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Full Length Research

Analysis of compliance with biosecurity and wastes disposal of selected animal farms in Bataan, Philippines

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ABSTRACT: This analysis assessed the compliance of selected animal farms in Bataan, Philippines, with biosecurity measures focusing on physical, biological, and chemical aspects, as well as farm waste disposal regulations. The study was conducted using a survey questionnaire during on-site farm assessments. The results showed a 52.63% compliance rate for physical aspects, with farms meeting location requirements (more than 0.5-1.0 km from communities) and having established perimeters, boundary fences, and disinfection areas. However, farms were lacking in controlling the entry of people, animals, and vehicles, washing and disinfecting incoming vehicles, and providing boots and overalls. Biological compliance was 38.99%, indicating inadequate animal care, feed delivery practices, use of quality drinking water, waste disposal, and vaccination against common diseases. Compliance with chemical aspects was 49.68%, with farms having disinfection programs, disinfecting incoming vehicles or equipment, and using disinfectant on tires, foot baths, and after cleaning. Overall, the assessment found a 47.10% compliance rate with the three aspects of animal farm biosecurity, suggesting low compliance in protecting animals from disease contamination. Farm waste disposal compliance was 42.72%, highlighting the lack of waste disposal facilities and low adherence to government regulations. This study was able to identify risk areas that can still be further developed through a continuing training program to be sponsored by concerned government agencies to capacitate the local animal raisers in proper animal husbandry practices to be followed by regular monitoring of their compliance with biosecurity measures and proper waste management to avoid disease outbreaks and prevent environmental pollution.

Keywords: Animal farms, biosecurity, disinfection, food safety, vaccination, waste disposal.

INTRODUCTION

Due to the rising demand for food safety, there is a need to enhance the food safety regulatory system in the Philippines (Philippine Republic Act No. 10611). This is essential to protect both consumer and animal health, because many consumers regard animal-friendly products as healthier, safer, more flavorful, cleaner, authentic, eco-friendly, and traditional (Alonso *et al*., 2020), facilitate market access to local foods and products, and ensure the overall health and wellness of food consumers worldwide. Consequently, it is important to understand how animal farms produce food in compliance with food safety standards to ensure a safe food supply throughout the chain and provide a framework of the internationally harmonized system (Panghal *et al*., 2018). The primary focus of this study is on strategies to protect animals from disease-causing organisms and minimize the use of harmful chemicals in food production to prevent the spread of diseases (Costa and Akdeniz, 2019).

Since animal farms are often less hygienic and can harbor many pathogens, it is crucial to assess their current level of biosecurity compliance in Bataan province. This involves evaluating whether farms are meeting the minimum biosecurity standards in ten key areas. Public interest in preventing and controlling new pests and diseases is growing, partly due to the perception that the threat is increasing. However, there has been limited

analysis of the changing rates of biosecurity threats, and the existing evidence is inconclusive.

Traditional biosecurity systems for animal farms vary widely but are starting to align (Maye and Chan, 2020). Bio-economic risk modeling can guide the allocation of resources for biosecurity (Barnes *et al*., 2020). Advances in technology and the increasing involvement of the private sector will heavily influence future prevention and management systems. Biosecurity measures are crucial to prevent disease transmission between animals and from farm to farm. Personal biosecurity practices such as hand washing and using protective clothing and footwear are necessary on all farms, along with measures related to acquiring new animals (Scollo *et al*., 2023; Verzhykhovskyi and Nedosekov, 2024).

A comprehensive biosecurity approach is needed to mitigate the risk posed by non-native organisms to agriculture, the economy, the environment, and human health (French, 2017). Assessing compliance with environmental protection and sustainable development standards is also important, as a clean and healthy environment benefits everyone and should be a universal concern (Republic Act 8749).

Therefore, it is essential to evaluate the strategies and current practices of privately owned animal farms in preventing animal diseases. This evaluation can address the existing issues by first analyzing how farm owners implement biosecurity measures to protect their animals from infectious and contagious diseases, as well as their practices in disposing of farm wastes.

MATERIALS AND METHODS

The study was approved by the BPSU- Peninsulares Research Ethics Committee (REDO.PROJ.AC.2018.03) and aimed to assess the compliance of selected commercial and backyard animal farms in Bataan with biosecurity measures and waste disposal regulations. The focus was on the physical, biological, and chemical aspects of biosecurity, as well as awareness and facilities for farm waste disposal. This research used the survey method and the sample size before the survey was determined using the Slovins' formula; $\mathbf{n = N / (1 + Ne^2)}$, where: **n** - sample size needed, **N** - population size, and **e**- acceptable margin of error (Muatip *et al*., 2022). Data were collected through interviews using a detailed questionnaire covering various factors on the following areas of concern:

Physical aspects: farm location (distance to other farms, highways, households, and communities), perimeter security (boundary fences, driveways), favorable relationships with neighboring communities and local government, entrance control (limiting the entry of non-workers and animals), cleanliness and structure of the farm surroundings, shipping and transport of animals (washing and disinfecting incoming vehicles).

Biological aspects: health checks and quality certification for new or replacement stocks, introduction of new technologies, isolation and quarantine practices, feed delivery safety, water treatment and testing, secured disposal of dead animals, and regular vaccination programs.

Chemical aspects: disinfection programs, disinfection of incoming vehicles and equipment, use of disinfectants after cleaning.

The study also evaluated compliance with waste management regulations, including awareness of waste production, waste disposal management programs, segregation, recycling, regular cleaning, hazardous waste containers, biogas systems, composting methods, solid-liquid separation, wastewater treatment, and willingness to receive training. Data were analyzed using simple descriptive statistics such as frequency distribution, percentage, mean, and ranking.

Scope and limitation

This study covers all eleven municipalities and one city in the province of Bataan, Philippines. It is limited only in those commercial, semi-commercial, and small hold animal farms registered in the municipal and/or city agriculture offices.

RESULTS

Table 1 provides the profile of respondents from 100 animal farms in Bataan. The participants had an average age of 55.87 years, with 74.08% being male and 26.02% female. Each farm averaged 2.58 hectares in size. The animals raised included: poultry (broiler-107,167; chicken layer-8,075; duck layer-1,117; native chicken-52), swine (imported-933; native pig-23), small ruminants (goat-17; sheep-3), large ruminants (cattle-15; carabao-5), and other animals such as game fowls, horses, turkeys, and geese (15).

The results (Table 2) show that the compliance rate for the physical aspects of animal farm biosecurity was 52.63%. While farm locations met the recommended distance of 0.5-1.0 km from communities and other animal traffic and had well-established perimeters, boundary fences, disinfection areas, and driveways, as well as favourable conditions with neighboring communities, farms, and Local Government officials, the farms did not adequately control the entry of people, animals, and vehicles. Additionally, practices such as washing and disinfecting incoming vehicles and providing boots and overalls to visitors, sales agents, customers, and workers were not sufficiently prioritized by the respondents.

The study revealed a grand mean compliance rate of 38.99% for the biological aspect of farm biosecurity (Table

Table 1. Profile of the respondents.

Parameters	Mean
Age (year)	55.87
Gender	
Male (%)	74.08
Female (%)	26.02
Area (has)	2.58
Number of Animals raise	
Poultry: (hd))	
Broiler	107,167
Chicken layer	8,075
Duck layer	1,117
Native chicken	52
Swine: (hd)	
Imported	933
Native pig	23
Small ruminants – goat/sheep (hd)	20
Large ruminants- cattle/carabao (hd)	17
Others (hd)	15

Table 2. Physical aspects of farm biosecurity.

Aspect	Mean compliance, %
Farm location	98.00
Perimeter (with boundary fence, disinfection area and driveways)	60.09
Favorable communities, neighboring farms and Local Government units	51.89
Entrance (control the entry of people, animals, and vehicles)	40.64
Farm condition (with biosecure facilities)	54.71
Shipping/ Transport	
Allow the entry of people, and vehicles	74.32
Practice washing and disinfection	28.27
Provide boots and overalls	13.11
Grand mean	**52.63**

3. This indicates low compliance in several areas: caring for stock or replacement animals, practicing safe delivery of feeds, ensuring the use of quality drinking water, securing the disposal of dead animals, and implementing vaccination programs to regularly vaccinate animals against common diseases.

The study found a compliance rate of 49.68% for the chemical aspects of farm biosecurity (Table 4). This included having a disinfection program in place, disinfecting incoming vehicles and equipment, applying disinfectant to tires and foot baths, and using disinfectant after cleaning.

The analysis (Table 5) showed a grand mean compliance of 42.72% for farm waste disposal, indicating that the lack of facilities led to low adherence to government regulations. The willingness of some respondents to be trained in proper farm waste disposal highlights the need for capacity building among the surveyed animal farm owners, focusing on biosecurity and effective waste disposal practices to protect animals from disease contamination and prevent environmental pollution.

DISCUSSION

Profile of the respondents

This is restricted to documenting the average age and gender of the animal farm owners, the farm area (in hectares), and the variety of animals raised on the surveyed farms. Table 1 provides the profile of respondents from 100 animal farms in Bataan. The participants had an average age of 55.87 years, with 74.08% being male and 26.02% female. This is consistent with findings that show the average age of Filipino farmers is between 57 and 59 years old (IRIN, 2013, as cited by

Table 3. Biological aspects of farm biosecurity.

Aspect	Mean compliance, %
Stocks	
Check the health status of incoming stocks	74.31
Use quality stocks as certified by a disease diagnostic laboratory	23.82
Introduce new breed/s of animals	47.01
Have a reliable source	56.46
Introduce new stocks every year	21.14
Isolate incoming stocks	22.67
Have an isolation or quarantine area for incoming stocks	21.48
Follow the 60-day minimum quarantine period	19.10
Conduct diagnostic tests for incoming stocks	9.87
Practice no returns of personnel after exposure outside	7.78
There is a quarantine system	22.67
Feeds and water	
Safe delivery of feeds	64.14
Quality drinking water for the animals	64.78
Disposal of the dead carcass	
Secured disposal	95.16
Vaccination program	
With vaccination program	57.87
Regularly vaccinate	15.56
Grand mean	**38.99**

Table 4. Chemical aspect of farm biosecurity.

Aspect (Disinfection)	Mean compliance, %
With disinfection program	65.18
Disinfect incoming vehicles and equipment	28.90
Put disinfectant on the foot and tire bath	36.04
Use disinfectant after cleaning	68.61
Grand mean	**49.68**

RA- Philippine Republic Act; EO- Executive Order 481.

Table 5. Farm wastes disposal.

Government regulation/law/order	Mean compliance, %
Awareness with government regulations about wastes disposal (RA 9512)	98.81
With a wastes disposal management program (RA 9003)	41.53
Practice wastes segregation (RA 9003)	38.39
Recycle farm wastes (RA 9003)	37.38
With a regular cleaning program (RA 8749)	85.89
With sealed containers for hazardous wastes (RA 6969)	21.75
Have a biogas system (RA 8749)	15.07
Have composting method (EO 481)	23.13
With solid-liquid separator (RA 9003)	3.04
With wastes water treatment (RA 6969)	7.74
Willing to be educated in farm wastes management (RA 9512)	97.22
Grand mean	**42.72**

Kingan *et al*., 2024). The aging trend is evident in Bataan as well, with a notable increase in the proportion of male farmers. This situation raises concerns about who will take on the crucial role of farming in the future (Asis, 2020). Each farm had an average size of 2.58 hectares, which is somewhat larger than the national average of 1.54 hectares. This suggests that the animal farms are not yet losing their comparative advantage, which is not in agreement with what was concluded by Otsuka (2022). The animals raised included: poultry (broiler-107,167; chicken layer-8,075; duck layer-1,117; native chicken-52), swine (imported-933; native pig-23), small ruminants (goat-17; sheep-3), large ruminants (cattle-15; carabao-5), and other animals such as game fowls, horses, turkeys, and geese (15). The survey results highlight that the majority of the animal farms are primarily focused on poultry production. This trend is largely due to the limited farm sizes, which restrict the capacity for raising larger animals.

Physical aspects of farm biosecurity

Table 2 outlines the physical aspects of farm biosecurity in this study, which includes farm location, perimeter protection, entrance protocols, surrounding conditions, farm facilities, and animal transport. Farms located within the recommended 0.5-1.0 kilometers distance from communities, neighboring farms, and traffic had a compliance rate of 52.63% for physical aspects, meaning only about half of the surveyed farms met the criteria for protecting their animals.

Farm locations showed a mean compliance of 98.00%, adhering to the recommended distance from neighboring farms, waterways, households, communities, and main roads. Preventing and controlling animal diseases, primarily spread through human activities, can be achieved through biosecurity measures along the production and marketing chain, coupled with increased awareness and education (FAO/OIE/WB, 2010, as cited by Ebata *et al*., 2020).

The perimeter had a mean compliance of 60.09%, indicating that farms had boundary fences, disinfection areas, and driveways to protect animals from disease transmission. However, 39.91% of farms lacked adequate perimeter protection and remained susceptible to contamination. Biosecurity is important to prevent disease transmission between animals on farms as well as from farm to farm (Sahlström *et al*., 2014). Accordingly, hazard reduction through environmental manipulation", is often defined as practices that reduce the number of pathogens that enter a facility. Biosecurity is the concept of protecting cultured animals from contamination by diseases and of preventing the spread of diseases across boundaries (Yadav *et al.,* 2020).

A mean compliance of 51.89% for favorable conditions with neighboring communities, farms, and Local Government officials suggests that most farm owners had no concerns about their neighbors or local authorities. Collaborating with people to adopt practical, cost-effective, and sustainable biosecurity measures is crucial (Inyagwa and Mungube, 2021).

Controlling the entry of people, animals, and vehicles showed a mean compliance of 40.64%, indicating reluctance from farm owners to allow entry to safeguard animals. However, 59.36% did not control entry, increasing the risk of disease contamination. The main concept is to prevent the spread of diseases, both between farms and within a single farm. This requires understanding the epidemiology of the diseases, which may not always be fully known. However, since there are only a few ways pathogens can be transmitted, it's still feasible to take effective measures such as controlling the entry of people, even if we lack complete information about a specific disease (Alarcón *et al*., 2021).

Although most farms had acceptable biosecurity, few implemented measures like showering and quarantine periods for people entering the premises (Verzhykhovskyi and Nedosekov, 2024). Farms should limit or control entry, provide foot or tire baths, changing areas, showering requirements, clothing, and boots for visitors, sales agents, customers, and workers, and disinfect incoming equipment and vehicles to prevent the spread of disease-causing microorganisms.

The ideal farm environment had a mean compliance of 54.71%, indicating that more than half of the farms maintained a good farm environment with perimeter fences, farm-to-market roads, wind barriers, concrete and slatted floors, and areas free from flooding, stray animals, and drafts. Farm owners demonstrated awareness and care for maintaining an ideal farm environment.

Observations showed that 74.32% allowed vehicle entry for visitors, sales agents, customers, and workers, but only 28.27% practiced washing and disinfecting incoming vehicles, and 13.11% provided boots and overalls, suggesting a lack of biosecurity concerns for vehicle entry.

The biological aspect of farm biosecurity

This aspect of biosecurity encompasses various animal health care measures, including checking the health status of incoming livestock, using quality stock certified by a disease diagnostic laboratory, introducing new technologies, considering the number of source farms and the frequency of introducing new stock, maintaining isolation, quarantine, and Intensive Care Units (ICU), conducting diagnostic tests, practicing no return after exposure, using safe and quality feeds and water, securely disposing of dead animals, and implementing a vaccination program.

Table 3 shows that the surveyed animal farms had a grand mean compliance of 38.99% in the biological aspect of biosecurity. This indicates that only 29.67% of the farms

were concerned with the health care of their stocks, with 70.33% lacking awareness in this area. Alarmingly, 43.54% did not have reliable sources for replacement stocks, posing a risk of introducing diseases. Regarding the safe delivery of feeds and quality drinking water, 64.14% practiced safe delivery of feeds, and 64.78% used quality drinking water. Farms without safe feed delivery practices should be educated on the importance of this aspect of animal husbandry. Secured disposal of dead animals showed an average compliance of 95.16%, with most farms practicing burial or incineration to prevent disease contamination. This indicates a high awareness of the importance of proper disposal to avoid spreading harmful microorganisms. The vaccination program compliance was 57.87%, with only 15.56% regularly vaccinating animals against common diseases. This suggests that respondents did not prioritize boosting animal immunity, highlighting the need for capacity building on the importance of immunization for safe and effective animal husbandry.

Chemical aspects of farm biosecurity

This aspect of biosecurity involves using chemical disinfectants to prevent pathogens from causing diseases in animals. It assesses whether the surveyed animal farms have a disinfection program, disinfect incoming vehicles and equipment, apply disinfectant to tires and foot baths, and use disinfectant after cleaning the animal pens. The compliance rate for the chemical aspect of biosecurity presented in Table 4 is 49.68%. Specifically, 65.18% of the farms had a disinfection program; 28.90% disinfected incoming vehicles or equipment; 36.04% applied disinfectant to tires and foot baths; and 68.61% used disinfectant after cleaning.

These findings highlight challenges in biosecurity systems, such as the responsibility and costs of disinfection. The low number of owners providing disinfection facilities and disinfecting vehicles after unloading suggests a need for seminars on the importance of regular disinfection programs to build farm owners' capacity for biosecurity. Implementing biosecurity measures can be challenging and often unaffordable for backyard poultry farms, especially in tropical and low-income settings. The concept of biosecurity includes all measures aimed at disease prevention and promotes its importance within the livestock industry. Generally, biosecurity compliance is poor across animal production systems worldwide. Therefore, strategies to improve the implementation of biosecurity measures, such as using chemical disinfectants on tools, footwear, and clothing before they enter farm premises, are essential. This proved that biosecurity systems are challenged by new concerns to establish the state of the art of current knowledge regarding animal welfare, biosecurity, and animal health (Delsart *et al*., 2020). It noted that the number of owners of animal facilities who are responsible for providing facilities for disinfection and disinfecting vehicles after unloading is very low (Department of Agriculture Administrative Order No. 19 series of 2006). This further suggests that a seminar on the importance of the disinfection program and its regular use needs to be conducted to educate the farm owners to help build their capacity on biosecure animal farms. Biosecurity measures are difficult to implement and often unaffordable for backyard poultry farming, particularly in tropical and low-income settings (Otieno, 2013). The concept of biosecurity encompasses the full range of measures aimed at disease prevention. It aims to promote biosecurity to a livestock industry that, in the past, has not always given it a high priority (Huber *et al*., 2022). Biosecurity compliance is generally poor in all types of animal production systems around the world. Therefore, it is essential to define strategies to improve the implementation of biosecurity measures such as the use of chemical disinfectants to treat materials and other potential vectors such as tools, footwear, and clothing before they enter the farm premises thus, reducing the spread of infectious diseases in livestock is an essential step in maintaining and improving livestock health status and standards (Butucel *et al*., 2022) which can be achieved through high biosecurity standards including a set of preventive measures aimed at reducing the presence of infectious agents (Kirtonia *et al*., 2021).

Farm wastes disposal

The analysis of farm wastes disposal presented in Table 5 includes the evaluation of compliance with various government regulations such as awareness with government regulations on proper wastes disposal (Philippine Republic Act 9512), such as having a waste disposal management program (Philippine Republic Act 9003), practicing wastes segregation (Philippine Republic Act 9003), recycling (Philippine Republic Act 9003), regular cleaning program (Republic Act 8749), having sealed containers for hazardous wastes (Philippine Republic Act 6969), presence of a biogas system (Republic Act 8749), composting methods (Philippine Republic Act 10068), solid-liquid separator (Philippine Republic Act 9003), and wastes water treatment as part of biosecurity and environmental awareness activity (Philippine Republic Act 6969). It also presents the willingness of the animal farm owners to be capacitated about proper farm waste management (Philippine Republic Act 9512). It can be observed that 98.81% of the animal farms surveyed are having awareness with government regulations on proper wastes disposal (RA 9512) but only 41.53% are having wastes disposal management programs (RA 9003), 38.39% practice wastes segregation (RA 9003), 37.38% recycle farm waste (RA 9003), 85.89% are having a regular cleaning program (RA 8749), 21.75% with a sealed container for hazardous

wastes (RA 6969), only 15.07% have biogas system (RA 8749), 23.13% have a composting method (EO 481) for farm wastes in their farm. It was also noted that only 3.04% have solid-liquid separators (RA 9003), and 7.74% have wastewater treatment (RA 6969). Those that are willing to be capacitated about proper farm waste disposal (RA 9512) have an average of 97.22%, which indicates the need to conduct capacity building for the surveyed animal farm owners about proper farm waste disposal so as not to pollute the environment. The 42.72% grand mean on compliance with government regulations about farm waste disposal among the surveyed animal farms indicates that the absence of facilities resulted in low compliance, which in turn may harm the environment. Environmental contamination, particularly from water and soil pollution, has far-reaching consequences. Soil waste contamination leads to diseases and complications for humans, animals, and vegetation. Pollution, with its direct and indirect harmful impacts on humans and animals, remains a pressing issue that experts are diligently investigating to find innovative solutions (Ghosh *et al.,* 2022). There should be an established environmental impact statement system for every proposed project and undertaking that significantly affects the quality of the environment (Philippine Presidential Decree 1586).

Based on the result of the survey, the following conclusions on the extent of compliance with biosecurity measures and farm wastes disposal regulations in the selected animal farms in Bataan were drawn: The very small percentage that limits the entry of people, animals, and vehicles from the outside would endanger the farm animals from possible disease contamination. The absence of a foot bath or tire bath, changing area, showering requirement, and disinfection of incoming vehicles and equipment welcomes the spread or possible disease outbreak. Washing or disinfection of incoming vehicles, especially from visitors, sales agents, and customers, is not regularly done, as well as the provision of boots and overalls, which may encourage contamination by disease-causing organisms. Health care was done by less than half of the surveyed animal farms, and buying replacement stocks as certified by a disease diagnostic laboratory was not practiced. Isolation and quarantine of incoming stocks were minimally done to acclimatize the newly arrived animals to the microbial flora and fauna of the farm. Diagnostic tests for incoming stocks were not done to ensure disease-free and healthy stocks. Though there were vaccination and disinfection programs, there is a very low percentage that regularly vaccinates animals and disinfects incoming equipment. This confirmed the lack of emphasis on vaccinating the animals to boost immunity against common diseases and to prevent possible disease outbreaks on their farm. Failure to vaccinate animals may cause them to lose their immunity against diseases, while the absence of disinfection invites contamination and the multiplication of pathogens. Very few are complying with waste minimization through segregation, recycling, and composting regulations due to a lack of regularity and the absence of facilities (Philippine Republic Act 6969). To help animal producers in the province of Bataan, it is recommended that there should be strict implementation and monitoring of the compliance to biosecurity measures of animal farms as well as with various government regulations. To prevent potential disease outbreaks, both external and internal biosecurity measures must be implemented. External biosecurity involves preventing the entry of disease-carrying vectors to the farm through physical barriers or regulations prohibiting certain animals, people, or vehicles from entering. Internal biosecurity focuses on minimizing the spread of pathogens once the farm is infected and includes strategies related to herd management, facility hygiene, cleaning and disinfection, and personnel practices (Alarcón *et al.,* 2021; Nieto-Flores *et al*., 2025). Additionally, a thorough approach to biosecurity requires an interdisciplinary review of emerging research supporting One Biosecurity. Four key advancements have been identified: the introduction of new surveillance technologies using advanced sensors linked to the Internet of Things, the deployment of handheld molecular and genomic tracing tools, the incorporation of wellbeing and diverse human values in biosecurity decision-making, and the use of advanced socio-environmental models and data capture techniques (Hulme *et al.,* 2023). Moreover, disease control strategies should be designed to minimize the impact of disease challenges by using bioexclusion to reduce exposure, immunization to enhance animal resistance, and quarantine to prevent spread. These measures should be consistently applied for endemic diseases within the epidemiological unit and implemented as needed during unexpected epidemic outbreaks (Collett *et al.,* 2020). Furthermore, there should be a model biosecure animal farm to showcase the science and technology interventions (Flores *et al*., 2015) for the farm owners to see the positive effects of having a biosecure animal farm to highlight the importance of encouraging applied research toward identifying sustained and adapted biosecurity measures. Presenting model bio-secure animal farms, whether for large-scale commercial or small backyard production, is valuable for public education. Finally, enhancing our biosecurity and veterinary public health measures is not just about addressing a particular animal disease but also about preparing for future outbreaks, including potential zoonotic diseases. It is important to highlight its broader context through a One Health approach (WHO, 2017), linking veterinary health, human health, and environmental health (Kazim, 2023).This study was able to identify risk areas that can still be further developed through a continuing training program to be sponsored by concerned government agencies to capacitate the local animal raisers in proper animal husbandry practices to be followed by regular monitoring of their compliance with biosecurity measures and proper waste management to avoid disease outbreaks

and prevent environmental pollution. Based on the dataset created in this study, the implementation of biosecurity measures and environmental policies for animal farms in the examined areas can be revised and integrated into local, regional, and national environmental policies.

CONFLICT OF INTEREST

The author declares no conflict of interest.

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