Indian J Anim Health (2025), 64(2) : 350 - 358
DOI: https://doi.org/10.36062/ijah.2025.09225

Research Article

A study on judicious use of antibiotics among livestock keepers' knowledge, attitude and practices in Sundarban region of West Bengal, India

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Abstract

The concerns for Anti-Microbial Resistance (AMR) are rapidly increasing worldwide. The growing concern of Antimicrobial Resistance is significantly fuelled by the misuse of antibiotics in livestock. The present study was undertaken in Sundarban region of West Bengal, India to evaluate the knowledge, attitude and practices (KAP) of 116 livestock farmers regarding use of antibiotics inlivestock farming. Data were collected using semi -structured interview and then partitioned. Means were compared for significant difference using SPSS. Correlation matrix was drawn using R program. The study found that most farmers were middle-aged (53.4%), had primary education (32.8%), and were small-scale (56% with <1 acre land). The majority (85.3%) practiced mixed livestock farming. The livestock keepers under present survey reported using 12 different antibiotics, most commonly Penicillin (46.55%) followed by Oxytetracycline (25%), Azithromycin (21.55%) and Gentamicin (18.96%). While most respondents knew what antibiotics were (82.8%) and believed veterinary prescriptions were necessary (91.4%), overall KAP scores were moderate (knowledge: 3.56±1.09; attitude: 4.10±0.99; practice: 3.94±1.35 on a 5-point scale). Knowledge and attitude scores varied significantly across different development blocks, with remote island areas showing poor understanding. Interestingly, female respondents exhibited better attitudes and practices than males. Intensive farming systems also showed higher practice scores. A positive correlation was observed between knowledge, attitude, and practice scores. This study highlights the critical need for targeted education and knowledge dissemination about antibiotic usage, especially in the remote island blocks of the Sundarban, to effectively combat AMR.

Keywords: AMR, Antibiotic, Attitude, Knowledge, Livestock, Practice

Highlights

- The worldwide emergence of antimicrobial resistance (AMR) is a serious global issue.
- KAP Score on use of antibiotics was lowest in remote islands of Indian Sundarban region
- Most common antibiotics are - Penicillin, Oxytetracycline, Azithromycin, and Gentamicin.
- Sundarban remote islands need antibiotic knowledge diffusion to curb rising AMR risks.

INTRODUCTION

Anti-Microbial Resistance (AMR) has become a global concern (Ferri et al., 2017) due to the emergence of resistant bacterial species with potential health hazards to humans or animals. Irresponsible and excessive use of antimicrobials in animal health sector is one of the major causes of AMR. Bandyopadhyay et al. (2018) reported quinolone-resistant *Klebsiella pneumoniae* in buffalo milk from seven districts of West Bengal. Further, Mahanti et al. (2020) identified multidrug-resistant *Escherichia coli* from raw cow milk samples collected from six agro-climatic zones of West Bengal. The growing pattern of AMR in the human-animal continuum may significantly impact lives of millions and might develop another pandemic in coming days.

The Indian Sundarban area, situated in the southern part of West Bengal state, is the conglomerate of several islands spreading across the tightly inter-woven estuaries in the mouth of Bay of Bengal. It is the home of over 4.5 million people (Halder et al., 2021) who are mostly dependent on animal husbandry and agriculture for their subsistence. Due to the high population density and less disease surveillance system prevalent in the remote areas, the Indian Sundarban might become a future epicentre for deadly communicable diseases. The understanding of knowledge, attitude, and practice associated with

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prudent use of antimicrobials among livestock keepers are critical for limiting such possibility. To the best of our knowledge, no systematic study on knowledge, attitude and practice parameters of livestock farmers on use of antibiotics has been done so far in this region. In this background, the present research was aimed to understand knowledge, attitude and practice levels of livestock farmers on use of antibiotics in small livestock holding system in Sundarban region of West Bengal.

MATERIALS AND METHODS

Study area and duration: Six blocks (Basanti, Gosaba, Canning I, Canning II, Patharpratima, and Sandeshkhali I) of Indian Sundarban region were purposively selected for the study during May-June 2022. Map of the studied area was shown in Fig. 1 and the precise locations where the samples were collected are indicated by red dots. The map was prepared using QGIS v.2.2 software (QGIS Development Team, 2013). Randomly 116 numbers of livestock keepers from the selected blocks were chosen for door-to-door survey and interviewing. A pre-tested and semi-structured questionnaire was used for analysis of knowledge, attitude and practice of farmers on prudent use of antibiotics in small holder livestock farming. The questionnaire was developed in local language (Bengali) with consultations from subject expert and previous research studies. The questionnaire had 5 questions each on knowledge, attitude and practice aspects of antibiotics. These questions were asked on 'yes'/'no'/'don't know' basis. A list of antibiotics was also prepared and shown to the participants during the survey to test their capacity to recognize each antibiotic name.

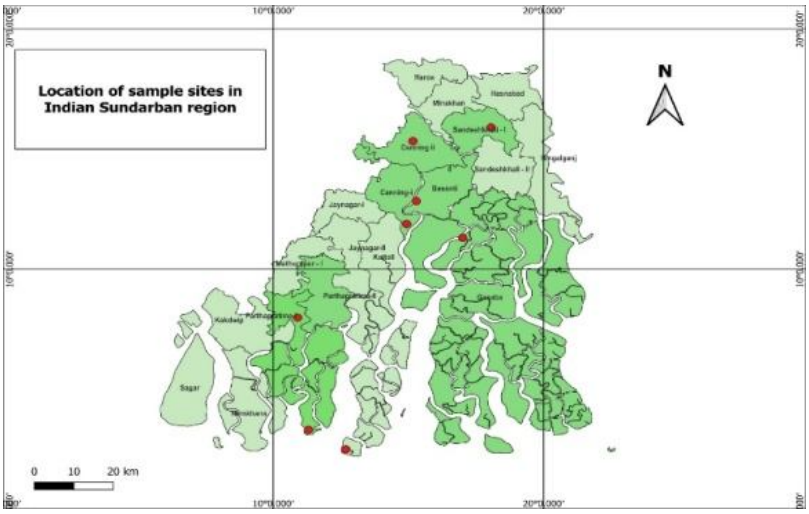

Fig. 1. Sampling sites in study location

Data collection and scoring system: The knowledge, attitude and practice score of the farmers were recorded as per the method described by Hager et al. (2020). Questionnaire for the respondents (S1) were answered on a yes/no based response and each correct answer was scored as '1' and incorrect as '0'. Respondents choosing the 'Don't know' option was treated as incorrect reply and scored as '0'. Individual variables were scored based upon these responses.

Statistical analysis: The data was statistically analyzed by using SPSS program v. 20.0 (IBM Corp. NY, USA) as per method described by Snedecor and Cochran (1994). For descriptive statistics, frequency, mean and standard deviation was used. For comparing categorical data between different groups, suitable statistic (t test/ANOVA) was performed. Correlation matrix was plotted using R programming (V.4.2.1, USA). Values were considered significant at $p<0.05$.

RESULTS

Socio-demography: A total of 116 respondents from 6 blocks in the Indian part of Sundarban region participated in the survey. Table 1 depicts the socio-demographic variables of the present survey. The highest proportion (21.6% of each) of participants was from Gosaba, Basanti, and Patharpratima block. The least number of participants (9.5%) was from Canning I block. In the present study, the number of women respondents was the highest (81%).

Data revealed that the middle-aged (31-45 years of age) persons from smaller family sizes (3-5 numbers of family members) are engaged in livestock rearing. Our study further showed that most of the respondents (32.8%) had education up to primary level. Our results further revealed that most (41.4%) of the respondents (both males and females) were primarily involved in farming. However, 34.5% respondents did not have any specific job role. Present study showed that most of the respondents (56%) were small farmers with less than 1 acre of agricultural land holding. Semi-intensive livestock farming is the most prevalent (93.1%) farming type in the surveyed area. Majority (85.3%) of the respondents have mixed-type animal farming involving bovines, caprines, and poultry in their backyard. The study showed that 71.6% farmers do not have any extension contacts needed for

Table 1. Socio-demographic characteristics of the participants (n=116)

Variables	Name/ Characteristics	No of respondents (N)	Frequency (%)
Blocks	Basanti	25	21.6
	Canning I	11	9.5
	Canning II	14	12.1
	Gosaba	25	21.6
	Pathar Pratima	25	21.6
	Sandeshkhali I	16	13.8
Gender	Male	22	19.0
	Female	94	81.0
Age (Years)	20-30	18	15.5
	31-45	62	53.4
	>45	36	31.0
Education level	Illiterate	18	15.5
	Primary	38	32.8
	Secondary	28	24.1
	College	12	10.3
	Other	20	17.2
Occupation	Farmer	48	41.4
	Business	5	4.3
	Non-Agricultural Labourer	2	1.7
	Job	12	10.3
	Agricultural Labourer	5	4.3
	Unemployed	40	34.5
	Other	4	3.4
Economic status	Poor	38	32.8
	Middle class	77	66.4
	Rich	1	0.9
Land holding (acre)	No Land	3	2.6
	<1	65	56.0
	1-3	35	30.2
	>3	13	11.2
Farm type	Intensive	8	6.9
	Semi Intensive	108	93.1
Type of livestock rearing	Bovine	3	2.6
	Caprine	3	2.6
	Poultry	11	9.5
	Mixed	99	85.3
Cooperative membership/ Farmer Cluster	Yes	33	28.4
	No	83	71.6

good management practices in livestock.

Knowledge towards use of antibiotics: A total of 5 questions (Table 2) were solicited to check the knowledge of antibiotic use in livestock. Majority (82.8%) of the population were familiar with the term 'antibiotic', whereas only 54.3% of the respondents were aware that antibiotic could be used to treat bacterial infection. Besides, 32.8% believe that antibiotics can be used for viral disease like cow pox or FMD. Almost all the participants (91.4%) responded positively on use of antibiotics as per veterinarians' prescription. Surprisingly, 94.8% respondents were aware that antibiotics have a specific dosage and duration during treatment.

Knowledge towards use of antibiotics: Respondents were also shown a list of 12 common antibiotics used frequently for treating ailing animals. Each of them was asked to identify the name of the antibiotic(s) they used before in their farm. Data (Table 3) revealed that penicillin (46.55%) was the most commonly identified antibiotic followed by oxytetracycline (25%), azithromycin (21.55%), gentamicin (18.96%) and sulphadimidine (16.37%). The least common antibiotic identified was ceftriaxone (5.17%). Our study (Fig. 2) revealed that the middle-aged (31-45 years of age) participants were more aware about antibiotic than the younger participants in Sundarban area.

Attitude towards use of antibiotics: Table 4 depicts responses (Yes/No/Don't Know) of participants on aspects of attitudes for antibiotic use in livestock sector. The majority (85.3%) of the participants affirmed that they did not give antibiotics to their livestock on their own. At the same time, almost all the respondents (91.4%) said that they purchased the antibiotics with a valid prescription from veterinarian. More than half of the respondents (55.2%) told that when somebody else's livestock gets sick they did not

Table 2. Knowledge about use of antibiotics among participants (n=116)

Knowledge parameters	Response	N	Frequency (%)
Heard about antibiotic	Yes	96	82.8
	No	13	11.2
	Don't know	7	6.0
Antibiotics used to treat bacterial infections.	Yes	63	54.3
	No	10	8.6
	Don't know	43	37.1
Antibiotics can be used against viral diseases	Yes	38	32.8
	No	23	19.8
	Don't know	55	47.4
You need a veterinary expert's prescription for giving antibiotics to your livestock.	Yes	106	91.4
	No	5	4.3
	Don't know	5	4.3
Antibiotics have a specific dosage and duration.	Yes	110	94.8
	No	3	2.6
	Don't know	3	2.6

Table 3. Number of respondents recognized the antibiotic correctly (n=116)

Antibiotics	Number (N)	Frequency (%)
Penicillin	54	46.55
Amoxicillin	16	13.79
Ampicillin	8	6.89
Ceftriaxone	6	5.17
Cefalexin	9	7.75
Oxytetracycline	29	25.00
Doxycycline	18	15.51
Enrofloxacin	12	10.34
Gentamicin	22	18.96
Sulfamethoxazole	7	6.03
Sulfadimidine	19	16.37
Azithromycin	25	21.55

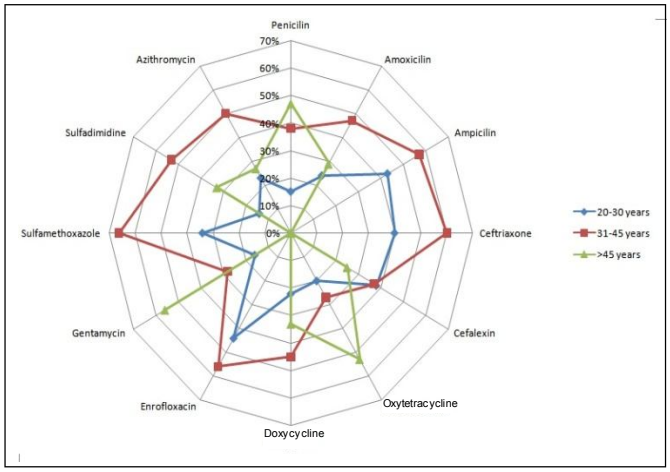

Fig. 2. Recognition of specific antibiotics and percentage of participants by their age group

Table 4. Attitude of respondents towards use of antibiotics (n=116)

Attitude parameters	Response	N	Frequency (%)
I do not give antibiotics to my livestock on my own when they are diseased	Yes	99	85.3
	No	17	14.7
	Don't know	0	0
I think antibiotics should not be purchased from vet shops without prescription	Yes	106	91.4
	No	10	8.6
	Don't know	0	0
When somebody else's livestock gets sick I will not recommend the same antibiotics that I have used.	Yes	64	55.2
	No	52	44.8
	Don't know	0	0
I will give antibiotics to my livestock after checking the expiry date.	Yes	110	94.8
	No	6	5.2
	Don't know	0	0
I will not give left over antibiotics to my animals once they start showing any previously known symptoms.	Yes	97	83.6
	No	19	16.4
	Don't know	0	0

Table 5. Practice of different participants regarding use of antibiotics (n=116)

Practice parameters	Response	N	Frequency (%)
I do not borrow antibiotics from my family, friends or neighbours when my livestock get sick.	Yes	95	81.9
	No	21	18.1
	Don't know	0	0
I only use antibiotics when it is prescribed by my veterinary doctor	Yes	93	80.2
	No	23	19.8
	Don't know	0	0
I always try to be careful do not overdose my cattle with antibiotics for symptomatic relief.	Yes	105	90.5
	No	11	9.5
	Don't know	0	0
I always make sure that I complete the dose of antibiotics as prescribed by my veterinary doctor	Yes	90	77.6
	No	26	22.4
	Don't know	0	0
I do not suggest antibiotics or other medicines to anyone I know for their cattle	Yes	75	64.7
	No	41	35.3
	Don't know	0	0

recommend the same antibiotics that they had used for their own livestock. Most of the respondents (94.8%) said that they would give antibiotics to their livestock only after checking the expiry date of the same. Whereas, 83.6 per cent participants said that they would not give leftover antibiotics to the animals once they start showing any previously known symptoms.

Practices towards use of antibiotics: The responses regarding practices of antibiotics by livestock farmers are presented in Table 5. Most (81.9%) of the respondents revealed that they had never borrowed antibiotics during the sickness of their livestock from any casual sources. Majority (80.2%) of the farmers reiterated that they only purchase antibiotics from clinics whenever the treating veterinarian prescribes for it. In the present study, 90.5% of respondents agreed that they remained careful about antibiotic over-dosing or under-dosing during treatment of cattle. Moreover, 77.6% respondents positively affirmed that they completed the full dose schedule of antibiotics during the treatment period. 64.7% respondents mentioned that they never suggest antibiotics to their friends or fellow farmers for using in sickness of dairy cattle but 35.3 per cent farmers were do the practices.

Comparisons of knowledge, attitude and practice among different socio demographic variables: Table 6 shows the knowledge, attitude and practice (KAP) scores in different socio-demographic variables. The statistics used for comparisons of KAP scores among different development blocks in Sundarban delta showed significant ($p<0.05$) variations. The knowledge score (4.07±0.82), attitude score (4.78±0.42) and practice score (4.71±0.82) were the highest in Canning II development block. The knowledge scores were in the order of Canning II>Basanti>Sandeshkhali I> Patharpratima>Canning I>Gosaba. Whereas the attitude scores were in the order of Canning II>Canning I> Patharpratima>Gosaba>Basanti>Sandeshkhali I. The order of the practice scores was Canning II> Canning I> Basanti> Patharpratima> Gosaba> Sandeshkhali I. Overall knowledge, attitude and practice scores among the respondents were respectively 3.56±1.09, 4.10±0.99 and 3.94±1.35 in 5 point scale.

Knowledge score was statistically significant ($p<0.05$) across the variables like genders, education levels, farm types, and cooperative memberships. Knowledge score was found the highest in- farm women (3.65±0.97), farmers (4.33±0.77) with degree from a college, farmers (3.87±0.64) engaged in an intensive type of farming and farmers (4.18±0.68) having cooperative membership. On the other hand, the attitude scores were statistically significant ($p<0.05$) in the gender groups (male/female). Females had significantly positive attitude score (4.25±0.89) compared to males (3.45±1.18). Again, socio-demographic variables like gender groups, educational levels, type of farms and institutional membership can significantly influence ($p<0.05$) the practice scores. Our study showed that like attitude, female respondents have also higher practice scores (4.14±1.19). Maximum score (5) was also observed among the holders of intensive farming systems. It is noted that respondent's economic status or land holding capacity have influence neither on knowledge level nor attitude and practice levels.

Table 6. Socio-demographic variables and scores (mean±SD) of knowledge, attitude and practice among livestock keepers

Variables	Characteristics	n (%)	Knowledge score (mean±SD)	Attitude Score (mean±SD)	Practice Score (mean±SD)
Development Blocks	Basanti	25 (21.6)	3.96±0.88^{ab}	4.04±0.88^{b}	4.40±0.70^{ab}
	Gosaba	25 (21.6)	3.16±0.89^{c}	4.12±0.83^{b}	3.68±1.10^{b}
	Canning I	11 (9.5)	3.18±0.98^{bc}	4.36±0.92^{ab}	4.45±0.82^{ab}
	Canning II	14 (12.1)	4.07±0.82^{a}	4.7857±0.42^{a}	4.7143 ±0.82^{a}
	Patharpratima	25 (21.6)	3.48±1.15^{abc}	4.28±1.02^{ab}	4.04±1.61^{ab}
	Sandeshkhali I	16 (13.8)	3.50±1.54^{abc}	3.12±1.14^{c}	2.50±1.59^{c}
Statistics			F test= 2.36 p= 0.04	F test= 5.65 p= 0.00	F test= 7.20 p= 0.00
Gender	Male	22 (19)	3.13±1.45	3.45±1.18	3.09±1.65
	Female	94 (81)	3.65±0.97	4.25±0.89	4.14±1.19
Statistics			t test = -1.60 p=0.002	t test = -2.98 p=0.038	t test = -2.82 p=0.003
Age	20-30	18 (15.5)	3.5±1.33	4±0.97	3.38±1.85
	31-45	62 (53.4)	3.74±0.90	4.17±0.93	4.14±1.12
	>45	36 (31.1)	3.27±1.23	4.02±1.13	3.88±1.36
Statistics			F test= 2.10 p= 0.12	F test= 0.366 p= 0.69	F test= 2.28 p= 0.10
Education level	Illiterate	18 (15.5)	2.50 ±0.98	4.05±1.0	3.77±1.35
	Primary	38 (32.8)	3.68±0 .87	4.21±1.04	4.18±1.15
	Secondary	28 (24.1)	3.50± 1.13	3.85±1.007	3.25±1.57
	College	12 (10.3)	4.33±0.77	4.08±1.08	4.08±1.62
	Others	20 (17.2)	3.90±1.07	4.30±0.80	4.55±0.68
Statistics			F test= 7.80 p= 0.000	F test= 0.73 p= 0.57	F test= 3.54 p= 0.009
Occupation	Farmer	48 (41.4)	3.56±1.12	4±1.01	4.04±1.16
	Business	5 (4.3)	3.20±0.83	4±0.70	4±0.70
	Non agri labourer	2 (1.7)	4.00±0	3.5±2.12	3.5±2.12
	Salaried Job	12 (10.3)	4.33±0.887	4.08±1.37	4.08±1.50
	Agri labourer	5 (4.3)	3.00±1	4±1	3.2±2.04
	Unemployed	40 (34.5)	3.52±0.96	4.42±0.712	4.02±1.423
	Others	4 (3.4)	2.50±2.5	2.75±0.957	2.75±1.707
Statistics			F test= 2.09, p= 0.06	F test= 2.28, p= 0.04	F test= 0.89, p= 0.50
Economic status	Poor	38 (32.8)	3.42±1.15	3.89±0.95	3.68±1.41
	Middle class	77 (66.4)	3.62±1.07	4.19±1.013	4.09±1.30
	Rich	1 (0.9)	4±0	5±0	3±0
Statistics			F test= 0.5, p= 0.60	F test= 1.57, p= 0.21	F test= 1.41, p= 0.24
Land holding	Land less	3 (2.6)	4.33±0.57	3.33±1.52	2.66±2.08
	<1 acre	65 (56)	3.43±1.17	4.09±0.97	3.78±1.43
	1 to 3 acres	35 (30.2)	3.6±1.06	4.22±1	4.14±1.24
	>3 acres	13 (11.2)	3.92±0.75	4±1	4.53±0.66
Statistics			F test= 1.29, p= 0.27	F test= 0.82, p= 0.48	F test= 2.37, p= 0.07

Cont. Table 6.

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Variables	Characteristics	n (%)	Knowledge score (mean±SD)	Attitude Score (mean±SD)	Practice Score (mean±SD)
Farm type	Intensive	8 (6.9)	3.87±0.64	4.5±0.75	5 ± 0
	Semi intensive	108 (93.1)	3.53±1.12	4.07±1.01	3.87±1.36
Statistics			t test= 1.34, p= 0.02	t test= 1.49, p= 0.4	t test= 8.58, p= 0.000
Type of livestock rearing	Bovine	3 (2.6)	4.33±0.55	5±0	5±0
	Caprine	3 (2.6)	3±1	4.33±1.15	4.66±0.577
	Poultry	11 (9.5)	3.54±1.21	4.09±0.94	4.18±1.60
	Mixed	99 (85.3)	3.55±1.09	4.07±1.01	3.86±1.34
Statistics			F test= 0.75, p= 0.52	F test= 0.89, p= 0.44	F test= 1.11, p= 0.34
Cooperative membership	Yes	33 (28.4)	4.18±0.68	4.21±0.92	4.57±0.75
	No	83(71.6)	3.31±1.13	4.06±1.02	3.69±1.45
Statistics			t test= 5.042, p= 0.002	t test= 0.73, p= 0.31	t test= 4.24, p= 0.000
Overall			3.56± 1.09	4.10 ± 0.99	3.94 ± 1.35

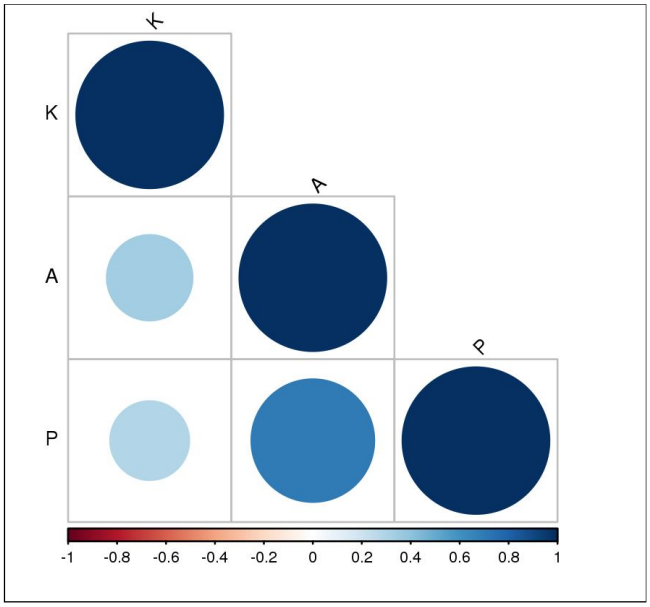

Fig. 3. Correlogram of knowledge, attitude, and practice scores

Correlation of knowledge, attitude and practices: The correlogram (Fig. 3) among knowledge, attitude and practice shows that the knowledge is positively correlated with the attitude. The present survey also indicated that attitude and practices are highly correlated.

DISCUSSION

The socio-demographic findings of this survey, particularly the high involvement of women (81%) in livestock rearing in the Sundarban region, support the observations of Das et al. (2016) and, Dumrya et al. (2015), regarding women's engagement and their role in milk production systems. The prevalence of middle-aged individuals with a blend of working capability and farming experience may explain their engagement in livestock rearing. The finding that a significant portion of respondents had only primary education aligns with Diaz-Quijano et al. (2018), who opined that education level is a key determinant of KAP for disease identification and control, suggesting a potential influence on antibiotic use patterns. The high percentage of small farmers (56%) is consistent with Dhara et al. (2019) and reflects the fragmented land holding and resource deficits in the Sundarban area. The widespread mixed livestock farming, as observed in 85.3% of respondents, is a concern given Deng et al. (2023) suggestion that multi-species farming could trigger multi-drug resistant pathogens, implying a high chance of resistant microbe emergence in this area. The low extension contact (93.1% lacking) among farmers is in accordance with Dhara et al. (2019) and highlights a critical gap in enhancing KAP.

While a majority of the population was familiar with the term 'antibiotic', the limited understanding that antibiotics are specifically for bacterial infections, and the misconception about their use for viral diseases, indicate a basic knowledge deficit. This could be attributed to poor education levels and thin extension contacts. However, the high positive response regarding veterinarian prescriptions and awareness of dosage/duration is encouraging and aligns with Benavides et al. (2021), who reported similar adherence

among small-scale farmers. The identification of penicillin as the most commonly used antibiotic, followed by oxytetracycline and azithromycin, provides insight into local practices. Contrary to Ding et al.'s (2015) report from rural China, our study found middle-aged participants to be more aware of antibiotics, suggesting regional differences in knowledge acquisition.

The overall prudent attitude reflected by participants, such as not self-prescribing, purchasing with valid prescriptions, and avoiding recommendations to others, is a positive indicator. This aligns with Ding et al. (2015) findings on similar attitudes in rural China. The high adherence to checking expiry dates and not using leftover antibiotics further reinforces a responsible approach. These attitudes translate into good practices, as evidenced by respondents not borrowing antibiotics from casual sources and purchasing only from clinics, a finding similar to Islam et al. (2022) in Bangladesh. The high percentage of respondents careful about over/under-dosing and completing full dose schedules is crucial, given that misuse is a major cause of AMR (Caneschi et al., 2023). The reluctance to suggest antibiotics to peers reflects a prevailing sense of good management practice among livestock farmers of Sundarban.

The significant variations in KAP scores among different development blocks, with Canning II showing the highest scores and remote island blocks like Gosaba and Sandeshkhali I lagging, suggest that geographical location is a major determinant. This is supported by Ahmed et al. (2023), who documented higher KAP scores in urban areas compared to rural ones. The lower KAP scores in remote islands might be attributed to poor access to livestock extension services. The influence of socio-demographic factors on KAP scores is evident. Higher knowledge scores among farm women, those with higher education, intensive farming types, and cooperative memberships are significant. Geetha et al. (2022) also reported better knowledge levels among rural farm women. This study confirms that gender, educational qualification, farming type, and institutional membership significantly impact knowledge levels, suggesting that education and community involvement can augment judicious antibiotic use. The statistically significant positive attitude of female respondents aligns with Randler et al. (2021) regarding farm women's attitudes towards animal welfare. Similarly, female respondents' higher practice scores and maximum scores in intensive farming systems highlight their role in promoting better practices. It's noteworthy that economic status or land holding capacity did not influence KAP levels in this study.

The positive correlation between knowledge and attitude, and the strong correlation between attitude and practices, reinforce the interconnectedness of these factors. This observation is consistent with Afzal et al. (2021) and underscores that improving knowledge can lead to better attitudes, which in turn drive improved practices. The study highlights that despite some awareness among Sundarban livestock farmers, more training programs are urgently needed in remote island areas to improve their knowledge base on judicious antibiotic use. Accommodating individual farmers in groups like cooperatives/clusters can facilitate timely changes. The indiscriminate use of antibiotics in livestock farming poses a great danger of AMR worldwide, and this study elaborates on the KAP of livestock keepers in this context. More research with larger sample numbers is required to understand the precise picture of antibiotic use/misuse in this densely populated and ecologically fragile delta.

Conflict of interest: The Authors have no conflict of interest in this study

Author's contribution: SG: Major advisor, engaged in conceptualization, supervision and final editing; SB: Involved in methodology, discussion and editing; AD: Presented MSc research work, involved in investigation, data generation and preparing original draft.

Data availability statement: All data generated or analyzed during this study are included in this article. The corresponding author is willing to provide the raw data upon reasonable request.

Ethical approval: This study is not entitled to ethical approval as the research data were collected by structured interview questionnaire only.

Use of artificial intelligence tools: During the preparation of this work, the author(s) did not use any such artificial intelligence tools. The author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

ACKNOWLEDGEMENT

The authors are thankful to the authority of Ramakrishna Mission Vivekananda Educational and Research Institute for fund support during this study.

REFERENCES

Afzal, M. S., Khan, A., Qureshi, U. U. R., Saleem, S., Saqib, M. A. N., Shabbir, R. M. K., Naveed, M., Jabbar, M., Zahoor, S., & Ahmed, H. (2021). Community-based assessment of knowledge, attitude, practices and risk factors regarding COVID-19 among Pakistanis residents during a recent outbreak: a cross-sectional survey. *Journal of Community Health*, *46*(3), 476-486. https://doi.org/10.1007/s10900-020-00875-z

Ahmed, M. N. Q., Lalin, S. A. A., & Ahmad, S. (2023). Factors affecting knowledge, attitude, and practice of COVID-19: A study among undergraduate university students in Bangladesh. *Human Vaccines & Immunotherapeutics*, *19*(1), 2172923. https://doi.org/10.1080/21645515.2023.2172923

Bandyopadhyay, S., Banerjee, J., Bhattacharyya, D., Samanta, I., Mahanti, A., Dutta, T. K., Ghosh, S., Nanda, P. K., Dandapat, P., & Bandyopadhyay, S. (2018). Genomic identity of fluoroquinolone-resistant bla CTX-M-15-Type ESBL and pMAmpC â-lactamase producing *Klebsiella pneumoniae* from buffalo milk, India. *Microbial Drug Resistance*, *24*(9), 1345-1353. https://doi.org/10.1089/mdr.2017.0368

Benavides, J. A., Streicker, D. G., Gonzales, M. S., Rojas-Paniagua, E., & Shiva, C. (2021). Knowledge and use of antibiotics among low-income small-scale farmers of Peru. *Preventive Veterinary Medicine*, *189*, 105287. https://doi.org/10.1016/j.prevetmed.2021.105287

Caneschi, A., Bardhi, A., Barbarossa, A., & Zaghini, A. (2023). The use of antibiotics and antimicrobial resistance in veterinary medicine, a complex phenomenon: A narrative review. *Antibiotics*, *12*(3), 487. https://doi.org/10.3390/antibiotics12030487

Das, S., Ghosh, S., Goswami, R., & Sahu, N. C. (2017). Socio-economic characterisation and dairy production system maintained by women milk producer cooperative societies in Indian Sundarban region. *Journal of Krishi Vigyan*, *6*(1), 180-186. http://dx.doi.org/10.5958/2349-4433.2017.00076.9

Deng, Y. T., Feng, Y. Y., Tan, A. P., Zhao, F., Jiang, L., & Huang, Z. B. (2023). High occurrence of multiple drug resistance mediated by integron in *Aeromonas* isolated from fish livestock integrated farms. *Aquaculture Research*, *2023*(1), 8512657. https://doi.org/10.1155/2023/8512657

Dhara, K., Moitra, N. J., Misra, S., Ghosh, S., Bose, S., & Poddar, K. (2019). Socio-economic status of the sheep and goat farmers in Sundarban, West Bengal. *International Journal of Livestock Research*, *9*(9), 168-79. Retrieved from https://ijlr.org/ojs_journal/index.php/ijlr/article/view/1131

Diaz-Quijano, F. A., Martínez-Vega, R. A., Rodriguez-Morales, A. J., Rojas-Calero, R. A., Luna-González, M. L., & Díaz-Quijano, R. G. (2018). Association between the level of education and knowledge, attitudes and practices regarding dengue in the Caribbean region of Colombia. *BMC Public Health*, *18*(1), 143. https://doi.org/10.1186/s12889-018-5055-z

Ding, L., Sun, Q., Sun, W., Du, Y., Li, Y., Bian, X., He, G., Bai, H., & Dyar, O. J. (2015). Antibiotic use in rural China: a cross-sectional survey of knowledge, attitudes and self-reported practices among caregivers in Shandong province. *BMC Infectious Diseases*, 15(1), 576. https://doi.org/10.1186/s12879-015-1323-z

Dumrya, S., Ghosh, S., & Goswami, R. (2015). Characterization of backyard poultry farming in Indian Sundarban region. *Indian Journal of Poultry Science*, *50*(1), 90-95.

Ferri, M., Ranucci, E., Romagnoli, P., & Giaccone, V. (2017). Antimicrobial resistance: A global emerging threat to public health systems. *Critical Reviews in Food Science and Nutrition*, *57*(13), 2857–2876. https://doi.org/10.1080/10408398.2015.1077192

Geetha, K., Yankanchi, G. M., Sunitha, A. B., & Shigihalli, S. (2022). Knowledge, attitude and practice (KAP) on nutrition among rural farm women of Chickballapur district of Karnataka, India. *Current Journal of Applied Science and Technology*, *41*(35), 30-39. https://doi.org/10.9734/cjast/2022/v41i353958

Hager, E., Odetokun, I. A., Bolarinwa, O., Zainab, A., Okechukwu, O., & Al-Mustapha, A. I. (2020). Knowledge, attitude, and perceptions towards the 2019 Coronavirus Pandemic: A bi-national survey in Africa. *PloS One*, *15*(7), e0236918. https://doi.org/10.1371/journal.pone.0236918

Halder, S., Samanta, K., Das, S., & Pathak, D. (2021). Monitoring the inter-decade spatial–temporal dynamics of the Sundarban mangrove forest of India from 1990 to 2019. *Regional Studies in Marine Science*, *44*, 101718. https://doi.org/10.1016/j.rsma.2021.101718

Islam, M. Z., Islam, M. S., Kundu, L. R., Ahmed, A., Hsan, K., Pardhan, S., Driscoll, R., Hossain, M. S., & Hossain, M. M. (2022). Knowledge, attitudes and practices regarding antimicrobial usage, spread and resistance emergence in commercial poultry farms of Rajshahi district in Bangladesh. *PloS One*, *17*(11), e0275856. https://doi.org/10.1371/journal.pone.0275856

Mahanti, A., Joardar, S. N., Bandyopadhyay, S., Ghosh, S., Batabyal, K., & Samanta, I. (2020). Milk from healthy or infected cattle as a source of multi-drug resistant, AmpC α-lactamase-producing *Escherichia coli*. *Indian Journal of Dairy Science*, *73*(4), 343-7. https://doi.org/10.33785/IJDS.2020.v73i04.009

QGIS Development Team. (2013). *QGIS Geographic Information System*. Open Source Geospatial Foundation Project. http://qgis.osgeo.org

Randler, C., Adan, A., Antofie, M. M., Arrona-Palacios, A., Candido, M., Boeve-de Pauw, J., Chandrakar, P., Demirhan, E., Detsis, V., Di Milia, L., Fanèovièová, J., Gericke, N., Haldar, P., Heidari, Z., Jankowski, K. S., Lehto, J. E., Lundell-Creagh, R., Medina-Jerez, W., Meule, A., L Milfont, T., … Vollmer, C. (2021). Animal welfare attitudes: effects of gender and diet in university samples from 22 countries. *Animals*, *11*(7), 1893. https://doi.org/10.3390/ani11071893

Snedecor, G.W. and Cochran, W.G. (1994). *Statistical Methods* (8th ed.). Iowa State University Press, USA.

Received - 30.05.2025, Accepted - 23.08.2025, Published - 20.09.2025 (Online), 01.12.2025 (Print)
Section Editor: Dr. Arun Kumar Das, Editorial Board Member