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Relationship between Livestock Pen Sanitation, Fly Density, Well Conditions, and Diarrhea Incidence in Aek Banir Village, Panyabungan District

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ABSTRACT

Introduction: Inadequate livestock pen sanitation has been demonstrated to increase fly populations in the surrounding environment, thereby elevating the risk of diarrhea transmission among communities living in proximity to the pens. Additionally, wells constructed without adherence to proper construction standards have been associated with an elevated risk of water contamination, which, in turn, can lead to an increased incidence of diarrhea. The objective of this study is to ascertain the correlation between livestock pen sanitation, fly density, and well conditions with diarrhea incidence in the community of Aek Banir Village, Panyabungan Sub-District. **Method:** A quantitative approach with a cross-sectional design was utilized, involving 40 livestock owners as the sample, selected through total sampling. The collection of data was executed through the utilization of observation sheets, questionnaires, and fly grills. The analysis of the data was conducted using the chi-square test and Fisher's Exact Test. **Results:** The results indicated that 60.0% of livestock pens did not meet sanitation standards, 52.5% exhibited high fly density, 50.0% of wells were in poor condition, and 55.0% of livestock owners had experienced diarrhea. The chi-square test with Fisher's Exact Test indicated a significant relationship between livestock pen sanitation, fly density, and well conditions with the incidence of diarrhea. **Conclusion:** The present study posits that there is a relationship between livestock pen sanitation, fly density, and well conditions with diarrhea incidence in the community of Aek Banir Village, Panyabungan Subdistrict.

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INTRODUCTION

Diarrhea is a prevalent public health problem, particularly in developing countries. The disease under consideration is typified by the passage of loose or watery stools three or more times a day. Such an occurrence is generally attributed to bacterial, viral, or

parasitic infections that result from unsanitary environmental conditions. (WHO, 2023). According to data from the World Health Organization (WHO), diarrhea is the second leading cause of death among children, responsible for more than 505,000 deaths annually. Beyond its impact on children, diarrhea also exerts a significant influence on the overall health of the community, particularly in regions characterized by constrained access to clean water and adequate sanitation.

This condition is also observed in Indonesia, where diarrhea is the third most prevalent infectious disease, with the highest incidence rates. According to the following source:Profil Kesehatan Indonesia (2018)The occurrence of diarrhea cases remains a recurrent phenomenon, with frequent reports being received from health service facilities. In North Sumatra Province, data from the Badan Pusp Statistik (2022) documented 4,143 cases of diarrhea in Mandailing Natal Regency. Panyabungan District was identified as the area with the highest number of cases, with a total of 2,005 cases. A high incidence of diarrhea has been reported in Aek Banir Village, a village within Panyabungan District, with a total of 1,083 cases documented in 2023 alone.

Environmental factors play an important role in the spread of diarrheal diseases. Poor livestock pen sanitation contributes to the increase in diarrhea cases. The accumulation of animal waste and pens built too close to residential areas increase the risk of environmental contamination and disease transmission. Research by Ramadhani et al., (2022) showed that farmers working in livestock pens with poor sanitation experienced cases of diarrhea. In addition, high fly density resulting from inadequate livestock waste management serves as a major vector for diarrhea transmission. The condition of wells that do not meet health standards also contributes to the risk; the poorer the well construction, the higher the possibility of *coliform* bacterial contamination, which can cause diarrhea Syafarida et al., (2022).

Diarrhea remains one of the most serious public health challenges, especially in developing countries such as Indonesia. This disease is characterized by the passage of loose or watery stools more than three times a day and is generally caused by bacterial, viral, or parasitic infections closely associated with unhygienic environmental conditions. According to (WHO, 2023). diarrhea is the second leading cause of death among children worldwide, with more than 505,000 deaths annually. Based on Profil Kesehatan Indonesia (2018), diarrhea ranks third among infectious diseases with high incidence rates continuously reported in various health care facilities.

Mandailing Natal Regency in North Sumatra Province, particularly the Panyabungan District, has been identified as a region with a high incidence of diarrhea. According to data from Badan PUSAT Statistik (2022), Panyabungan District recorded the highest number of cases, with 2,005 cases, while Aek Banir Village, which is part of this district, reported 1,083 cases in 2023. Preliminary surveys indicate that the environment in this village does not meet health standards. Most livestock pens are built in close proximity to houses, with a distance of less than 10 meters, and lack adequate sanitation. Additionally, the fly density around the pens is quite high, with a mean of 6–20 flies per pen. Furthermore, it has been determined that the wells are in substandard condition and do not meet the requisite health standards.

Based on these issues, it is necessary to conduct an analytical study on livestock pen sanitation, fly density, and well conditions in relation to the incidence of diarrhea among residents of Aek Banir Village, Panyabungan District. The purpose of this study is to determine the relationship between livestock pen sanitation, fly density, and well conditions with the incidence of diarrhea among the community in Aek Banir Village, Panyabungan District.

LITERATURE REVIEW

Livestock pen sanitation plays a significant role in maintaining environmental cleanliness around residential areas. Pens that are rarely cleaned, have improper waste disposal, or have wet and poorly maintained floors can become sources of environmental contamination (Dinas Peternakan, 2023). Furthermore, pens built too close to residential homes increase the likelihood of water and food contamination, which can trigger various diseases, including diarrhea. According to Syafitri and Indirawati (2022), poor livestock pen sanitation that fails to meet health standards can increase the fly population in surrounding areas, potentially becoming a vector for disease transmission—especially in residential areas located near livestock pens. The components of pen sanitation, as stated in the Regulation of the Minister of Agriculture of the Republic of Indonesia No. 70 of 2015 concerning Animal Facilities, include the construction of the pen building, the adequacy of feed and drinking facilities, the condition of the pen floor and roof, the waste collection system, waste treatment facilities, and the cleanliness of the surrounding environment.

Fly density around residential areas is also an important factor contributing to the transmission of diarrhea. Flies can act as mechanical vectors, carrying various pathogenic microorganisms from livestock feces to food or beverages consumed by humans (Fatrisia et al., 2020). High fly density is commonly found in environments with poor sanitation, which increases the likelihood of disease transmission. Therefore, fly control efforts through improved sanitation and proper waste management are essential to reduce this risk.

The quality of water sources, particularly wells, is another crucial factor influencing the risk of diarrhea. Wells that are not constructed according to health standards—such as being too close to livestock pens, having cracked or non-waterproof walls, or lacking protective structures—are highly susceptible to contamination by pathogenic bacteria (Syafarida et al., 2022). Using contaminated well water for daily consumption increases the risk of diarrhea, especially in rural areas.

Diarrhea continues to be a major public health issue, particularly in developing countries where access to clean water and adequate sanitation facilities remains limited. The disease is characterized by the passage of loose or watery stools three or more times per day and can lead to severe dehydration (WHO, 2023). Contaminated environments and unsafe water sources are the main factors contributing to the high incidence of diarrhea. Therefore, improving environmental sanitation quality plays a vital role in preventing this disease.

Findings from several previous studies indicate that the combination of poor livestock pen sanitation, high fly density, and inadequate well conditions significantly increases the risk of diarrhea in communities (Saidi et al., 2022). Hence, improving livestock pen sanitation, controlling fly vectors, and providing clean water that meets health standards are key integrated strategies needed to reduce the incidence of diarrhea in affected populations.

METHOD

The type of research used in this study was an analytical survey with a cross-sectional design. The population in this study consisted of residents who owned cattle pens, totaling 40 farmers, who also served as the research samples. The samples were taken using a total sampling technique, in which the entire population under study was included as the sample; therefore, the sample size did not require separate calculation. The study was conducted in Aek Banir Village, Panyabungan District, from March to April 2025. The independent variables in this study were livestock pen sanitation, fly density, and well

conditions, while the dependent variable was the incidence of diarrhea. The cross-sectional design was used to observe the cause-and-effect relationship between livestock pen sanitation, fly density, well conditions, and diarrhea incidence, with data collected at a single point in time.

The data collection methods used in this study consisted of two data sources Primary data, which included observation sheets, questionnaires, and fly grills. Secondary data, which included records of diarrhea case reports obtained from relevant institutions, namely Puskesmas Panyabungan Jae. Observation sheets were used to assess livestock pen sanitation and well conditions, questionnaires were used to evaluate diarrhea incidence, and fly grills were used to measure fly density.

The data analysis was carried out in two stages Univariate analysis was used to describe the frequency distribution and percentage of each variable. Bivariate analysis was performed using the Chi-square test, with Fisher's Exact Test as an alternative, to determine the relationship between the independent variables (livestock pen sanitation, fly density, and well conditions) and the dependent variable (diarrhea incidence). The analysis was conducted at a 95% confidence level with a significance value of $\alpha = 0.05$.

RESULTS AND DISCUSSION

Aek Banir Village is one of the areas located in Panyabungan Subdistrict, Mandailing Natal Regency, North Sumatra Province. Aek Banir Village is situated on the outskirts of Panyabungan City, with a total area of approximately ±40,000 hectares. The total population is recorded at 3,062 people, consisting of 1,446 males and 1,596 females, distributed among 763 households. The majority of the residents earn their livelihood as farmers. In addition to agriculture, some of the community members are engaged in livestock farming. There are 40 livestock farmers in Aek Banir Village.

An overview of the respondents' characteristics based on age, education, and duration of livestock farming can be seen in Table 1.

Table 1. Respondent Characteristics

Respondent Characteristics	Frequeny (n)	Percentage (%)
Age (years)		
25-29	4	10.0
30-49	29	72.5
50-55	7	17.5
Education		
Completed Elementary School	40	100.0
Duration of Livestock Farming (years)		
1-4	21	52.5
5-8	15	37.5
9-12	4	10.0

It is known that in terms of age, the majority of respondents (72.5%) are between 30–49 years old, with the youngest age group being 25–29 years (10.0%) and the oldest being 50–55 years (17.5%). Based on the education level, all respondents were found to have completed elementary school as their highest level of education. Meanwhile, in terms of livestock farming experience, 52.5% of respondents have been raising livestock for 1–4 years, 37.5% for 5–8 years, and 10.0% for 9–12 years (Table 1).

The livestock pen sanitation variable includes the distance between the pen and the farmer's house as well as the cleanliness of the pen. The following section presents the details of the observation results regarding livestock pen sanitation (Table 2). Based on

Table 2 regarding livestock pen sanitation parameters, several aspects have not yet met the required standards. A total of 30 livestock pens was not equipped with a drainage system. As many as 34 pens do not have floors that slope toward the drainage channel. Additionally, 28 pens lack facilities for collecting liquid and solid waste. Moreover, 36 pens produce strong odors, and 28 pens are still unclean, with garbage found around the pen area

Table 2. Distribution of Livestock Pen Sanitation

Livestock Pen Cleanliness	Yes		No	
	n	%	n	%
The pen structure is strong and easy to clean	32	80	8	20
Feeding and watering facilities are easy to clean	32	80	8	20
The pen is equipped with a well-functioning drainage system or ditch	10	25	30	75
The pen floor is made of cement and waterproof	20	50	20	50
The pen floor is not slippery	23	57.5	17	42.5
The pen floor slopes toward the drainage channel	6	15	34	85
The pen floor is clean from animal waste	23	57.5	17	42.5
The pen floor is clean from feed residues	30	75	10	25
The pen roof is made of strong and leak-proof materials	25	62.5	15	37.5
The pen has facilities for collecting liquid and solid waste	12	30	28	70
The pen has facilities for livestock waste treatment	27	67.5	13	32.5
Clean water sources are available for pen sanitation	32	80	8	20
Adequate cleaning equipment for the pen is available	22	55	18	45
The pen does not produce a strong odor	4	10	36	90
The area around the livestock pen is clean and free from garbage	12	30	28	70

The data show that the majority of livestock pens in the study area do not meet the sanitation standards, with 60% categorized as *not eligible*, while only 40% fulfill the required sanitation criteria. This finding indicates that more than half of livestock owners maintain pens with substandard hygiene conditions, which may contribute to environmental contamination and increase the risk of vector-borne diseases (Table 3).

Table 3. Distribution of Livestock Pen Sanitation, Distance from Houses, and Fly Density Categories

Distribution of Livestock	Frequency (n)	Percentage (%)
Livestock Pen Sanitation Categories		
Eligible	16	40
Not eligible	24	60
Distance Between Livestock Pen and House		
Eligible (≥10 meter)	14	35
Not eligible (<10 meter)	26	65
Fly Density		
Low	6	15,0
Moderate	6	32.5
High	21	52.5

Regarding the distance between livestock pens and residential houses, it was found that 65% of livestock owners have pens located less than 10 meters from their homes, failing to meet the minimum distance requirement. Only 35% of respondents comply with the recommended standard (≥10 meters). This condition suggests a potential risk of disease transmission from livestock to humans, as closer proximity facilitates the spread of pathogens and odors, and may attract flies to domestic areas (Table 3).

Furthermore, observations of fly density around the farmers' kitchen areas reveal that more than half (52.5%) fall into the *high-density* category (6–20 flies), while 32.5% are in the *moderate* category, and only 15% are classified as *low*. The high fly density levels likely correlate with inadequate livestock pen sanitation and the short distance between pens and residential areas, both of which provide favorable breeding conditions for flies (Table 3).

Table 4. Distribution of Farmers' Well Conditions

Well Condition	Yes		No	
	n	%	n	%
Well walls are made of concrete and watertight	27	67.5	13	32.5
Minimum wall depth is 300 cm from the well floor surface	14	35	26	65
Well walls are plastered and tightly sealed	23	57.5	17	42.5
Well rim height is at least 80 cm above the floor surface	36	90	4	10
The well rim is plastered on both the inside and outside	19	47.5	21	52.5
The well rim is clean and free from cracks or damage	10	25	30	75
The well floor is made of cement and watertight	36	90	4	10
The well floor extends at least 1 meter from the well wall	29	72.5	11	27.5
The well floor surface slopes toward the drainage channel	19	47.5	21	52.5
There are no cracks on the well floor	27	67.5	13	32.5
The bucket rope is securely hung and does not touch the ground	25	62.5	15	37.5
There is a wastewater drainage channel around the well	29	72.5	11	27.5
The wastewater drainage channel functions properly	18	45	22	55
There is no standing water around the well	13	32.5	27	67.5
The distance between the well and the livestock pen (pollution source) is ≥10 meters	17	42.5	23	57.5

The well condition variable in this study was determined through direct observation of the wells' conditions. The distribution of the farmers' well conditions can be seen in Table 4. Several aspects were found not to meet the established standards. A total of 30 wells had rims that were not clean or showed cracks. Twenty-seven wells still had standing water around them. In 26 wells, the wall depth had not yet reached 300 cm. Additionally, 23 wells were located less than 10 meters from pollution sources such as livestock pens. Twenty-two wells were not equipped with wastewater drainage channels. Meanwhile, in 21 wells, the inner and outer parts of the well rim had not been plastered, and an equal number of wells had floor surfaces that were not sloped toward the drainage channel. The following section presents detailed observation results based on well condition categories.

Based on the data presented in Table 5, it can be seen that half of the farmers' wells (50%) are categorized as *eligible*, while the remaining 50% are *not eligible* according to sanitation standards. This finding suggests that the overall well condition among farmers is still inadequate, with a significant portion failing to meet environmental health requirements such as sufficient distance from contamination sources and proper structural protection.

In terms of health outcomes, the data show that 55% of respondents experienced diarrhea, while 45% did not. The relatively high proportion of diarrhea cases indicates the potential impact of poor environmental sanitation, particularly related to water sources. Wells that are not properly constructed or maintained may serve as pathways for pathogenic contamination, especially from livestock waste or domestic sewage.

Table 5. Distribution of Farmers' Well Conditions and Diarrhea Incidence

Distribution of Livestock	Frequency (n)	Percentage (%)
Well Condition Categories		
Eligible	20	50
Not eligible	20	50
Diarrhea Incidence		
Diarrhea	22	55
No Diarrhea	18	45

Table 6. Relationship Between Environmental Sanitation Factors and Diarrhea Incidence Among Farmers in Aek Banir Village, Panyabungan District

Environmental Sanitation Factors	Diarrhea Incidence Among Farmers				Total		P-value
	Diarrhea		No Diarrhea		N	%	
	n	%	n	%			
Livestock Pen Sanitation Categories							
Eligible	22	91.7	2	8.3	24	100	<0.0001
Not eligible	0	0.0	16	10.0	16	100	
Fly Density							
Low	0	0.0	6	100	6	100	<0.0001
Moderate	1	7.7	12	92.3	13	100	
High	21	100	0	0.0	21	100	
Well Condition Categories							
Eligible	19	95.0	1	5.0	20	100	<0.0001
Not eligible	3	15.0	17	85.0	20	100	

The results of Fisher's Exact Test showed that environmental sanitation factors—specifically livestock pen sanitation, fly density, and well condition—had a statistically significant relationship with diarrhea incidence among farmers ($p < 0.0001$ for all variables). Among the 24 farmers whose livestock pen sanitation did not meet standards, 22 (91.7%) experienced diarrhea, while only 2 (8.3%) did not. In contrast, none of the 16 farmers whose livestock pens met sanitation standards experienced diarrhea. Similarly, fly density showed a strong association with diarrhea incidence: all 21 farmers in areas with high fly density reported diarrhea, compared to only 1 farmer (7.7%) in the moderate density group and none in the low-density group. The condition of wells also demonstrated a significant effect; among farmers using wells that did not meet health standards, 19 (95.0%) had diarrhea, while only 1 (5.0%) did not. Conversely, of those with wells meeting standards, 17 (85.0%) did not experience diarrhea. These findings indicate that poor sanitation in livestock pens, high fly populations, and unsafe water sources substantially increase the risk of diarrheal disease. Therefore, improving livestock pen hygiene, controlling fly breeding sites, and ensuring clean water sources are critical measures for preventing diarrhea among rural farming communities.

Livestock Pen Sanitation in Aek Banir Village, Panyabungan District

Livestock pen sanitation is an important aspect of creating a healthy environment and preventing the spread of environmentally related diseases. However, based on the results of this study involving 40 respondents' livestock pens, 24 pens (60.0%) were categorized as not meeting the required standards, while 16 pens (40.0%) met the standards.

Most of the livestock pens were not equipped with proper drainage systems. The absence of a drainage system causes livestock waste to accumulate inside the pen instead of being effectively channeled to a designated storage area. Field observations showed that

unmanaged waste often overflows from the pens, contaminating the surrounding environment such as yards and water channels. This condition generates unpleasant odors that can affect comfort and health.

These findings are supported by a study conducted by Chayati et al. (2023), which stated that inadequate waste disposal systems and poor livestock waste management negatively impact not only human health but also environmental quality. This highlights the importance of proper waste management as a crucial effort to maintain environmental health and prevent disease transmission.

Livestock waste can produce methane gas (CH_4) and serve as a breeding ground for both pathogenic and non-pathogenic microorganisms such as *Escherichia coli*, *Salmonella sp.*, and *Shigella*, which are commonly found around livestock areas. The presence of such waste poses health risks to both farmers and nearby residents. Therefore, to minimize these risks, proper livestock pen sanitation and personal hygiene among farmers are essential to prevent disease transmission (Fawaid, 2020).

The study also revealed that most of the observed livestock pens remained in unclean conditions and did not meet proper sanitation standards. Poor pen hygiene contributes to the spread of various diseases. This finding aligns with research by Harianja et al. (2022), which found that settlements located close to livestock pens with inadequate sanitation tend to have a higher risk of diarrhea compared to those maintaining proper livestock sanitation practices.

Distance Between Livestock Pens and Farmers Residences in Aek Banir Village, Panyanbungan District

Based on the study results, the majority of farmers (65.0%) placed their livestock pens less than 10 meters from their homes. This condition indicates that most farmers have not met the ideal distance standard to properly separate residential areas from livestock locations. Field measurements showed that some pens were directly attached to the walls of the houses, with the closest distance being 0 meters, causing a strong odor from livestock waste to spread inside the farmers' homes.

This finding is consistent with the study by Simamora et al. (2015), which showed that placing livestock pens too close to residential areas can produce unpleasant odors from cattle waste, leading to discomfort for residents and reflecting substandard environmental sanitation conditions. This statement is also supported by Welfian and Purwaningsih (2022), who noted that one of the serious impacts of having livestock pens close to houses is the potential health risk for both residents and surrounding communities. In addition, livestock pens can become breeding grounds for various microorganisms such as germs, bacteria, and viruses.

Livestock pens located too close to residential areas—especially those within a distance of less than 10 meters—can contribute to health problems such as diarrhea. Residential environments that do not maintain the recommended distance between homes and livestock pens tend to have a higher potential for diarrhea incidence (Harianja et al., 2022).

Fly Density in Aek Banir Village, Panyabungan District

Livestock activities in Aek Banir Village, which are carried out near residential areas without adequate consideration of livestock pen sanitation, have led to an increase in fly populations around the area. The results of the study showed that the majority of farmers experienced high fly density, with 21 farmers (52.5%) categorized as high, 13 farmers (32.5%) as medium, and only 6 farmers (15.0%) as low.

This condition is closely related to the suboptimal management of livestock pens. Livestock manure that is left to accumulate both inside and outside the pens without proper management is the main factor contributing to the high fly density. This finding is consistent with the research of Syafitri and Indirawati (2022), which showed that poor pen sanitation contributes to increased fly density in the homes of residents living near livestock areas.

Proper livestock waste management plays an important role in controlling fly populations. When waste is not properly managed, it creates an environment that is highly conducive to fly breeding. Livestock manure serves as a primary source that attracts flies to reproduce. An increased fly population heightens the risk of disease transmission, such as diarrhea, among the community (Drajad et al., 2023).

High fly density is not limited to the livestock pens themselves. The close proximity between livestock pens and houses allows flies to easily enter residential areas. Kitchens or food storage areas are particularly vulnerable, as the smell of food attracts flies. The presence of flies in kitchens poses a serious health risk because they can transfer harmful microorganisms from waste to food that will be consumed. This is supported by Ariansyah et al. (2025), who stated that high fly density around livestock pens or residential areas significantly increases the risk of diarrhea.

Well Conditions in Aek Banir Village, Panyabungan District

Based on the results of the study, several issues were identified regarding the condition of the respondents' wells. Although the well walls were watertight, many did not reach the required depth of 3 meters and lacked concrete retaining walls, leaving the soil directly exposed. This increases the risk of contamination, as wells without impermeable walls allow pollutants from the surrounding soil to seep into the water. Harmful substances such as household waste and livestock manure can penetrate the well walls and contaminate the groundwater.

This finding is supported by Syafarida et al. (2022), who stated that well water contamination does not depend solely on the amount and proximity of pollution sources around the well, but is also strongly influenced by the quality and structural integrity of the well itself. The key construction elements that determine water safety include the condition of the well walls, the well rim, the floor surface, and the wastewater drainage system.

Another important component of well condition is the well floor. The study found that four wells did not meet the construction standards — these wells had only earthen floors. Additionally, 21 wells (52.5%) had floors that did not slope toward the drainage channel, and stagnant water was observed around several wells. Cracks on the well floor, or the absence of a solid floor, can allow bacteria to enter the well through the movement of contaminated water (Syafarida et al., 2022).

Measurement results also showed that 23 wells (57.5%) did not meet the safe distance requirement from livestock pens. This condition increases the likelihood of water contamination by microorganisms, particularly *Escherichia coli*. *E. coli*bacteria originating from livestock waste can spread when manure is left to accumulate, and if the distance between livestock pens and the water source is less than 10 meters, the bacteria can migrate into the water supply. Consumption of contaminated water poses a significant risk of diarrhea (Qorni et al., 2022).

To meet environmental health standards, the safe distance between wells and potential pollution sources must be at least **10 meters**. If the distance is less than 10 meters,

the well is categorized as not meeting the established health and safety criteria. (Kementerian Pekerjaan Umum dan Perumahaan Rakyat 2016).

Incidence of Diarrhea Among Residents of Aek Banir Village, Panyabungan District

The results of the study show that the incidence of diarrhea among livestock farmers in Aek Banir Village is relatively high, reaching 55% of all respondents. This indicates that more than half of the farmers experience digestive health problems, particularly diarrhea.

Field observations revealed that most livestock pens were not equipped with adequate waste management systems. This situation creates a damp and unhygienic environment that promotes the growth of pathogenic microorganisms and the proliferation of disease vectors such as flies. Such conditions pose a significant risk to the surrounding community's health, especially by increasing the likelihood of gastrointestinal diseases. This finding is consistent with the study of Harianja et al. (2022), which showed that livestock pens with poor sanitation standards have a significant association with diarrhea incidence, particularly in residential areas close to livestock activities.

Another contributing factor to the increase in diarrhea cases is the high fly density in farmers' kitchen areas, which was found in this study to have a significant relationship with diarrhea incidence. All farmers living in environments with high fly density reported experiencing diarrhea, strengthening the assumption that flies act as vectors in transmitting disease-causing agents.

The condition of wells as the primary water source also plays an important role in the analysis of diarrhea cases. Field findings revealed that many wells owned by farmers did not meet sanitation standards. This issue is exacerbated by the short distance between wells and livestock pens, increasing the likelihood of waste contamination. Poor well construction quality and substandard locations significantly raise the risk of pathogenic bacteria entering drinking water sources. This is supported by Nurhalimah and Putri (2022), who stated that inadequate physical well conditions and improper locations can increase the concentration of coliform bacteria, which play a key role in the occurrence of diarrhea in communities living near livestock areas.

Relationship Between Livestock Pen Sanitation and the Incidence of Diarrhea Among Residents of Aek Banir Village, Panyabungan District

The study obtained an p-value of 0.000, which is statistically significant at the 0.05 level (p 0.05). This conclusion was reached through a thorough statistical analysis that utilized the chi-square test and Fisher's exact test as an alternative. This finding suggests a substantial association between the condition of livestock pen sanitation and the prevalence of diarrhea among the population of Aek Banir Village. The present findings underscore the pivotal role of livestock sanitation in determining the prevalence of diarrhea within a community.

The sanitation of livestock enclosures constitutes a pivotal element in the prevention of the transmission of diseases of a environmental nature. Nonetheless, the results of the observations conducted on 40 livestock pens indicated that 24 pens (60.0%) were classified as not meeting sanitation standards. In this group, 22 respondents (91.7%) experienced diarrhea, while only 2 respondents (8.3%) did not. Conversely, 16 pens (40.0%) satisfied the sanitation standards, and no respondents in this category reported experiencing diarrhea. The findings indicate a robust correlation between the quality of pen sanitation and the prevalence of diarrhea within the community.

Livestock pens that are not designed according to sanitation standards have a high potential to become breeding grounds for disease-causing agents. Solid waste such as

manure that is left to accumulate can serve as a medium for microorganisms like *Escherichia coli* and *Salmonella* sp. The study by Gunawan, Kholik, and Agustin (2022) identified the presence of *E. coli* through sample testing of cow feces, while Muzadin, Ferasyi, and Fakhrurrazi (2018) confirmed the presence of *Salmonella* sp. in cow feces. These findings suggest that livestock waste not only poses environmental contamination risks but can also serve as a direct source of infectious disease transmission to humans.

This result aligns with the study by Nurochmah and Rachma (2017), which found a significant relationship between livestock pen sanitation and diarrhea incidence in Sruni Village, Musuk District, Boyolali Regency, with a p-value = 0.000 < α = 0.05. Similarly, Kurnia et al. (2020) reported a statistically significant association (p-value = 0.000 < α = 0.05) between pen sanitation conditions and the occurrence of diarrhea, further reinforcing the findings of this study.

Relationship Between Fly Density and the Incidence of Diarrhea Among Residents of Aek Banir Village, Panyabungan District

Based on data analysis using the chi-square test with Fisher's Exact Test as an alternative, the results showed a p-value = 0.000 (p < 0.05). This indicates a significant relationship between the level of fly density and the incidence of diarrhea among the residents of Aek Banir Village. In other words, high fly density plays a significant role in the occurrence of diarrhea cases within the community.

The high population of flies in farmers' kitchen areas is largely attributed to poor livestock pen sanitation, which contributes to an increase in diarrhea incidence. This condition is also influenced by the proximity between the livestock pens and the farmers' homes. The research data showed that all respondents whose kitchen environments had a high fly density experienced diarrhea, while respondents living in areas with low fly density did not experience diarrhea at all. These findings clearly demonstrate the role of flies as a potential vector in transmitting pathogens that cause gastrointestinal diseases such as diarrhea.

This finding is consistent with the study conducted by Karimuna et al. (2023), which found a significant association between fly density and diarrhea incidence in residential areas near the fish auction site in Kendari City, with a p-value = 0.000 < 0.05. Similarly, Jannah and Maftukhah (2018) reported a meaningful relationship between fly density and diarrhea incidence (p-value = 0.000) in residential areas surrounding poultry farms in Rambang District, Muara Enim. These studies support the conclusion that poor environmental sanitation and high fly density are closely linked to the spread of diarrheal diseases in communities living near livestock or waste-producing environments.

The Relationship Between Well Conditions and the Incidence of Diarrhea Among the Community in Aek Banir Village, Panyabungan District

Based on data analysis using the chi-square test with the Fisher Exact Test as an alternative, a ρ-value of 0.000 (p < 0.05) was obtained. This finding indicates a significant relationship between well conditions and the incidence of diarrhea among the community. In other words, the condition of the wells plays a significant role in influencing the occurrence of diarrhea cases in the area.

Field findings show that the residents of Aek Banir Village do not treat or purify their water before using it for daily needs such as cooking, drinking, and washing. Wells that are not constructed according to sanitation standards — for example, lacking protective barriers against contamination or being located too close to livestock pens — make the water highly susceptible to contamination by diarrhea-causing microorganisms such

as *Escherichia coli* and *Salmonella* sp. When contaminated water is consumed without prior purification or treatment, the risk of disease transmission increases directly through the consumption of unhygienic water.

This study's results are consistent with the findings of Triana and Lilia (2023), who also demonstrated a significant relationship between well conditions and the incidence of diarrhea, with a ρ-value = 0.000 < p = 0.05. Similar results were reported by Simanullang and Nanda (2018), who found a significant relationship between well conditions and diarrhea cases among the community in Ujung Teran Village, with a ρ-value = 0.003.

Researh Limitations

In conducting this study, the researcher encountered several limitations, particularly in the aspect of communication. Some respondents initially assumed that the data collection activity was related to social assistance or government programs, which made them less open in providing information. The researcher had to provide persuasive and repeated explanations to help respondents understand that this research was purely academic in nature and not associated with any aid or government program.

CONCLUSION

The findings of the study indicate a substantial correlation between the sanitation of livestock enclosures, the density of flies, and the quality of wells with the occurrence of diarrhea among the population of Aek Banir Village, Panyabungan District. A total of 60% of livestock pens did not meet sanitation requirements, 52% of livestock owners' kitchens had high fly density, and 50% of wells failed to meet environmental health standards—corresponding with a high diarrhea incidence rate of 55%.

The primary objective of this study is to ascertain the extent to which wells and livestock activities contribute to the risk of diarrheal disease. Poor sanitation practices in livestock enclosures can serve as a source for the dissemination of pathogens. High fly density in kitchen areas can act as a vector for diarrhea-causing agents, and inadequate physical and sanitary well conditions may facilitate disease transmission through contaminated water.

These findings underscore the significance of enhancing livestock pen sanitation, implementing fly vector control measures, and upgrading well infrastructure to meet health standards as effective preventive measures to reduce diarrhea cases within the community.

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