



Strengthening disease control and trade through zoning and biosecurity

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Abstract

Zoning and biosecurity are fundamental tools in veterinary public health and international trade. However, their implementation suffers from fragmented approaches to geospatial representation and uneven adoption across countries. This article discusses outcomes of the G7 Chief Veterinary Officers (CVOs) meeting (Padua, October 2024), where the integration of zoning and biosecurity was highlighted as a possible pathway to strengthen disease control and facilitate trade. Two initiatives, GeoZone and ClassyFarm are used to illustrate this approach. The former advances zoning clarity through a geospatial framework based on ISO TC211 standards, defining spatial data structures and exchange protocols to improve cross-country GIS interoperability, while the latter complements this approach by providing structured biosecurity data collection and risk classification at farm, regional and national levels. We critically discuss the potential and limitations of both systems, and their contribution to the advancement of geospatial epidemiology. By treating zoning and biosecurity as harmonized, data-driven frameworks, these initiatives mark progress towards more a transparent, standardised and globally applicable animal health management.

Key words: animal disease, zoning, biosecurity, GIS, ISOTC211, international trade.

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Introduction

The prevention and control of trans-boundary animal diseases remain priorities in veterinary public health. Zoning allows veterinary authorities to delineate areas based on disease status, thereby limiting trade disruptions and protecting disease-free zones. Biosecurity reinforces this by reducing the likelihood of disease introduction and spread within and between zones.

Despite their importance, significant challenges persist. Zoning often relies on heterogeneous maps or narrative descriptions, which are difficult to interpret consistently across countries. Similarly, biosecurity data are collected unevenly, mostly at the farm level, and are rarely integrated into broader decision-making frameworks. These weaknesses complicate international trade negotiations, where importing countries must assess the credibility of declared zones and biosecurity measures.

Recent discussions at the G7 Chief Veterinary Officers meeting in Padua, Italy, 16-18 October (2024) emphasized the need to integrate zoning and biosecurity into a coherent framework. Two ini-

tiatives exemplify this effort: the GeoZone project, which focuses on standardizing the representation and exchange of geospatial zoning information, and ClassyFarm, which structures biosecurity monitoring in Italy.

GeoZone: advancing zoning clarity

The GeoZone project (2021), led by the World Organization for Animal Health (WOAH) Collaborating Centre on Epidemiology, Training and Control of Emerging Avian Disease at Istituto Zooprofilattico Sperimentale delle Venezie, Italy (<https://www.izsvenezie.it/>), is a pilot initiative aimed at defining a structured framework for the representation and communication of geospatial zoning information, in accordance with Chapter 4.4 of the WOAH Terrestrial Code (1968). The project brings together six WOAH Collaborating Centres¹ with expertise in epidemiology to address the geospatial elements that characterize the management of zones.

¹The WOAH Collaborating Centres are: i) Animal Disease Surveillance Systems, Risk Analysis and Epidemiological Modelling Centers for Epidemiology and Animal Health - USDA-APHIS-VS-CEAH (USA); ii) Diagnosis and Control of Animal Diseases and Related Veterinary Product Assessment in Asia - National Institute of Animal Health (Japan); iii) Diagnosis, Epidemiology and Control of Animal Diseases in Tropical Regions - Centre International en Recherche Agronomique pour le Développement (France); iv) Epidemiology, modelling and surveillance - Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise (Italy); v) Epidemiology, Training and Control of Emerging Avian Diseases - Agronomique pour le Développement (France); iv) Epidemiology, modelling and surveillance - Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise (Italy); v) Epidemiology, Training and Control of Emerging Avian Diseases - Istituto Zooprofilattico Sperimentale delle Venezie (Italy); vi) Veterinary Epidemiology and Public Health - EpiCentre (New Zealand).

While geographic data on infected and containment zones are well established in disease response, their terminology does not fully align with the definitions provided in Chapter 4.4 of the Terrestrial Code. In contrast, geographic is of free and protection zones are rarely documented in practice – despite their crucial role in facilitating international trade. Clearly and transparently communicating GI on free and protection zones can support the recognition of disease-free areas by trade partners, thereby supporting international trade. To address these challenges, the GeoZone framework integrates Geographic Information Systems (GIS) into zoning practices, which offers veterinary authorities and trade partners a reliable, data-driven approach to spatially represent and communicate zones. GeoZone develops a data product specification based on the ISO TC211 family of standards. The specific standards used are based on geographic information (GI) as follows: i) ISO 19101: GI— Reference model — Part 1: Fundamentals; ii) ISO 19103: GI— Conceptual schema language; iii) ISO 19106: GI— Profiles; iv) ISO 19107: GI— Spatial schema; v) ISO 19108: GI— Temporal schema; vi) ISO 19109: GI— Rules for application schema; vii) ISO 19110: GI— Methodology for feature cataloguing; viii) ISO 19111: GI— Referencing by coordinates; ix) ISO 19115: GI— Metadata — Part 1: Fundamentals; x) ISO 19117: GI— Portrayal; xi) ISO 19125-1: GI— Simple feature access — Part 1: Common architecture; xii) ISO 19131: GI— Data product specifications; xiii) ISO 19157: GI— Data quality.

Number 12, ISO 19131, GI — Data product specifications, which describes the requirements for the specification of geographic data products, is of particular relevance. It outlines the content and structure of a data product specification and provides guidance ensuring that data product specifications are understandable and fit for their intended purpose.

By developing a data product specification for zones defined according to the WOA 4.4 chapter, GeoZone transforms zones into geospatial objects, complete with attributes such as zone type and validity period. Adhering to ISO standards, GeoZone ensures cross-platform interoperability, enabling importing countries to integrate zoning data into their own GIS and risk analysis systems without ambiguity. GeoZone also proposes a protocol for transferring geospatial zoning data across borders. It specifies the use of standard formats (Shapefiles, GML, GeoJSON), metadata requirements, and version control mechanisms. This protocol supports authenticity, traceability, and harmonization. Together, these characteristics address one of the major obstacles in international trade: the lack of clarity in how zoning declarations are communicated and validated. However, while promising, GeoZone faces several limitations: i) heterogeneous GIS capacity: many veterinary services outside Europe lack the infrastructure to adopt ISO-based frameworks; ii) static representation: current models emphasize boundaries but under-represent temporal or probabilistic dynamics of disease spread; iii) implementation costs: effective adoption requires sustained investment in Information Technology (IT) infrastructure and staff training.

Despite these challenges, GeoZone represents an important step toward global GIS interoperability in veterinary health.

ClassyFarm: monitoring biosecurity in practice

Biosecurity refers to a set of management and physical measures designed to reduce the risk of introducing, establishing and spreading animal diseases, infections or infestations to, from and

within an animal population. Within the context of disease response strategies and zoning approaches, compliance with biosecurity requirements is critically important, especially in preventing the introduction and spread of diseases within zones, particularly in international trade. These measures should be tailored to specific contexts and consider the epidemiology of the disease, environmental factors, the health status of animals in the adjacent areas, applicable biosecurity protocols (such as movement controls, use of natural, artificial, or legal boundaries, spatial separation of animals, control of fomites, and commercial management and farming practices), and surveillance activities. The choice of measures to implement should therefore vary according to: i) geographical factors (e.g. natural barriers, wildlife habitats such as wetlands); ii) infection status of animals and the impact of pathogen on health and welfare; iii) risk of introduction and dissemination of infectious agents; iv) cost/effectiveness of control measures.

The availability of zone-based biosecurity data is essential for comprehensive and effective management of animal health, provided that measures are applied consistently and monitored across broader geographical areas. In recognition of this, the G7 Chief Veterinary Officers meeting (2024) emphasized the need for tools to assess and monitor biosecurity at the farm, regional and national level. These tools should include information systems capable of collecting data on biosecurity practices and integrating risk-based models that evaluate risks, considering epidemiological, environmental, and human-related factors. One such tool presented at the G7 convention was ClassyFarm, an Italian national-level system developed by the Italian Ministry of Health.

ClassyFarm represents an integrated approach to biosecurity monitoring and enhances surveillance of biosecurity practices across major livestock sectors, including pigs, poultry, and ruminants. The system collects data on animal welfare, antimicrobial use, herd health, and slaughterhouse assessments, providing a detailed overview of biosecurity compliance (<https://www.classyfarm.it/index.php/en/what-en>). Key features include: i) customized checklists: tailored to different production types of livestock production, these assess both mandatory and optional biosecurity measures; ii) risk-based categorization: farms are evaluated according to risk profiles, influencing the frequency of official inspections; iii) multi-level application: biosecurity protocols are implemented at farm, regional, and national levels, addressing diverse risks across transport, markets, and farming practices; iv) stakeholder engagement: central and local veterinary services collaborate with farmers, veterinarians, and other stakeholders to ensure effective implementation.

The information collected in the field is uploaded to a central online database and originate from official controls carried out by the competent authorities, and from private veterinarians trained to complete specific surveys (self-surveillance). Specific checklists have been developed for each livestock sector. Items in the checklist fall into three categories: i) compulsory in all Italian territories; ii) compulsory only in some areas or during at higher risk periods; and iii) not compulsory, but considered potential risk factors for the introduction or spread of infectious diseases.

The overall risk calculation for each farm influences how frequently it is subject to official inspection, higher risk facilities are more likely to be checked. Central, regional and local Veterinary Services assume a key role in defining and ensuring the application of such measures. They also maintain dialogue with the key stakeholders (farmers, transporters, technicians, private veterinarians, etc.) who are ultimately responsible for biosecurity implementation. ClassyFarm demonstrates how structured biosecurity monitoring can support zoning by providing actionable data for targeted

interventions. Its success highlights the importance of harmonized protocols, advanced information tools, and robust training programs to foster a strong biosecurity culture across the livestock sector.

While ClassyFarm provides a valuable framework for structured biosecurity monitoring, several limitations remain. Its effectiveness depends on consistent data collection, veterinary capacity, and stakeholder engagement, all of which can vary significantly across regions. Moreover, the system is designed within the Italian and EU regulatory context, supported by strong veterinary infrastructures and harmonized legislation. This raises questions about scalability to countries with limited resources, different production systems, or less centralized governance. For ClassyFarm to be globally applicable, adaptations are needed to account for local epidemiological conditions, resource availability, and cultural practice. In parallel, efforts should be made to harmonize minimum biosecurity standards at the international level.

Conclusions

The significance of GeoZone and ClassyFarm extends beyond policy; together, they advance the field of geospatial epidemiology by: i) establishing a standardized data model for representing and sharing disease-free zones; ii) developing protocols that enhance cross-country GIS interoperability, a prerequisite for global epidemiological analysis; iii) generating structured, georeferenced biosecurity data that can be integrated into spatial models of disease risk; iv) enabling the linkage of zoning information with remote sensing, mobility, and environmental datasets, expanding opportunities for predictive modelling.

By situating disease control measures within a geospatially standardized framework, these initiatives strengthen both epidemiological analysis and international trade governance. GeoZone and ClassyFarm demonstrate how zoning and biosecurity can be inte-

grated into a coherent geospatial framework. This integrated approach has the potential to enhance transparency, promote mutual recognition of disease-free zones, and ultimately, safe trade. However, important challenges remain: limited GIS capacity in many countries, the need for temporal modelling of disease dynamics, and the challenge of adapting tools like ClassyFarm to non-EU contexts. Addressing these challenges requires not only technical refinement but also capacity building, global governance, and international collaboration. By embedding GIS standards and structured biosecurity monitoring into disease control, these initiatives contribute to the methodological development of geospatial epidemiology, and offer a pathway toward more resilient, transparent, and globally harmonized systems of animal health and trade. While GeoZone faces challenges related to uneven GIS capacity and dynamic disease modelling, ClassyFarm's reliance on strong veterinary infrastructures and EU-specific regulations similarly constrains its broader application. Scaling the tool for use beyond Italy will require simplification, adaptation to diverse production systems, and convergence around internationally recognized biosecurity standards.

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