

Promotion of Safe Food to Consumers of Milk and Dairy Products in Kibaha Town Council [†]

Damas Theobald Msaki

Planning, Monitoring and Evaluation Unit, Kibaha Education Centre, Kibaha P.O. Box 30054, Tanzania;
msakidt@gmail.com

[†] Presented at the International One Health Conference 2022, Catania, Italy, 27–28 September 2022.

Abstract: A cross-sectional baseline survey was conducted at Kibaha Town Council (KTC), Pwani Region (Tanzania), to assess the awareness and practices of smallholder dairy producers towards antimicrobial use (AMU), a major cause of foodborne antimicrobial resistance (AMR) in livestock production systems. The aim was to improve consumers' confidence in the consumption of milk and other dairy products. Quantitative data were collected from a total of 30 randomly selected respondents from a sampling frame of households keeping dairy cattle in 3 administrative wards of Tumbi, Picha ya Ndege, and Maili Moja. A structured questionnaire was administered through face-to-face conversations between the interviewer and the interviewees. Six other respondents participated in the Focus Group Discussions (FGDs) for qualitative data collection. The quantitative data were analyzed using the statistical package for social science (SPSS, Version 16) and MS Office Excel 2010 for window packages. There were more male respondents (63.3%) than female respondents, whereas the level of education was primary for 46.7%, secondary for 33.3%, and tertiary level for the remaining 20%. About 76.6% of them were using antimicrobials to treat lactating dairy cows, mainly oxytetracycline (OTC 20%), penicillin, and Peni-Strep. Twice the number of males (53.3%) used antimicrobials compared to females (23.3%). Respondents with tertiary education rarely administered antimicrobials themselves. The common diseases being treated were diarrhea (46.7%), mastitis (43.3%), and respiratory diseases (36.7%). A proportion of milk from sick animals (those treated with antimicrobials) was fed to calves (33.3%), sold to milk collection centers (26.7%) where it goes through normal market channels, 26.7% fed to other animals while little is consumed by the family at home (6.7%). In conclusion, it should be noted that milk producers administer antimicrobials themselves even when the animals are being milked. This situation poses health challenges among milk consumers. We advise dairy producers to avoid unnecessary AMU.

Keywords: antimicrobials; AMR; lactating; smallholder; mastitis



Citation: Msaki, D.T. Promotion of Safe Food to Consumers of Milk and Dairy Products in Kibaha Town Council. *Med. Sci. Forum* **2023**, *19*, 8. <https://doi.org/10.3390/msf2023019008>

Academic Editors: Chiara Copat, Antonio Cristaldi, Gabriela Fernandez, Margherita Ferrante, Melissa Jimenez, Gomez Tagle, Paolo Lauriola, Graziella Machado, Valerio Paolini, Prisco Piscitelli, Domenico Vito, Gea Oliveri Conti, Carla Albanese, Alfina Grasso, Carol Maione and Lorenzo Laquinteri

Published: 12 June 2023



Copyright: © 2023 by the author. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Smallholder dairy keepers across Kibaha Town Council (KTC) in Pwani Region (Tanzania) enjoy the easiest market for their milk and dairy products due to its vicinity to major markets in Kibaha Town and Dar es Salaam city. However, the irrational use of antimicrobial agents in the dairy production poses health risks to milk consumers.

Antimicrobial agents by definition refer to either natural or synthetic substances used to kill or inhibit the growth of microorganisms (pathogens) without harming the host. These microorganisms are bacteria, fungi, viruses, and parasites that acquire resistance to antimicrobial agents (FAO, 2020) [1].

Thus, this study was chosen since the safety of the animal source food (ASF) to consumers generally requires all stakeholders involved to take stern measures against any health-related threats pertaining to the overuse of antimicrobial agents in the animal production system. It aims at reducing cases of antimicrobial resistance (AMR) which then can easily be transferred to human beings through the consumption of milk and

dairy products. According to David et al. (2019) [2], AMR refers to a process in which a microorganism evolves to become either more or fully resistant to an antimicrobial agent which could previously treat it effectively. Since antimicrobial agents are meant for diseased livestock and not needed for healthy ones, every stakeholder concerned in the food value chain needs to understand the whole concept of AMR in livestock production systems so that consumption of the ASF by humans is made as safe as possible from the healthy livestock.

1.1. Problem Statement

Some smallholder farmers in the area use their previous experience to directly treat their unhealthy animals without consulting veterinary personnel as a matter of saving the life of their unhealthy animals (although this is on a trial-and-error basis).

Some animals are administered with improper dosage or inappropriate antimicrobials, which lead to the building up of antimicrobial resistance (AMR). AMR can easily be transferred to human beings through the consumption of products of animal origin. As a result, the consumers of the dairy products in the area are, therefore, not guaranteed food safety due to unregulated and extensive misuse of antimicrobial agents in the dairy production system, which later pose a threat to public health.

1.2. Project Objectives

The main objective of this study was to promote safe food to consumers of milk and dairy products to improve consumers' confidence in Kibaha Town Council (KTC). The specific objectives are

1. To assess the smallholder dairy producers' point of view on the use of antimicrobials;
2. To build up the capacity of various stakeholders in the dairying value chain, particularly on the effects of AMR and zoonosis;
3. To disseminate knowledge of dairy management as a major source of safe dairy products in the area.

2. Methodology

2.1. Study Area

This particular study was carried out in Kibaha Town Council (KTC), which is the headquarter of Pwani Region (Tanzania), located almost 40 km west of Dar es Salaam business city. The KTC has an estimated area of 750 square kilometers and lies between latitude 6.8° South and longitudes 38.2° and 38.5° East.

The KTC has 14 administrative wards, which are Tumbi, Maili-Moja, Kibaha, Visiga, Mkuza, Kongowe, Misugusugu, Picha-ya-Ndege, Sofu, Msangani, Tangini, Mbwawa, Viziwaziwa and Pangani.

However, due to resource constraints especially a lack of funds and manpower, this study involved only 3 administrative wards of Tumbi, Picha-ya-Ndege, and Maili Moja, respectively.

2.2. Demographic Information and Sample Size

According to the 2012 national population census of Tanzania, KTC had a population of 128,488 (62,653 males and 65,835 females). However, the 3 wards where this study was carried out had a population of 51,250 (24,602 males and 26,648 females) as shown in Table 1 below.

N: The 3 areas had an estimated population size of 40 dairy keepers. Hence, the Taro Yamane (1973) [3] formula was employed to compute a sample size of 36 respondents. The formula is expressed as

$$n = \frac{N}{1 + N(e)^2} \quad (1)$$

where n = sample size, N = population size (of dairy keepers), and e = the level of precision (error 0.05) reliability level 95%.

Thus, sample size = 40:

$$36 = \frac{40}{1 + 40(0.05)^2} \quad (2)$$

Table 1. Population of Kibaha Town Council by sex.

Ward	Population (Number)		
	Total	Male	Female
1. Maili Moja	21,606	10,419	11,187
2. Picha ya Ndege	17,994	8680	9314
3. Tumbi	11,650	5503	6147
Total	51,250	24,602	26,648

2.3. Study Design and Data Collection

A cross-sectional baseline survey was conducted to assess the awareness and practices of smallholder dairy producers towards the use of antimicrobials in the livestock production system in Kibaha Town Council (KTC), Pwani Region (Tanzania).

Quantitative data were collected from a total of 30 respondents, who were randomly selected for interview from a sampling frame of households keeping dairy cattle in the 3 selected administrative wards of Tumbi, Picha ya Ndege, and Maili Moja, respectively. In this case, one livestock extension officer was involved from each of the selected administrative wards. Six other respondents participated in the Focus Group Discussions (FGDs) for in-depth qualitative data collection.

In both cases, data were collected by using well-structured questionnaires and administered through face-to-face conversations between the interviewer and the interviewees.

2.4. Pre-Testing of the Questionnaire

A pre-testing interview was carried out with a total of 5 respondents keeping dairy cattle alongside Lulanzi street (Picha ya Ndege Ward). However, these data were not included in this study since the aim was just to test the clarity and sequence of the questions for the final questionnaire. After this, the questionnaire was revised and re-arranged as a final tool for the study.

2.5. Data Management and Analysis

The quantitative data set was analyzed by using the statistical package for social science (SPSS, Version 16) and MS Office Excel 2010 for window packages to explore smallholder dairy producers' practices and their awareness in relation to antimicrobial use in daily dairy production systems.

3. Results

3.1. Producer's Socio-Demography

In the baseline survey, the participating respondents engaging with keeping dairy cattle were mostly males (63.3%) and the remaining percent were females (36.7), as shown in Table 2.

Table 2. Gender of the responders.

	Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	19	63.3	63.3	63.3
	Female	11	36.7	36.7	100.0
	Total	30	100.0	100.0	

It was observed that the majority of the respondents had a primary level of education (46.7%), followed by those with secondary level education (33.3%) and tertiary (20%), as shown in Table 3.

Table 3. Education of the respondents.

	Education Level	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Primary	14	46.7	46.7	46.7
	Secondary	10	33.3	33.3	80.0
	College	6	20.0	20.0	100.0
	Total	30	100.0	100.0	

3.2. Animals and Husbandry Practices

It was noted that 76.6% of the respondents were using antimicrobial agents in their dairy cattle production system. This portrays the magnitude of the problem cited in the study area and becomes a wake-up call for all stakeholders to take stern measures to alleviate it. A similar previous study by Karimuribo et al. (2005) [4] reported that antimicrobial usage in animal production in Tanzania is quite unregulated due to a weak regulatory framework that later on contributes to unwise use of antimicrobials leading to the emergence and spread of antimicrobial resistance [5,6].

The relationship between males and females on the use of antimicrobial agents found that 76.6% used antimicrobials in the dairy cattle production system, in which the number of males was over twice (53.3%) the number of the female counterpart (23.3%) as shown in Table 4.

Table 4. Gender versus antimicrobial use.

		Antimicrobials		Total
		Use Antimicrobials	No Antimicrobials	
Gender	Male	16	3	19
	Female	7	4	11
	Total	23	7	30

The reason for this could not be established easily, probably since the number of male respondents was larger than that of the female counterpart in this study.

However, based on the gender perspective, previous studies in Tanzania demonstrate that men, unlike women, are more responsible for buying veterinary drugs and treating animals and can also easily travel long distances to purchase these drugs from primary markets or retailer shops located in urban areas [7].

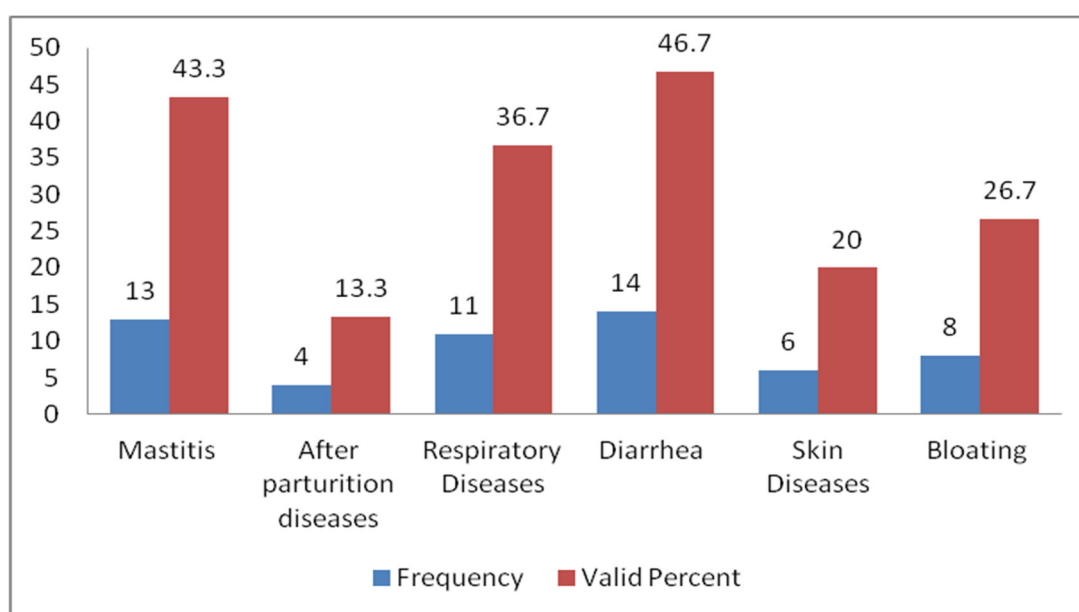
With regards to the level of education, it was observed that overuse of antimicrobial agents was common to those with a primary level of education (43.5%), followed by those with secondary education (39.1%), and hence, less use of antimicrobial agents was observed in those with tertiary education (17.4%) as shown in Table 5. This signifies that the more people get higher education, the less they engage in risky behavior of extensive use of antimicrobials in livestock production. This concurs with another study in Tanzania conducted by Karimuribo et al. (2005) [4] which revealed that smallholder farmers with low educational qualifications (primary school qualifications and below) were three times more likely to have unfavorable antimicrobial use practices than those with tertiary education.

As a result, such mishandling of antimicrobials by smallholder farmers with improper veterinary skills may lead to incorrect dosages or applications and non-adherence to withdrawal periods for human consumption of milk products that later pose risks to public health in the country.

Table 5. Level of education versus use of antimicrobials.

Level of Education	Antimicrobials		Total
	Use Antimicrobials	No Antimicrobials	
Primary	10	4	14
Secondary	9	1	10
College	4	2	6
Total	23	7	30

Almost six types of common disease episodes had driven smallholder dairy keepers to extensively use antimicrobials, namely diarrhea (46.7%) followed by mastitis (43.3%) and respiratory diseases (36.7%). Figure 1 summarizes their valid percentages with their frequencies of occurrence as mentioned by individual dairy keepers.

**Figure 1.** Common disease episodes in the area.

However, as far as Figure 2 is concerned, the data indicated that although the total number of diarrhea cases was higher ($n = 14$) than those of mastitis ($n = 13$), the use of antimicrobials was much higher in the treatment of mastitis (84.6%; $n = 11/13$) as compared to the treatment of diarrhea (78.6%; $n = 11/14$). This was probably due to the fact that farmers would pay more attention to lactating animals since they are their sole source of milk and cash in the family.

These findings agree with several other previous studies that mention mastitis in both clinical and subclinical forms as the main disease that affects milk production and its quality in Tanzania [8,9]. This study recommends smallholder farmers to avoid rushing into using antimicrobials since not all subclinical mastitis cases are due to microbial pathogens.

Therefore, it is also suggested that smallholder farmers in the study area need to observe biosecurity protocols for dairy attendants and other farm visitors as well as improve milking hygiene and apply udder disinfectants instead of antimicrobials to control mastitis and other contagious zoonosis in the dairy production.

During the focus groups discussion (FGD), it was revealed that common types of antimicrobial agents in use along KTC are oxytetracycline (OTC 20%), penicillin and Peni-Strep (penicillin + streptomycin), and those antimicrobials were administered even by smallholder farmers that had no basic veterinary knowledge. The study concurs with another study by Katakweba et al. (2012) [10] that revealed that the most common antimicrobials used by most dairy farmers in the nearest city of Dar es Salaam (Tanza-

nia) were sulphonamides, followed by beta-lactamase, aminoglycosides, tetracyclines, and macrolides.

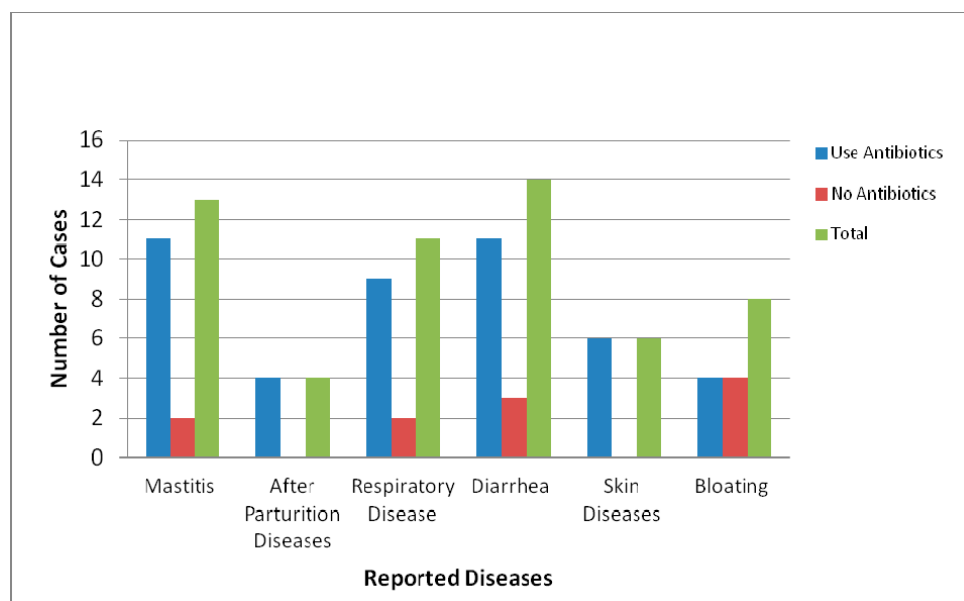


Figure 2. Control of dairy cattle diseases by antimicrobials in KTC.

3.3. Sales and Consumption of Milk

In order to understand the magnitude of the problem of antimicrobials on public health, an investigation was done to find out who are end users (consumers) of the milk collected from the lactating animals underwent treatment using antimicrobials or not. It was observed that three major markets of this milk existed: neighbors that formed a major market for the produced milk (46.7%), followed by milk collection centers (30%), and other miscellaneous markets (23.3%). Since the neighborhood forms a huge informal market of milk produced by smallholder dairy keepers, the findings alert the necessity to sensitize the community about the risks involved in the consumption of unsafe livestock products. This agrees with a previous study by Sikira et al. (2018) [7] that showed much of the milk produced in Tanzania is mainly sold at the informal market by smallholder farmers.

Nevertheless, during the FGD, it was revealed that none of the respondents accepted selling milk from animals treated with antimicrobials to their neighbors. However, the majority of respondents indicated that milk from animals treated with antimicrobial agents was fed to calves (33.3%), sold to milk collection centers (26.7%), fed to other animals e.g., dogs and cats (26.7%), consumed by the family members (6.7%), or thrown away (6.7%) as shown in Table 6. The respondents iterated that the costs of dairy production are too high and practically unbearable; hence, throwing away milk from animals under antimicrobial treatments is next to impossible. The collection centers were viewed as the best alternative market since the chemical reagents used are weak and hence, unable to trace milk contaminated with antimicrobials.

Table 6. Milk markets from lactating animals treated with antimicrobials.

Milk Market	Milk from Lactating Animals Treated with Antimicrobials					Total
	Fed to Calves	Sold to Milk Collection Centre	Consumed by Family	Fed to Dogs/ Other Animals	Thrown Away	
Neighbors	2	5	1	4	2	14
Milk Collection Centers	5	1	0	3	0	9
Other markets	3	2	1	1	0	7
Total	10	8	2	8	2	30

3.4. Building Up the Capacity of Various Stakeholders in the Dairy Production

A total of 27 college students (19 males and 8 females) were trained as ToT at the KFDC in October 2019. The participants were in their second and final years of pursuing an animal husbandry certificate course. The main purpose was to build their understanding and awareness of the effects of extensive use of antimicrobials in the livestock production system and the resultants of AMR so that they would become “Agents of Change” in their community as they graduate. The training was also carried out for 17 internship students from 2 different colleges at the KFDC between February and March 2020. The participants were 10 students (5 males and 5 females) from Tengeru Livestock Training Agency (LITA) in the Arusha region and 7 other students (4 males and 3 females) from Buhuri LITA in the Tanga region, respectively. These were trained as ToTs (Training of Trainers) so as to disseminate the knowledge about management of healthy livestock and the effects of AMR in livestock production systems in the country. A total number of 39 smallholder dairy farmers (22 males and 17 females) were trained on the effects of zoonosis, AMR, and best practices of other livestock management practices.

3.5. Knowledge Dissemination of Dairy Management in the Area

This was an important aspect of this study to give them feedback on the baseline survey results. The training was carried out in the 3 administrative wards of Tumbi, Picha ya Ndege, and Maili Moja by involving smallholder dairy producers who previously participated in the baseline survey and several others who keep dairy cattle.

3.6. Study Limitations (Gap)

In carrying out this particular study, there were several limitations that need to be mentioned for the sake of learning and future ITP programs. These include but are not limited to:

1. Lack of financial resources for conducting farm visits. Some smallholder farmers reside far away from the KEC which required some transport costs for the farm visits. Unfortunately, my request for project sponsorship did not materialize. Because of that, my timetable for farm visits was somehow disrupted.
2. Lack of PPE (personal protective equipment) for demonstration of biosecurity protocol. The PPEs could include disposable safety jackets, cover coats, and disposable boots for demonstration purposes since “Seeing is believing”. So many of the smallholder farmers that were trained had never seen all these protective gears with their naked eyes; hence, it was a bit difficult to demonstrate them all this equipment theoretically.
3. The outbreak of the COVID-19 pandemic made it impossible to conduct further community meetings in Tanzania by mid-March 2020. This is because the government had to shut down schools, colleges, and all forms of social gatherings making it unlawful to hold meetings or any form of training to contain the spread of COVID-19. As a result of this particular lockdown, college students who were trained as ToT for conducting outreach training and extension services in the surrounding community were obliged to observe and maintain social distancing and, hence, returned home earlier than the expected period of staying at the KEC.

3.7. Future Perspectives

Given the results found in the baseline survey and the number of stakeholders unreached due to limited resources, it is imperative that further studies and training with regard to the effects of extensive use of antimicrobials in livestock production systems are needed in this area. In the future, once funds are availed, this particular change project should also be scaled up to other administrative wards alongside the KTC, the whole Pwani Region, and Tanzania at large. Meanwhile, sensitization through awareness creation and capacity building for smallholder dairy producers to stop the misuse of antimicrobials should continue in Tanzania to avail safe food to consumers. It is also recommended that a

topic on the effects of AMR should be introduced in the formal curriculum of vocational training colleges such as the KFDC to mitigate this emerging global challenge.

4. Conclusions

This study focused on the improvement of livestock production among smallholder dairy farmers in which good agricultural and livestock management practices were emphasized. Since prevention is better than cure, the approach used was to train college students as ToTs to bring about multiple changes in the community of livestock keepers. Once farmers have a better understanding of livestock management, obviously, they would take the right steps that safeguard the health of livestock as a source of safe food for the community.

This project recommends smallholder farmers to practically observe biosecurity protocols for dairy attendants and other farm visitors as well as improve milking hygiene and apply udder disinfectants as a strategy towards the control of mastitis and the spread of other contagious zoonosis in the dairy production and avoid unnecessary use of antimicrobials. We believe that the more farmers get aware of the effects of the misuse of antimicrobials in livestock production systems, the more challenges of AMR are minimized and thereby improving consumers' confidence towards consumption of the ASF, particularly dairy products from healthy livestock across the KTC. Nevertheless, further studies are needed to assess the awareness of livestock keepers in developing countries, such as Tanzania, about the risk of AMR and their respective role in controlling this global challenge.

Funding: This research received no external funding.

Institutional Review Board Statement: The management of Kibaha Education Centre (KEC) approved the research clearance and ethical protocol (Ref. KEC/EA/178/293/01/10) on 7 June 2019 for studies involving animals and humans.

Informed Consent Statement: All study participants provided their informed consent for inclusion before they participated in the study.

Data Availability Statement: Not applicable.

Acknowledgments: My profound gratitude goes to the KEC for allowing me to participate in this study. Secondly, my heartfelt appreciation goes to the Government of Sweden through SIDA for sponsoring my participation in the 2nd Cohort of the ITP 2019—Healthy Livestock, Safe Food. I also thank Erika Chenais from the National Veterinary Institute (SVA)—Sweden for proof reading this work and my mentor Sigrid, Agenäs from the Swedish University of Agricultural Sciences (SLU) Sweden, for her competent supervision out of her wealth of knowledge and words of encouragement, which made this study a success. I would like also to thank the authority of the KTC for approving a permit for conducting the baseline study and training carried out for smallholder farmers thereafter. I would like also to thank my fellows in the 2nd Cohort of the ITP 2019 from all countries involved for their critique and advice. Last but not least, I would like to thank my family members for being patient during the whole period when my presence at home was missed in the course of fulfilling requirements pertaining to this particular change project.

Conflicts of Interest: The author declares no conflict of interest.

References

1. Food and Agriculture Organization of the United Nations. *Regional Conference for Asia and the Pacific. Thirty-fifth Session, Thimphu, Bhutan, 17–20 February 2020*; Report on Antimicrobial Resistance (AMR), APRC/20/INF/16; FAO: Rome, Italy, 2020.
2. Nelson, D.W.; Moore, J.E.; Rao, J.R. Antimicrobial resistance (AMR): Significance to food quality and safety. *Food Qual. Saf.* **2019**, *3*, 15–22. [\[CrossRef\]](#)
3. Yamane, T. *Statistics: An Introductory Analysis*; John Weather Hill, Inc.: London, UK, 1973.
4. Karimuribo, E.D.; Mdegela, R.H.; Kusiluka, L.J.M.; Kambarage, D.M. Assessment of drug usage and antimicrobial residues in milk on smallholder farms in Morogoro, Tanzania Evaluation de l'utilisation des médicaments et détermination des résidus antimicrobiens dans le lait dans les petites exploitations agricoles à Morogoro en Tanzanie. *Bull. Anim. Health Prod. Afr.* **2005**, *53*, 234–241.

5. Kashoma, I.P.; Kassem, I.I.; John, J.; Kessy, B.M.; Gebreyes, W.; Kazwala, R.R.; Rajashekara, G. Prevalence and antimicrobial resistance of *Campylobacter* isolated from dressed beef carcasses and raw milk in Tanzania. *Microb. Drug Resist.* **2016**, *22*, 40–52. [CrossRef] [PubMed]
6. Kimera, Z.I.; Mdegela, R.H.; Mhaiki, C.J.; Karimuribo, E.D.; Mabiki, F.; Nonga, H.E.; Mwesongo, J. Determination of oxytetracycline residues in cattle meat marketed in the Kilosa district, Tanzania: Research communication. *Onderstepoort J. Vet. Res.* **2015**, *82*, 1–5.
7. Sikira, A.N.; Waithanji, E.M.; Galie, A.; Baltenweck, I. Gender Aspects in the Dairy Value Chain in Tanzania: A Review of Literature. 2018. Available online: <https://www.suaire.sua.ac.tz/handle/123456789/2392> (accessed on 24 October 2019).
8. Kivaria, F.M.; Noordhuizen JP, T.M.; Kapaga, A.M. Risk indicators associated with subclinical mastitis in smallholder dairy cows in Tanzania. *Trop. Anim. Health Prod.* **2004**, *36*, 581–592. [CrossRef] [PubMed]
9. Mdegela, R.H.; Kusiluka, L.J.M.; Kapaga, A.M.; Karimuribo, E.D.; Turuka, F.M.; Bundala, A.; Kambarage, D.M. Prevalence and determinants of mastitis and milk-borne zoonoses in smallholder dairy farming sector in Kibaha and Morogoro districts in Eastern Tanzania. *J. Vet. Med. Ser. B* **2004**, *51*, 123–128. [CrossRef] [PubMed]
10. Katakweba, A.A.S.; Mtambo, M.M.A.; Olsen, J.E.; Muhairwa, A.P. Awareness of human health risks associated with the use of antibiotics among livestock keepers and factors that contribute to selection of antibiotic resistance bacteria within livestock in Tanzania. *Livest. Res. Rural Dev.* **2012**, *24*, 170.

Disclaimer/Publisher’s Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.