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FARMERS' PERCEPTION AND AWARENESS REGARDING CONSTRAINTS AND STRATEGIES TO CONTROL LIVESTOCK DISEASES

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The livestock sector of Pakistan is facing many problems due to which it has low milk productivity as compared to other countries in the world. Livestock diseases are one cause which lower the productivity of this sector and weaken the farmers economically. This study attempts to identify the key constraints which prevent the livestock farmers from controlling livestock diseases. In addition, the study aims to find out the discrepancies in farmers' knowledge about incidence of livestock diseases and the actual situation. Based on the constraints identified in this study, we aim to suggest strategies which can help farmers to overcome the constraints faced in control of livestock diseases. The study was carried out in the districts of Sahiwal, Jhang and Sargodha in Punjab province because these districts have the highest population of buffaloes and cattle. Primary data was collected from 340 livestock farmers by using a multi-stage random sampling technique. In addition, a separate field survey was planned to conduct the clinical testing of diseases to identify the differences in farmers knowledge about diseases and the actual situation. The results of the study indicate that the key constraints toward control of livestock diseases included insufficient finance, low quality and high price of medicines, low level of awareness about diseases, poor availability and facilities of veterinary hospitals, and lapses in vaccination programs and their effectiveness. The knowledge constraint was also confirmed by clinical testing done in the field. To this end, the results revealed a wide discrepancy in farmers' knowledge about incidence of diseases and the actual situation. The study recommends that a comprehensive policy framework is needed to overcome financial, awareness, and access to input/facility constraints in animal disease control.
Keywords: Dairy farmers, livestock diseases, mastitis, tick infestation, constraint analysis.

INTRODUCTION

Livestock rearing and domestication was one of the earliest achievements of mankind. When hunting animals became short in supply, people started to domesticate livestock making their lives less difficult and more secure. Since then, livestock has been serving mankind in many different ways. Livestock continues to be an integral part of Pakistan's agricultural economy. It is the primary activity, along with crop husbandry, in rural areas of Pakistan. This sector contributes 60.5 percent of agriculture value added, and 11.2 percent of GDP of the country (GoP, 2019).

Pakistan occupies second position in possessing number of buffaloes, ninth position in number of cattle, and third position in number of goats. It ranks 4th in terms of milk production in the world. Livestock diseases are one of the major causes of low milk productivity in Pakistan (Ashfaq *et al*., 2015). Given the subsistence nature of Pakistani livestock farmers and the high prices of dairy animals, farmers cannot afford to lose their animals due to rampant diseases. Mortality and low productivity caused livestock disease which posed a great threat to overall well-being of poor farmers (Husnain and Usmani, 2006). There are many fatal diseases in the country which deprive farmers of livestock incomes and put them risk of food insecurity. Farmers do not regularly vaccinate their animals against these diseases which lower dairy production. Consequently, every third cow/buffalo is suffered from mastitis, greatly contributing to loss of milk production. In addition, parasites such as ticks are also lowering the production of sector (Saleem and Ashfaq, 2009). Like any other developing country, Pakistan still has some livestock diseases which have already been long controlled for in developed countries.

The economic losses due to livestock diseases are no less. Although, the national level data on economic losses due to livestock diseases is not available for Pakistan, however, it is estimated that the economic losses caused by subclinical mastitis in the United States alone amount to $1 billion annually (Ott, 1999). Mastitis It is a highly prevalent disease in Pakistan. Ali *et al*., (2011) reported an overall occurrence rate of 44 percent for subclinical mastitis among dairy buffaloes in Punjab province. Similarly, tick infestation is another economically important disease. The annual losses caused by external parasites such as ticks to the US beef cattle

industry amount to $2.4 billion (Tolleson *et al*., 2007). Similarly, diseases like parturient hemoglobinuria and FMD also cause huge economic losses worldwide (DPE, 1996; Arzt *et al*., 2011 a,b).

The current study is motivated by a previous study of Ashfaq *et al.*, 2015 which focused on estimating economic losses due to livestock diseases. In that study, four livestock diseases of economic importance were selected for analysis; mastitis, Parturient Hemoglobinuria, Foot and Mouth disease (FMD), and tick infestation. It was found that farmers faced significant economic losses due to Foot and Mouth Disease (FMD) and tick infestation, both in buffaloes and cattle. The combined per animal economic losses (in buffaloes and cattle) due to these four major livestock diseases were found to be Rs. 24,218 (US$ 237) per year. On the other hand, the return on controlling for livestock diseases (the benefit-cost ratio) was sufficiently high to motivate the farmers to invest in disease control measures. However, the farmers were not fully aware of the extent of economic losses caused by livestock diseases, as it was evident from their attitude toward tick control, which was relatively cheaper, however, most of the farmers did not consider as a disease of economic importance. Ironically, tick infestation was the second most important disease in terms of economic losses. The benefit-cost analysis of disease control measures showed that the returns were sufficiently high for all categories of farmers to incentivize them to control for livestock diseases (Ashfaq *et al.*, 2015). So, the question was why the farmers were still unable to control for the diseases, and the very question led us to plan this study i.e. to identify the constraints which prevent the farmers from going for such control.

Within this backdrop, the prime focus of this study is to identify the key constraints in prevention/control of livestock diseases, and development of strategies to eliminate those constraints in order to control livestock diseases.

MATERIALS AND METHODS

***Description of study area and data collection*:** This study is basically primary data based. Three districts (Sahiwal, Jhang, and Sargodha) from Punjab province were selected purposively on the basis of highest total population of buffaloes and cattle in Punjab (PBS, 2010). The district Sahiwal has 2 *tehsils*, district Jhang has 4 *tehsils*, and district Sargodha has 7 *tehsils*. The location of sampling districts in Punjab province is given in Figure 1.

To account for the geographical variations, all *tehsils* from districts of Sahiwal and Jhang were selected, while 4 out of 7 *tehsils* were randomly selected from district Sargodha. So, data was collected from 4 *tehsils* in Jhang and Sargodha district, and two *tehsils* of Sahiwal district. After the selection of *tehsils*, 3 villages were randomly selected from each *tehsil* of district Sargodha and Jhang, while 5 villages were randomly selected from each *tehsil* of district Sahiwal. The reason for selecting more villages from district Sahiwal was the division of such a large district into two *tehsils* only. In order to capture the differences in farmers' characteristics and practices, we made sure these villages belonged to different Union Councils (UCs). Therefore, our sample came from a total of 34 UCs from the three districts of Jhang, Sargodha, and Sahiwal. Finally, 10 farmers were selected from each village (or UC) by systematic random sampling. Hence, the final sample size was 340 farmers from 34 UCs of three districts in Punjab province. Figure 2 shows the sampling framework and data collection procedure used in this study.

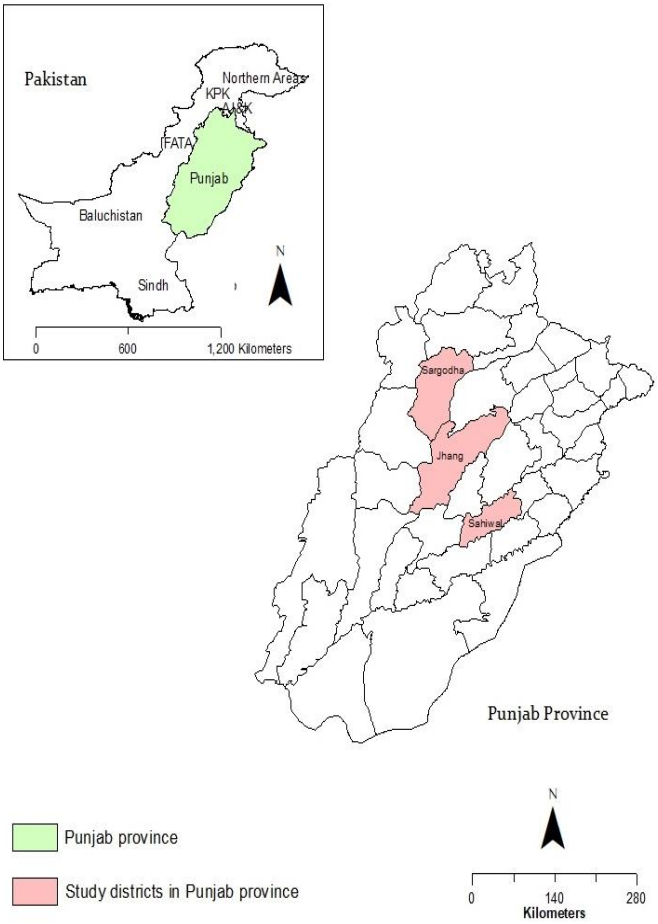

Figure 1. Map of study area.

Data were collected from 340 livestock farmers through pre-tested structured questionnaires. Livestock farmers were categorized as small, medium, or large farmers based on their possession of adult buffaloes and cattle shown in Table 3. Farmers having 1-3 adult animals were categorized as small farmers. Medium farmers were those having 4-6 adult animals and those, having more than 6 adult animals were categorized as large farmers. The categorization of farmers in such a way is also found in Moaeen and Babar (2006) and Ashfaq *et al.* (2015).

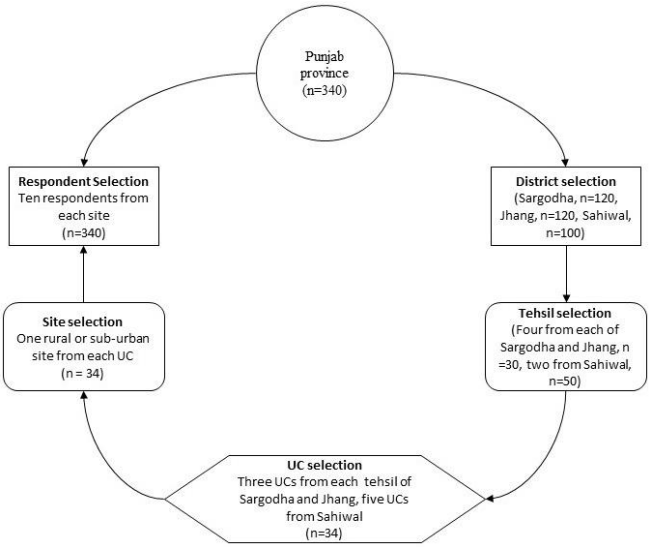

Figure 2. Sampling framework and procedure of data collection.

***Characteristics of sample farmers*:** The number of various farm sizes in the sample from all three districts is presented in Table 1. Most of selected farmers are small (about 55 percent). It implies that farming communities in these districts consists of small, subsistence farmers. It is also worth noting that many farmers, in the small farm category, were landless. In the previous study which was conducted in district Faisalabad (Ashfaq *et al.*, 2015), the majority of randomly selected farmers were also small (48 percent).

Table 1. Number of farms in the sample.

Farm Category	Frequency	Percent
Small	190	55.9
Medium	90	26.5
Large	60	17.6
Total	340	100.0

***Empirical strategy for ranking of constraints*:** This study aims to identify key constraints which prevent farmers from controlling livestock diseases of economic importance. The farmers were asked to prioritize the constraints they face in controlling livestock diseases. Farmers were presented with 17 constraints related to disease control. The feedback of respondents was recorded on a Likert scale of 1 – 5. For instance, a farmer responded with 1 if he 'strongly disagreed' with a statement, and 5 if he 'strongly agreed' with the statement. So the score of 1 meant the constraint was 'least important' and a score of 5 meant the constraint was 'most important'. The recorded scores for each statement/constraint were converted into percentages by using following formula (Farooq *et al.*, 2009);

$$W_i = \frac{X_i}{\sum_{i=1}^{n} X_i} * 100 \qquad (1)$$

Where, W*i* = Percent score of *ith* constraint in controlling livestock diseases, X*i* = Score of *ith* constraint in controlling livestock diseases, $\sum X_i$ =Total sum of scores of all the constraints in controlling for livestock diseases, i =1, 2, 3….. etc. are the constraints in controlling for livestock diseases

The constraints for which the percent scores were greater than the average percent score on the all the constraints (for instance for all the constraints on diseases component), were considered as the severe constraints. The remaining constraints were not considered as severe constraints. This categorization was adopted for the disease component. The constraints having a percent score of equal to or greater than 5 percent were considered as severe constraints, whereas the constraints having a score of equal to or greater than 4.35 percent but lower than 5 percent were considered as moderate constraints.

***Assessment of farmers' perception about livestock diseases via objective testing for the incidence of diseases*:** A unique feature of this study, in contrast to our previous study (Ashfaq *et al*., 2015), was to assess the farmers' perception about livestock diseases through objective clinical testing for the diseases in the field. With the help of a veterinary expert, an additional survey round was arranged to test for mastitis and tick infestation on the animals of already surveyed farmers. The other two diseases i.e. parturient hemoglobinuria and FMD were not tested for because the symptoms of the former are too obvious to test for farmers' perception while the latter is purely seasonal. In addition, there was no incidence of FMD at any farm at the time of the survey.

Surf field mastitis test (SFMT), as described by Muhammad *et al*. (2010), was used to test for incidence of mastitis. For the incidence of tick infestation, a magnifying glass was used to observe the tick load on animals of selected farmers. A well-structured questionnaire was used to assess farmers' awareness about diseases, attitude toward treatment, treatment methods, and for recording the results of clinical testing.

RESULTS AND DISCUSSION

***Descriptive statistics of livestock farms in the sample*:** The socioeconomic characteristics of farmers including age, livestock farming experience, education, and family size are provided in Table 2. These results are generally in line with the results of the previous study (Ashfaq *et al.*, 2015). The farmers are on average are 40 years old and their livestock experience is a little more than half of their age which is an interesting finding.

Education levels are generally low among all farm categories (about 7 years of schooling). However, large farmers are more educated than small farmers. They have 9 years of schooling as compared to about 5 years of schooling for small farmers. The family size of farmers is proportional to the farm size category as the large farmers have larger family size than the

Table 2. Socioeconomic characteristics of livestock farmers.

General Information	Farm Category			
	Small	**Medium**	**Large**	**Overall**
Age (Years)	40.92 (14.3)	41.28 (13.9)	40.63 (14.1)	40.97 (14.1)
Livestock Farming Experience (Years)	23.43 (14.2)	23.38 (14.2)	23.46 (13.9)	23.42 (14.2)
Schooling (Years)	5.87 (4.3)	7.77 (3.8)	9.22 (3.7)	6.96 (4.3)
Family Size (No.)	7.56 (3.6)	9.63 (5.8)	10.02 (4.6)	8.54 (4.6)
Family Type (%)				
Nuclear	42.5	18.3	15.0	75.8
Joint	4.2	5.8	13.3	23.3
Extended	0.00	0.8	0.00	0.8
Owned Land (Acres)	3.65 (5.9)	9.45 (15.1)	20.59 (17.7)	8.56 (13.5)
Operational Landholding (Acres)	4.51(5.6)	11.49 (12.3)	22.38 (18.1)	9.51 (12.5)
Area of Animal Farms (Marlas)	11.34 (9.9)	21.11 (17.9)	44.38 (36.1)	19.76 (22.6)
Animal Shed Area (Marlas)*	3.19 (2.5)	5.67 (4.4)	14.05 (13.1)	5.76 (7.4)

*Area of Animal farms is Pens and Facilities for livestock. 1 acre = 160 marlas, Figures in parenthesis show std. deviations

small farmers. This result is partly due to higher proportion of large farmers living as joint families. The land ownership of farmers is also proportional to the farm size category chosen in this study. Although, our classification of small, medium, and large farmers is based on number of animals, this result shows that land ownership is linked with the number of animals at a farm. Finally, the area of animal farms and shed area of those farms is also proportional to the far size category. Large farmers have large animal farms and build large sheds for their animals.

In Table 3, the inventory of buffaloes and cattle is provided. Overall, farmers had more adult buffaloes (2.31 buffaloes per farm) at their farms than adult cattle (1.78 cattle per farm). The other animals are included for more context. Another interesting result here is the existence of very few numbers of bulls at farms. This finding shows that farmers cannot afford to feed a bull because they do not consider it as productive as buffalo and cattle. They usually sell it to the butcher before it becomes an adult. The difference in means values of number of animals at small, medium, and large farms was statistically tested using one-way ANOVA. The results show that mean differences for animals are statistically significant at small, medium, and large farms.

Table 3. Buffaloes and cattle inventory.

Animals	Farm Category				
	Small	**Medium**	**Large**	**F (p-value)**	**Overall**
Buffaloes					
Adult	0.98	2.91	5.62	113.0 (0.00)	2.31
Heifer	0.49	1.04	2.47	33.23 (0.00)	0.99
Bulls	0.04	0.14	0.47	21.74 (0.00)	0.14
Calves	0.62	1.79	3.18	58.24 (0.00)	1.38
Cattle					
Adult	0.83	1.80	4.78	93.80 (0.00)	1.78
Heifer	0.39	0.61	1.20	14.86 (0.00)	0.59
Bulls	0.19	0.67	0.38	4.96 (0.01)	0.35
Oxen	0.08	0.07	0.28	6.78 (0.00)	0.11
Calves	0.59	1.09	2.97	53.78 (0.00)	1.14

The productivity of dairy animals also depends on their daily water intake. Studies have shown that dairy animals watered more frequently or freely produce more milk (Etgen and Reaves, 1978; Ali *et al.*, 2011). However, the results of watering frequency and type of water access in this study indicated a poor situation (Tables 4). On average, farmers water their animals 2.55 times a day. Ali *et al.*, 2011 showed that Sahiwal cattle watered 3 times a day produce more milk than those watered two times a day. Further, the results of ANOVA show that mean differences for watering frequency among small, medium, and large farmers were not statistically significant.

Table 4. Daily watering frequency for animals.

Farm Category	Watering Frequency
Small	2.53
Medium	2.67
Large	2.45
Total	2.55

Note: The results of ANOVA show that mean differences are not significant (F=2.85, p=0.059).

The practice of providing free water access was not prevalent in small and medium farms. However, our results indicate that about 26 percent of large farmers provided free water access to their animals. This outcome may also be related to size of livestock farms, as large farmers had spacious farms for their animals (Table 5).

Table 5. Type of water access (percent).

Farm Category	Free Water Access		Total
	Yes	**No**	
Small	2.1	97.9	100
Medium	10.0	90.0	100
Large	26.7	73.3	100
Total	8.5	91.5	100

***Key constraints in controlling livestock diseases*:** One of the main objectives of this study is to identify the constraints in controlling livestock diseases. The main constraints in controlling the diseases reported by farmers in percent scores are presented in Table 6. Overall, the primary constraints faced by farmers included the insufficient financial resources, low quality and high price of medicine, late diagnosis and lack of awareness about diseases, unavailability of veterinary hospitals in the villages, disease outbreaks, and insufficiency and ineffectiveness of vaccination.

When the results were compared across farm size categories, it can be seen from Table 6 that large farmers did not report insufficient finance as a constraint. This probably means that they are more affluent than the other two categories. In addition, large farmers did not report the unavailability of veterinary hospitals as a constraint. This might be due to their increased access to private doctors working in the area. Similarly, perhaps due to same reasons the large farmers did not report the unavailability of qualified doctors and veterinary staff in the hospitals as a constraint in controlling for the diseases. The results further indicate that small and medium farmers reported the ineffectiveness of vaccination done by the livestock, however, it was not reported by the large farmers. This could mean that large farmers rely on private vendors for vaccination or the veterinary staff provides different quality of vaccination for small and large farmers. During the field survey, most of the small farmers reported that their animals fell prey to the disease despite vaccinating their animals against FMD and hemorrhagic septicemia.

The results also indicate the issues in quality and prices of medicines. Farmers reported that quality of medicine they purchased from the market was low while its prices were very high. It was also the reason for some of the farmers to rely on traditional methods of treatments for many diseases. Further, the farmers reported that they were not aware of the symptoms

Table 6. Constraints in animal disease control (percent score).

Constraints in disease control	Farm category			Overall
	Small	Medium	Large	
Insufficient financial resources	6.63	6.26	-	6.22
Low quality of medicine	6.28	6.09	6.40	6.25
High price of medicine	6.50	6.33	6.17	6.40
Late diagnosis of disease	6.12	-	6.27	6.07
Lack of awareness about diseases	6.24	5.97	6.17	6.16
Unavailability of veterinary hospitals	6.19	6.69	-	6.25
Unavailability of qualified doctors in vet. hospitals	-	-	6.15	-
Insufficient staff in veterinary hospitals	-	-	6.07	-
Disease outbreaks	6.26	6.25	6.42	6.29
Insufficient vaccination by livestock department	6.13	5.95	6.00	6.06
Vaccination is not effective	6.31	6.35	-	6.06

Table 7. Awareness about symptoms of mastitis.

Question	Responses	Statistic	Farmer Category			Total
			Small	Medium	Large	
Are you aware about symptoms of mastitis?	Yes	Frequency	43	25	19	87
		Percent	68.3	75.8	79.2	72.5
	No	Frequency	20	8	5	33
		Percent	31.7	24.2	20.8	27.5
Total		Frequency	63	33	24	120
		Percent	100	100	100	100

Table 8. Farmers' attitude toward treatment of mastitis.

Question	Responses	Statistic	Farmer Category			Total
			Small	Medium	Large	
Did you treat your animal?	Yes	Frequency	17	15	11	43
		Percent	100	100	100	100
	No	Frequency	0	0	0	0
		Percent	0	0	0	0
Total		Frequency	17	15	11	43
		Percent	100	100	100	100

of most diseases until it became severe, and they had to bear high expenditures afterwards. The occurrence of disease outbreaks was also reported to be one of the main reasons for the incidence of diseases. Farmers also reported that not all farmers vaccinated their animals against diseases. Therefore, the occurrence of diseases on such farms affected others farms as well. So, the negligence of one farmer could affect the whole area.

***Farmers knowledge about livestock diseases and their economics losses, and attitude toward treatment of livestock diseases*:** A unique feature of this study, in contrast to our previous study (Ashfaq *et al*., 2015), was to assess the farmers' perception about the incidence of livestock diseases and compare these perceptions with actual disease prevalence discovered through objective clinical testing for the diseases in the field. With the help of a veterinary expert, an additional round of survey was arranged to test for mastitis and tick infestation on the animals of surveyed farmers. The details of this survey are provided earlier in the methodology section and the analytical results are described in the following paragraphs.

***Mastitis*:** The results of farmers' awareness about symptoms of mastitis are reported in Table 7. The results show that the levels of awareness increase across farm size, from small to large. Large farmers seem to be more aware about the symptoms of mastitis than small farmers. This could be due to generally higher levels of schooling among large farmers (Table 2).

The results further indicate that all farmers have tried to treat their animals for mastitis (Table 8). The results show that 100 percent of the farmers in all farm size categories stated that they treated their animals for mastitis. This could be due the fear of permanent productivity loss due to mastitis, which significantly reduces the value of the animal.

When asked about the harmful health-related effects of mastitis milk, all farmers reported that milk from the mastitis-affected teat during the course of disease was harmful (Table 9). They further stated that they discarded the milk obtained from the affected teats.

Although fully aware about the harmful of effects of mastitis milk, farmers were not fully aware about subclinical mastitis – a type of mastitis for which the symptoms are not visible. However, the awareness regarding subclinical mastitis also increased across farm size, moving from small to large (Table 10). The results show that about 84 percent of large farmers had knowledge of subclinical mastitis, as compared to 73

Table 9. Awareness about harmful effects of mastitis milk.

Question	Responses	Statistic	Farmer Category			Total
			Small	Medium	Large	
Do you know mastitis milk is harmful?	Yes	Frequency	63	33	24	120
		Percent	100	100	100	100
	No	Frequency	0	0	0	0
		Percent	0	0	0	0
Total		Frequency	63	33	24	120
		Percent	100	100	100	100

Table 10. Awareness about sub-clinical mastitis.

Question	Responses	Statistic	Farmer Category			Total
			Small	Medium	Large	
Do you know about subclinical mastitis?	Yes	Frequency	46	26	20	92
		Percent	73	78.8	83.3	76.7
	No	Frequency	17	7	4	28
		Percent	27.0	21.2	16.7	23.3
Total		Frequency	63	33	24	120
		Percent	100	100	100	100

Table 11. Incidence of mastitis as perceived by farmers.

Question	Responses	Statistic	Farmer Category			Total
			Small	Medium	Large	
Does any of your animal currently has mastitis?	Yes	Frequency	8	7	9	24
		Percent	12.7	21.2	37.5	20.0
	No	Frequency	55	26	15	96
		Percent	87.3	78.8	62.5	80.0
Total		Frequency	63	33	24	120
		Percent	100	100	100	100

Table 12. Incidence of mastitis detected by Surf Field Mastitis Test.

Test	Test Result	Statistic	Farmer Category			Total
			Small	Medium	Large	
Incidence of Mastitis	Positive	Frequency	21	15	16	52
		Percent	33.3	45.5	66.7	43.3
	Negative	Frequency	42	18	8	68
		Percent	66.7	54.5	33.3	56.7
Total		Frequency	63	33	24	120
		Percent	100	100	100	100

Table 13. Discrepancy in farmers' perception about incidence of mastitis and actual situation.

Variable	Discrepancy	Statistic	Farmer Category			Total
			Small	Medium	Large	
Discrepancy in perception and real situation about incidence of mastitis	Discrepancy exists	Frequency	13	8	7	28
		Percent	20.6	24.2	29.2	23.3
	Discrepancy does not exist	Frequency	50	25	17	92
		Percent	79.4	75.8	70.8	76.7
Total		Frequency	63	33	24	120
		Percent	100	100	100	100

Table 14. Awareness among farmers about economic losses caused by tick infestation.

Question	Responses	Statistic	Farmer Category			Total
			Small	Medium	Large	
Are you aware Ticks cause economic losses?	Yes	Frequency	44	26	21	91
		Percent	69.8	78.8	87.5	75.8
	No	Frequency	19	7	3	29
		Percent	30.2	21.2	12.5	24.2
Total		Frequency	63	33	24	120
		Percent	100	100	100	100

percent of small farmers. Overall, about 77 percent of farmers were aware of subclinical mastitis. The reason for the difference in awareness level regarding subclinical mastitis among small and large farmers may be the difference in schooling levels, as well as the difference in access to extension services.

Finally, farmers were asked about the incidence of mastitis in their animals at the time of survey. About 20 percent farmers reported the ongoing incidence of mastitis in some of all of their adult milking animals (Table 11). The higher incidence was reported among large farmers as compared to small farmers.

Table 15. Farmers' perception about severe risk population of ticks.

Farmer Category	Population of Ticks considered as Severe Risk by Farmers (Mean)	Frequency (Farmers)
Small	39.27	63
Medium	39.55	33
Large	40.00	24
Total	39.49	120

However, contrary to Table 11, the results of the SFMT revealed a different picture. When tested in the field, about 43 percent of farms were found to be affected by subclinical mastitis (Table 12).

It can be seen from Table 12 that about 23 percent farmers were wrong in their perceptions regarding incidence of mastitis on their farms; they were not aware of the fact that their animal was suffering from mastitis at the time of the survey. Interestingly, this discrepancy increases across farm sizes, moving from small to large; meaning despite relatively higher levels of education, large farmers were more incorrect in their perceptions. This wrong perception about the disease could lead to huge economic losses, if the results are generalizable for other districts of Punjab.

***Tick infestation*:** A similar approach as described above was used for identifying farmers' perception about tick infestation. The results of the analysis are reported in Tables 14 through 20.

As reported in our previous study (Ashfaq *et al.*, 2015), farmers in these three districts were not fully aware about the economic losses caused by tick infestation (Table 14). About 30 percent of small farmers did not even consider tick

infestation as a disease of economic importance. However, a higher proportion of large farmers (about 88 percent) was aware about the economic losses caused by tick infestation. This difference in perceptions of tick infestation could yet again be due to the differences in education levels of small and large farmers, as well the different levels of access to extension services. It was observed during the field survey that most of the large farmers had someone from the private sector visiting their farms to provide extension services.

Farmers were asked about what level of the number of ticks present on animals was considered a severe risk. The results

Table 16. Farmers' attitude toward treating tick infestation

Question	Responses	Statistic	Farmer Category			Total
			Small	Medium	Large	
Do you treat your animal for tick infestation?	Yes	Frequency	55	31	23	109
		Percent	87.3	93.9	95.8	90.8
	No	Frequency	8	2	1	11
		Percent	12.7	6.1	4.2	9.2
Total		Frequency	63	33	24	120
		Percent	100	100	100	100

Table 17. Various methods of treatment used by farmers for treating tick infestation.

Question	Treatment Method	Statistic	Farmer Category			Total
			Small	Medium	Large	
What method do you use for treatment of tick infestation?	Vet. Care	Frequency	35	23	20	78
		Percent	55.6	69.7	83.3	65.0
	Manual Removal	Frequency	17	7	4	28
		Percent	27.0	21.2	16.7	23.3
	Oils etc.	Frequency	8	2	0	10
		Percent	12.7	6.1	0	8.3
	Others	Frequency	3	1	0	4
		Percent	4.8	3.0	0	3.3
Total		Frequency	63	33	24	120
		Percent	100	100	100	100

Table 18. Interval of treatment for tick infestation.

Question	Treatment	Statistic	Farmer Category			Total
			Small	Medium	Large	
After how many days do you apply treatment?	Within 1 Week	Frequency	17	16	17	50
		Percent	27.0%	48.5%	70.8%	41.7%
	Within 2 Weeks	Frequency	40	15	6	61
		Percent	63.5%	45.5%	25.0%	50.8%
	Within Weeks	Frequency	6	2	1	9
		Percent	9.5%	6.1%	4.2%	7.5%
Total		Frequency	63	33	24	120
		Percent	100.0%	100.0%	100.0%	100.0%

Table 19. Incidence of tick infestation

Question	Response	Statistic	Farmer Category			Total
			Small	Medium	Large	
Was there a recent tick attack on your animals?	Yes	Frequency	57	28	18	103
		Percent	90.5	84.8	75.0	85.8
	No	Frequency	6	5	6	17
		Percent	9.5	15.2	25.0	14.2
Total		Frequency	63	33	24	120
		Percent	100	100	100	100

Table 20. Discrepancy in perception about current tick load and actual situation observed by researchers.

Question	Response	Statistic	Farmer Category			Total
			Small	Medium	Large	
Discrepancy in tick load perceived by farmers and actually observed by researchers	Yes	Frequency	29	18	15	62
		Percent	46.0	54.5	62.5	51.7
	No	Frequency	34	15	9	58
		Percent	54.0	45.5	37.5	48.3
Total		Frequency	63	33	24	120
		Percent	100	100	100	100

are reported in Table 15. All three categories of farmers reported a population of 40 ticks per animal as a severe risk. Of those who considered ticks a disease of economic importance, about 87 percent of small farmers stated that they treat their animals for tick infestation (Table 16), while about 96 percent of large farmers treated their animals for tick infestation. Overall, 10 percent of farmers did not treat their animals for ticks. This attitude could translate to high economic losses when seen on a larger scale (e.g. in all districts of Punjab province). Since Ashfaq *et al*. (2015) found ticks to be the most important disease in causing economic losses, therefore, this attitude has serious negative consequences.

Farmers used a variety of methods to treat for tick infestation. The most effective method is thought to be veterinary care, but a small percentage of small farmers used this method as compared to the large farmers (Table 17). Instead of using a clinical method for curing tick infestations, about 27 percent of small farmers relied on manual removing of ticks – which is a partial cure. Though they manually remove ticks, they seldom are able to remove all the ticks from an animal.

When asked about the interval between the incidence of disease and the application of treatment, the results were different for different categories of farmers (Table 17). Most of the farmers (about 70 percent) applied the treatment in timely fashion, i.e. within one week of the infestation. However, only 27 percent of small farmers applied the treatment timely. Most of them (about 63 percent) applied the treatment within 2 weeks. This is in line with their low level of awareness about the economic importance of tick infestation.

According to the farmers perceptions, there was a higher incidence of tick infestation among animals of small farmers (about 90 percent), as compared to animals of large farmers (about 75 percent) (Table 19). The overall incidence of tick infestation was about 85 percent which could be a cause of huge economic losses considering the higher economic importance of tick infestation (Ashfaq *et al*., 2015).

Finally, the results of objective testing for incidence of tick infestation on animals revealed significant discrepancies between farmers' perceptions and the actual situation. The results are reported in Table 20. The results show that about 46 percent of small farmers were wrong in their perceptions of tick load intensity. They considered the load intensity of ticks to be low, while the observed intensity by researchers was found to be quite high. Again, there is a surprising finding here. As we move across farm size, from small to large, the incorrect perceptions increase dramatically. About 62 percent of large farmers were wrong about the tick load intensity, as compared to about 46 percent of small farmers. This could be due to the large herd sizes of large farmers, and that they do not monitor all of their animals for tick load intensity. Because the small farmers have fewer animals, they are more aware about the tick load intensity of their animals.

***Strategies to control for livestock diseases*:** Based on the above analysis, the following strategies to control for livestock diseases can be suggested. We found that many of the small and medium farmers said they were unable to control for animal diseases due to insufficient finances. As well, the highest percentage of farmers, from all three groups, said that the high price of medicine was a significant constraint to disease control. This could lead to farmers not following the full treatment as proscribed and only applying the initial treatment. Consequently, the animal could not recover fully, and the diseases would come back or the damage become permanent e.g. in case of mastitis. A solution to this problem, in the context of disease control, could be the provision of soft loans to livestock farmers especially for treatment purposes. Other forms of this intervention may be the provision of medicine on credit. Milk collection centers present in most of the villages could be taken on board to provide this facility. The farmers could then pay back the loans by selling milk to the collection centers.

Farmers complained about the quality of medicine being low and prices being high. For these reasons, farmers were reluctant to buy medicine. Some farmers stated that they had no faith in veterinary treatment, and they were only relying on traditional methods of treatment. However, the results of this kind of treatment are not satisfactory. According to farmers, there was a huge variation in prices and quality of medicines being sold in the market. The livestock department could take solid measures toward quality control of the medicines available in the markets. These measures could be helpful in incentivizing farmers to buy medicine for treating their animals.

Another common constraint in animal disease control was late diagnosis of diseases. Farmers stated that they were not fully aware of the symptoms of diseases. Therefore, it was difficult to control a disease once it was past its initial stage. After the initial stages, it required more expenditures for treatment, and sometimes they had to slaughter their animals. Lack of awareness about diseases was identified as a major constraint toward controlling for the livestock diseases during the survey. To bridge this gap, awareness campaigns might be launched on a seasonal basis. For instance, during times associated with FMD outbreaks, which is mostly in the rainy seasons, 'farmer field days' should be conducted prior to that. The literature about prevention, symptoms, and treatment of diseases should also be distributed in villages. Livestock extension workers could be hired on contractual basis for this task.

The unavailability of veterinary hospitals, qualified doctors, and veterinary staff were also identified as important constraints. There are veterinary hospitals at the union council levels, but the staff in the hospitals is insufficient. Farmers did not even visit these hospitals, because they had developed a negative perception about them. Farmers stated that those hospitals only served the influential farmers. Whenever a poor farmer visited, either the doctor was not available or the medicine was out of stock. Ultimately, the small farmers only relied on private vendors for treatment, which was expensive. These veterinary hospitals could be made functional to serve an expanded base of farmers. In some cases, a single hospital was found to be serving a large area. The distance to veterinary hospitals stopped farmers from visiting the hospital. Mobile veterinary staff should be available in the hospitals. It is necessary to provide better public veterinary services to farmers to eradicate disease.

The disease outbreaks and insufficiency and ineffectiveness of vaccination against endemic diseases were also identified as major constraints toward controlling diseases. The livestock department could do a far better job to improve the vaccination rates at livestock farms. The practice of adulteration of vaccines should be discouraged, and severe penalties be introduced. A full coverage of livestock farms is necessary to stop an outbreak. Follow-up visits could be made to the farms left out in the first attempt. When just a few of the farms are not vaccinated, the possible endemic affects the other farms.

***Conclusions*:** The livestock sector of Pakistan shown a positive growth for many years, and it contributes more than half of total agricultural value added of the country. However, the performance of the livestock sector is not sufficient to keep up with the growing milk demand of the country's population. Livestock diseases are one of the main reasons for lower productivity of this sector. This study aims at identifying the key constraints in controlling for the livestock diseases and developing strategies to control diseases. The livestock sector of Punjab mostly consists of small farmers possessing 1-3 adult animals, which lack in education and perform poorly in other socioeconomic indicators. The key constraints perceived by farmers toward controlling for the livestock diseases include insufficient finance, low quality and high price of medicines, low level of awareness about diseases, poor availability and facilities of veterinary hospitals, and lapses in vaccination programs and their effectiveness. The study also showed that there is a wide discrepancy in what farmers perceive about the incidence of diseases and the actual situation at their farms. The testing for diseases in the field confirmed that farmers are not fully aware about the incidence of mastitis and tick infestation.

It is imperative to take a corrective action regarding the situation of livestock diseases at farms. Keeping in view the results of this study, the following policy recommendations can be made to eliminate constraints in controlling for the livestock diseases:

- The majority of the farming community consists of cash starved, small farmers, which is also identified as key constraints toward controlling for livestock diseases. Therefore, alleviating financial solutions should be sought to address the issue of diseases. Farmers could be provided with medicine on credit or easy installments. Microfinance or the cooperative credit schemes could also be proven helpful in this regard.
- The low quality of medicine, and its high price came out as key constraints toward controlling diseases. Veterinary drug policy reforms could be introduced to eliminate these issues.
- Farmers lack awareness, and there exist wide discrepancies in their perception and actual incidence of diseases. This knowledge gaps needs to be bridged with effective awareness campaigns.
- The poor veterinary facilities and the insufficient and non-qualified staff impede the farmers' ability to control for diseases. It is time to overhaul the veterinary care provided at the public level.
- Vaccination campaigns lack vigor and effectiveness. New policy could focus on improving these conditions. The new vaccination campaigns should be focused on providing full coverage rather than the sparse coverage provided now.

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