

A Study on Farmers' Awareness Levels of Antimicrobial Usage in Selected Areas of Chattogram District



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List of Acronyms

Abbreviation	Elaboration
AMR	Antimicrobial Resistance
AMU	Antimicrobial Uses
GDP	Gross Domestic Product
FAO	Food and Agriculture Organization
SSC	Secondary School Certificate
HSC	Higher Secondary Certificate
FMD	Foot and Mouth Diseases

ABSTRACT

Antimicrobial resistance (AMR) is a major health problem throughout the world. In Bangladesh, farmers often use antibiotics on dairy cattle without proper regulation or consulting veterinarians. This study aimed to learn about the knowledge and practices of farmers regarding Antimicrobial uses in selected areas of Chattogram District, Bangladesh. A total 21 dairy farms were randomly selected for this study and interviewed through a semi-structured questionnaire to evaluate the awareness level of the farmers. The results of this study indicates, a significant cause of increasing antimicrobial resistance is the improper administration of antibiotics, associated with lack of knowledge about these medications. Farmers were frequently seen treating their animals on their own. They didn't know about AMR, also unaware about antimicrobial misuse. The farmers don't imagine that antibiotics can predispose in human bodies. The study also shows, the farmers with lower educational background has poorer practice regarding antibiotics. Overall the findings of the current investigation identifies the lack of knowledge and faulty practices of the antibiotics by the dairy farmers where by using this insights, a better antibiotics use policies can be designed for the dairy industry.

KEYWORDS: Antibiotics, Antibiotic resistance, dairy farmers, awareness, knowledge, practices

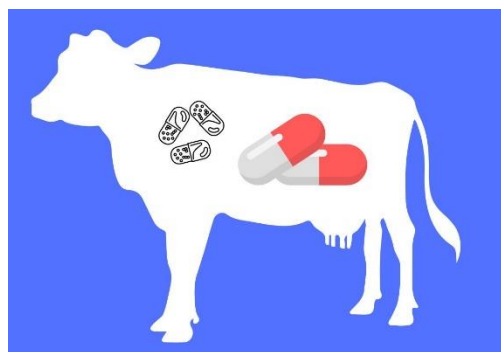
Chapter 1

INTRODUCTION

Antimicrobials are really important for preventing and treating bacterial diseases in animals. They started being used in farming around the late 1940s, which helped control diseases that were very hard to manage before (Prescott, 2019). These medicines are also used to keep animals healthy and productive (Saini et al., 2012). But, there's a big problem called antimicrobial resistance (AMR). It happens when the drugs don't work anymore because the microorganisms become resistant. This is a big concern for both animals and people (Jones et al., 2015).

Various national and international organizations has found that these antibiotic inactivity is associated with the misuse of antibiotics (Kassaify et al., 2013; WHO, 2020). Farmers sometimes use antimicrobial drugs too much, not in the right way, or don't follow the treatment schedule. A significant issue arises from the fact that these antimicrobial agents often belong to the same drug classes used in human medicine. (Prestinaci et al., 2015).

According to Van Boeckel et al. (2015), around 63,000 tons of antimicrobial drugs are given to food animals worldwide each year, and it's expected to rise by 70% in livestock by 2030. Apart from the leading consumers like China, the United States, and Brazil, the most substantial rise in the use of antimicrobial drugs in livestock is anticipated in developing nations such as



Nigeria and Indonesia. In these countries, an increase of over 200% is projected (Van Boeckel et al., 2015).

Bangladesh is a developing nation located in the Southeast Asian region. The livestock industry in Bangladesh is significant, boasting a population of 403 million terrestrial animals. This sector contributes approximately 1.47% to the country's gross domestic product (GDP), playing a vital role in the national economy. Additionally, the livestock sector serves as a substantial source of employment, offering full-time jobs to around 20% of the population and part-time opportunities to approximately 50% of the country's workforce (DLS, 2020).

Because there is no sufficient government-run animal healthcare system in place, most farm owners rely on informal and unqualified healthcare providers to treat their animals. As a result, antibiotics are often prescribed without proper consideration, and they are readily accessible, which encourages their misuse, overuse, abuse, and suboptimal usage on farms (Roess A.A et al., 2015).

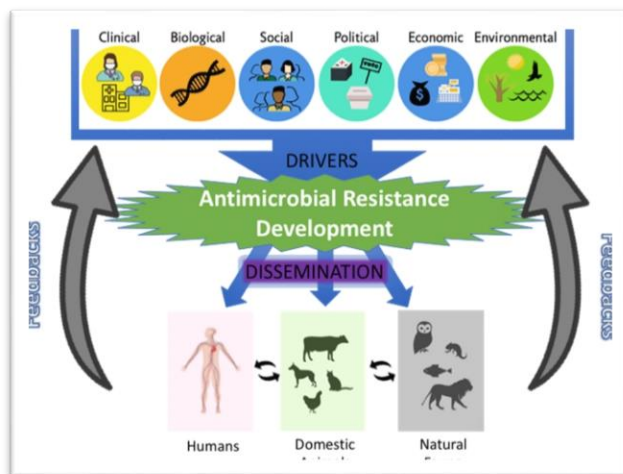


Figure 1: Antibiotic Resistance Development

The Food and Agriculture Organization (FAO) has a plan from 2021 to 2025 to fight this problem. They want to make sure everyone knows about this issue, do more research, use these medicines responsibly, and have good rules and enough resources (FAO, 2020).

To best of my knowledge, a very limited work has been done about AM in particularly in Chattogram District. So considering the above facts, the present study was intended to visualize the awareness level of the farmers regarding antimicrobial uses of some selected areas of Chattogram District. The present study is designed with this following objectives:

1. To evaluate the farmers' awareness level of antimicrobial use in selected dairy farmers of Chattogram District.
2. To examine the farmers' level of knowledge and practices regarding antibiotics and their application within the context of dairy farming.

Chapter 2

MATERIALS AND METHODS

2.1 Study area

21 dairy farms from 4 different areas of Chattogram District were randomly selected for this study. The farms were located in Patiya, Sikalbaha, Hathazari, and Chakbazar. (**Figure 2**)

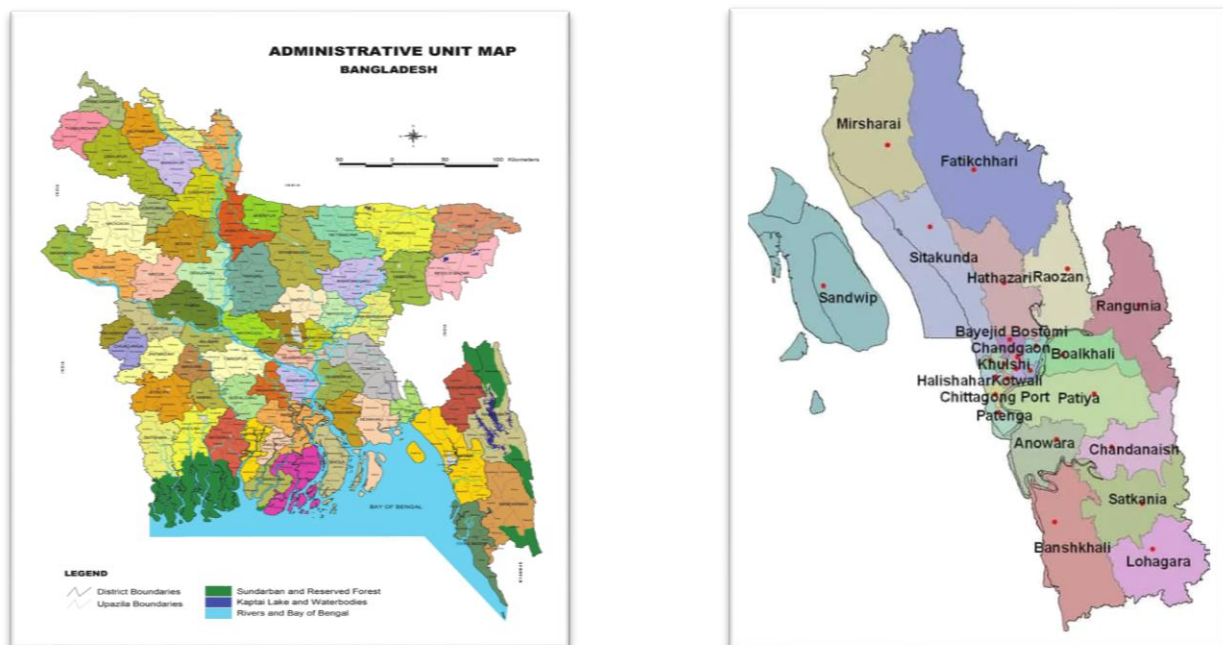


Figure 2: Study area

2.2 Study period

This study was conducted during the Internship period, commencing from June 2023 to August 2023.

2.3 Study Design

A semi-structured questionnaire was prepared to evaluate the awareness level of the dairy farmers about antimicrobial usages on lactating cows and interviewed the farmers with different educational and social backgrounds. The information were collected via face to face interviews. The data being used after the oral consent of the farmers.

2.4 Data collection

The questionnaire has 3 different sections. The first section was about demographic information of the farmer, which includes the name of the farmer, his age, gender, marital status, formal education, experience in farming, main occupation and size of the farm.

In the second and third sections, the farmers were asked different questions to evaluate their knowledge (12 questions) and practices (14 questions) about antimicrobial usage in lactating cows. The questionnaire was primarily made on English, but it was translated into local language during the face to face interviews.

2.5 Data Analysis

The qualitative data (Yes/No and multiple choices) were collected from the farmers. To analyze this data, descriptive statistics, such as frequencies, percentages and average were used. To visualize the results, different tables and charts were created and presented for clear understanding.

Picture Gallery

(Collection of data and inspection of management of dairy farms)



Figure 3: Collecting data from dairy farmer (female)



Figure 4: Collecting data from dairy farmer (male)



Figure 5: Collecting data from dairy farm manager (male)



Figure 6: Inspecting Dairy cows.



Figure 7: Inspecting Dairy farm management.



Figure 8: Inspecting Dairy farm management (Feeding system)

Chapter 3

RESULTS

3.1 Description of the selected farms

3.1.1 Size of the farms

The size of the farms are divided into three groups based on the number of dairy cattle: "Small (3-25 dairy cattle)," "Medium (26-50 dairy cattle)," and "Large (more than 50 dairy cattle)." The majority of surveyed farms, 15 (71.43%), manage medium-sized dairy farms with 26 to 50 dairy cattle. 6 farms (28.57%) operate small dairy farms with 3 to 25 dairy cattle. None of the surveyed individuals (0.00%) operate large dairy farms with more than 50 dairy cattle. The average size of dairy cattle herd in this category is approximately 23.33. **(Table 1)**

Table 1: Size of the farms according to the dairy animals.

Farm	Frequency(n=21)	Percentage (%)	Average
Small (3-25 dairy cattle)	6	28.57	23.33
Medium (26-50)	15	71.43	
Large (more than 50)	0	0.00	

3.1.2 Location of the selected farms

Among the selected farms, 6 farms located in Patiya, 12 farms in Sikalbaha, 2 farms in Chawkbazar and only 1 farm in Hathazari. The highest numbers of farms were included from Sikalbaha and the lowest were picked from Hathazari. **(Figure 9)**

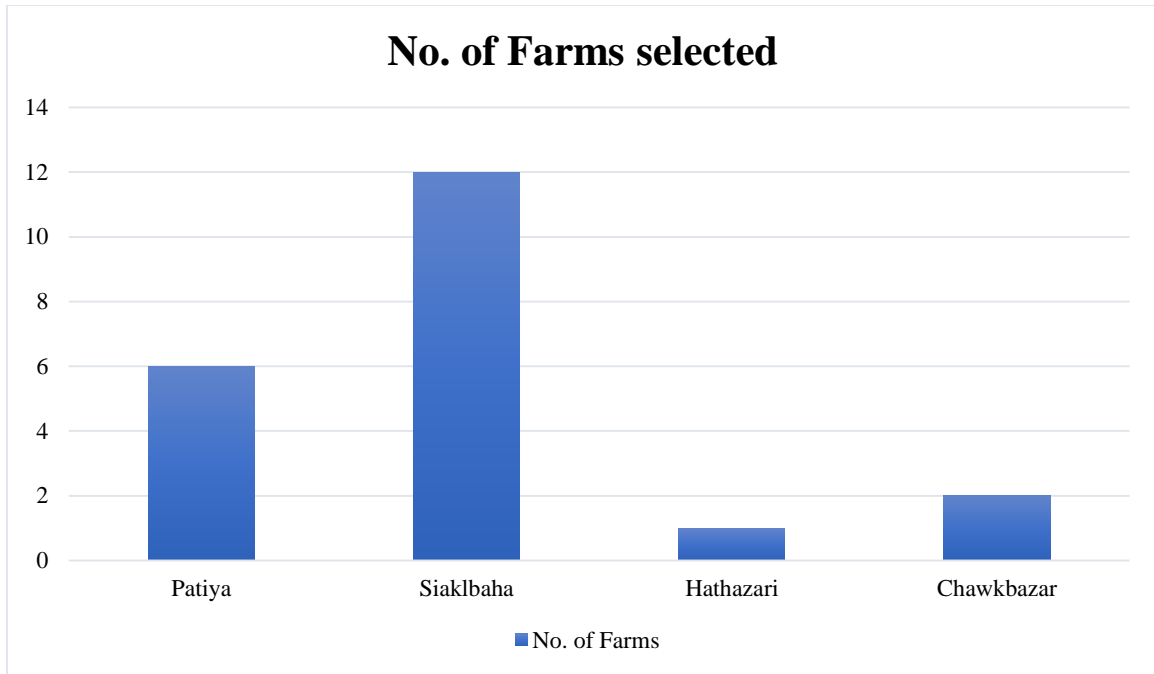


Figure 9: Location of the selected farms.

3.2 Description of the farmers

3.2.1 Age of the farmers

The age of the farmers are divided into 3 groups, Young, Middle and Old. The majority of the surveyed dairy farmers fall into the "Young" group, comprising 47.62% of the total farmers. The "Middle" age group, consisting of farmers aged 36 to 50 years, accounts for 33.33% of the sample. Lastly, the "Older" farmers, those aged over 50 years, represent 19.05% of the sample. The average age of the farmers is 7.71 years where the median age of the farmers is 43 years. **(Figure 10)**

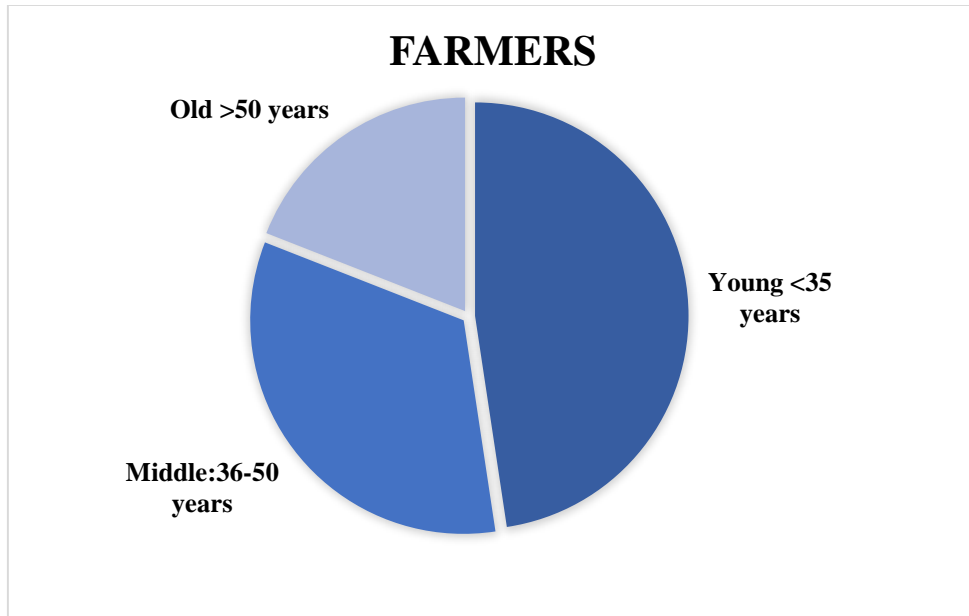


Figure 10: Age of the farmers

3.2.2 Formal Education status

Among the selected 21 dairy farmers, 12 (57.14%) farmers studied upto SSC and the rest 9 (42.86%) completed their HSC. In our chosen farmers, there was none either illiterate or graduate. (Figure 11)

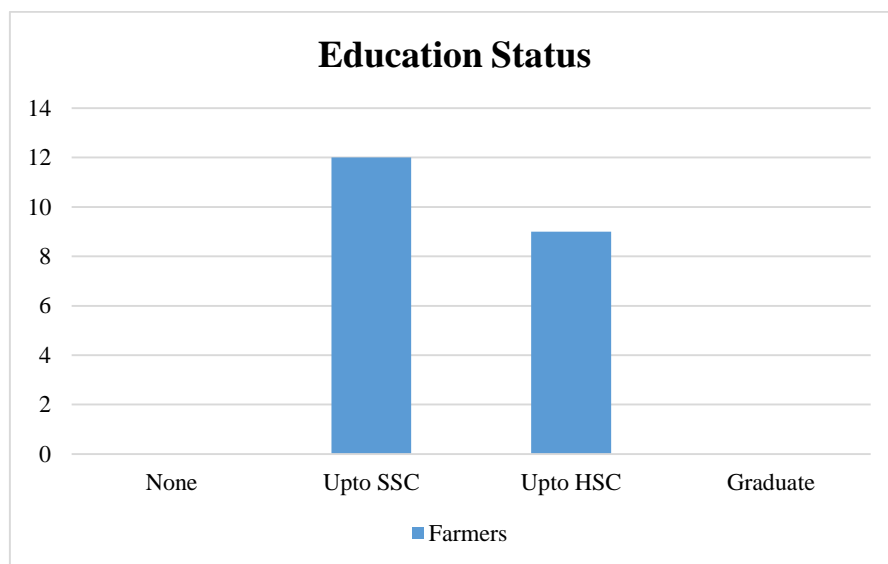


Figure 11: Education Status of the dairy farmers

3.2.3 Farming Experience

Among the selected farms, 2 dairy farmers (9.52%) have between 0 to 4 years of experience in dairy farming. 3 farmers (14.29%) have between 5 to 8 years. Similarly, 3 farmers (14.29%) possess experience levels spanning 9 to 12 years. The majority of the surveyed dairy farmers, 13 individuals (61.90%), have extensive experience exceeding 13 years in the dairy farming industry. The average value is approximately 10.38 years, and the median value is 13 years. (Table 2)

Table 2: Previous farming experiences of the selected dairy farmers.

Experience (in years)	Frequency(n=21)	Percentage (%)	Average	Median
0 to 4	2	9.52	10.38	13
5 to 8	3	14.29		
9 to 12	3	14.29		
13 or more	13	61.90		

3.2.4 Main Occupation

All 21 individuals in the sample (100.00%) are engaged in dairy farming. None of the surveyed individuals (0.00%) reported engaging in farming activities other than dairy farming. This suggests that the entire sample is solely dedicated to dairy farming practices.

3.3 Knowledge about Antimicrobial usage in Lactating cows

Among 21 dairy farmers, All of the respondents (100.00%) have heard about antimicrobial drugs, where 19 respondents (90.48%) are aware of what antimicrobials are used for on lactating cows. 5 respondents (23.80%) know what antimicrobials misuse indicates in lactating cows. Subsequently, 7 respondents (33.33%) know the effects of antimicrobials misuse on lactating cows, agree that antimicrobials misuse on lactating cows can predispose to resistance emergence. 20 respondents believe that antimicrobial resistance in lactating cows can be passed to humans

through the food chain. And lastly, all 21 respondents (100.00%) do not know the effects of antimicrobial resistance in humans. (Table 3)

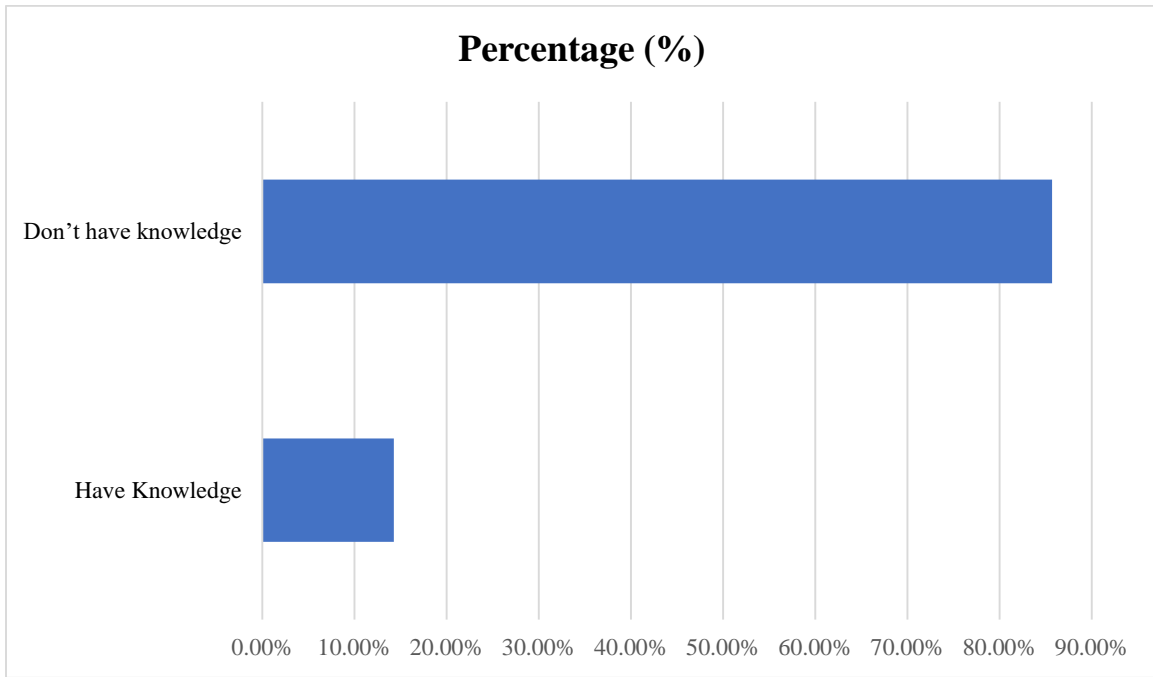


Figure 12: Knowledge about Antimicrobial usage in Lactating cows

Table 3: Response to the questionnaire to evaluate the knowledge about AMU

Items	Frequency (n=21)	Percentage (%)
Have you ever heard about antimicrobial drugs?(Yes)	21	100.00
Do you know what antimicrobials are used for on lactating cows? (Yes)	19	90.48
Do you know what antimicrobials misuse indicates in lactating cows? (Yes)	5	23.80
Do you know the effect(s) of antimicrobials misuse on lactating cows? (Yes)	7	33.33
Antimicrobials misuse on lactating cows can predispose to resistance	7	33.33

emergence. (Agree)		
Can antimicrobial resistance in lactating cows be passed to humans through the food chain? (Yes)	20	95.24
Do you know the effects of antimicrobial resistance in humans? (No)	21	100.00

3.4 Practices regarding Antimicrobial usage in Lactating cows

In this survey of 21 dairy farmers, all the participants (100%) use antimicrobials to treat the lactating cows. Veterinarians were the most common prescribers (57.14%), followed by non-registered Animal Health personnel (28.57%). Besides, some respondents practiced self-prescription (14.29%). All antimicrobials were sourced from veterinary drug shops. Self-administration was the unanimous method of administration (100%), and dosages were predominantly determined either from label instructions (52.38%) or arbitrarily (47.62%). While the majority followed prescribed dose, none employed a single high dose, and some opted for daily use until recovery (28.57%) or twice daily (19.05%). The most common diseases treated with antimicrobials were mastitis, foot-and-mouth disease, and udder injuries (100%). All respondents administered antimicrobials via injection, with none using oral suspension or feed-based methods. Surprisingly, none observed withdrawal period, and all used antimicrobials solely for treating infections, not for prevention or increased milk yield. A substantial portion (66.67%) reported experiencing antimicrobial resistance to their herds. On the other hand, all respondents consistently checked the expiration dates of purchased drugs (100%). (Table 4)

Table 4: Response to the questionnaire to know the AM practices.

Items (Questions)	Frequency (n=21)	Percentage (%)
Do you use antimicrobials to treat infected lactating cows in your herd?		
Yes	21	100
No	0	0
Who prescribed antimicrobials used on lactating cows for you?		

Veterinarian	12	57.14
Non-registered Animal Health personnel	6	28.57
Self-prescription	3	14.29
Where do you usually buy the antimicrobials from?		
Veterinary drug shops	21	100
Human drug shops	0	0
Animal drug marketing officers	0	0
Who administers antimicrobials used on the cows in your herd?		
Self-administer	21	100
Veterinarian	0	0
Non-registered Animal Health personnel	0	0
How is antimicrobial dosage determined per cow?		
From instructions on the label	11	52.38
Arbitrary	10	47.62
What is the frequency of daily antimicrobial usage on lactating cows?		
As prescribed	11	52.38
One single high dose	0	0
Once daily until the cows recovered	6	28.57
Twice daily until the cows recovered	4	19.05
What common disease condition(s) of lactating cows do you use antimicrobials for in your herd?		
Mastitis	21	100
FMD	21	100
Udder injuries	21	100
What route(s) do you use for administering antimicrobials in lactating cows?		
By injection	21	100
POS	0	0
Through feed	0	0

Do you observe withdrawal period for any antimicrobial administered on lactating cows before consumption of their milk and/or products?		
Yes	0	0
No	21	100
What purpose(s) do you administer antimicrobials for on lactating cows?		
To treat infection	21	100
To prevent infections	0	0
To increase milk yield	0	0
Have you ever experienced antimicrobial resistance in sick lactating cows?		
Yes	14	66.67
No	7	33.33
Do you check the expiration date before purchasing the drugs?		
Yes	21	100
No	0	0

Chapter 4

DISCUSSION

The findings of this study shed light on the awareness level of dairy farmers in relation to antimicrobial use (AMU) of the farms. This information is crucial as AMR poses a significant threat to human and animal health worldwide (Hoque et al., 2020). The study's results provide valuable insights for policymakers and stakeholders, particularly in low-income countries like Bangladesh, to design effective interventions and policies to combat AMR. The study highlighted that dairy farmers commonly used various antimicrobials to treat diseases and conditions. Despite government regulations in Bangladesh prohibiting the use of certain antimicrobials in animal feed, farmers often resorted to using these antibiotics (MFL, 2010). This practice raises concerns as it can contribute to the development of AMR (Goutard et al., 2017).

A concerning finding was that a significant proportion of farmers did not seek prescriptions from registered veterinarians. This could be due to several factors, including the remoteness of farms, limited access to veterinary services, and cost considerations. The ease of purchasing antibiotics without a prescription contributes to this issue. The misuse of antimicrobials in dairy farming was driven by factors such as insufficient knowledge of on-farm management and biosecurity measures. Farmers often used antibiotics to compensate their substandard farm conditions, to treat common diseases, but without maintaining the ideal generic dose. These practices contribute to the development of AMR (Bari et al., 2020).

The study also found that several demographic factors significantly influenced farmers' awareness related to AMU. Age and years of farming experience were important determinants, with older farmers with more years of experience tending to have a more positive awareness towards AMU. This is likely due to their accumulated knowledge and exposure to training and awareness programs. Education also played a crucial role in farmers' awareness level. Those with higher education, particularly up to HSC, exhibited more positive knowledge and practices regarding AMU. Better-educated farmers had better access to veterinary services, farm management knowledge, and understanding of antimicrobial use guidelines. Farm type and total herd size were also associated with better awareness. Dairy farmers operating medium-sized farms demonstrating more positive responses. Dairy farming typically requires a longer

investment period and more extensive knowledge and experience, leading to better practices and attitudes towards antimicrobial use. The study confirmed a strong link between farmers' knowledge, and practices to AMU. Farmers with lower knowledge about proper antimicrobial uses tended to exhibit less appropriate awareness and poorer practices (Waseem et al., 2019). This emphasize the importance of raising awareness and providing education to improve farmers' awareness level in addressing AMR.

To combat AMR in dairy farming, several strategies can be considered. First, there is a need for improved access to veterinary services and education for farmers, particularly those in remote areas. Strict enforcement of regulations on antimicrobial use, sale, and prescription is essential. Encouraging farmers to seek guidance from registered veterinarians and promoting biosecurity measures are critical steps. Additionally, awareness programs and the dissemination of information through mass and social media can empower farmers with the knowledge needed to combat AMR (Roess et al., 2013)

While this study has provided valuable insights into the awareness level of dairy farmers regarding AMU, there are several limitations that should be considered. Firstly, the study only looked at 1 districts (Chattogram) in Bangladesh, not the whole country. Secondly, the information collected from farmers in interviews might not always be completely accurate because people might forget things or not tell the truth. Also, this study didn't go deep into understanding why farmers do what they do, like why they use antibiotics. So, more research is needed to understand these things better. Despite these limitations, this study gives us a basic idea about what farmers know and do when it comes to antibiotics and antibiotic resistance.

Chapter 5

CONCLUSION

From this present study, we can get some idea about the dairy farmer's knowledge and practices to antimicrobial usage on lactating cows, which overall suggests some essential information about awareness level of the farmers. It indicates that the respondents' socioeconomic factors, including their level of education, source of income, and age, significantly impact their knowledge, and practices regarding antimicrobial use (AMU), ultimately AMR. From my present study it can be concluded that, lack of awareness of the farmers and inadequate veterinary technical facilities lead to irrational uses of AM in the dairy animal. In short, this study looked at what dairy farmers in one part of Bangladesh know about antibiotics and how they practices antibiotics to their farms. These findings are important because antibiotic resistance is a big health problem for people and animals worldwide. To fix this problem, it's suggested to supply adequate veterinary technical facilities and to teach the dairy farmers about better farming practices and awareness on antimicrobial uses. As this study has some limitations, further similar study with broader sample size is suggested to confirm the present results and observations.

Annex 1

The following questionnaire was used to collect the data from the dairy farmers to assess the awareness level of Antimicrobial usages on lactating cows in the selected areas of Chattogram District.

Questionnaire

All information given will be kept strictly confidential. PLEASE tick one or more appropriately and write where necessary.

Name of interviewer: _____ Herd Name: _____

Demographic Information

A1. Name of interviewee: _____

A2. Age (in years): _____

A3. Gender: a. Male b. Female

A4. Marital status: a. Married b. Single c. Widow

A5. Highest formal education:

a. None b. up to SSC c. up to HSC d. Graduate

A6. Experience in farming (Years) a. 0-4 b. 5-8 c. 9-12 d. 13
or more

A7. Main Occupation: a. Dairy Farming b. Other than farming

A8. Herd Size: _____

Knowledge about Antimicrobial usage in Lactating cows

B1. Have you ever heard about antimicrobial drugs? Yes () No ()

B2. If Yes, from what source?

- a. TV () b. Friends & Relations () c. Internet () d. Animal health authorities ()

B3. Do you know what antimicrobials are used for on lactating cows? Yes () No ()

B4. If yes, what are they used for in lactating cows?

- a. To treat mastitis (udder infections) () b. To prevent mastitis (udder infections) ()
c. To increase milk yield () d. All of the above ()

B5. Do you know what antimicrobials misuse indicates in lactating cows? Yes () No ()

B6. If Yes, What is it?

- a. When given under-dose () b. When given over-dose ()
c. When given in normal dose () d. Don't know ()

B7. Do you know the effect(s) of antimicrobials misuse on lactating cows? Yes () No ()

B8. If yes, what is/are the effect(s)?

- a. Non response to treatment of udder infections () b. Extra cost on treatment of infections ()
c. Don't know ()

B9. Antimicrobials misuse on lactating cows can predispose to resistance emergence.

- a. Agree () b. Disagree () c. Don't know ()

B10. Can antimicrobial resistance in lactating cows be passed to humans through food chain?

Yes () No ()

B11. If Yes, through what type of chain?

- a. Drinking of raw milk () b. Drinking of fermented milk () c. Eating of raw cheese ()
d. Milking of lactating cow () e. Don't know ()

B12. Do you know the effects of antimicrobial resistance in humans? Yes () No ()

B13. If yes, what are the effects?

- a. Non response to treatment of bacterial infections ()
- b. Extra cost on treatment of infections ()
- c. Longer duration of illness and treatment ()
- d. Don't know ()

Practices regarding Antimicrobial usage in Lactating cows

C1. Do you use antimicrobials to treat infected lactating cows in your herd? Yes () No ()

C2. Who prescribed antimicrobials used on lactating cows for you?

- a. Veterinarian ()
- b. Non registered Animal Health personnel ()
- c. Self-prescription ()
- d. All of the above ()

C3. Where do you usually buy the antimicrobials from?

- a. Veterinary drug shops ()
- b. Human drug shops ()
- c. Animal drug marketing officers ()

C4. Who administer antimicrobials used on the cows in your herd?

- a. Self-administer ()
- b. Veterinarian ()
- c. Non registered Animal Health personnel
- d. All of the above ()

C5. How is antimicrobial dosage determined per cow?

- a. From instructions on the label ()
- b. Arbitrary ()
- c. don't know

C6. What is the frequency of daily antimicrobial usage on lactating cows?

- a. As prescribed ()
- b. One single high dose ()
- c. Once daily until the cows recovered ()
- d. Twice daily until the cows recovered ()

C7. What common disease condition(s) of lactating cows do you use antimicrobials for in your herd?

- a. Mastitis ()
- b. FMD ()
- c. Udder injuries ()
- d. Others (please specify).....

C8. What route(s) do you use for administering antimicrobials in lactating cows?

- a. By injection () b. POS () c. Through feed () d. All of the above ()

C9. Do you observe withdrawal period for any antimicrobial administered on lactating cows before consumption of their milk and/or products? Yes () No ()

C10. What purpose(s) do you administered antimicrobials for on lactating cows?

- a. To treat infections () b. To prevent infections () c. To increase milk yield ()
d. All of the above ()

C11. Have you ever experience antimicrobial resistance in sick lactating cows? Yes () No ()

C12. If yes, what are the experiences?

- a. Non response to treatment () b. Extra cost on treatment of infected cows ()
c. Longer duration of treatment () d. All of the above ()

C13. Do you check the expired date before purchasing the drugs? Yes No

C14. Name antimicrobials you most frequently used on infected lactating cows:

Thank you for the kind responses

Signature of the respondents

Signature of the Interviewer

REFERENCES

- Ahmed, I., Rabbi, M. B., & Sultana, S. (2019). Antibiotic resistance in Bangladesh: A systematic review. *International Journal of Infectious Diseases*, 80, 54-61.
- Bari, M. S., Kober, A. K. M. H., Hoque, M. A., Debnath, G. K., & Chanda, G. C. (2020). Prevalence of antibiotic residues and associated risk factors in milk in Chittagong, Bangladesh. *Advances in Animal and Veterinary Sciences*, 8(7), 701-708.
- Department of Livestock Services. (2020). *Livestock Economy*.
- Food and Agriculture Organization. (2020). Progress report on the implementation of FAO Action Plan on Antimicrobial Resistance (AMR) 2016–2020, and the proposal for a new FAO Action Plan on AMR 2021–2025.
- Goutard, F. L., Bordier, M., Calba, C., Erlacher-Vindel, E., Góchez, D., de Balogh, K., Vong, S. (2017). Antimicrobial policy interventions in food animal production in South East Asia. *BMJ*, 358, j3544.
- Hoque, R., Ahmed, S. M., Naher, N., Islam, M. A., Rousham, E. K., Islam, B. Z., & Hassan, S. (2020). Tackling antimicrobial resistance in Bangladesh: A scoping review of policy and practice in human, animal and environment sectors. *PLoS ONE*, 15, e0227947.
- Jones, P. J., Marier, E. A., Tranter, R. B., Wu, G., Watson, E., & Teale, C. J. (2015). Factors affecting dairy farmers' attitudes towards antimicrobial medicine usage in cattle in England and Wales. *Preventive Veterinary Medicine*, 121, 30-40.
- Kassaify, Z., Abi Khalil, P., & Sleiman, F. (2013). Quantification of antibiotic residues and determination of antimicrobial resistance profiles of microorganisms isolated from bovine milk in Lebanon. *Food Science & Nutrition*, 4(1), 1-9.
- Ministry of Fisheries and Livestock. (2010). *Fish Feed and Animal Feed Act, 2010*; Bangladesh Parliament: Dhaka, Bangladesh.
- O'Neill, A. (2021). Lebanon—Share of economic sectors in the gross domestic product 2010–2020.

- Prescott, J. F. (2019). History of antimicrobial usage in agriculture: An overview. In *Antimicrobial Resistance in Bacteria of Animal Origin* (pp. 19-27). ASM Press.
- Prestinaci, F., Pezzotti, P., & Pantosti, A. (2015). Antimicrobial resistance: A global multifaceted phenomenon. *Pathogens and Global Health*.
- Roess, A. A., Winch, P. J., Akhter, A., Afroz, D., Ali, N. A., Shah, R., & Darmstadt, G. L. (2015). Household animal and human medicine use and animal husbandry practices in rural Bangladesh: Risk factors for emerging zoonotic disease and antibiotic resistance. *Zoonoses and Public Health*, 62(7), 569-578.
- Roess, A. A., Winch, P. J., Ali, N. A., Akhter, A., Afroz, D., El Arifeen, S., ... & Baqui, A. H. (2013). Animal husbandry practices in rural Bangladesh: Potential risk factors for antimicrobial drug resistance and emerging diseases. *American Journal of Tropical Medicine and Hygiene*, 89, 965–970.
- Saini, V., McClure, J. T., Léger, D., Dufour, S., Sheldon, A. G., Scholl, D. T., & Barkema, H. W. (2012). Antimicrobial use on Canadian dairy farms. *Journal of Dairy Science*, 95(3), 1209-1221.
- Van Boeckel, T. P., Brower, C., Gilbert, M., Grenfell, B. T., Levin, S. A., Robinson, T. P., & Laxminarayan, R. (2015). Global trends in antimicrobial use in food animals. *Proceedings of the National Academy of Sciences of the United States of America*, 112(18), 5649-5654.
- Waseem, H., Ali, J., Sarwar, F., Khan, A., Rehman, H. S. U., Choudri, M., & Jamal, A. (2019). Assessment of knowledge and attitude trends towards antimicrobial resistance (AMR) among the community members, pharmacists/pharmacy owners, and physicians in district Sialkot, Pakistan. *Antimicrobial Resistance and Infection Control*, 8, 1–7.

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