.
14. **MoAIWD.** National Agricultural Policy, Ministry of Agriculture IaWD, Editor. 2016: Lilongwe. 1-115.
15. **Tebug SF, Kasulo V, Chikagwa-Malunga S, Chagunda MGG, Roberts DJ and S Wiedemann** Smallholder dairy production in northern Malawi: production and health constraints. *Trop Anim Health Prod* 2012; **44:22-62**.
16. **Baur I, Gazzarin C, Banda M and M Lips** The determinants of the performance of dairy smallholders in Malawi. *Journal of Agriculture and Rural Development in the Tropics and Subtropics (JARTS)*, 2017; **118(1)**: 59-68.
17. **Banda M, Chigwa F and D Chiumia** Developing and evaluating sustainable integrated farming systems for improvement of smallholder dairy production in milk-shed areas of malawi – baseline survey report. *Unpublished report*, 2016.
18. **Buck BJ** Designing a private sector oriented dairy designing development program: experience from Africa. Land O' Lakes. Presentation for the FAO Asia Regional Dairy Conference. November, 19, 2008.
19. **Fintrac Inc** Best analysis – Malawi - Bellmon estimation studies for Title II (best) project. Publication produced for review by the United States Agency for International Development. December, 2008. Available online: http://pdf.usaid.gov/pdf_docs/Pnado944.pdf (accessed April 23, 2017).
20. **Barnard J** Milk Enterprise Development in Malawi – final report. 2007, Lilongwe: Volunteer Service Organisation (VSO) Report, ESE/003.