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Article

Animal anthrax in Sirajganj district of Bangladesh from 2010 to 2012

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Abstract: A descriptive study was conducted using secondary surveillance data of animal anthrax from the Epidemiology Unit of Department of Livestock Services (DLS) for the years 2010, 2011 and 2012. The objectives of this study were to describe the pattern of animal anthrax in Sirajgong district of Bangladesh from 2010 to 2012 and to assess the current use of anthrax vaccine (Vaccine Coverage) based on animal, time and place. The study found that the disease was more prevalent in this district at the beginning of the early monsoon (Month of May, June when flood water enters) and the late monsoon (Month of September, October, when flood water recedes). Cattle were the predominant animal species affected with anthrax in this district followed by goats and sheep. The overall mean case fatality rate was 30.19%. The numbers of reported anthrax outbreaks in cattle had declined each year with 111 in 2010, 32 in 2011 and 20 in 2012. The annual mean vaccination coverage during the same years was 44.29%, 46.23% and 37.88% respectively. To reduce the number of outbreaks in animals and humans in Sirajganj district the annual vaccination coverage requires improvement. Behavior change through building greater awareness of anthrax is also needed at the farmer level for control and eradication of anthrax in animals as well as human.

Keywords: anthrax outbreak; epidemiology; surveillance; Bangladesh

1. Introduction

Animal anthrax or 'Torka' has been considered to be enzootic for long in Bangladesh. It emerged as a zoonotic disease in this country during 2009-2010 (Ahmed *et al.,* 2010). The disease caused by the bacterium *Bacillus anthracis*is primarily a disease of ruminants and was one of the main causes of uncontrolled mortality in cattle, sheep, goats, horses and pigs worldwide until the development of an effective vaccine and introduction of antibiotics (Ahmed *et al.,* 2010). Anthrax was periodically reported both in animals and humans in between 1949 and 1986. In the 1980s, 590 animals were confirmed with *Bacillus anthracis* based on laboratory tests (Samad *et al.*,1986, Ahmed *et al.,* 2010). A cutaneous anthrax outbreak in human was reported in August 2009 the first reported in the past 25 years (ICDDR,B, 2009). Anthrax outbreaks have continued to be reported from different areas of the country both animal and human (Samad *et al.*,1986 , Ahmed *et al.,* 2010). Anthrax infection among livestock in Bangladesh has been reported routinely in accordance with standards set by the World Organization for Animal Health (OIE, 2010).

As people are not aware of the hazards of improper disposal of dead anthrax infected animals, they are rarely buried. Usually an animal carcass is either thrown in the flood or river water or in the open field, which results in contamination of the grazing land with anthrax bacilli. Exposure to air and high temperatures (>20°C) ensure

that Anthrax bacilli sporulate (Ahmed *et al.,* 2010). Although there is a routine livestock anthrax vaccination programme in Bangladesh, vaccination coverage has been reported to be very low (Chakraborty *et al.,* 2012). As a result, more animals acquire anthrax by ingestion of spores while grazing and the cycle of infection of carcass to grazing land continues. This transmission cycle has resulted in anthrax being enzootic among livestock in Bangladesh (Ahmed *et al.,* 2010). Although the organism has always been high on the list of potential agents with respect to biological warfare and bioterrorism, humans almost invariably contract the natural disease directly or indirectly from animals or animal products (ICDDR,B, 2011). Due to human behavior the likelihood of anthrax spill over from animals to humans is more common in rural areas where most of the cases of animal infection go unnoticed and unreported. In rural Bangladesh, people commonly slaughter sick animals infected with anthrax for food, which creates an avenue for spill over in humans. Lack of awareness and poor socio economic conditions are the main factors for spill over of anthrax in humans.

Sirajganj district is located in the North West part of Bangladesh with high density (approximately 1% of total cattle population) of cattle. This district is considered as a part of cattle zone of the country since century. The secondary surveillance data of DLS indicates that the disease prevails in this district during the monsoon season. Despite various initiatives taken by DLS like ring vaccination, creating awareness towards prevention and control of the disease remains challenging. However, a limited study has been conducted in animal to access the disease burden and there is no specific program for eradication of anthrax in Bangladesh. The objective of this study is to describe the spatial and temporal distribution of animal anthrax along with vaccine coverage in Sirajganj district during the period 2010-2012. It is expected that this study will inform strategies for preventing and controlling animal anthrax before the chance of spill over to humans.

2. Materials and Methods

2.1. Study area and study design

Data from nine (9) Upazilas (sub-districts) of Sirajganj district (Figure 1) were selected to conduct the study during the years of 2010-2012.

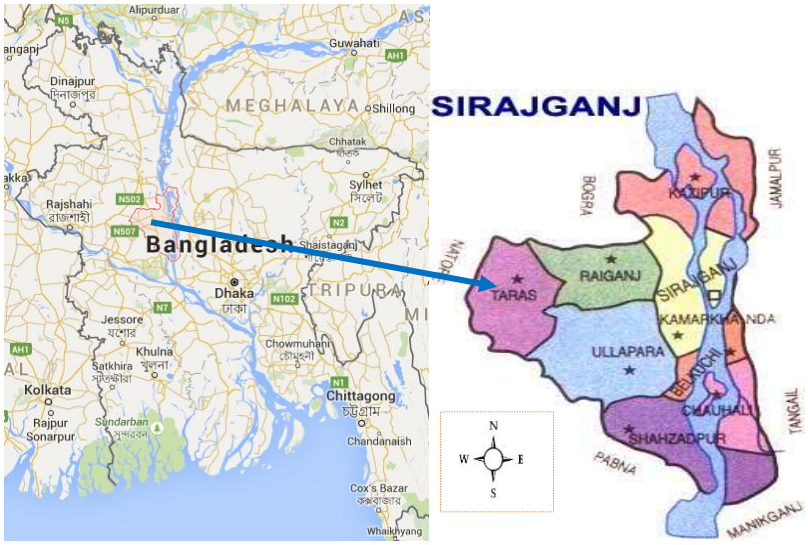

Figure 1. Map showing 9 Upazilas (sub-districts) of Sirajganj district where the study was conducted.

A descriptive study was designed to find out the pattern of animal anthrax during the years of 2010-2012. The data on 'suspect' anthrax cases were recorded using monthly passive surveillance system of respective Upazilas (sub-districts)received by the Epidemiology Unit of DLS on monthly basis. Among the reported suspected cases, 50% were confirmed through laboratory (FDIL) and District Veterinary Hospital (DVH) visits.

2.2. Case definition at the animal level

Suspected 'peracute case': Cattle, sheep, goat and buffalo dying without showing apparent signs with bloody discharges from an external orifice of the body in Sirajganj district from 2010 to 2012.

Suspected 'acute cases': Cattle, sheep, goat and buffalo with fever, depression, difficulty in breathing bloody discharges from natural openings, convulsion and death within two or three days if not treated.

***'Confirmed Case'*:** Blood samples taken from suspect animals from superficial blood vessels or natural orifice of dead animals (Cattle, sheep, goat and buffalo) stain positively with polychrome methylene blue staining technique under microscope with high power objective(X100) using immersion oil (OIE, 2008).

2.3. Data collection, management and statistical analysis

Written records of secondary surveillance data for the years 2010, 2011 and 2012 were converted electronically using Microsoft Excel® worksheets. The method of data collection and the data was validated through field visits in Upazila Livestock Offices, District Veterinary Hospital (DVH) and Field Disease Investigation Laboratory (FDIL). The data was analyzed using Microsoft Excel® tools including proportion, percentage, mean and other relevant descriptive statistics. The results are presented in narrative, tabular and also in graphical presentation.

3. Results

3.1. Temporal pattern of anthrax outbreaks in 2010

One hundred eleven cases of animal anthrax were detected in the year 2010.The mean of number of monthly anthrax cases was 9.25; median 2; within a range of 0 to 59 cases. In terms of temporal frequency, 59 cases (53.15%) occurred in the month of September followed by 20 in August (18.01%), 13 in April (11.71%), 6 in June (5.4%) and 6 in July (5.4%), 2 in February (1.80%) and 2 in March (1.80%). Only a single case was identified in the month of January, October and November and no cases were identified in the month of May and December. In 2010 there were 219 reported cases of human cutaneous anthrax (IEDCR, 2010) shown in Figure 2.

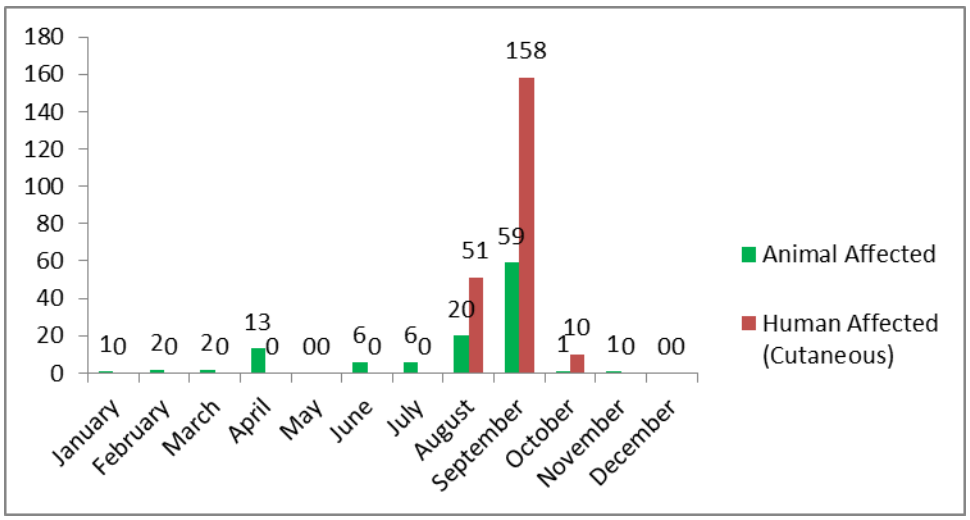

Figure 2. Temporal pattern of animal and human cutaneous anthrax in 2010

3.2. Temporal pattern of anthrax outbreaks in 2011

In 2011, a total of 28 cases of animal anthrax were detected where mean of monthly anthrax cases was 2.33; median1; range, 0 to10 cases. Of the 28 cases, 10(35.71%) were identified in the month of September followed by 9 in August (32.14%), 3 in July (10.71%) and 2 in June (7.14%). Only a single case was identified in the month of February, March, April and May. No cases were identified in the months of January, October, November and December. There were 65 human cutaneous anthrax cases reported as shown in Figure 3 (IEDCR, 2011).

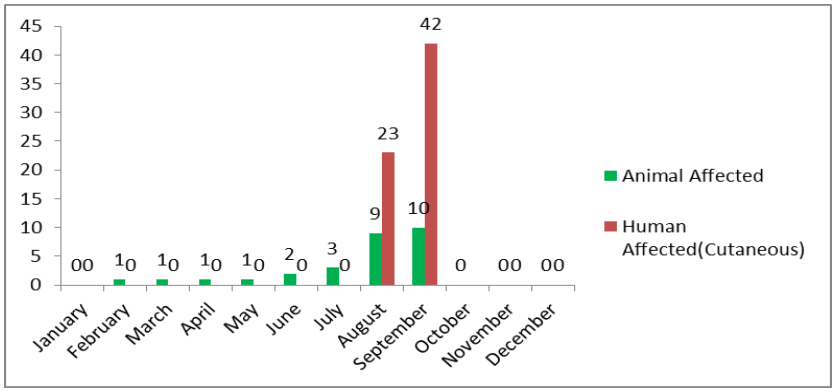

Figure 3. Temporal pattern of animal and human anthrax (Cutaneous) in 2011.

3.3. Temporal pattern of anthrax outbreaks in 2012

A total of 20 cases of animal anthrax were identified through the passive surveillance system in the year 2012 where the mean of monthly anthrax cases was 1.66; median 0.5 range 0 to10 cases. Of 20 animal cases, 10 (50%) cases were identified in the month of May 6 in June (30%) and 1 case each in the month of April, July, August and September. No cases were identified during January –March and October –December. There were 74 human cutaneous anthrax cases reported as shown Figure 4 (IEDCR, 2012).

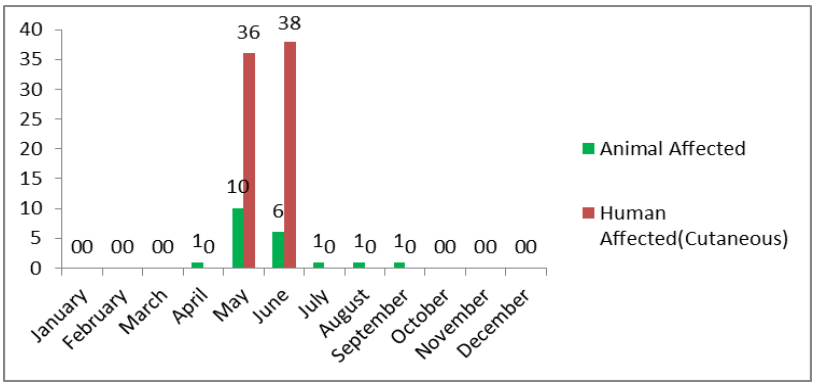

Figure 4. Temporal pattern of animal and human anthrax (Cutaneous) in 2012.

3.4. Spatial pattern of anthrax from 2010-2012

In 2010, of 111 anthrax cases 56 (50.5%) were identified in Belkuchi Upazila, followed by Shahazadpur (42, 37.8%), Kamarkhanda(10, 9%), Ullahpara Upazila (3, 2.7%). No cases were detected in Chouhali, Kazipur, Raijanj, Sadar and Tarash Upazila (Table 1). Moreover, a number of 219 (Shahazadpur-56, Belkuchi-54, Kamarkanda 99 & Ullapara10) human cutaneous cases were recorded in the four Upazilas in this district (IEDCR, 2010). Spatial distribution of animal anthrax in 2010 is shown in Figure 5.

Table 1. Spatial summery for the year 2010.

Upazila	Animal anthrax	Human case (Cutaneous anthrax)
Belkuchi	56	54
Chouhali	0	0
Kamarkhanda	10	99
Kazipur	0	0
Raiganj	0	0
Shahazadpur	42	56
SirajganjSadar	0	0
Tarash	0	0
Ullapara	3	10
Total	**111**	**219**

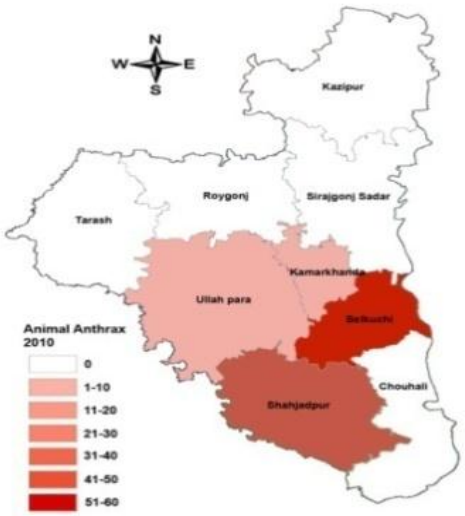

Figure 5. Spatial distribution of animal anthrax in 2010.

Table 2. Spatial summery for the year 2011.

Upazila	Animal anthrax	Human case (Cutaneous anthrax)
Belkuchi	15	0
Chouhali	0	0
Kamarkhanda	1	0
Kazipur	0	0
Raiganj	0	0
Shahazadpur	6	65
SirajganjSadar	0	0
Tarash	0	0
Ullapara	6	0
Total	**28**	**65**

In 2011, of 28 anthrax cases 15 (53.57%) were identified in Belkuchi Upazila, followed by Shahazadpur (6,21.42%), Ullahpara (6,21.42%) and Kamarkhanda (1,3.59%) Upazila. No cases were detected in Chouhali, Kazipur, Raiganj, Sirajganj Sadar and Tarash Upazila (Table 2). However, a number of 65 human cutaneous anthrax cases indentified in Shahazadpur Upazila in this year (IEDCR, 2011). Spatial distribution of animal anthrax of 2011 is shown in Figure 6.

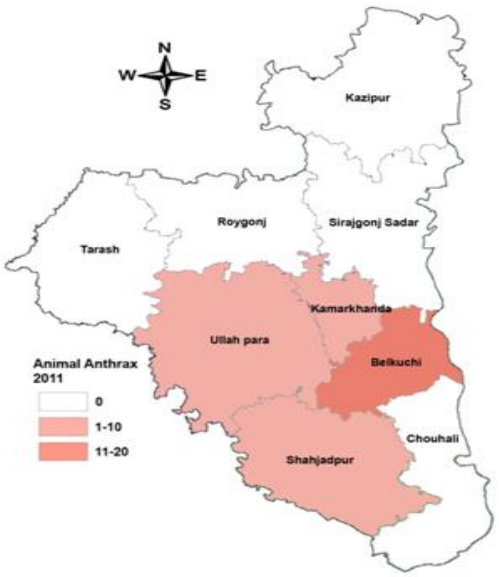

Figure 6. Spatial distibution of animal anthrax of 2011.

Table 3. Spatial summery for the year 2012.

Upazila	Animal anthrax	Human case (Cutaneous anthrax)
Belkuchi	7	22
Chouhali	0	0
Kamarkhanda	2	0
Kazipur	0	0
Raiganj	1	0
Shahazadpur	6	52
SirajganjSadar	0	0
Tarash	0	0
Ullapara	4	0
Total	**20**	**74**

In 2012, of 20 anthrax cases 7(35%) were found in Belkuchi Upazila, followed by Shahazadpur (6,30%), Ullahpara Upazila (4,20%), Kamarkhanda (2,10%) and Raigonj (1, 5%). No cases were indentified in Chouhali, Kazipur, Sirajganj Sadar and Tarash Upazila (Table 3). Moreover, a number of 74 human cutaneous anthrax cases indentified in Shahazadpur and Ullapara Upazila in this year (IEDCR, 2012). Spatial distribution of animal anthrax in 2012 is shown in Figure 7.

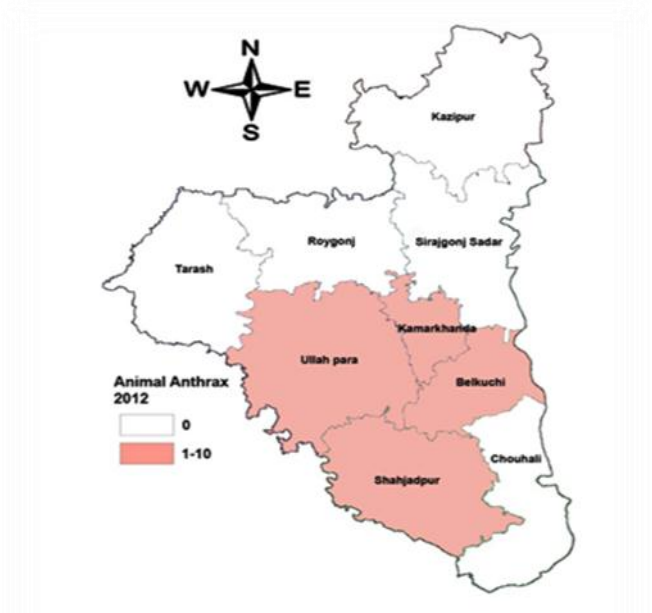

Figure 7. Spatial distribution of animal anthrax in 2012.

3.5. Species distribution of animal anthrax

Table 4. Species distribution of animal anthrax from 2010 to 2012.

Year	Cattle	Buffalo	Goat	Sheep	Total
2010	96	2	11	2	111
2011	24	-	2	2	28
2012	18	-	2	-	20

Species distribution of animal anthrax from 2010 to 2012 is summarized in Table 4. Of 111 cases of 2010, 96 (86%) were identified in Cattle, followed by Goat (11, 10%), Sheep (2, 2%) and Buffalo (2, 2%). In 2011, of 28 cases, 24 (86%) were identified in cattle, followed by goat (2, 7%) and Sheep (2, 7%). In 2012, 18 (90%) were identified in cattle, followed by goat (2, 10%).

3.6. Animal population-wise vaccine utilization

In 2010 (Figure 8), the highest vaccination coverage was in Kamarkando Upazila (82.20%) followed by Shahazadpur (70.89%) and Belkuchi Upazila (61.80%). Upazila-wise average vaccine utilization was 55, 661 doses. The maximum number of doses used by Upazila was 284,900 and minimum dose was 800.

In 2011 (Figure 9), the highest vaccination coverage was in Shahazadpur Upazila (72.38%) followed by Ullapara (53.53%) and Kamarkhanda Upazila (47.80%). In 2012 (Figure 10), the highest vaccination coverage was in Shahazadpur Upazila (53.54%) followed by Kamarkando (47.80%) and Ullapara(44.44%) Upazila.

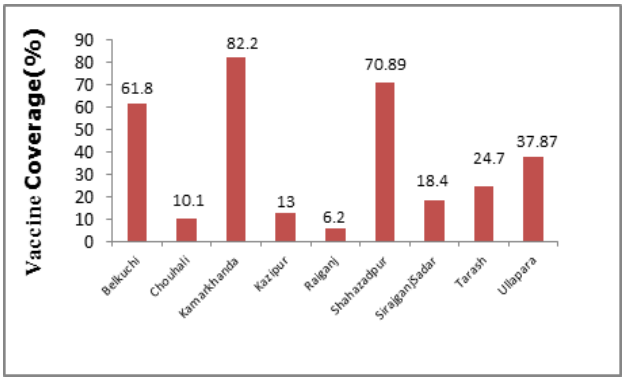

Figure 8. Vaccine Coverage in 2010.

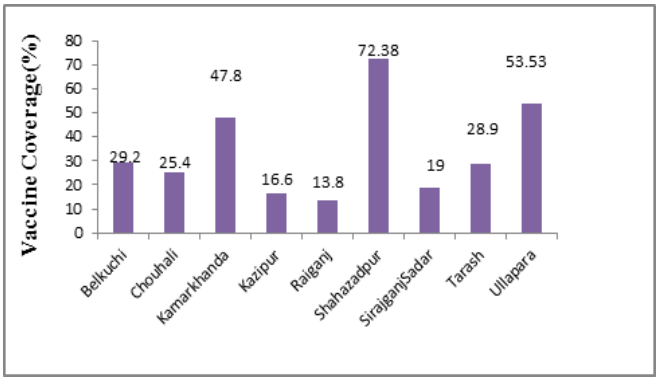

Figure 9. Vaccine Coverage in 2011.

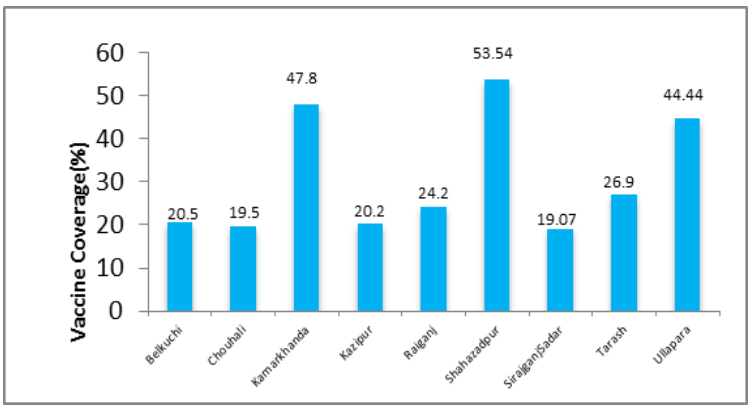

Figure 10. Vaccine Coverage in 2012.

3.7. Yearly comparison among reported cases, deaths and case fatality rate

A total of 159 anthrax cases were identified in animal during the years 2010, 2011 and 2012 in Sirajganj district where 48 deaths occurred. More deaths were occurred during the year of 2010 followed by 2010 and 2012 (Figure 11). The highest case fatality rate (CFR) was in the year of 2012 (35%) with an average case fatality with an average 30.19%.

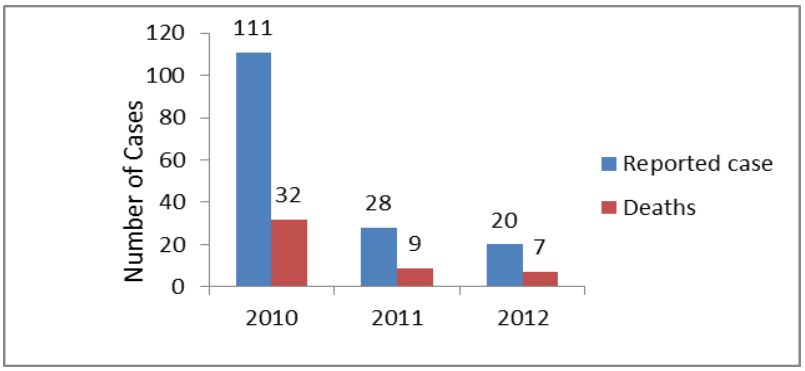

Figure 11. Yearly comparison between number of animal anthrax reported cases with deaths in Sirajganj district.

4. Discussion

Anthrax outbreak was present in Sirajganj district since 2010 in animal population but the trend was declining gradually in the succeeding years (2011, 2012) as vaccination campaign in the earlier year and motivational activities were taken by the respective Upazila Livestock Offices for generating awareness among the farmers. However, recurrent outbreak of anthrax in livestock were frequently found in this district due to low level of anthrax vaccination coverage in animals (CDC, 2010).

The highest incidence of anthrax in this district occurred at the beginning of the early monsoon season (Month of May, June when flood water enters) and the late monsoon season (Month of September, October, when flood water recedes). This study agrees with previous ones showing that the monsoon rains and warm weather followed induces favorable condition anthrax outbreaks (Moazeni-Jula *et al.*, 2004; Dey *et al*., 2012). Since the district has low lying areas during the rainy season, this increases the risk of exposure of animals to anthrax spores (Hugh- Jones *et al.*, 2009). Cattle are the dominant species in this district affected in anthrax followed by goat, sheep and buffalo. The temporal sequence of animal and human cases indicates that animal anthrax is followed by human cutaneous anthrax, thus supporting the hypothesis that anthrax spillover occurs from animals to humans (Ahmed *et al*., 2010). A previous study shows that human risk behaviors and lack of awareness provoke the transmission of anthrax from animals to humans (Ahmed *et al.*, 2010).

A few Upazilas (sub-districts), Shahajatpur, Belkuchi had more outbreaks and they also had the highest vaccination coverage, although it was below 70-80% of the population at risk. The eradication and control of disease has posed great challenges due to the formation of temporary islands creates during the monsoon season by the heavy rains since most of areas are low lying land (Hugh-Jones *et al.*, 2009). However, risky behavior of farmers like throwing the dead body of animals in flood water or open land enable an avenue for further spill over of anthrax bacilli to both animals and humans (Hossain *et al.,* 2013). During outbreaks farmers slaughter sick animal to minimize the economic loss. Vaccination against anthrax is an effective prevention measure for both animals and humans (ICDDR,B, 2011). Bangladesh produces about 4 million doses of animal vaccine each year for the 50.00 million herbivores, an amount not sufficient to fulfill the demand (anon/ unpublished data). For proper prevention and control of anthrax in animals, the national vaccine production needs be increased to cover at least eighty percent of the population with a provision of twice yearly vaccination to for susceptible animals. This study further supports the conclusion of a previous study that increasing the anthrax vaccination coverage is needed to reduce anthrax outbreaks in animals as well as minimize the spillover in humans within this district (Mongoh *et al.,* 2008). Several ecological factors (e.g soil type, calcium content, organic carbon content and soil pH) responsible for survival of anthrax spore in this district necessitate an increase in the current vaccine coverage (Ahsan *et al.,* 2013). In this regards, a targeted vaccination strategy could be considered in order to cover maximum animal population where the risk is greatest.

The limitations of this study include the limited availability of complete data and the limited number of studies on animal anthrax in Bangladesh. Moreover, data relevant to assess possible risk factors impeded further analytical study. The study also relied solely on Polychrome Methylene Blue smearing technique rather than microbiological culture and biochemical tests.

5. Conclusions

The results of this study support the need for an adequate supply of animal anthrax vaccine to be administered twice in a year in all susceptible animal in this high risk district. The targeted vaccination of high risk districts such Sirajganj where recurrent outbreaks occur each year should be further considered. This will require adequate manpower including trained paraveterinarians to conduct vaccination campaign for covering entire area. The Department of Livestock Services (DLS) should modify the present secondary data format to include variables related to the possible risk factors(like breed, sex, age, Body Condition Score, farm type etc.); for collection of necessary information towards analytical study of the disease; and to understand the actual disease burden in relation to animal, place and time. Proper awareness on anthrax prevention, transmission and control in animals should be ensured. Behavior change and motivational activities under a One Health approach should be conducted. This joint effort will focus on proper awareness on anthrax prevention, transmission and control along with disposal of dead animals, handing and slaughtering of infected animals among the cattle owners and community people.

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Conflict of interest
None to declare.

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