P-ISSN: 2304-3075; E-ISSN: 2305-4360
International Journal of Veterinary Science
www.ijvets.com; editor@ijvets.com

Research Article

Effect of Water Quality Parameters on Some Health and Reproductive Indicators in Cattle Farms Associated Emerged Epidemics in Egypt

Kamal MA[1], Khalaf MA[1], Zakia AM Ahmed[1]* and JK EL-Jakee[2]

[1]Department of Veterinary Hygiene and Management, Faculty of Veterinary Medicine, Cairo University, 11221, Giza, Egypt; [2]Department of Microbiology, Faculty of Veterinary medicine, Cairo University, 11221, Giza, Egypt
***Corresponding author:** zakia.ahmed@vet.cu.edu.eg

Article History: Received: June 11, 2019 Revised: July 03, 2019 Accepted: July 13, 2019

ABSTRACT

Drinking water of bad quality plays detrimental role in suppression of cattle immunity, causing health and reproductive problems, giving chance for increasing rate of emerged epidemics and resulting in high rates of morbidity and mortality. The present study aimed to evaluate rate of emerged epidemics with different health and reproductive indicators in cattle farms in relation to drinking water quality in these farms. Structured questionnaire is used to survey convenience sample of 132 Egyptian cattle beef and dairy farms suffering emerged epidemics to identify different risk factors and hygienic standards which may affect cattle health and reproduction. 132 water samples were collected for physiochemical and microbial analysis. Statistical analysis was performed to identify the level of association between each water quality parameter and number of emerged epidemics, health and reproductive indicators in each farm. Results revealed that large percent (78.8, 30.3, 70.5, 48.5, 15.9, 13, 86.3, 86.3 %) of the survey farms showed levels of pH, TDS, Hardness, Chloride, Nitrate, Sulfate, TCC and Coliform, respectively out of the permissible limits. Statistical analysis shows moderate positive correlation (rho 0.3-0.7) between number of emerged epidemics and all farm indicators with all water parameters except pH in both winter and summer season. Each farm indicator has specific water parameters that predict its value better, but water nitrate level was the highest predictor of all farm indicators with highest Beta value (0.5-0.8), followed by TDS, hardness, chloride, sulfate and microbial count. Weak to moderate correlation (rho 0.1-0.4) was found with some farm risk factors such as housing system, bedding type, water source type, water tanks and pipes type, drinker lining type, herd size, operation type, pregnancy detection and breeding methods. We could conclude that drinking water quality highly affects the rate of emerged epidemics and different farm health and reproductive indicators, but we cannot exclude the effect of some risk factors and hygienic standards inside each farm.

Key words: Drinking water quality, Cattle farms, Emerged epidemics, Hygiene, Risk factors

INTRODUCTION

Water as an essential nutrient is second only to oxygen in importance to sustain life and optimize growth, lactation, and reproduction of cattle (Beede, 2006). The water requirement per unit body mass of a cattle is greater than that of any other land-based mammal (Murphy, 1992).

Seventy to 97% of total water consumption by cattle was from drinking water (Dahlborn *et al.*, 1998). In addition to the quantity of water that cattle needs, the quality of their drinking water is also important, because it affects productivity and health. Water quality is affected by its source and contamination from abiotic and biotic factors as a result of either dissolved nutrients or direct deposition of urine or fecal material. Water from deep wells or springs may have a high salt content if it originates from marine shales while dugouts and ponds are recharged mostly from surface water runoff or ground water that contains variable amounts of dissolved nutrients (Olson *et al.*, 1997).

The quality of drinking water provided for cattle is usually evaluated according to five major aspects, among these five components, physiochemical characteristics (including pH, TDS and Hardness), the presence of excessive amounts of minerals (such as nitrates, chloride, sulfates), and microbial content (total colony count TCC, and total coliform), are the most detrimental agents lowering the quality of the drinking water (Willms *et al.*, 2002).

Cite This Article as: Kamal MA, MA Khalaf, ZAM Ahmed and JK EL-Jakee, 2019. Effect of water quality parameters on some health and reproductive indicators in cattle farms associated emerged epidemics in Egypt. Inter J Vet Sci, 8(4): 275-282. www.ijvets.com

These water quality parameters, by variable mechanisms, affect cattle herd's health, immunity, morbidity, mortality rate and number of emerged epidemics in that herd (Alves *et al*., 2017; Mohamed, 2016). Also, water quality parameters affect other farm indicators such as 1) some health indicators as culling, mastitis and lameness rate which normally must not exceed 10%, 5%, and 3%, respectively (Mohd Nor *et al*., 2015). 2) some reproductive performance indicators as average days open (DO), average number of inseminations per conception (NIPC), conception and infertility rate which normally must be 115-125 days, < 2.5, > 40%, < 8%, respectively (Mohamed *et al*. 2015). 3) some reproductive problems indicators as dystocia, retained placenta (RP), metritis and abortion rate which normally must not exceed 10%, 2%, 10%, 4%, respectively (Mohd Nor *et al*., 2015).

Rates of epidemics and Farm indicators are also affected by season, hygienic standards and other risk factors such as operation type, cattle breed, housing factors, water distribution system (Makris *et al*., 2014).

The aim of the study is to survey some dairy and beef farms which have emerged epidemics in Egypt and assess the quality and health aspects of water intended for cattle consumption and find if there is association between rate of emerged epidemics, health and reproductive problems, and the presence of some drinking water contaminants which cause sever health and performance problems.

MATERIALS AND METHODS

Field survey

Study area and period: A field study was conducted during period from October 2016 to September 2018 in four districts, all over Egypt; West Delta (Behira, Alex desert road), Middle Delta (Monoufia, Gharbia), East Delta (Kaluobia, Sharkia, Dakahlia, Ismailia desert road), Upper Egypt (Fayoum, Beni-Suef, Minya). Representative water samples were collected from water troughs in adult animal houses, at beef farms (n = 60), dairy farms (n = 60), and dairy beef mixed farms (n = 12), total 132 farms in the investigated area.

Study design: The protocol of the study involved steps that aimed to investigate the hygienic quality of drinking water in both beef and dairy cattle farms located in different areas in Egypt and suffering from emerged epidemics. For this purpose, a structured questionnaire was assembled. The obtained data was analyzed to identify the risk associated with the occurrence and spreading of emerged epidemics in these areas.

Questionnaire survey: A structured questionnaire was prepared including full farm identification and information regarding to prevalence and risk indicators of emerged epidemics in dairy and beef herds including those attributed to both cows and farm. house attributes (housing type, contact with other animals, waste handling, carcass disposal methods and bedding type), water attributes (water source, tanks type, pipes type and drinkers lining type), disinfection attributes (wheel dip, foot dip, hoof dip and teat dip), data related to recorded emerged epidemics, rate of morbidity and mortality, health indicators (culling rate, lameness, clinical mastitis), reproductive performance indicators (Mohamed *et al*. 2015) (average days open (DO), average number of inseminations per conception (NIPC), conception, infertility rates), reproductive problems indicators (Mee, 2008) (dystocia, retained placenta, metritis and abortion rate). All data were obtained from clinical records of the farm and interviews with the owners and veterinarians.

Cattle farms descriptions: In most of study dairy and large beef farms, the housing type is loose/free stalls in which the animals are kept in separate yards and each yard is provided with manger and water trough located under sheds. The animals are left free in a yard with area of about 7-10 square meters per head. Yards were not provided with drainage system resulting in accumulation of manure except only one closed farm which keep cows in cubicle/free stalls. Water was available at all time. The hygienic measures prevailed in these farms were fair.

Water sampling: A total of 132 water samples collected from 132 survey cattle farms. Water samples were collected equally in winter (Dec., Jan., Feb.) and summer (Jun., July., Aug.) seasons from all survey farms. Samples collected in clean, dry, one-liter capacity; screw capped plastic bottles for physiochemical examination. For microbiological analysis, clean, dry, sterilized screw capped glass bottle of 1 L capacity in hot air oven at 170° C for 60 min were used, the container was rinsed several times with the water that to be sampled before collection (HACH, 2003). Samples were stored at 4°C and analyzed within 48 h of samples collection. Each sample labeled and transferred to lab within two hours.

Laboratory examination of water samples

Chemical examination: according to (APHA, 1998). pH values by electrometric pH meter (pHep® HI 98107- Italy). Total Dissolved Solids (TDS) using waterproof EC/TDS/NaCl % /°C meter (HI 9835- Italy). Total hardness by "EDTA titrimetric method". Chlorides (CL) by "Argentometric method". Nitrate (NO3) and Nitrate-nitrogen (NO3-N) by " Ultraviolet Spectrophotometric Screening Method ". Sulphates (SO4) by" The gravimetric methods with drying of residues".

Microbiological examination of water samples: Total Colony Count (TCC) using pour plate method, Total Coliform Count using multiple tube fermentation technique (APHA, 1998).

Statistical and data analysis

1. Data analysis: Data and results were collected and computed using Microsoft Excel 2016.
2. Statistical analysis: For analysis of data, Statistical Package for Social Sciences software, version 25.0 (SPSS Inc., Chicago, IL) was used. Initially, all information gathered via questionnaire was coded into variables. Normality of data was tested using Kolmogorov-Smirnov test. Both descriptive and inferential statistics involving Wilcoxon signed rank test, Kruskal Wallis H test and Linear regression were used to present results. Effect size was calculated by cohen's d and Eta Squared value. For each test, a P-value of less than 0.05 was considered

statistically significant according to (Campbell and Swinscow, 2009).

RESULTS

Survey applied on 46 farms in West Delta (17 in Behira, 29 in Alex desert road),12 farms in Middle Delta (6 in Monoufia, 6 in Gharbia), 52 farms in East Delta (6 in Kaluobia, 7 in Sharkia, 6 in Dakahlia, 33 in Ismailia desert road), 22 farms in Upper Egypt (16 in Fayoum, 6 in Beni-Suef and Minya).

Cattle operations in the survey: Table 1 includes information on herd size and operation type. Overall, 2.3% of the cattle operations were classified as small (<100 cattle), 40.9% were medium (100 to 500 cattle), and 56.8% were large (>500 cattle).

Table 1: Number (%) of herds classified by size and operation type.

Operation type	Values by herd size [a]			Total
	Small	Medium	Large	
Dairy	1 (0.8)	27 (20.5)	32 (24.2)	60 (45.5)
Beef	1 (0.8)	25 (18.9)	34 (25.8)	60 (45.5)
Mixed	1 (0.8)	2 (1.5)	9 (6.8)	12 (9.1)
Total	3 (2.3)	54 (40.9)	75 (56.8)	132

[a] Small, <100 head; medium, 100-500 head; large, >500 head.

The questionnaire survey including: a total 132 questionnaires which collected one from each farm. They revealed the number of different description items and risk factors in survey farms. Descriptive statistics for each item in the questionnaire are given in Table 2.

The study survey recorded numbers of emerged epidemic including one or more of these epidemics (FMD, LSD, BEF, IBR, BVD) in each farm, with variable morbidity and mortality rates. Also, recorded farm indicators frequencies, such as culling, lameness, mastitis, conception, DO, NIPC, dystocia, retained placenta, metritis, abortion and infertility rates, are shown in Table 3 and 4.

Laboratory analysis of water samples from house drinkers, revealed that some samples show normal values within permissible limits and others not, according to water quality standards for cattle (CCME, 2005). Also, Table 6. shows frequency quartiles (first quartile (Q1), second quartile or median (Q2), third quartile (Q3)) for each water parameter.

For evaluation of the correlation between chemical and microbial parameters each other, inferential statistics using spearman rank correlation revealed statistically significant positive correlation (P-value <0.05) between water TDS with (hardness, chloride, nitrate, sulfate) with rho (correlation coefficient) 0.77, 0.89, 0.32, 0.78,

Table 2: Number (%) of significant risk factors in survey farms.

Variable	N (%)	Variable	N (%)	Variable	N (%)
Housing system		**Water tanks type**		**Water pipes type**	
- Loose/Free stalls	94 (65.3)	- Concrete	60 (45.5)	- Metal	67 (50.8)
- Cubicle/Free Stalls	1 (0.7)	- Fiberglass	21 (15.9)	- Plastic	65 (49.2)
- Open Tie-Stall	23 (16)	- Galvanized steel	45 (34.1)	**Breeding method**	
- Closed Tie-Stall	26 (18.1)	- Plastic	6 (4.5)	- AI	62 (86.1)
Bedding type		**Drinkers lining**		- Natural service	6 (8.3)
- Sand	87 (65.9)	- Ceramic	29 (22)	- Embryo transfer	4 (5.6)
- Soil	1 (0.8)	- Cement	92 (69.7)	**Pregnancy detection**	
- Straw	41 (31.1)	- Stainless steel	5 (3.8)	- Ultrasound	40 (55.6)
- Artificial mats	3 (2.3)	- Galvanized steel	2 (1.5)	- Rectal palpation	32 (44.4)
Water source		- Aluminum	3 (2.3)		
- Underground	91 (68.9)	- Plastic	1 (0.8)		
- Tap	32 (24.2)				
- Surface	9 (6.8)				

Table 3: Frequency of some recorded indicators in survey farms.

Percentiles	Emerged Epidemics	Morbidity Rate	Mortality Rate	Culling Rate	Lameness Rate		Mastitis Rate		Conception Rate		DO	
					W	S	W	S	W	S	W	S
Q1	3	1	0.2	23	3.2	3.7	3.8	9.7	41.13	18	122	145
Q2	4	1.8	0.75	25	4	4.75	4	10.05	47	20	123	150
Q3	4	3.4	1.8	26.6	8.5	13.75	9	14.45	50	22	125	155

W: winter, S: summer, DO: days open, Percentiles equals frequency quartiles (quartiles are the alternative to the arithmetic mean in non-normally distributed data) and Q2 is the median.

Table 4: Frequency of some recorded indicators in survey farms.

Percentiles	NIPC		Dystocia Rate		Retained Placenta Rate		Metritis Rate		Abortion Rate		Infertility Rate	
	W	S	W	S	W	S	W	S	W	S	W	S
Q1	1.5	2.7	0.5	2.2	0.7	2.8	5.1	12.6	2.4	3.5	7	14.4
Q2	1.95	3	0.95	2.5	1	3.2	5.3	13	2.65	3.9	7.3	15
Q3	2.48	3.88	2.22	3.38	3.38	5.38	10.88	15.33	3	4.6	12.88	19.72

W: winter, S: summer, NIPC: number of inseminations per conception.

Table 5: Count (%) of farms water quality parameters.

WQ limits	pH	TDS	Hardness	Chloride	Nitrate	Sulfate	TCC	Coliform
Within PL	28 (21.2)	92 (69.7)	39 (29.5)	68 (51.5)	111 (84.1)	119 (90.2)	18 (13.6)	18 (13.6)
Out PL	104 (78.8)	40 (30.3)	93 (70.5)	64 (48.5)	21 (15.9)	13 (9.8)	114 (86.3)	114 (86.3)

WQ: water quality, PL: permissible limit, TDS: total dissolved solids, TCC: total colony count.

Table 6: Frequency of water quality parameters in survey farms.

Percentiles	pH	TDS	Hardness	Chloride	Nitrate	Sulfate	TCC (winter)	TCC (summer)	Coliform (winter)	Coliform (summer)
Q1	8.1	305	285	150	2	66	$3.7x10^4$	$5.9x10^4$	$3.8x10^3$	$6.1x10^3$
Q2	8.4	680	472	240	4	100	$30.5x10^5$	$55x10^5$	$2.7x10^5$	$4.3x10^5$
Q3	8.8	1472.5	698	448	8	141.5	$32x10^6$	$76x10^6$	$5.3x10^5$	$9.7x10^5$

respectively. Also, revealed significant positive correlation (P-value <0.05) between water TCC with Total Coliform with rho 0.84.

For evaluation of seasonal effect and significant difference between winter and summer results, inferential statistics was done using Wilcoxon signed rank test to obtain mean ranks, (Z) value and calculate effect size by Cohen's d value. Test shows significant difference between winter and summer results in microbial water parameter (TCC and Total Coliform) by mean rank 65.5, (Z) value 9.89 and Cohen's d 0.86. Also, shows significant difference between winter and summer rates of lameness, mastitis, conception, DO, NIPC, dystocia, retained placenta, metritis, abortion and infertility by average mean rank 36.5, (Z) value 7.4 and Cohen's d 0.87.

Inferential statistics using spearman rank correlation revealed statistically significant correlation (P-value <0.05) of all examined water quality parameters except pH, with emerged epidemics number, morbidity, mortality and culling rates as shown in Fig. 1 which shows Spearman's rho Correlation coefficient with the significant water parameters. Also, Fig. 2 and 3 shows Spearman's rho Correlation coefficient of significant water parameters with farm indicators in winter season (W), Fig. 4 and 5 in summer season (S).

Inferential statistics using Linear Regression with stepwise method to obtain Standardized Coefficient (Beta) that determines the most harmful water parameters i.e. the best predictors for different farm indicators, Fig. 6 shows the best predictor water parameter for each farm indicator with its Beta value. The average R square value ranged from 0.56 to 0.86.

Inferential statistics using spearman rank correlation revealed statistically significant correlation (P-value <0.05) between specific farm risk factors such as housing system, bedding type, water source and drinkers lining with emerged epidemics number, morbidity, mortality and culling rates as shown in Fig. 7 which represents Spearman's rho Correlation coefficient of significant risk factors. Also, Fig. 8 shows Spearman's rho Correlation coefficient of significant risk factors (housing type, bedding type, water source, water tanks type and drinkers lining type with particular farm indicators in winter season (W) and Fig. 9 in summer season (S).

For evaluation of the effect of each farm risk factor type on different farm indicators, Inferential statistics using Kruskal Wallis H test to obtain mean ranks, Kruskal-Wallis H value and calculate effect size by Eta Squared measures of association, were done. The test shows that the housing system type affects morbidity, mortality and culling rate with mean ranks 89, 62.1, 62, 29 for Open Tie-Stall, Closed Tie-Stall, Loose/Free stalls, Cubicle/Free Stalls, respectively, and affects other farm indicators with mean ranks 64.5, 37.2, 23.3, 13.8 for Open Tie-Stall, Loose/Free stalls, Cubicle/Free Stalls, Closed Tie-Stall, respectively with average Eta Squared about 0.272.

The bedding type affects emerged epidemics number, morbidity, mortality and culling rate with mean ranks 77.5, 56.8, 44.6, 32.5 for Sand, Straw, Soil, Artificial mats, respectively, and affect other farm indicators with mean ranks 46.3, 41.2, 23.3, 20.4 for Straw, Sand, Artificial mats, Soil, respectively with average Eta Squared about 0.076.

The water source affects all farm indicators with mean ranks 71.4, 45.2, 23.8 for Surface, Underground, tap water, respectively with average Eta Squared about 0.086. The water tanks type affects all farm indicators with mean ranks 42.9, 27.9, 21.7, 17.9 for Concrete, Galvanized steel, Plastic, Fiberglass, respectively with average Eta Squared about 0.060. The drinkers lining type affects emerged epidemics number, morbidity, mortality and culling rate with mean ranks 73.1, 68.4, 55.5, 51.6, 43.9, 32.5 for Cement, Galvanized steel, Aluminum, Ceramic, Stainless steel, Plastic, respectively, and affects other farm indicators with mean ranks 41.4, 31.1, 30.4, 21.7 for Cement, Ceramic, Stainless steel, Plastic, respectively with average Eta Squared about 0.132. The water pipes type affects emerged epidemics number, morbidity, mortality and culling rate with mean ranks 76.7, 56.6 for plastic and metal, respectively with average Eta Squared about 0.057.

The herd size affects morbidity, mortality and culling rate with mean ranks 72.4, 59.9, 38.8 for large, medium, small herd, respectively with average Eta Squared about 0.062. The operation type affects morbidity, mortality and culling rate with mean ranks 74.3, 70.8, 57.9 for beef, mixed, dairy, respectively with average Eta Squared about 0.055. The breeding method affects culling rate with mean ranks 37.9, 31.8, 21.8 for artificial insemination, natural service, embryo transfer, respectively with average Eta Squared about 0.026. The pregnancy detection method affects culling rate with mean ranks 37.8, 34.9 for ultrasound, rectal palpation, respectively with average Eta Squared about 0.024.

DISCUSSION

Drinking water considered as important nutrient for livestock health and production, but prone to different quantity and quality continuous issues. The present study has focused on finding if there is association between emerged epidemics occurrence, health and reproductive indicators with the presence of some drinking water quality issues which cause sever health and performance problems.

The results of current study (table 5. and 6.) indicate that large percent (78.8, 30.3, 70.5, 48.5, 15.9, 13, 86.3, 86.3 %) of survey farms showed levels of pH, TDS, Hardness, Chloride, Nitrate, Sulfate, TCC and Coliform, respectively out of permissible limits for livestock.

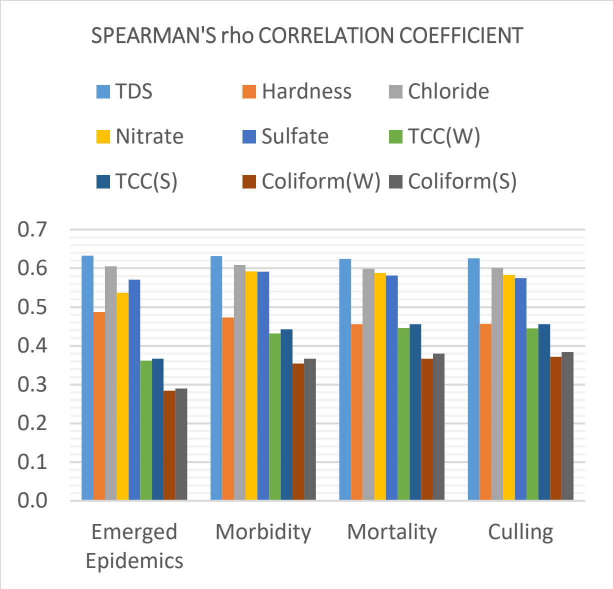

Fig. 1: Correlation between water parameters and recorded indicators.

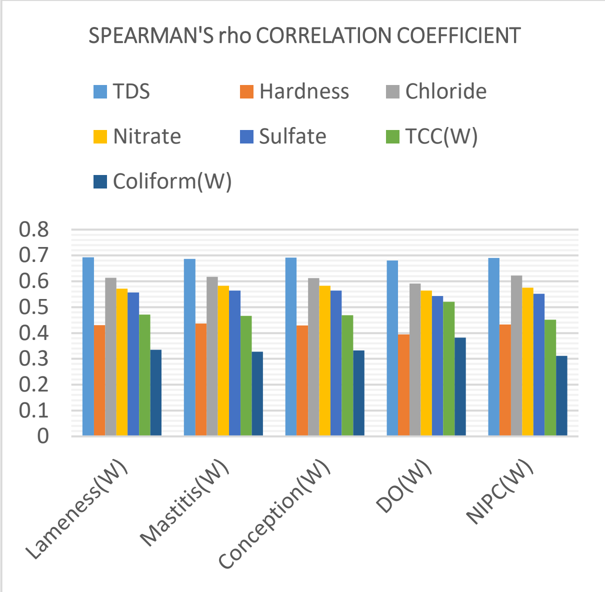

Fig. 2: Correlation between water parameters and winter recorded indicators (W).

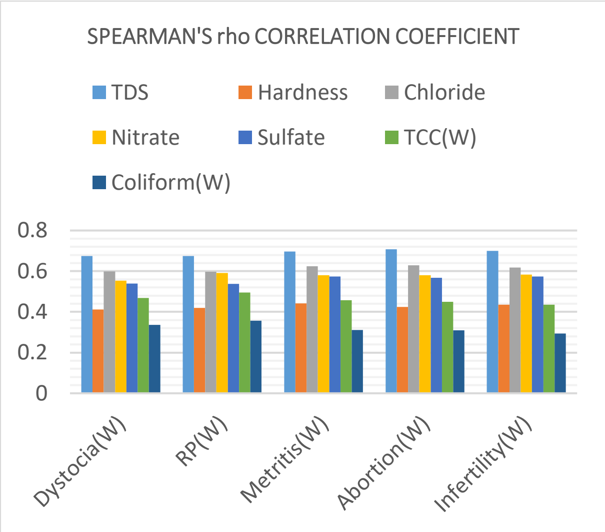

Fig. 3: Correlation between water parameters and winter recorded indicators (W).

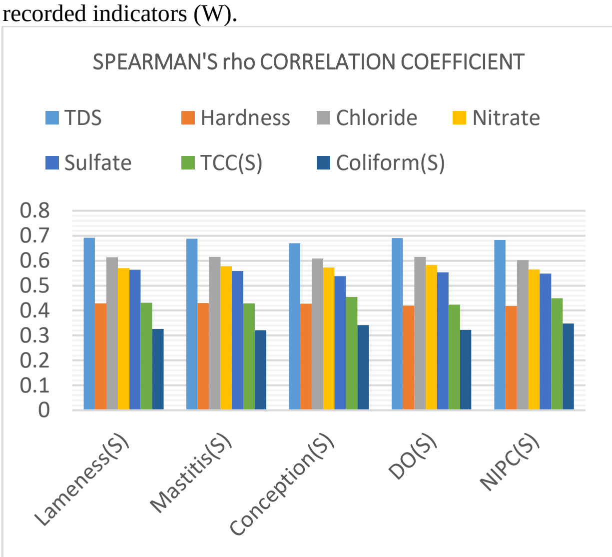

Fig. 4: Correlation between water parameters and summer recorded indicators (S).

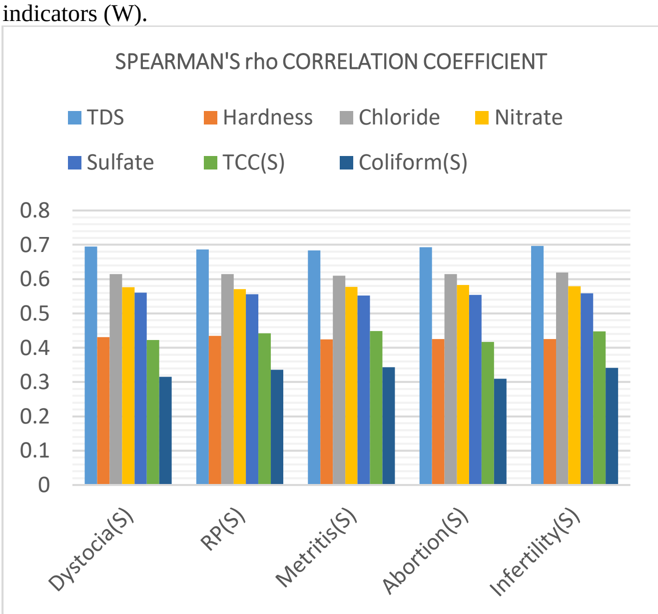

Fig. 5: Correlation between water parameters and summer recorded indicators (S).

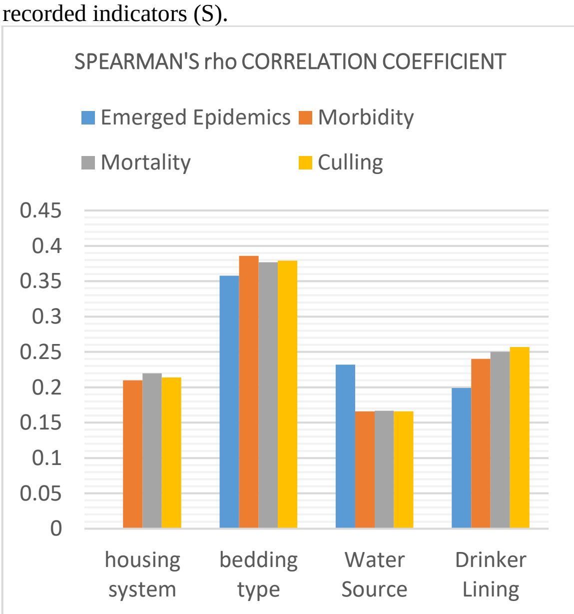

Fig. 7: Correlation between significant risk factors and recorded indicators.

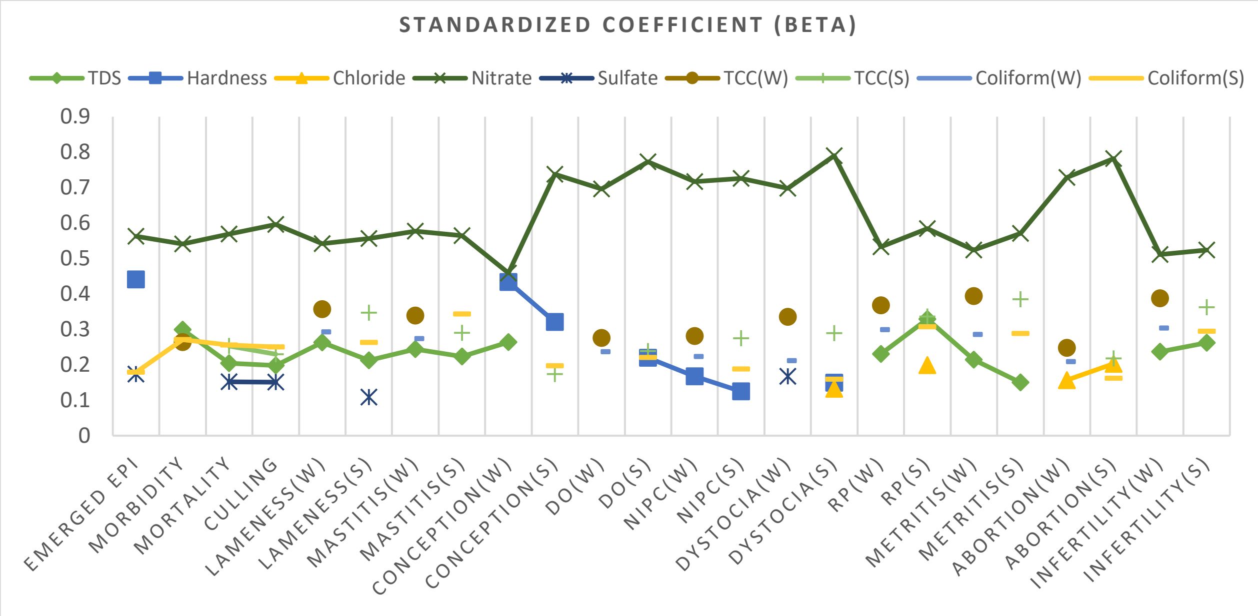

Fig. 6: Beta value of best predictor water parameters for each recorded indicator.

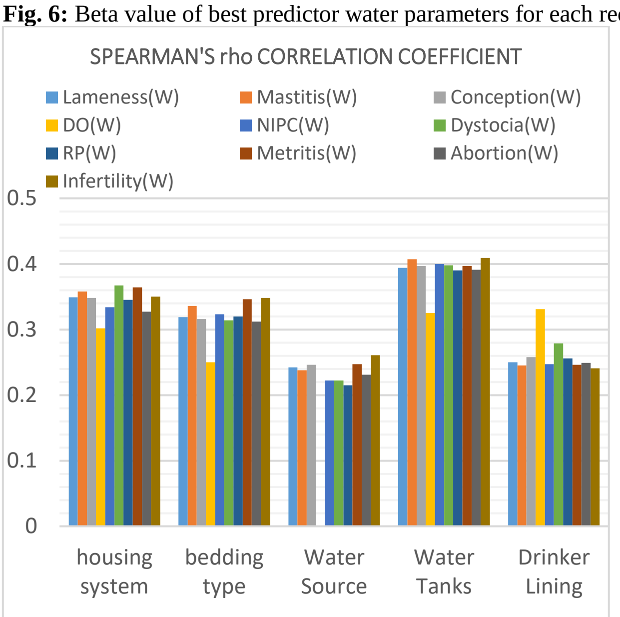

Fig. 8: Correlation between significant risk factors and winter recorded indicators (W).

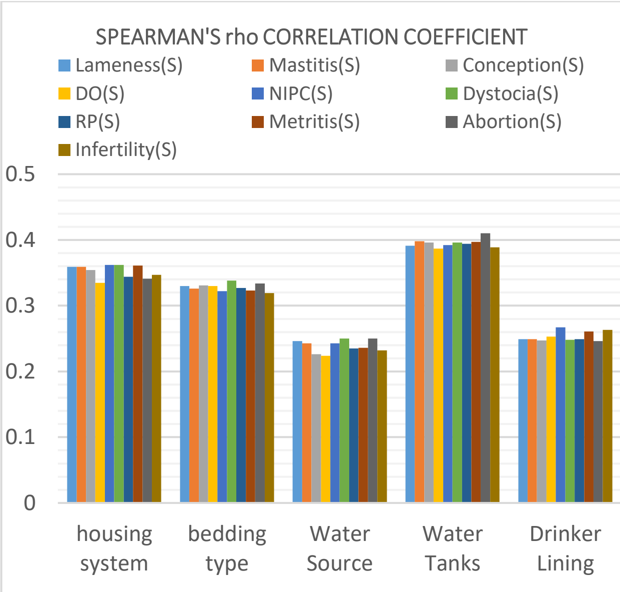

Fig. 9: Correlation between significant risk factors and summer recorded indicators (S).

The survey study recorded number of emerged epidemics in each farm with variable rates of morbidity and mortality around the year, and also recorded some farm indicators as shown in table 3. and 4. Statistical analysis shows moderate positive correlation (rho 0.3-0.7) between number of emerged epidemics and all farm indicators with all water parameters except pH in both winter and summer season (Fig. 1, Fig. 2, Fig. 3, Fig. 4, Fig. 5). But, with linear regression, found that each farm indicator has specific water parameters that predict its value better as showed in Fig. 6.

Nitrate is the highest predictor of all farm indicators with highest Beta (0.5-0.8) as previously reported that water nitrate causes reproductive problems (Beede, 2006), Nitrate also incriminated in cattle poor growth, infertility problems, abortions, vitamin A deficiencies, impairs thyroid and immune function (Manassaram *et al*., 2006).

Followed by TDS with Beta (0.2-0.3) as previously reported that water TDS level is a pre-indicator of poor quality water, high levels of TDS decrease feed intake, water intake, growth and production as mentioned by (Chizzotti *et al*., 2008), While some authors declared that high water TDS levels may not such a problem and not affect animal health and production (Phillips *et al*., 2015).

Then hardness with Beta (0.1-0.4) as reported that high water hardness reduces water intake, has cumulative daily intake effect and consider a predisposing factor of many cattle problems (CCME, 2005), but other authors hypothesized that high water hardness has not any detrimental effects (Looper and Waldner, 2002).

Followed by chloride with Beta (0.1-0.2) as some authors revealed that high water chloride affects rumen microbes negatively, increase rumen and urine osmolality, suppress feed intake and decrease ruminant performance (Alves *et al*., 2017), but other authors as (Valtorta *et al*., 2008) reported that chloride has no effect on animal performance and ruminants can tolerate high levels of chloride in water.

And sulfate with Beta (0.1-0.2) which reported to has laxative effect, synergize with molybdenum and cause deficiency of essential minerals such as Cu, Se, Fe and vitamins such as thiamin and vitamin E, sulfates have negative effect on reproduction and affect both humoral and cellular immunity so, increase the rate of infection, morbidity and mortality rates (McKenzie *et al*., 2009), but no adverse effects of high water sulfate with presence of ruminal adaptation was reported by (Digesti and Weeth, 1976).

For water microbial analysis TCC with Beta (0.2-0.4) is a predictor slightly higher than coliform count with Beta (0.2-0.3) in both winter and summer season, these results are in accordance with (Mohamed, 2016) who mentioned that high microbial count in water affects performance and immunity, causing health problems, disease transmission and retard the cattle production. In contrast, (Willms *et al*., 2002) found that contamination and high microbial count in water has no adverse effect on cattle.

Statistical correlation revealed that water TDS values significantly correlated with other water chemical parameters; strong positive correlation with chloride (rho = 0.89), sulfate (rho = 0.78), hardness (rho = 0.77), and moderate correlation with nitrate (rho = 0.32) (Looper and Walder, 2002). Also, TCC has strong positive correlation with Coliform (rho = 0.84).

Seasonal difference in water microbial analysis is evaluated by effect size Cohen's d value which reveals that there is significant difference between TCC and coliform count in winter and summer with effect size (d) value 0.86 and positive mean rank 65.5 which indicates that summer results are higher. Also, Seasonal significant difference appears in farm indicators with effect size (d) value 0.87 and positive mean rank 36.5 which indicates that summer rates are also higher (Arias and Mader, 2011).

To exclude other risk factors which recorded through the study questionnaire in each farm (table.1 and table. 2), statistically analyzed and correlated with farm indicators (Fig. 7, Fig. 8, Fig. 9). Weak to moderate correlation (rho 0.1-0.4) was found between different farm indicators and some significant risk factors such as housing system (rho 0.21-0.4), bedding type (rho 0.25-0.4), water source type (rho 0.17-0.3), water tanks type (rho 0.3-0.4), drinkers lining type (rho 0.20-0.3), water pipes type (rho 0.20-0.3), herd size (rho 0.1), operation type (rho 0.1), breeding method (rho 0.21), pregnancy detection method (rho 0.1) as shown in Fig. 7, Fig. 8, Fig. 9. Then, by evaluating mean ranks and Eta squared can identify and order effect size of each risk factor (USDA, 2007; Makris *et al*., 2014).

Conclusions

Drinking water quality parameters (physiochemical and microbial) highly affect rate of emerged epidemics and different farm health and reproductive indicators. There is seasonal effect on water microbial counts and on different farm indicators. Different risk factors and hygienic standards could not be ignored as they affect rate of epidemics and different farm indicators. Further investigation on water quality effects on beef, dairy performance and calf health.

REFERENCES

Allen NN, D Ausman, WN Patterson and OE Hays, 1958. Effect of zeolite treatment on hard drinking water on milk production. J Dairy Sci, 41: 688-691.

Alves JN, GGL Araújo, SG Neto, TV Voltolini, RD Santos, PR Rosa and ALA Neves, 2017. Effect of increasing concentrations of total dissolved salts in drinking water on digestion, performance and water balance in heifers. J Agric Sci, 155(05): 847–856.

APHA, 1998. Standard Methods for the Examination of Water and Wastewater, 20th Edition. American Public HealthAssociation, Washington, DC, pp: 9.1–9.113.

Arias RA and TL Mader, 2011. Environmental factors affecting daily water intake on cattle finished in feedlots. J Anim Sci, 89: 245-251.

Beede DK, 2006. Evaluation of Water Quality and Nutrition for Dairy Cattle. In: High Plains Dairy Conference. Reno, Nevada, March 9-11, pp: 13-31.

Campbell MJ and TDV Swinscow, 2009. Statistics at square one. 11th edition: BMJ books.

CCME, 2005. Canadian water quality guidelines for the protection of agricultural water uses.

Chizzotti ML, SC Valadares Filho, RF Diniz Valadares, FH Martins Chizzotti and LO Tedeschi, 2008. Determination of creatinine excretion and evaluation of spot urine sampling in Holstein cattle. Livestock Sci, 113: 218–225.

Dahlborn K, M Akerlind and G Gustafsson, 1998. Water intake by dairy cows selected for high or low milk-fat percentage when fed two forage to concentrate ratios with hay or silage. Swedish J Agric Res, 28: 167-176.

Digesti RD and HJ Weeth, 1976. A defensible maximum for inorganic sulfate in drinking water of cattle. J Anim Sci, 42:1498-1502.

HACH, 2003. HACH Water Analysis Handbook. Printed In USA.

Jaster FH, D Schuh and TN Weguer, 1978. Physiological effects of saline drinking water on high producing dairy cows. J Dairy Sci, 61: 66-71.

Looper ML and DN Waldner, 2002. Water for Dairy Cattle. Guide D-107. New Mexico State University Cooperative Extension Service.

Makris KC, SS Andra and G Botsaris, 2014. Pipe scales and biofilms in drinking water distribution systems: undermining finished water quality. Critical Rev Environm Sci Technol, 44(13): 1477–1523.

Manassaram DM, LC Backer and DM Moll, 2006. A review of nitrates in drinking water: maternal exposure and adverse reproductive and developmental outcomes. Environ Health Perspect, 114: 320-327.

McKenzie RA, AM Carmichael, ML Schibrowski, SA Duigan, JA Gibson and JD Taylor, 2009. Sulfur-associated polio encephalomalacia in cattle grazing plants in the Family Brassicaceae. J Aust Vet, 87: 27-32.

Mee F, 2008. Prevalence and risk factors for dystocia in dairy cattle: a review. J Vet, 176(1): 93-101.

Mohammed AN, 2016. Field study on evaluation of the efficacy and usability of two disinfectants for drinking water treatment at small cattle breeders and dairy cattle farms. Environm Monit Assess, 188(3): 151.

Mohammed AN, RL Abdel Aziz and MMA Zeinhom, 2015. Exploitation of Multiple Approaches to Adapt and Mitigate the Negative Effects of Heat Stress on Milk Production and Fertility of Friesian Cows Under Field Conditions. J Assiut Vet Med, 61: 147.

Mohd Nor, W Steeneveld, MCM Mourits and H Hogeveen, 2015. The optimal number of heifer calves to be reared as dairy replacements. J Dairy Sci, 98 :1–11.

Murphy MR, 1992. Nutritional factors affecting animal water and waste quality. J Dairy Sci, 75: 326-333.

Olson, ME, NJ Guselle, RM O'Handley, ML Swift, TA McAllister, MD Jelinski and DW Orck, 1997. Giardia and Cryptosporidium in dairy calves in British Columbia. Can J Vet, 38: 703–706.

Phillips CJC, MO Mohamed and PC Chiy, 2015. Effects of duration of salt supplementation of sheep on rumen metabolism and the accumulation of elements. Anim Prod Sci, 55: 603–610.

USDA, 2007. Reference of Dairy Cattle Health and Management Practices in the United States. APHIS Veterinary Services, (October).

Valtorta SE, MR Gallardo, OA Sbodio, GR Revelli, C Arakaki, PE Leva, M Gaggiotti and EJ Tercero, 2008. Water salinity effects on performance and rumen parameters of lactating grazing Holstein cows. Int J Biometeorol, 52: 239–247.

Willms WD, OR Kenzie, TA McAllister, D Colwell, D Veira, JF Wilmshurst, T Entz and ME Olson, 2002. Effects of water quality on cattle performance. J Range Manag, 55: 452-460.