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FROM AWARENESS TO ACTION: THE IMPERATIVE OF BIOSECURITY RISK ASSESSMENT IN SERBIAN CATTLE PRODUCTION

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Abstract: Biosecurity is the base of sustainable cattle production, preventing pathogen outbreaks and spreading threatening cows' health and productivity and public safety. Serbian dairy and beef operations are mostly small- to medium-sized family farms with structural, economic, and other constraints, limiting biosecurity implementation. Despite increasing farmers' awareness of disease risks, systematic evaluation of biosecurity practices and critical risk factors remain limited. Risk-based approach with standardized assessment tools may limit pathogen transmission and enhance herd health. The socio-economic, managerial, and educational factors that influence farmers' adoption of preventive practices, underscoring the need for targeted interventions and capacity-building programs were reviewed. The strategies integrating risk assessment into national veterinary frameworks and extension services, emphasizing the potential benefits for productivity, disease prevention, and One Health outcomes were discussed.

Keywords: biosecurity, cattle production, risk assessment, disease prevention, herd health

1. Introduction

Biosecurity engirdle all farm production practices designed to prevent the introduction and spread of pathogens on farms, protecting animal health, productivity, and public health (FAO, 2020; OIE, 2021). The growth of global livestock production has increased risks of disease transmission, making

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systematic biosecurity protocols crucial. The cattle production in Serbia mainly consists of small and medium-sized family farms, predominantly constrained by limited resources, knowledge, and infrastructure (Bogdanov & Božić, 2010; Perišić et al., 2011). Despite growing farmers' awareness regarding infectious diseases fear, the implementation of structured biosecurity risk assessment remains sporadic and poorly documented.

It is usual to talk about three pillars which establish concept of biosecurity: isolation, movement control and sanitation (Buhman et al., 2005), but for practical purposes biosecurity measures are typically divided as external measures, preventing disease introduction (e.g., quarantine, visitor and vehicle controls, feed and water hygiene), and internal measures, limiting disease spread within the farm, such as isolation of sick animals, cleaning, disinfection, equipment management (Postma et al., 2016; Alarcon et al., 2014). Previous research in European dairy systems has shown that even farms aware of biosecurity principles often do not apply consistently both external and internal measures (Laanen et al., 2013; Brennan & Christley, 2012).

This paper aims to analyze and assess the necessity of biosecurity risk evaluation in Serbian cattle production, integrating evidence from national and international studies. The paper emphasizes the role of socio-economic, professional and educational factors, evaluates risk assessment methodologies, and proposes strategies for improving compliance and sustainability of biosecurity measures.

2. Biosecurity Principles in Cattle Production

Using disease prevention strategies (biosecurity) to maintain good animal health and welfare on cattle farms is crucial (Richens et al., 2018). Its' efficacy relies on a multilayer approach including prevention, monitoring, and control (Hristov et al., 2024). External biosecurity measures include:

1. *Animal introduction protocols* – which are related to the quarantine measures, newly acquired animals' health documentation, immunisation and testing for endemic diseases (Racicot et al., 2012).
2. *Visitor and vehicle management* – considers controlled access, use of clean footwear and clothing, and feet and hands as well as vehicle disinfection checkpoints (Kristensen & Jakobsen, 2011).
3. *Feed and water hygiene* – are related to security of feed storages, water testing and protection against contamination (Gelaude et al., 2014a).

Internal biosecurity involves:

1. *Segregation of animals* – Segregation measures point out importance of isolating sick animals, or newly purchased ones, or vulnerable groups, particularly offspring and reproductive categories (Gunn et al., 2008). This principle enables application of several effective measures, related to movement policy for cattle, humans, and equipment between production sites where different categories of cattle are located.
2. *Cleaning and disinfection protocols* – These refer to regular sanitation of barns, milking parlours and equipment (Skuce et al., 2012). Sanitation procedures have to be applied daily, weekly or whenever they are required.
3. *Equipment and resource management* – Correct management of instruments and any other equipment and reserves used on farm is related to minimizing sharing equipment and controlling vectors, such as insects and rodents (Nöremark & Sternberg-Lewerin, 2014).

Evidence indicates that *structured biosecurity risk assessment tools*, such as Biocheck.UGent (Gelaude et al., 2014a), may improve both compliance and farm-level disease monitoring, enabling targeted interventions (Postma et al., 2016; Sarrazin et al., 2014). For the same purpose may be useful any other questionnaires, suggested in several national biosecurity standards, for instance biosecurity level assessment questionnaire by Hristov & Stanković (2009a;b), given in national biosecurity standards for cattle production for Ministry of Agriculture, Water Management and Forestry of Republic of Serbia, or others used in Denmark (Anon., 2015) or Canada (2021).

3. Biosecurity Challenges in Serbian Dairy and Beef Farms

Generally, dairy and beef production is wide open to the environment, and thus to the risks that occur in close and far environment for all age categories. The cattle is being fed mostly fresh cut from the field, and located in the barns which are mostly wide open.

3.1. Structural and Economic Constraints

Serbian cattle farms are mostly of small- to medium-size, with limited capacities and investment capacity for infrastructure improvements such as quarantine facilities, controlled entry points, and manure storage management (Stanković & Hristov., 2009). Economic limitations often lead to prioritization of production over preventive measures, reducing adherence to biosecurity

protocols. There is question of validity of building isolation units for recently acquired animals, or even disinfection points with showers for visitors or even entrance with sprinklers for vehicles, keeping in mind size of production operation and frequency of visits. Spraying disinfectant on lower parts and wheels of vehicles may be acceptable solution. On the other hand, investments in manure management systems are supposed to enable it for a long time.

3.2. Knowledge and Training Gaps

While awareness of disease risks is growing, formal training on biosecurity practices is limited. Many farmers rely on traditional management methods or sporadic veterinary visits, resulting in inconsistent hygiene and risk mitigation measures (Kristensen & Jakobsen, 2011; Young et al., 2019). The farms'disease prevention strategies depend on a number of factors, including receiving tailored advice from vets (Cardwell et al., 2016) and farmers' personal views on the procedures (Stanković et al., 2024). It appears farmers perceive the implementation of biosecurity measures as beneficial (Sayers et al., 2013; Mankad, 2016).

3.3. Behavioral Factors

Farmer perception significantly affects biosecurity adoption. Studies indicate that measures perceived as costly or time-consuming are often ignored, even when the risks of disease spread are recognized (Brennan & Christley, 2012; Skuce et al., 2012). Behavioural interventions and training have proven effective in more effective fulfilment (Alarcon et al., 2014). However, such measures do not appear to be widely implemented, even in countries perceived to have 'biosecurity cultures' such as Sweden (Nöremark et al., 2016) and Australia (Lanyon et al., 2015). Farmers' attitude towards farms' biosecurity is mostly related to their ability to control, rather than prevent disease; available data analysis suggested a difference between influencing beliefs and whether specific types of measure were more likely to be undertaken (Richens et al., 2018). For example, farmers' beliefs about other stakeholders appeared to play a role in influencing the utilization of measures preventing direct contact (e.g. nose to nose contact), rather than indirect contact, such as fomite transmission). In addition, their awareness, which is based on possession of specific information, efficacy of government policy and knowledge about safety principles (Stanković et al., 2024), may be the problem. It happens that farmers

often overestimate measures they already apply and underestimate those they do not apply.

4. Socio-Economic and Managerial Influences

Socio-economic factors, such as farm size, education level, and access to veterinary services, strongly influence biosecurity compliance (Laanen et al., 2013). It was confirmed in results of the study performed by Hristov et al. (2023), it can farm characteristics (capacity, housing system, breed, milking system, number of cows, capacity occupancy mostly had a very significant or significant impact on hygiene on the cattle farm, as well as on milk quality (protein and fat content, somatic cell and presence of microorganisms). Larger farms with better organization and frequent veterinary supervision generally achieve higher biosecurity scores, both externally and internally. Conversely, smaller farms often lack formal record-keeping, pest control, and structured isolation protocols, increasing disease risk (Gelaude et al., 2014b; Postma et al., 2016).

Managerial practices, including daily routines, labour allocation, and monitoring of animal health, also affect the consistent implementation of biosecurity measures. Structured risk assessment allows farmers to identify critical points where disease introduction and spread are most likely and prioritize interventions effectively.

5. Risk Assessment Methodologies

Internationally, biosecurity risk assessment relies on quantitative and semi-quantitative scoring systems. Tools such as Biocheck.UGent provide standardized evaluation of farm practices, enabling benchmarking and continuous improvement (Sarrazin et al., 2014). These tools assess both the frequency and effectiveness of preventive measures, covering external and internal biosecurity domains.

Combining risk scores with SWOT analysis allows farms to identify strengths, weaknesses, opportunities, and threats in their management system, guiding targeted interventions and resource allocation (Racicot et al., 2012; Gunn et al., 2008;). For instance, previously mentioned Belgrade farm biosecurity level questionnaire (Hristov & Stanković, 2009a) provides very efficient combination of objective numeric biosecurity level assessment and SWOT analysis of available data, which points out all weak points and suggests

measures that should be undertaken in order to improve farm biosecurity situation.

6. Recommendations for Serbia

In order to make transition from awareness to action efficient, the following strategies are recommended:

1. **Implementation of standardized risk assessment tools** on all farms. Previously mentioned questionnaires provide realistic picture for stakeholders of observed farm biosecurity level, or biosecurity risk. It is highly recommended to not only register all production sites of same livestock species, but to categorize them according assessed biosecurity risk. This is useful to acquaintance to situations that may happen and the manner of possible disease outbreak spreading. This was performed for swine production units in Serbia (Anon., 2010), but unfortunately not for other farm animals.
2. **Farmer education and capacity-building programs** on biosecurity principles. Knowledge is crucial, in order to raise awareness of farmers and other stakeholders in livestock production regarding diseases outbreaks and spread, as well as choice of biosecurity measures to be undertaken to prevent incidents. This requires further work to produce innovative and affordable tools to assess the biosecurity level and engage main fanimal production stakeholders, farmers and vets fight against livestock biosecurity threats with more efficacy (Saegerman & Renault, 2024).
3. **Incentivised adoption** of preventive measures through subsidies or cooperative schemes. For instance, when cattle production operation is planned or due to modernizing production unit, it is recommendable to include biosecurity measures, in the form of standard operative procedures (SOP) into the farm technology project. These principles and measures should be included in a comprehensive biosecurity plan (Hristov et al., 2024).
4. **Integration of biosecurity assessment into veterinary and extension services** will ensure regular monitoring and feedback. Along with active surveillance, this should enable quick response and early reaction if outbreak occurs. The most important biosecurity principles should be followed continuously and in cooperation with government officers and veterinarians, farmers enable themselves to play a significant role in

keeping the animals and the production as healthy as possible (Hristov et al., 2024).

5. **Encouragement of One Health approaches** is linking animal, human and environmental health considerations in farm management. This means that, according to the World Health Organization (WHO/OIE) and the Food and Agriculture Organization (FAO) of the United Nations, it is possible to establish "a strategic and integrated approach that encompasses the policy and regulatory frameworks (including instruments and activities) that analyse and manage risks in the sectors of food safety, public health, animal life and health, and plant life and health, including associated environmental risk" through the concept of farm biosecurity (Saegerman & Renault, 2024). The One Health concept is based on coordinated multidisciplinary collaboration on local, national and international level to achieve optimal health for people, animals and our environment (Pantaleon, 2019).

Mentioned strategies for integrating risk assessment into national veterinary frameworks and extension services emphasize the potential benefits for productivity, disease prevention and One Health outcomes. Moving from general awareness to actionable, measurable biosecurity interventions is not only desirable but imperative for the sustainability of Serbian cattle production.

7. Conclusion

Biosecurity is essential for sustainable cattle production in Serbia. While awareness of disease risks is increasing, practical application remains inconsistent, particularly regarding internal biosecurity and structured risk assessment. Socio-economic and behavioural factors play a crucial role in compliance. Evidence from both Serbian and international contexts demonstrates that risk-based evaluation, standardized assessment tools, and targeted interventions are necessary to improve herd health, productivity, and One Health outcomes. Moving from general awareness to measurable, actionable biosecurity practices is imperative for the long-term sustainability of Serbian dairy and beef farms.

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