

Original Research Article

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Socioeconomic Factors and Use of Antibiotics by Dairy Farmers vis-a-vis Antibiotic Resistance

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ABSTRACT

Keywords

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The use of antibiotics for preventive purpose and symptom relief are common in India. One third (67%) of the global increase in antibiotic consumption in livestock animals over 2010-2030, will be evident in Low and Middle Income Countries like India (Van Boeckel *et al.*, 2015). Reinforcing the education and excellence among stakeholders about antibiotic conservation practices, issue of antibiotic resistance and the One Health approach can play crucial role in leading the resistance from farm-to-fork (OIE, 2016). In the study, two districts namely Karnal and Kurukshetra were purposively selected from Eastern zone of Haryana state. In which, 4 villages from each district were selected randomly. From each village 21 farmers were randomly selected through random stratified sampling methods constituting the total respondents to 168. Mean, standard deviation, frequency and cumulative square root frequency were statistical tools to be used. The educational campaigns increase awareness about the resistance and reinforcing the education and fostering the excellence among stakeholders about antibiotic conservation practices is needed. The large farmers performed judicious use of antibiotics, higher incomes helped them to adopt better management practices at their farms. A well-structured target segmentation strategy to percolate the policies for small, medium and large dairy farmers can be designed by considering the socio-economic conditions.

Introduction

The irrational use of antibiotics is prevalent among the dairy farmers. If it continues with same pace, then between 2010 and 2030, its global consumption in the livestock sector can increase by about 67%. The substantial part of this increase in antibiotics consumption will be determined by a shift in farming techniques in major developing countries (Van Boeckel *et al.*, 2015). In the world, only 48 countries (25% of the 194 WHO member countries) considered national plans in to operation to tackle antibiotics resistance (Cecchini *et al.*, 2015).

An updated preclinical paradigm is needed to assess the risk of resistance development in early preclinical development. This change is feasible and is not limited by methodology but rather by tradition (Sommer *et al.*, 2017).

A paradigm shift is required in utilization of conventional antibiotics and its screening for next-generation to improve efficacy to treat biofilms associated with recurrent and device related infections in the development of antibiotics (Ceri *et al.*, 2010). The constant advancement in molecular techniques and

next-generation sequencing led to a paradigm shift in the thoughts of health dynamics (Falentin *et al.*, 2016). In the United States of America, the use of antibiotics including antibiotics in livestock sector accounts for about 80% of the total consumption annually (FDA, 2010).

The resistance crossed the boundary of countries, e.g. carbapenem resistant strain of *Klebsiella* identified in 2003 needed only 5 years to spread from the United States, where it was, to Israel (2005) to the United Kingdom, Italy and Colombia (2008) (McKenna, 2013).

Developing countries (OECD) may face cumulative losses for USD 2.9 trillion (about 0.16% of their GDP) by 2050 as compared to world (Cecchini *et al.*, 2015). One third (67%) of the global increase in antibiotic consumption in livestock animals over 2010-2030, will be evident in Low and Middle Income Countries like India (Van Boeckel *et al.*, 2015). National guidelines for antibiotic use were introduced and implemented in India since 2013 (Founou *et al.*, 2016).

One health approach is multifaceted, comprehensive and integrated processes imperative to ensure food safety, combat infectious diseases, preserve the efficacy of antibiotics for future generations and control the spread of antibiotic resistance (Founou *et al.*, 2016).

The One Health science seems to fall short when it comes to understanding the economic forces behind many emerging infectious diseases; there is a further gap to be bridged between the biomedical, environmental and animal sciences, and the social sciences (Robinson *et al.*, 2016). This approach endorses the supranational entities such as WHO, FAO, and OIE referred as the "Tripartite Alliance (WHO, 2015).

Interconnected interests of stakeholders integrating human health, veterinary medicine and the environment, surveillance should be established.

Reinforcing the education and excellence among veterinarians about antibiotic conservation practices, issue of antibiotic resistance and the One Health approach can play crucial role in leading the resistance from farm-to-fork (OIE, 2016). WHO Global Action Plan and FAO Action Plan advocated multifaceted strategies with One Health approach, are urgently required to prevent the transmission of resistance and infectious diseases from farm-to-fork and preserve the efficacy of antibiotics to promote food security resulting global health (Founou *et al.*, 2016).

There is need to formulate the strategies regarding the prudent use of antibiotics among the Indian farmers. Their socio-economic conditions need to be addressed to design the strategies for the small, medium and large dairy farmers. Considering above view points, the present study was conducted to address the issue of antibiotic resistance.

Materials and Methods

In the study, two districts namely Karnal and Kurukshetra were purposively selected from Eastern zone of Haryana state. In which, 4 villages from each district were selected randomly. From each village 21 farmers were randomly selected through random stratified sampling methods.

The farmers were categorised into small, medium and large farmers on the basis of their herd size, constituting a total of 168 farmers as respondents. Mean, standard deviation, frequency and cumulative square root frequency were statistical tools to be used.

Results and Discussion

Socio-economic conditions of dairy farmers

Age

Age determines the maturity of the individual which is guided by experience and exposure to the situation for the person. Result indicated that half of respondents (52.38%) were in the middle category of age, followed by 25 % of the respondents in the category of old age and the remaining belonged to the category of young age (Table 1).

Family size

Majority (59.52%) of respondents belonged to medium family size comprising of 5 to 10 members, followed by 28 % of respondents in low family size category. Family size influenced the annual income, labour availability and per capita milk consumption (Table 2).

Family type

Majority of respondents (76.19%) belonged to joint family and remaining respondents belong to nuclear family. Joint family has the advantage of availability of surplus labour for the agriculture and allied activities and proportion of joint family is high as compared to nuclear family in the rural society (Table 3).

Education

Education broadens the mental horizon at the same time it increases the readiness and predisposition to the acquisition of the new and novel ideas. Majority of small farmers were illiterate followed by functionally literate and 21.78 % had middle level of education. Among medium farmers 29.31 % were literate up to middle level followed by 22.41 % farmers having primary level and

14.66 % of farmers were educated up to secondary level of education. Among large farmers, the education level was highest for middle level followed by secondary level of education (24.19%) which was higher as compared to small and medium farmers. Thus, education level varied from small farmers to medium farmers and was found highest among large farmers thus showing a wide variation from illiterate to the graduate level of education.

Social participation

Majority of small farmers (40.51%) were reported to have medium level of social participation and 33.86 % of them were found to have low level of social participation followed by 25.63 % having high level social participation. Majority of medium farmers (39.66%) were found to have medium level of social participation and 33.03 % of them had low level of social participation followed by 27.31 % having high level social participation (Table 5).

Majority of large farmers (42.07%) were having medium level of social participation and 29.14 % of them had low level of social participation followed by 28.80 % having high level social participation.

Land holding

Majority of the small holder dairy farmers (40.69%) were having land holding of less than 1 hectare, followed by 31 % of farmers having land holding more than 2 hectare. The land holding was higher among medium dairy farmers as compared to small dairy farmers, in which majority (49.24%) of them belonged to land holding 2.25 to 4.75 hectare followed by 27.07 % of farmers having land holding more than 4.45 hectare (Table 6). The size of land holding was highest among large dairy farmers as compares to small and medium dairy farmers. Out of which, 50 % of large

dairy farmers were having the land holding of 3.50 to 7 hectare followed by 27.38 % of farmers were having the land holding more than 7 hectare.

Herd size

Majority of small holder dairy farmers (76 %) had the average herd size (3 Livestock Animal Unit). Majority of medium dairy farmers (71%) had the average herd size of 7 animals belonged to the middle category. Among large dairy farmers, majority (75%) of them had the average herd size of 13 Livestock Animal Unit (Table 7).

Milk production, milk consumption and milk sale

Majority of the small farmers (51.19%) belonged to the medium level of milk production (5-11 lits./day) followed by 25.01% of them in low and 23.80 % in high category. It was revealed that 77 % of the respondents consumed 2.23 to 5.2 litres of milk for household purpose (Table 8). It was found that 14.28 % of the respondents were consuming less than 2.3 litres of milk per day belonged to low category of milk consumption.

It was revealed that 22.62 % of the respondents did not sell the milk thus consumed the whole milk at household level. About 27.38 % of the respondents sold 3.5 to 8.2 litres of milk which belonged to the medium category of the classification. Majority of medium farmers (48.81%) belonged to the medium level of milk production (9-16 lits. / day) followed by 28.57 % who belonged to low category of milk production (<9 lits./ day) and remaining 22.62 % of respondents belonged to high category. It was revealed that 75.38 % of the respondents consumed 4.5 to 9.2 litres of milk for household purpose. It was found that 14.29 % of the respondents consumed less

than 4.5 litres of milk per day belonged to low category of milk consumption. It was found that 59.52 % of the respondents sold the milk belonged to the middle category (7.5-13.2 lits./day) of milk sale. About 25.6 % of the respondents sold more than 13.2 litres of milk that belonged to the high category of the classification.

Majority of the respondents (42.26%) belonged to the medium level of milk production (16-26 lits./day) followed by 33.93 % of the respondents belonged to low category of milk production (<16 lits./day) and remaining 23.81 % of respondents were in high category. It was revealed that 77.38 % of the respondents consumed 7.5 to 9.2 litres of milk for household purpose (Table 9). It was found that 14.28 % of the respondents consumed less than 7.5 litres of milk per day belonged to low category of milk consumption. It was found that 52.98 % of the respondents sold the milk belonged to the middle category (13.5-20.4 lits./ day) of milk sale. About 25 % of the respondents sold more than 20.4 litres of milk belonged to the high category of the classification.

Annual Income

Majority of the small farmers (73.7%) belonged to the medium level of income of Rs. 91678-Rs. 242454 per annum, while, 15.17 % of the them were from high income level, earning more than Rs. 122638 per annum and 11.8 % of them were earning less than Rs. 51660 per annum. Majority of the medium farmers (63.12%) belonged to the medium level of income of Rs. 91678- Rs. 242454 per annum, while, 21.61 % of the them were from high income level, earning more than Rs. 242454 per annum and 15.27 % of them were earning less than Rs. 91678 per annum. Among large farmers, majority of them (70.54%) belonged to the medium level of income of Rs. 203647- Rs. 328452 per annum.

Table.1 Distribution of respondents as per age (n=168)

Category	Karnal	Kurukshetra	Total
Young Age (<35)	25	20.24	22.62
Middle Age (35-50)	48.81	55.95	52.38
Old age (>50)	26.19	23.81	25.00

(Numerical figures indicate %)

Table.2 Distribution of respondents as per family size (n=168)

Category	Karnal	Kurukshetra	Total
Low (<5)	25	30.95	27.98
Medium (5-10)	55.95	63.10	59.52
High (>10)	19.05	5.95	12.5

(Numerical figures indicate %)

Table.3 Distribution of respondents as per family type (n= 168)

Family type	Karnal	Kurukshetra	Total
Joint	67.86	84.52	76.19
Nuclear	32.14	15.48	23.81

(Numerical figures indicate %)

Table.4 Distribution of respondents as per education (n=168)

Small farmers (n=56)			
Educational level	Karnal	Kurukshetra	Total
No schooling	25.86	27.59	26.72
Functionally literate	29.31	18.97	24.14
Primary	5.17	8.62	6.90
Middle	22.41	21.14	21.78
Secondary	6.90	8.62	7.76
Higher secondary	6.90	8.17	7.53
Graduate	3.45	6.90	5.17
Medium farmers (n=56)			
Educational level	Karnal	Kurukshetra	Total
No schooling	13.79	15.52	14.66
Functionally literate	5.17	8.62	6.90
Primary	25.86	18.97	22.41
Middle	32.76	25.86	29.31
Secondary	15.52	13.79	14.66
Higher secondary	5.17	13.80	9.48
Graduate	1.72	3.45	2.59
Large farmers (n=56)			
Educational level	Karnal	Kurukshetra	Total
No schooling	12.50	16.67	14.58
Functionally literate	5.36	9.26	7.31
primary	16.07	18.52	17.29
Middle	26.79	24.07	25.43
Secondary	28.00	20.37	24.19
Higher secondary	5.93	7.41	6.67
Graduate	5.36	3.70	4.53

(Numerical figures indicate %)

Table.5 Distribution of respondents as per social participation (n=168)

Small farmers (n=56)			
Category	Karnal	Kurukshetra	Total
Low(<2.4)	31.31	36.42	33.86
Medium (2.4-4.7)	41.79	39.24	40.51
High (>4.7)	26.90	24.34	25.63
Medium farmers (n=56)			
Category	Karnal	Kurukshetra	Total
Low (<3.8)	32.07	33.98	33.03
Medium (3.8-6.2)	39.02	40.30	39.66
High (>6.2)	28.91	25.72	27.31
Large farmers (n=56)			
Category	Karnal	Kurukshetra	Total
Low (<4.1)	30.45	27.83	29.14
Medium (4.1-7.6)	41.03	43.10	42.07
High (>7.6)	28.52	29.07	28.80

(Numerical figures indicate %)

Table.6 Distribution of respondents as per land holding (n=168)

Small holder dairy Farmers (n=56)			
Category	Karnal	Kurukshetra	Total
(<1 Ha)	41.67	39.71	40.69
(1-2 Ha)	30.85	25.81	28.33
(> 2Ha)	27.38	34.5	30.94
Medium Farmers (n=56)			
Category	Karnal	Kurukshetra	Total
(<2.25Ha)	23.82	24.38	24.10
(2.25-4.75Ha)	45.33	53.14	49.24
(>4.45Ha)	30.95	23.18	27.07
Large Dairy Farmers (n=56)			
Category	Karnal	Kurukshetra	Total
(<3.50 Ha)	23.81	21.43	22.62
(3.50-7Ha)	47.62	52.38	50
(>7 Ha)	28.57	26.19	27.38

(Numerical figures indicate %)

Table.7 Distribution of respondents as per herd size (n=168)

Small farmer (n=56)			
Average herd size	Karnal	Kurukshetra	Total
3 SAU	74	78	76
Medium farmer (n=56)			
Average herd size	Karnal	Kurukshetra	Total
7 SAU	69	73	71
Large farmers (n=56)			
Average herd size	Karnal	Kurukshetra	Total
13 SAU	76	74	75

(Numerical figures indicate %)

Table.8 Distribution of small farmers as per milk production, milk consumption and milk sale (n=56)

Milk production per day (Litres)			
Category	Karnal	Kurukshetra	Total
low (<5 Lit/ day)	21.43	28.58	25.01
medium (5-11 lit/ day)	53.57	48.81	51.19
high (>11 lit/ day)	25	22.61	23.80
Milk consumption per day (Litres)			
Category	Karnal	Kurukshetra	Total
Low (<2.3)	20.24	8.33	14.28
Medium (2.3-5.2)	70.24	84.52	77.38
High (>5.2)	9.52	7.15	8.335
Milk sale per day (Litres)			
Category	Karnal	Kurukshetra	Total
No sale	16.66	28.57	22.62
Low (<3.5)	13.09	13.1	13.09
Medium (3.5-8.2)	59.54	46.42	27.38
High (>8.2)	10.71	11.91	11.31

(Numerical figures indicate %)

Table.9 Distribution of medium farmers as per milk production, milk consumption and milk sale (n=56)

Milk production per day (Litres)			
Category	Karnal	Kurukshetra	Total
low (<9 Lit/ day)	25	32.14	28.57
medium (9-16 lit/ day)	47.62	50	48.81
high (>16 lit/ day)	27.38	17.86	22.62
Milk consumption per day (Litres)			
Category	Karnal	Kurukshetra	Total
Low (<4.5)	20.24	8.33	14.29
Medium (4.5-9.2)	70.24	83.52	75.38
High (>9.2)	9.52	10.52	18.67
Milk Sale per day (Litres)			
Category	Karnal	Kurukshetra	Total
Low (<7.5)	13.1	16.67	14.88
Medium (7.5-13.2)	66.67	52.38	59.52
High (>13.2)	20.24	30.95	25.6

(Numerical figures indicate %)

Table.10 Distribution of large farmers as per milk production, milk consumption and milk sale (n=56)

Milk production per day (Litres)			
Category	Karnal	Kurukshetra	Total
low (<16Lit/ day)	32.14	35.71	33.93
medium (16-26 lit/ day)	45.24	39.29	42.26
high (>26 lit/ day)	22.62	25	23.81
Milk consumption per day (Litres)			
Category	Karnal	Kurukshetra	Total
Low (<7.5)	20.24	8.33	14.285
Medium (7.5-9.2)	70.24	84.52	77.38
High (>9.2)	9.52	7.14	8.33
Milk sale per day (Litres)			
Category	Karnal	Kurukshetra	Total
Low (<13.25)	23.81	20.24	22.02
Medium (13.5-20.4)	50	55.95	52.98
High (>20.4)	26.19	23.81	25

(Numerical figures indicate %)

Table.11 Distribution of respondents as per annual income (Rs.) (n=168)

Small farmers (n=56)			
Category	Karnal	Kurukshetra	Total
Low (<51660)	8.03	14.33	11.18
Medium (51660-122638)	77.07	70.33	73.7
High (>122638)	15	15.34	15.17
Medium farmers (n=56)			
Category	Karnal	Kurukshetra	Total
Low (<91678)	13.2	17.34	15.27
Medium (91678-242454)	64.7	61.54	63.12
High (>242454)	22.1	21.12	21.61
Large farmers (n=56)			
Category	Karnal	Kurukshetra	Total
Low (<203647)	16.83	15.83	16.33
Medium (203647-328452)	69.52	71.57	70.54
High(>328374)	13.65	12.6	13.13

(Numerical figures indicate %)

Table.12 Distribution of respondents according to mass media exposure (n=168)

Small farmers (n=56)			
Category	Karnal	Kurukshetra	Total
Low (<4)	18.63	15.2	16.915
Medium (4-7)	65.47	63.58	64.525
High (>7)	15.9	21.22	18.56
Medium farmers (n=56)			
Category	Karnal	Kurukshetra	Total
Low (<5)	21.36	24.63	22.995
Medium (5-8)	61.32	63.89	62.605
High (>8)	17.32	11.48	14.4
Large farmers (n=56)			
Category	Karnal	Kurukshetra	Total
Low (<7)	12.45	14.37	13.41
Medium (7-10)	63.46	61.62	62.54
High (>10)	24.09	24.1	24.095

(Numerical figures indicate %)

Table.13 Distribution of respondents as per extension contact (n=168)

Small farmers (n=56)			
Category	Karnal	Kurukshetra	Total
Low (<3)	11.90	22.62	17.26
Medium (3-7)	75.00	73.81	74.40
High (>8)	13.10	3.57	8.33
Medium farmers (n=56)			
Category	Karnal	Kurukshetra	Total
Low (<5)	40.48	42.86	41.67
Medium (5-10)	48.81	52.38	50.60
High (>10)	10.71	4.76	7.74
Large farmers (n=56)			
Category	Karnal	Kurukshetra	Total
Low (<7)	26.19	22.62	24.40
Medium (7-12)	57.14	75.00	66.07
High (>12)	16.67	2.38	9.52

(Numerical figures indicate %)

Table.14 Classification of respondents according to the factors considered while buying the antibiotics from medical store and feed store

Sr. No.	Factors	Never (0)	Sometimes (1)	Always (2)
Small farmers				
1.	Price as order of importance	10.50	14.50	75.00
2.	Brand Packaging as suggested by veterinary medicine store	7.15	21.42	71.43
3.	Quality in terms of previous experience	25.00	23.21	51.79
4.	Easy to obtain	19.64	23.21	57.15
5.	Previous recommendation slip of veterinarian or the residual scanty antibiotics brought by milk vender	16.07	26.79	57.14
Medium farmers				
6.	Price as order of importance	23.21	37.50	39.29
7.	Brand Packaging as suggested by veterinary medicine store	28.57	7.14	64.29
8.	Quality in terms of previous experience	21.42	10.71	67.87
9.	Easy to obtain	39.28	26.78	33.94
10.	Previous recommendation slip of veterinarian or the residual scanty antibiotics brought by milk vender	66.07	21.43	12.50
Large farmers				
11.	Price as order of importance	67.86	19.64	12.50
12.	Brand Packaging as suggested by veterinary medicine store	7.14	8.93	83.93
13.	Quality in terms of previous experience	75.00	14.29	10.71
14.	Easy to obtain	66.07	17.86	16.07
15.	Previous recommendation slip of veterinarian or the residual scanty antibiotics brought by milk vender	89.29	7.14	3.57

(Numerical figures indicate %)

Table.15 Classification of respondents according to practice(s) perform/ focus while using the antibiotics

Sr. No.	Practice(s)	Never (0)	Sometimes (1)	Always (2)
Small farmers (n=56)				
1.	I always follow best practice when making decisions about, and administering, antibiotics to my animals	60.79	17.63	21.58
2.	Every use of antibiotics on my animals is fully recorded	70.67	16.95	12.38
3.	Antibiotics are expensive and I minimize usage to reduce costs	13.64	21.54	67.82
4.	Preventative use of antibiotics in the dairy herd helps me meet production goals	95.57	1.64	2.79
5.	I always consult my vet before using antibiotics to treat an animal	33.63	34.74	31.63
Medium farmers (n=56)				
1.	I always follow best practice when making decisions about, and administering, antibiotics to my animals	30.83	25.53	43.64
2.	Every use of antibiotics on my animals is fully recorded	30.66	32.82	36.52
3.	Antibiotics are expensive and I minimize usage to reduce costs	40.42	16.96	42.62
4.	Preventative use of antibiotics in the dairy herd helps me meet production goals	56.63	28.62	14.75
5.	I always consult my vet before using antibiotics to treat an animal	9.35	27.92	62.73
Large farmers (n=56)				
1.	I always follow best practice when making decisions about, and administering, antibiotics to my animals	13.73	13.52	72.75
2.	Every use of antibiotics on my animals is fully recorded	9.84	21.38	68.78
3.	Antibiotics are expensive and I minimize usage to reduce costs	18.80	26.94	54.26
4.	Preventative use of antibiotics in the dairy herd helps me meet production goals	19.25	31.81	48.94
5.	I always consult my vet before using antibiotics to treat an animal	2.08	12.92	85.00

(Numerical figures indicate %)

Table.16 The classification of respondents according to responses and the prevailing practices which are accelerating factor as well as a matter of awareness about antibiotic resistance

Sr. No	Practice(s)	Never	Sometime	Always
Small farmers (n=56)				
1.	Do you discriminate usage of antibiotics for lactating and non-lactating cattle, calf and milch animal?	24.64	18.51	56.85
2.	Do you give the recommended dose of without any alteration?	16.75	39.83	43.42
3.	Do you sale the milk and it's product during the administration of antibiotics?	2.04	0.00	97.96
4.	Do you discard the use of milk of treated animals for the domestic consumption?	96.53	2.04	1.43
5.	Whether you demand for prescribing antibiotics to the veterinarians exclusively?	24.53	18.94	56.53
6.	Do you complete the course of prescription even when symptoms of disease disappear?	68.96	27.63	3.41
7.	Do you use the left over antibiotics for the common disease(s) which appears regularly?	14.75	6.83	78.42
8.	Do you share antibiotics with your neighbour/ relatives?	23.53	29.94	46.53
Medium farmers (n=56)				
9.	Do you discriminate usage of antibiotics for lactating and non-lactating cattle, calf and milch animal?	46.85	20.52	32.63
10.	Do you give the recommended dose of without any alteration?	26.65	5.71	67.64
11.	Do you sale the milk and it's product during the administration of antibiotics?	4.38	1.98	93.64
12.	Do you discard the use of milk of treated animals for the domestic consumption?	95.63	4.53	0.00
13.	Whether you demand for prescribing antibiotics to the veterinarians exclusively?	34.64	38.69	26.67
14.	Do you complete the course of prescription even when symptoms of disease disappear?	78.42	11.57	10.01
15.	Do you use the left over antibiotics for the common disease(s) which appears regularly?	11.74	1.73	86.53
16.	Do you share antibiotics with your neighbour/ relatives?	91.74	5.97	2.29
Large farmers (n=56)				
17.	Do you discriminate usage of antibiotics for lactating and non-lactating cattle, calf and milch animal?	45.74	40.62	13.64
18.	Do you give the recommended dose of without any alteration?	11.64	5.04	83.32
19.	Do you sale the milk and it's product during the administration of antibiotics?	3.85	3.62	92.53
20.	Do you discard the use of milk of treated animals for the domestic consumption?	91.75	4.64	3.61
21.	Whether you demand for prescribing antibiotics to the veterinarians exclusively?	68.40	18.86	12.74
22.	Do you complete the course of prescription even when symptoms of disease disappear?	87.96	2.74	9.3
23.	Do you use the left over antibiotics for the common disease(s) which appears regularly?	2.01	6.42	91.57
24.	Do you share antibiotics with your neighbour/ relatives?	96.12	1.35	2.53

(Numerical figures indicate %)

Table.17 Resistance in bacteria and resistant antibiotics as observed by veterinarians

Sr. No.	Bacteria	Resistance
1	<i>Coliform</i>	17.39
2	<i>Pseudomonas aeruginosa</i>	39.13
3	<i>Staphylococcus aureus</i>	30.43
4	<i>Streptococcus</i>	34.78
5	<i>Escherichia coli</i>	52.17
6	<i>Klebsiella</i>	13.04
7	<i>Salmonella</i>	26.09
Sr. No.	Antibiotics	Resistance
1	Gentamycin	65.22
2	Penicillin	72.34
3	Tetracycline	21.77
4	Beta-lactams	34.45
5	Tylosin	20.97
6	Sulpha drugs	14.11

(Numerical figures indicate %)

Mass media exposure

Majority of the small farmers (64.52%), medium farmers (62.60%) and large farmers (62.54%) had medium level of exposure to the mass media in their respective categories (Table 12).

Among small farmers, 18.56 % belonged to high mass media exposure and rest small farmers had low mass media exposure. Similarly 14.4 % of medium farmers and 24.09 % of large farmers had high level of mass media exposure in their respective categories.

Extension contact

Majority of small holder dairy farmers (74.40%) had medium level of extension contact followed by 17.26 % with low level of extension contact and rests of the farmers were having high extension contact. Similarly majority of the medium farmers were having medium level of extension contact followed

by 41.67 % of the farmers with low level of extension contact and remaining (7.74%) were having high extension contact (Table 13). Among large farmers majority (66.07%) revealed same pattern with medium extension contact followed by 24.40 % of farmers with low extension contact and rest with high level of extension contact. It was found that large farmers were having high level of extension contact as compared to the small farmers.

Factors affecting “over the counter” purchase of antibiotics

Large farmers never prioritized the price as the alternative to sought judicious use of antibiotics as evident in the table. Small farmers (75%) preferred the low cost antibiotics to treat the bacterial diseases in the herd.

Previous experience gives the insight in to use residual antibiotics which were not considered by large farmers (75.00%), while small farmers (51.79%) frequently looked for this

option (Table 14). Ease of obtaining the antibiotics were considered by small farmers (57.15%), while large farmers (66.07%) never compromised with the effectiveness of treatment by considering the ease of availability.

Practices performed while use of antibiotics

The decision regarding the best practices and judicious use of antibiotics were acknowledged by large farmers (72.75%) on the basis of consistency in decision making (Table 15). Large farmers (68.78%) practiced the recording of the use of antibiotics frequently where as small farmers were not aware of this practice. Production goals in relation to preventive use of antibiotics were considered by large farmers (48.94%) due to their large herd size. The veterinary consultancy was affected by the financial condition of the farmers, in which large farmers (85%) were having the relative advantage.

Practices attributing to antibiotic resistance

Discriminating the cattle and buffalo for antibiotics treatment by considering the lactation stage aimed to minimize economy of treatment were practiced mostly by small farmers (56.85%) frequently. Large farmers (83.32%) gave the recommended doses of antibiotic treatment without any alteration while small farmers changed the formulation and doses frequently as per convenience (Table 16). The sale of milk of cow treated with antibiotics were prevalent among all the small, medium and large farmers without a significant difference recognised with due consideration to the economy of production. The uses of left over antibiotics were prevalent among small farmers (78.42%) as the regular practice by them for its contingent use.

Resistance to antibiotics prevalent in the study area

Maximum resistance were observed for *Escherichia coli*, *Pseudomonas aeruginosa*, *Streptococcus*, *Staphylococcus aureus* and *Salmonella* by the veterinarians. Penicillin, Gentamycin, Tetracycline, Tyrosine and sulfa-drugs were found having maximum resistance (Table 17).

Education

Education broadens the mental horizon at the same time it increases the readiness and predisposition to the acquisition of the new and novel ideas. Increased in level of knowledge was pointedly associated with the use of antibiotics for preventative purpose, antibiotics purchase from medical-stores, complications experienced in animals after having giving antibiotics and the educational level of the farmer (Redding *et al.*, 2014). The educational campaigns can be relatively successful to increase awareness about the resistance issue across the world (Harbarth *et al.*, 2015). Reinforcing the education and fostering the excellence among veterinarians about antibiotic conservation practices have a crucial role to play in containing antibiotic resistance from farm-to-fork (OIE, 2016)

Herd size

Use of antibiotics in dry cow therapy to cure mastitis occurrences, had very low effects on resistance among bacteria and minimal inhibitory concentration (MIC) of *Escherichia coli* in herd as well as its environment (Rollins *et al.*, 1974). The good alternatives to above problems can be Organic dairy herds which receive minimal or no antibiotics drugs. More healthy conditions were present in organic than conventional herds (Pol and Ruegg, 2007).

Annual Income

The large farmers have judicious use of antibiotics, however farmers with higher incomes had pointedly higher levels of education and as result may adopt better management practices to improve the general health of their animals at their farm (Redding *et al.*, 2014).

The diffusion of dairy farming practices involving the judicious use of antibiotics is lacking in India due to lack of awareness and surveillance programmes. Large farmers were having better financial conditions and herd size. They were innovative and educated too, so the percolations of efforts to diffuse the prudent use of antibiotics were addressed to them in the target segmentation strategy. Small farmers though need more frequent insight to address the issue of antibiotic resistance but they were having low extension contact and mass media exposure. They were practicing the animal husbandry as per convenience and economic consideration so designing the policies and awareness programmes are necessary at their level of understanding and practices.

Further research

In future, research can be conducted in determining the policies and synthesis of strategies to address the small holder dairy farmers regarding the judicious use of antibiotics. The burden of antibiotic resistance is increased in the world and aggravated by low income and developing countries. So the co-ordination in policy formulation and its implementation should comply with international standards and mandates as mediated by WHO and FAO.

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