

# A Study of Infection Areas and Social Assessment Findings in HS (haemorrhagic Septicaemia)-affected Buffaloes on Samosir Island, Indonesia

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## ABSTRACT

HS case has first been reported on Samosir Island in 1989 which infect almost all buffaloes on the island. To date, number of buffaloes registered in this island is 17,352. The highest buffalo death in 2018 was 189 heads. The situation has gave a negative impact on the livestock farmers since rearing buffaloes bring many benefits to them. HS alternately occurs in the sub-district or several sub-districts at once. In this study, the occurrence of HS were evaluated in order to minimize HS spread and infection. Buffaloes in Samosir Island grazed on large grazing areas in remote land and this area were used by many buffaloes from many villages. The infected buffaloes may transmit the disease to other buffaloes. This has triggered cross HS infection of the buffaloes from different area. Buffaloes that died from HS were not always buried because the soil mixed with rocks made the burial process a bit difficult. Not all buffaloes are vaccinated mainly due to willingness to carry out vaccination, knowledge on vaccination, motivation on raising buffalo by the buffaloes owner and availability of vaccine. The cost of the vaccine is very cheap and some of the vaccine are procured by the government agencies with very limited quantity. The findings of this retrospective study may assist in policy making when saving buffaloes in future from HS infection.

*Key words* : Disease, Buffaloes, Infected, Samosir Island, Vaccine

## Introduction

Samosir Regency is an island area, namely the entire Samosir Island, surrounded by Lake Toba plus part of the mainland of Sumatra Island. Most people keep buffaloes, especially on Samosir Island. Buffalo (*Bubalis bubalis*) in Samosir Regency is a large ruminant with the highest population in North Sumatra Province. Buffaloes in Samosir is dominated by mud buffalo. These endemic animals are the foundation

of the residents' livelihood, but there is a trend of population decline. The decline in the buffalo population is unfortunate because buffalo are multi-functional animals. Besides being used as labor, buffalo is a potential meat provider. As in Banten Province, buffalo meat is the main consumption and culinary specialty of buffalo meat products (Rusdiana *et al.*, 2019). In Samosir, buffalo meat is processed into various local culinary.

The buffalo population on Samosir Island in Sep-

tember 2021 is 17,352 heads, where the data for the previous five years 2017 is 24,207 heads (Samosir Regency Agriculture Office, 2021). Various reasons that have caused the decline in the buffalo population are the insufficiency of balanced nutritional needs by their production and reproductive functions (Suhubdy, 2007), high rates of slaughter, and sales outside the region (Samosir Regency Agriculture Office, 2020). The cause of population decline is also disease. The disease that has seen outbreaks several times is Hemorrhagic septicemia (HS), a septicemic disease in cattle and buffalo. It was caused by the gram-negative bacteria *Pasteurella multocida* B:2 (Abubakar and Zamri-Saad, 2011), (Praveena *et al.*, 2014). HS is acute septicaemia, fatal with high morbidity and mortality in cattle and buffalo (Abubakar *et al.*, 2012; Khan *et al.*, 2013). HS has spread across South and Southeast Asia, including Indonesia, Malaysia, the Philippines, and Thailand. (World Organization for Animal Health, 2012). In Indonesia, the HS outbreak has caused enormous losses in East and West Nusa Tenggara, West Sumatra, and North Sumatra. In Malaysia, HS outbreaks repeatedly occurred, namely 48 outbreaks from 1994 to 2005, with 921 dead buffalo and 394 dead cows (Zamri-Saad and Annas, 2016). Buffaloes are more susceptible to HS. Buffalo mortality in Indonesia is even greater. In 1997 alone the deaths reached 9,288 heads. (Direktorat Bina Kesehatan Hewan, 1998)

*Pasteurella multocida* can survive for hours and days in moist soil and water buffalo ponds. These organisms are transmitted through direct or indirect contact. In addition, several studies have demonstrated the involvement of the gastrointestinal, reproductive, and urinary tracts in the transmission of *P. multocida* organisms during disease outbreaks (Abubakar and Zamri-Saad, 2011; Annas *et al.*, 2014A; Annas *et al.*, 2015).

The bacteria that cause HS are present in the oral cavity, nose, and upper respiratory tract (Larne *et al.*, 2018). *Pasteurella multocida* B:2 was detected from nasal and rectal swab samples on days 5 and 6 (Annas *et al.*, 2014A; Annas *et al.*, 2014B). Chung *et al.*, (2015) mentioned that infection of *Pasteurella multocida* type B:2 comes by oral route.

There are four clinical syndromes in sick animals. Animals will first show an increase in temperature above 40°C, followed by submandibular edema, respiratory distress with profuse nasal discharge, and finally, lie down and die (Annas *et al.*, 2015). Farm-

ers often find sudden death in HS during outbreaks.

## Materials and Methods

This study aims to qualitatively identify infection areas and social factors that cause HS outbreaks in Samosir Island from December 2017 to September 2021. This research is a descriptive case study used to describe the location of HS infection and the condition of buffalo farms on Samosir Island, which is thought to affect the condition of HS cases on Samosir Island.

## Data and Instrumentation

This research was conducted by collecting data, including primary data and secondary data. Primary data includes variables that affect HS cases. Primary data were obtained from direct observation and interviews with farmers using questionnaires. Secondary data were obtained from the Samosir Regency Agriculture Office, the Medan Veterinary Center, the Department of Food Security and Animal Health of North Sumatra Province, Statistics of Samosir Regency, and the Central Statistics Agency. The research method used is a survey with the respondent's family unit raising buffaloes. The sampling method used was Proportional Stratified Random Sampling by selecting four sub-districts with the most frequent SE cases, namely Pangururan, Ronggur Nihuta, Palipi, and Simanindo. The sample from this study amounted to 804 families of buffalo farmers obtained from 30% of farmers in each sub-district, namely Pangururan sub-district (252 farmers), Ronggur Nihuta (96 breeders), Palipi sub-district (204 breeders), and Simanindo sub-district (252 breeders). Social research on HS disease in Samosir is important to be carried out based on livestock owners who make vaccination treatment decisions. Therefore, studying why HS always recurs on Samosir Island is necessary. On the island of Lombok in 1985, HS was free from HS through a cooperation scheme between the government and buffalo owners for only three consecutive years with 100% vaccination coverage (Direktorat Bina Kesehatan Hewan, 1998).

## Research Parameters

Parameters observed in this study were infection area, social factors that influenced the case of SE, namely the willingness of farmers to vaccinate, farmers' knowledge about the benefits of vaccina-

tion, motivation of farmers to keep buffalo, and conditions for providing vaccines.

## Results and Discussion

### Infections area

The total area of Samosir Regency is 2,069.05 km<sup>2</sup>, consisting of a land area of 1,444.25 km<sup>2</sup> with various topography and land contours, namely flat, sloping, tilted, and steep. The largest lake in Southeast Asia is Lake Toba, with 624.80 km<sup>2</sup>. Samosir Regency consists of nine sub-districts. Six sub-districts are on Samosir Island, while three are on the mainland of Sumatra Island (Statistics of Samosir Regency, 2020).

Based on the results of land cover analysis using spot 5 images in 2005, it is known that the land cover pattern of Samosir Regency in 2006 was still dominated by forest vegetation, which was around 49% of the total district area (Statistics of Samosir Regency, 2015). On the other hand, grass and open ground vegetation are also quite dominant, around 27%. The state controls part of forest vegetation, while grass and open land are community land inherited from generation to generation. Ownership of inheritance land is quite extensive, and the community's buffaloes are usually left to graze freely. One respondent in the Simanindo sub-district own 50 hectares of land and releases all his buffaloes to graze freely on the land. The lack of land boundaries causes buffalo belonging to the community to graze on the land.

The abundance of food sources in the forest and grasslands causes the development of buffalo to be very good. The largest buffalo population in North Sumatra Province is in Samosir. In this place, buffalo belonging to people from different villages meet. Buffaloes love to soak in the mud, so there are many small ponds where the buffaloes take turns mud bathing.

Since 1989, HS cases have started to emerge in Samosir. There have been several outbreaks. The HS infection area has been evenly distributed in all sub-districts in Samosir. The transmission process occurs, one of which is the result of farmers selling buffalo from their herd of buffalo to other villages if there are buffalo that have HS.

From the data on livestock affected by HS, the sub-districts of Pangururan, Ronggur Nihuta, Palipi, and Simanindo are located on Samosir Island sub-

district where HS cases are often found. These four sub-districts have the largest human population and the traffic of buffaloes is more active, such as for ritual activities, traditional activities and buying and selling of buffalo as a way for disease transmission to occur. Data on buffalo population and buffalo population affected by HS are presented in Table 1.

Buffalo is hereditary livestock kept by the community. Because the population is large in the four sub-districts, the population of buffaloes is abundant in the four sub-districts. In each sub-district, there are hundreds of breeders with average ownership of between three and four buffaloes, although there are also breeders who have dozens.

The maintenance method released in the forests and grasslands, which is the cause of the transmission of HS cases, often occurs in the four sub-districts. Many deaths occur in buffalo that roam freely in the forest and meadows. Usually, buffalo showing symptoms of HS are sold by farmers before the buffalo die, even though the price of buffalo is cheaper. This is what causes all HS cases not to be recorded.

Buffaloes that die in the field due to HS are often not buried. This is because burying dead buffalo is very burdensome for farmers because the soil in Samosir is mixed with stone. The effort to burn buffalo requires a lot of wood, so farmers do not do this. Buffaloes that died but were not buried, buffalo feces, urine that carried bacteria, also mucus were the cause of transmission, especially with the contours of the land in Samosir. Referring to the data in Table 3, it is known that the topography in Samosir is predominantly sloping to tilted. At the time of HE, topography also played a role in spreading *Pasteurella multocida* B:2 bacteria involved with rainwater runoff. Buffaloes that soak in puddles contain bacteria, or those that eat grass with bacteria become infected by HS.

Another thing that affects the case of HS is the type of rainfall. Samosir Island has a C-climate type of rainfall based on the Schmit and Fergusson typology. Evapotranspiration will exceed rainfall in this type, especially in June, July, and August. During these months, observations in the field are indeed dry conditions on Samosir Island. In September, it starts to rain slowly, but there is a different pattern due to the topography on Samosir Island. The topographical image of Samosir Island is presented in Figure 1. This topography causes a lot of runoff to occur so that even though the rain has exceeded

evapotranspiration, drought is still occurring.

The transition season on Samosir Island, between the dry and rainy seasons, is the most common HS case. The changing weather conditions, namely heat and rain, stress the buffalo. According to Hajikolaei *et al.*, (2008), hot and humid air affects the occurrence of HS outbreaks. In addition, the air temperature of 37°C is favored by *Pasteurella* bacteria to grow.

The difference in temperature between day and night during the transition season causes buffalo stress. Buffalo has poor heat tolerance capacity and is more susceptible to heat stress. It has sweat glands that are not evenly distributed. The body color is darker. There are only thin hairs on the body's surface causes buffalo to be sensitive to hot air Ganaie *et al.*, (2013).

The previous statement by Carter and De Alwis (1989) that HS cases mostly occur in the rainy season because buffaloes are stressed due to work is no longer relevant for HS cases on Samosir Island. In Samosir, rice fields currently use tractors, especially hand tractors. Therefore, the trigger for HS on Samosir Island is due to climate.

**Table 1.** Population of Buffaloes in Samosir District

Subdistrict	Buffalo Population				
	2017	2018	2019	2020	2021
Sianjur Mulamula	640	646	637	592	515
Harian	719	719	666	636	518
Sitiotio	658	670	641	622	564
Onan Runggu	3741	3591	3459	3192	2787
Nainggolan	4517	4287	4083	3781	3348
Palipi	3079	2994	2793	2488	1994
Ronggur Nihuta	2569	2514	2379	2161	1839
Pangururan	4745	4494	4267	3932	3439
Simanindo	3539	3230	3059	2779	2348
Total	24.207	23145	21984	20183	17352

Source: Samosir Regency Agriculture Office (2021)

**Table 2.** Number of Died Buffaloes due to HS in Samosir District

Subdistrict	Buffalo Death Due to HS				
	2017	2018	2019	2020	2021
Palipi	0	0	0	0	2
Ronggur Nihuta	0	0	13	0	6
Pangururan	0	57	0	0	6
Simanindo	0	132	17	0	2
Total	54	189	30	0	16

Source: Samosir Regency Agriculture Office (2021)

From Table 1, it is known that in 2018 there was an HS outbreak where 189 buffalo and cows died. This data is smaller than the actual data in the field because many farmers sell buffalo affected by HS before the buffalo die. Buffalo deaths due to HS can be overcome if treatment is carried out as early as possible (Benkirane and de Alwis, 2002). However, this is not possible for buffaloes reared by releasing them in grasslands or forests such as in Samosir. Treatment as early as possible is only possible for buffaloes kept in cages because buffalo like this can be observed every day. If the buffalo shows, abnormal symptoms can be known soon.

Observations made on buffalo infected with HS on Samosir Island found the characteristics of buffalo not wanting to eat, high fever, shortness of

**Table 3.** Percentage of Land Slope in Samosir Regency

Land Slope	Classification	%
0-20	flat	10
2-150	sloping	20
15-400	tilted	55
> 400	steep	15

Source: Statistics of Samosir Regency (2020)

breath, buffalo secreted mucus, and exudate in the mouth. Buffaloes also have diarrhea. Puspitasari *et al.*, (2019) mentioned that a severe lung infection caused the shortness breath of buffalo. Observations on buffalo used to be kept in a cage found that infected buffalo by its owners were separated. The buffalo was fed with chopped grass and turmeric herbs plus brown sugar. In addition, the buffalo was injected with antibiotics and vitamins by an animal health worker.



Fig. 1. Map of Samosir Island with flat to steep topography. Source : Statistics of Samosir Regency (2020)

From Figure 1, it is known that the four sub-districts where HS cases often occur have topography ranging from flat to steep.

#### Farmers' Willingness to Carry Out Vaccination

Referring to Table 4 then:

- As many as 47.4% of respondents agreed to have their livestock vaccinated because they remembered the case of the buffalo death outbreak that occurred in previous years.
- 26.4% were vaccinated because they saw the neighbor's buffalo sick
- As much as 10.5% of the buffalo were vaccinated because of self-awareness and
- A vaccine procurement persuaded 15.7% of respondents whose livestock were vaccinated by the government.

Most people are willing to vaccinate buffalo in the event of an outbreak or if a neighbor's livestock is sick. This is because collecting buffalo is very inconvenient because the buffalo that are kept are scattered in the forest and grazing land while they are busy with farming activities.

The process of collecting buffaloes requires the

cooperation of farmers. Buffaloes are usually collected at a point previously installed with barbed wire. Next, a tree is chosen where the owner of the buffaloes climbs the tree and uses a rope to entangle the buffalo's horns. When the buffalo's safe position, the health worker enters and injects the buffalo. Furthermore, the buffalo was sprayed with paint to distinguish the buffalo vaccinated.

Table 4. Frequency distribution of respondents based on farmers' willingness to carry out vaccination on buffalo

Farmers' willingness to carry out vaccination on buffalo	Number of respondents	Percentage (%)
Because of the breakout	398	47.4
Because seeing the neighbor's buffalo is sick	212	26.4
Because the awareness itself wants the buffalo to be healthy	88	10.5
Due to government procurement of vaccines	142	15.7

This was done repeatedly so that it took three days to vaccinate about 50 buffaloes.

In another vaccination process, buffalo are collected under the traditional house. In rural areas, community houses are traditional with high and wide pits and are fenced. An animal health worker can vaccinate buffalo from outside the fence when the buffalo is close to the fence. Caution is needed because of dealing with wild buffalo. Because collecting buffalo is very inconvenient while the buffaloes owner is also farmers who are busy in the fields, the willingness of the buffalo owner to carry out vaccination is minimal. The age of the owner also influences the willingness of the buffalo owner to carry out vaccination. Most of the owners are over forty years old, both father and mother. Not many young people live in the village. Generally, they migrate.

Vaccination is often not carried out on buffalo raised by the community while its owners generally live in the city. This is because the buffalo owner's cost of vaccinating is not given to the community.

As previously mentioned, the willingness of farmers to vaccinate arises because they have experienced a large number of dead buffaloes during outbreaks. For example, in the district Ronggur

Nihuta, there has been a decline in HS in the last five years. People are still reminded of many deaths, so they ask for the buffalo to be vaccinated at least once a year.

The willingness of farmers to do vaccines has not been maximized, even though the vaccine price is very cheap. Some of the vaccines are government assistance, but farmers have to buy their own when the stock of vaccines runs out. The vaccine price is only IDR 160,000 for 100 doses, meaning that each buffalo to be vaccinated pays IDR 16,000 or the equivalent of USD 1.12.

The difficulties of the community and animal health workers in conducting vaccination in Samosir can be overcome if the grazing location is provided with clip-on cage facilities with long gangways. Buffaloes are herded into buffaloes collection sites that have gangways. Considering the buffalo is a large and strong animal, it is necessary to consider the strength of the cage material.

#### Public knowledge about the benefits of vaccination

Public knowledge about livestock health, in this case the benefits of vaccination, were examined, among others, from the level of education.

Based on the data in Table 5, it is known that the majority of the population in Samosir Regency has a low level of education. Lack of public knowledge about the benefits of vaccines concerning the level of education of farmers. From Table 6, it is known that only 35% of the farming community know the benefits of the vaccine. In addition, from the survey carried out, it is known that the knowledge of animal husbandry is passed down from generation to generation from parents. The location of many buffalo farms is far from the sub-district city, so there is not much access to information about diseases. News sources, such as newspapers, are almost non-existent. People who are busy farming cause the opportunity to get information about the disease is also minimal.

**Table 5.** Gross Enrollment Rate (GER) of Samosir Regency by Education Level 2019-2021 (percent)

School Enrollment Rate	Net Enrollment Rate
Elementary School	97.22
Junior High School	79.12
High School	67.05
Undergraduate	20.57

Source: Statistics of Samosir Regency (2020)

**Table 6.** Frequency distribution of respondents based on farmers knowledge about the benefits of vaccination

Farmers' willingness to carry out vaccination on buffalo	Number of respondents	Percentage (%)
Know the benefits of the vaccine	294	35
Don't know the benefits of the vaccine	546	65

From the survey conducted, most of them do not understand the benefits of vaccination. Society assumes that injecting vaccines is a treatment and that all diseases are treatable. People do not understand that there are preventive and curative actions. There are diseases that, when infecting livestock, livestock can still survive by injecting antibiotics, but survival chances are not always as good as HS in buffalo.

Due to the inconvenient process of vaccinating buffaloes, vaccination must be made that requires cohesiveness which can be realized if a buffalo farmer group is formed for several villages. HS disease is difficult to treat, and it is best to vaccinate. The death of just one buffalo is very painful for the farmers because they rely on the buffalo to help with living expenses. The same is true for farmers in the Van Gujjar community, North India (Wright and Thrusfield, 2016).

Furthermore, it is necessary to socialize about vaccines and how they benefit. Socialization is carried out sporadically by using various media models.

In Pangururan District, the capital city of Samosir district, is located, so in Table 7, Pangururan is 0 km away. However, the breeders live in the mountains around Pangururan, so there is a distance between the breeders' residences and the district capital.

#### The Motivation of Breeders to Raise Buffaloes

The motivation of breeders to keep buffaloes is because of something that has been passed down from generation to generation (72.6%). Meanwhile, the motivation to keep buffalo as the main job is 0%. This is in contrast to the Van Gujjar community in North India, where raising buffalo is the main occupation (Wright and Thrusfield, 2016).

The Van Gujjar farming community understands the various diseases that can infect buffaloes, includ-

**Table 7.** Distance to the Capital of Regency Samosir Regency, 2019

Subdistrict	Distance capital of the regency
Sianjur Mulamula	14
Harian	16
Sitiotio	22
Onan Runggu	34
Nainggolan	24
Palipi	16
Ronggur Nihuta	19
Pangururan	0
Simanindo	48

Source : Statistics of Samosir Regency (2020)

ing the HS disease or Galghotu.

There are many benefits of buffalo for the Samosir community. Buffaloes produce meat, milk and are traded for traditional events. Moreover, buffalo can live in marginal areas, especially if the available feed is very low quality. Buffaloes can be used as a source of labor. Buffalo meat supports the meat self-sufficiency program. The community processes buffalo milk into curd, which is a typical Samosir snack resulting from the clumping of buffalo milk using enzymes from the pineapple (*Ananas comosus*), papaya (*Papaya carica*), or Alo-alo (*Agave sisalana*) plants. Buffaloes are traditional livestock used for various traditional activities, such as death, marriage, and worship.

Despite the many benefits of buffalo, the main occupation of the people of Samosir is farming. The main crops are rice and maize, although the community also grows onions, coffee, and fruits such as avocado and mango. Waste from rice cultivation supports additional feed for buffalo.

Maintaining buffalo in Samosir depends on climatic factors because during the rainy season, there is abundant feed, and during the dry season, there is a shortage of food. The dry season is a crucial time

**Table 8.** Frequency distribution of respondents based on motivation farmers on raising buffalo

Motivation	Number of respondents	Percentage (%)
Hereditary	584	72.6
Taking care of people's deposits	110	13.7
Deliberately buying and raising buffalo for savings	110	13.7
The main job	0	0

for buffaloes; buffaloes become stressed due to a lack of feed and water. Buffaloes are kept on the island of Samosir, namely in the mountains, where forage and water shortages are the most common part of HS cases during the dry season.

### Vaccine Procurement Conditions

The vaccine process in Samosir Regency is carried out every year starting in September (third quarter). The vaccines used were the vaccine injected twice per year, and the vaccine injected once per year. The vaccine creates immunity after two weeks of the injection process.

The current population of buffalo in Samosir Regency is 17,352 heads. Table 9 present data of vaccines allocation from the Department of Food Security and Livestock of North Sumatra Province (2021).

**Table 9.** Allocation of vaccine from 2017 to 2021 in Samosir Regency

Tahun	Number of vaccinations (doses)	Number of buffalo (heads)	Vaccination percentage (%)
2017	1000	24,207	4.1
2018	2000	23,145	8.6
2019	3000	21,984	13.6
2020	2000	20,183	9.9
2021	5000	17,352	28.8

Source : Department of Food Security and Livestock of North Sumatra Province (2021)

The low percentage of vaccination in Samosir causes the disease to appear every year. Case data is always smaller than the actual data in the field. This is because farmers sell sick buffalo even at low prices. Qureshi and Saxena (2019) stated that vaccination is an appropriate HS prevention measure for livestock. Meanwhile, Khan *et al.* (2011) stated that the best treatment is early in infection. Ignorance and reluctance of buffalo owners to vaccinate their livestock cause great losses. Data from the Medan Diseases Investigation Center from July to October 2021, deaths due to HS in Singkil Regency, which is in the working area of the Medan Diseases Investigation Center, were 142 buffalo and 40 cows. If one livestock is valued at IDR 15,000,000, the total loss is IDR 2,730,000,000 or the equivalent of USD 182,000. Buffalo deaths in Samosir recorded in November-December 2021 were 16 heads or a loss of IDR 240,000,000 or USD 16,000, while the vaccine price

was US 1.2 per dose. Therefore, the loss due to the death of one buffalo not being vaccinated is very large.

Meanwhile, the income of the people in Samosir is low due to marginal land, which causes many young men to leave the village to look for work elsewhere. Efforts to overcome so that HS cases no longer appear in Samosir even though routine vaccinations have been carried out is to increase vaccine coverage to 100% for several years. As on the island of Lombok, vaccination was carried out for three consecutive years with 100% vaccine coverage resulting in HS-free Lombok. Consistent efforts to carry out vaccination and high awareness of buffalo vaccinating have caused countries such as Japan, America, and Australia to suppress HS disease successfully.

Samosir is categorized as an endemic area, which has long been exposed to HS evenly, and there are livestock carriers. If there is another infection, the carrier buffalo will be even more immune for areas like this. Carrier buffalo will transmit HS during stressful conditions such as climatic stress. Buffaloes that are susceptible are young or adult buffaloes that have never been exposed. The most appropriate action for Samosir is also to strengthen vaccination.

## Conclusion

Based on the results and discussion, it can be concluded that Samosir Island is an endemic area of HS. The cause of HS always appearing every year is because of farmers' willingness and low knowledge of vaccination. Because raising livestock is a hereditary habit, the seriousness of vaccinating is also low. Next is the very low procurement of vaccines from the government; thus, the low vaccine coverage.

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## Conflict of Interest

The author declares no conflict of interest in publishing the paper.

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