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Sustainibility ahd Efficiency of Dairy Farms Biosecurity Plans

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Abstract

Basic principles of biosecurity plans creation and inplementation were given in this review paper. This include goals wanted to be acheived related to specificities of dairy farm technology, sellection of measures that have to be included, order and manner of measures description, inplementation, as well as failures in plan execution. Efficiacy and further sustainibility of biosecurity plans inplementation could be measured through differences between biosecurity level before and after plans application established by questionnaire about biosecurity indicators, such as: 1. isolation of the farm and its organization, 2. quarantine and newly purchased cows policy, 3. visitors policy, 4. attitude towards equipment use, 5. pest control, 6. sanitation efficasy and 7. farm impact on environment. The stakeholders have to define and develop plan to keep potential pathogens for dairy herd health and production in cooperation with the veterinarian and the other professionals advising on organisation and production technology. At least once a year, it is necessary to reconsider the plan and supplemented by new practical experience and scientific knowledge.

Key words: biosecurity, dairy farms, efficiency, plan

Introduction

Farm-level biosecurity is a series of management practices designed to minimize or prevent and control: the introduction of infectious disease agents onto a farm, spread within a farm production operation, and export of these disease agents beyond the farm that may have an adverse effect on the economy, environment and human health. It is an essential aspect of on farm food safety programs. Keeping food products wholesome and of highest quality is important for the health and welfare of consumers (Cook, 2013; Anon., 2014). Biosecurity is important in avoiding not only catastrophic or foreign animal diseases, but in reducing the risks of endemic diseases (Bickett-Weddle and Ramirez, 2004), like digital dermatitis, Johne's disease, contagious mastitis, and enzootic bovine leukosis. Biosecurity practices are also designed to be adapted when emerging diseases are discovered, such as Schmallenberg virus in Europe in 2012 (Brennan et al. 2008).

Biosecurity plans refer to health management strategies and comprise key components like formal disease risk identification and risk assessment on a particular farm (BAMN, 2000). These plans make proper use of the issues addressed in forenamed paragraphs and convert these into a set of so-called working instructions or protocols, such as a Protocol on General Hygiene procedures, a Protocol on entrance: Procedures for animals, cars, professionals, cattle, a Protocol on disease diagnostics and animal treatment, or a protocol on good medicine application practice (Noordhuizen and Cannas da Silva, 2009; Anon, 2011).

Biosecurity planning for livestock farms have to be analyzed as part of a larger context, Rapid Response to Animal Disease Disasters. These are both components of what is now being called All-Hazard Preparation. Farm level biosecurity planning is the only thing that we can control in a disaster. Many of the other disaster components are things to which we can only react, but planning is something over which we can have certain control (Stanković et al., 2010).

Biosecurity planning - initial assumptions

Basically, the scope of the implemented biosecurity measures should be in accordance with the level and scale of production and cost effective (Uhlenhoop, 2007), which is difficult in the beginning.

The risks from diseases and pest that influence the viability of farms can reduce productivity, impact animal welfare, increase veterinary and

labor costs, affect consumer confidence, reduce prices that producers receive for their animals and products, close export markets, reduce farm incomes, and reduce the value of farmland (Nold, 2007; Gardner, 2007; Wells, 2011).

Preservation of required level of dairy herd health status is the most important aspect of biosecurity, farm production and animal welfare. This includes deliberate and persistent use of series of biosecurity measures that must be part of the production technology, including good housing conditions and use of prophylactic measures. Basic principles of biosecurity plans creation and implementation are related to manner of achieving wanted goals depending on specificities of dairy farm technology, selection of measures that have to be included, order and manner of measures description, implementation, as well as failures in plan execution (Stanković et al., 2012).

When thinking about farm biosecurity, it must be emphasized that there are four analogous, but some different concepts: bio-security plans, HACCP (Hazard Analysis and Critical Control Points - HACCP), risk management and urgent situations plans. Biosecurity plans are intended to prevent adverse situations and improve the business, which, in essence, is the prevention of disease (Uhlehoop, 2007, Noordhuizen et al., 2008). Plans for emergency situations are made for quick reaction to adverse events in order to continue production (Valčić, 2007; Anon., 2011).

Efficiency and further sustainability of biosecurity plans implementation could be measured through differences between biosecurity level before and after plans application established by questionnaire about biosecurity indicators, such as: 1. isolation of the farm and its organization, 2. quarantine and newly purchased cows policy, 3. visitors policy, 4. attitude towards equipment use, 5. pest control, 6. sanitation efficacy and 7. farm impact on environment.

Infectious disease transmission at the individual, herd and farm level relies on some form of contact, either direct or indirect. Early 1900s texts recognised a cause-effect relationship between animal contact and disease (Anderson, 1998) and as early as the mid-eighteenth century, livestock producers recognized animal movements as important routes for the spread of disease (Woolhouse and Donaldson, 2001). Many diseases, such as bovine TBC and foot and mouth disease (FMD) are likely to be spread by these movements (Gilbert et al., 2005; Woolhouse et al., 2005), which was confirmed during the 2001 FMD outbreak in the UK (Ortiz-Pelaez et al., 2006). Other contacts may also result in transmission of infectious agents.

Sharing of equipment, movement of people and vehicles, contact over/through fences with neighbouring stock, wildlife and even wind can play a role in transmission between contiguous or proximate premises (Mikkelsen et al., 2003; Woodroffe et al., 2006). It is obvious that there are many ways of spreading the pathogens which have to be anticipated and intercepted, as the main goal of every farm production biosecurity plan (Brennan et al. 2008).

Careful analysis of several farm locations in Serbia undoubtedly point out unexplainable negligence of the basic principles of animal hygiene and environmental protection, which menaces not only dairy production but human health as well. These failures could not be attributed to the lack of financials or ignorance during designing and building, but to the drastic negligence of professional and social irresponsibility (Stanković i Hristov, 2009).

Lack of green belt around the farm in areas dominated by east or northern wind contributes to inadequate housing conditions and allows airborne spread of pathogens (Stanković i Hristov, 2009).

Detachment of facilities for offspring in relation to potential sources of pathogens is an important measure of protection, especially when it comes to airborne infections. Nevertheless, it should be remembered that agents such as foot and mouth disease, Aujeszky disease and enzootic pneumonia viruses might be can be transmitted over long distances. Forming groups and housing is of particular importance. Calves should be allocated from other age groups and kept in separate boxes, 4-8 months old calves are kept in small groups separated from older heifers, cows and heifers should be kept separated, as well as dried from lactating cows, and those with mastitis which have to be milked and fed separately from the rest of the herd. It is important to provide enough accommodation space, litter, feedlots and access to water for all animals (Quakenbush, 2000; Hristov i sar., 2005).

General attitude of farms owners towards necessity to isolate their production unit is generally problematic, because dairy production is mainly outdoor oriented, so they conclude that contact with other farms, people and other species are inevitable. Studies conducted in The Netherlands, California and New Zealand have identified and quantified these contacts over time, particularly with regard to the potential spread of FMD (Brennan et al., 2008). The number of contacts varies greatly when considering characteristics such as type of enterprise, size of farm and number of animals on farm (Bates et al., 2003), illustrating the structural complexity

and heterogeneity of the contacts between farms. Social visits are responsible for a large number of contacts, and in 25% of these visits the persons had contact with the farm animals, causing the contact to be a high risk for spread of foot-and-mouth disease. Cattle farms and mixed pig and cattle farms have more contacts than pig farms, respectively, but the contact pattern would be expected to change drastically after the declaration of an outbreak of foot-and-mouth disease, because of the movement restrictions that would be imposed (Nielen et al., 1996). Measure of importance of these facts was presented in paper by van Schaik et al. (1998). In this paper, BHV1 (Bovine Herpes Virus 1) - positive farms were found to be situated closer to other cattle farms and had more (professional) visitors in the barn, who used farm clothing less often and purchased cattle and participated in cattle shows more often, compared with the BHV1-negative farms (Sayers et al., 2013; Sayers, 2014).

In addition, all ways of transport expanding in reach, speed of travel and volume of passengers and goods carried. Therefore three important consequences of global transport network expansion have to be emphasized: 1. infectious disease pandemics, 2. vector invasion events and 3. vector-borne pathogen importation (Tatem et al., 2006). This means that the role of the visitors from other countries as potential pathogen carriers increases and must not be neglected.

Nevertheless, there is permanent problem on dairy or beef cattle farms is misunderstanding or even deliberate neglect of the importance of systematic application of biosecurity measures by employed and/or owners, in respect of isolating and layout of individual buildings, the introduction of newly acquired animals in the herd, footbaths functioning, as well as the technological way of doing repetitive tasks such as feeding or milking, use of medical materials and disposal of carcasses. Procedures for sanitation facilities, resources and animals are often not followed, as well as keeping and managing data related to the envisaged and applied biosecurity measures (Stanković et al., 2010a; Stanković et al., 2010b).

Data presented by Stanković et al. (2011) revealed that feeding and watering could be rated as good on all observed farms, but problem of mixed use of equipment and vehicles for both feedstuffs and waste managing and transport might introduce pathogens into herd anytime, especially for younger categories.

Manure management is rather good organized on all farms. According to Oliver et al. (2005), good manure management practices are critical in assuring dairy farm hygiene. Identification of on-farm pathogen

reservoirs could aid with implementation of farm-specific pathogen reduction programs. Manure, lagoon water and bedding constituted areas have to be of major concern on dairy farms.

The stakeholders have to define and develop plan to keep potential pathogens for dairy herd health and production in cooperation with the veterinarian and the other professionals advising on organisation and production technology. At least once a year, it is necessary to reconsider the plan and supplemented by new practical experience and scientific knowledge.

According Brennan et al. (2008), almost half the farmers shared equipment with other farms and importantly, tractors were the most commonly shared item, farmers reporting that tractors were most frequently used for waste handling and feeding. This potentially increases the risk of pathogen transmission by the faecal-oral route. Therefore, application of appropriate biosecurity measures may be important in limiting this mode of transmission. Most farmers who borrowed equipment chose to clean and disinfect items only before returning them, suggesting that the cleaning process may have more to do with other factors (such as politeness) than concern over biosecurity.

Contamination of equipment with mucus, faeces and blood can harbour organisms such as *Salmonella* and *Mycobacterium spp*., so it is recommended that borrowed or hired equipment should be cleaned and disinfected before it is used (Caldow et al., 1998). Although the majority of farmers did not declare that they shared equipment, there was evidence of underreporting of this contact, suggesting that it may be a more important route of transmission than indicated by our data. Furthermore, many producers do not clean and disinfect shared equipment, increasing the potential importance of this network in facilitation of disease transmission, especially tractors, trailers and wagons, as well as machinery for harvesting and ploughing.

Although on some farms with educated staff takes care to limit the number of visits in one day and not allow entrance in the critical segments, the lack of a serious and consistent regime of vehicles and visitors entry is a serious problem, partly because of the unreliability of performed disinfection of vehicles efficiency entering the farm (Stanković i Hristov, 2009).

Disinfectant barriers for vehicles are poorly maintained, uncovered, and often lower than the surrounding terrain, which enables the collection of rainwater and surface water in them, and disinfectant solution quality is not

under control. Footwear and hand baths often represent only a psychological barrier, while changing places are often improvised. Also, crossing of pathways for own and "clean" footwear are not unusual. Showering before entering the farm is still considered "expensive and unnecessary luxury," and meaning of "stand-down period" is unknown (Gardner, 2007). Perimeters and fences are often in bad condition, as well as disinfectant barriers and entrance procedures, although it is anticipated in farm technology elaborate. Even in the countries with developed livestock production these things make problems, particularly in consistency of certain measures (Buhman et al., 2005). Finally, although staff is provided with new working clothes for every season, they are not required to wear it. Movement control and differentiation of individual staff from different production segments by different colors clothing and gears is practically unknown (Stanković i Hristov, 2009; Stanković, 2010).

In addition, often on farms cleaning and laundry are not implemented yet thoroughly, so disinfectants which operate only at the point of contact with the surface can make ineffective. Also, disinfection at the entrance to the farm is unsatisfactory. Price and efficiency are critical factors in the selection of disinfectants, but the easiness of preparation for the use and where his remains end up in nature are mostly neglected.

Occasional replacement preparations is justified when in sanitation are used simple ones that do not destroy the entire microbial population resulting resistance of the remaining species, while the synergistic composite products does not have to change for a long time, because they have broad germicidal spectrum, are buffered with a longer residual effect (Ledoux, 2006), but at the same time must be also take in account their corrosiveness and biodegradability (Ledoux, 2008).

Medication and vaccination have traditionally played a major role in preventing and treating diseases, but it is now widely accepted that they cannot, in isolation, prevent all the losses due to disease, but modern farming demands a more complete and global approach. Therefore, rigorous biosecurity program that is designed to maximize disease resistance and to minimize herd exposure to infectious agents is needed (Anon., 2014).

Risk analysis and biosecurity level assessment

The economics of modern-day dairy farming means larger herds that are kept in regions of high stock density. Increasing the size of herds under common management, keeping them in multiple premises and/or in

livestock-dense areas in which there is increased potential of direct contact with numerous neighbours, not only increases biosecurity risks, but also makes biosecurity management more relevant (Anon., 2014).

The fundamental basis of herd health planning and disease control is a science-based risk analysis. A disease risk analysis involves examining the probability of a disease occurring and the impact of that disease should it occur. Epidemiological investigations are required to provide the necessary data on biosecurity, disease prevalence, vaccination, and production losses associated with a particular infectious agent for the purposes of a comprehensive risk analysis (Sayers, 2014).

Efficiency and further sustainability of dairy cattle plan implementation could be measured through differences between dairy farm biosecurity level before and after plan application establishing by questionnaire. Assessment of reached biosecurity level based on presented indicators should be routine pattern to scrutinize actual farm situation, indicating the way to act in future. According to Stanković i Hristov (2009), the questionnaire which cover the most important indicators of farm biosecurity is very useful for the purpose. By this questionnaire relevant data are being collected regarding following indicators: planning and monitoring the implementation of biosecurity measures, quarantine, isolation farms, Health status of the herd, traffic control and movement, attitude toward workers and visitors, control of feeding and water supply, manuring, removing of animal carcasses, the presence of other animals on the farm, pest control, sanitation and relationship to the environment. The analysis included assessment of elements that make particular parameter and the average score of all parameters in the assessment of an indicator representing evaluation indicators, marked from 0 to 5. The average score of all indicators provide assessment of the biosecurity level on farm. Estimates of the parameters or indicators may be: 5 - excellent, 4 - very good 3 - Good 2 - sufficient, 1 - insufficient, but with the potential to improve the situation in the foreseeable future and 0 - insufficient without the potential to improve the situation in the foreseeable future. Scale score depending on the results achieved: 0.00 to 1.99: insufficient, 2.00 to 2.49: sufficient, 2.50 to 3.49: good, 3.50 to 4.49: very good and 4.50 – 5.00 in: excellent. Than average mark for farm biosecurity level in that particular moment of time and based on *SWOT analysis* - *Strengths, Weaknesses, Opportunities, Threats,* strong and weak points in dairy operation are doscribed, as well as threats and opportunities to improve farm biosecurity.

Health care and biosecurity organization on the farm

Biosecurity standards on dairy farm are generally based on disease risk assessments, internationally accepted best practices, and best-available science that can help mitigate disease. In essence, the biosecurity part of dairy cattle welfare plan addresses the risks associated with diseases and pests by focusing on three key actions: prevent the introduction of pathogens to cattle on dairy farms, prevent the spread of pathogens among cattle within a dairy farm and prevent the spread of pathogens between dairy farms or from dairy farms to other animal populations (Anon., 2014).

Although based on clear principles, the choice and manner of application of biosecurity measures is not unique, due to differences between farms, location, epizootic situation, technology organization and production, employees, purchase of food and other specifics (Stanković and Hristov, 2009). This means that every farm requires its own measures of disease prevention and control and biosecurity plan (Uhlenhoop, 2007; Hristov et al., 2007; Stanković et al., 2008; Hristov et al., 2013). Regarding biosecurity and economy issues, farms with enclosed system of rearing are the best technological solution. Technological design of enclosed farms makes the solid protection against penetration of many infectious diseases, such as viral respiratory, digestive, and other infectious diseases. If these infections were already present in the herd, the eradication program on enclosed farms has the highest chance to succeed (Anon., 2008).

Comprehensiveness and sustainability of biosecurity measures

There are strong economical reasons to prevent infectious diseases. Every year, many breeders spent significant amounts of money to suppress diseases which were already outspreaded in herd. These costs are always increased by cattle mortality and reduced production. Animal welfare, awareness and way of thinking of stockman should also be important motives for measures reducing disease undertake (Hristov et al., 2009). Investigations and farm biosecurity assessment showed that during production, omissions often occur allowing infectious agents to penetrate and endanger the entire herd health and production. Such phenomena occur not only as a result of ignorance or lack of information, as is often the case in developing countries, but sometimes producers include certain risk when protective measures cost “to much” as well. Animal breeders and manufacturers of animal products have to solve problems concerning

preservation of health, welfare and animal production on daily bases (Stanković, 2010), facing the fact that the outbreak of many diseases can be prevented, if the times taken appropriate preventive measures are performed. Nevertheless, procedures and measures to prevent the entry and/or spread of disease on farms are rarely systematically implemented (Hristov et al., 2007).

According to Canadian Food Inspection Agency (2014), these are recommended best practices: 1. work with the herd veterinarian to develop a Herd Health Management and Biosecurity Program; 2. have a Herd Health Management Program which includes the following components: vaccination protocols, observation of all animals for injury or signs of disease, complete, accurate, and reliable record keeping, protocols for the prevention, detection, and treatment of disease or injury, including lameness, protocols for pest control, training programs and protocols for animal handlers, individual animal identification and treatment records to ensure no animal is shipped prior to drug withdrawal times, ability to isolate new arrivals to the herd and calving protocols.

There is no comprehensive surveillance and programs of biosecurity measures for the most herds in Serbia. Cardinal elements of biosecurity are often (and even deliberately) ignored, such as reliable sources for procurement of new breeding animals and their isolation before introducing into herd *(Stanković et al., 2009)*. Generally, four levels of farm biosecurity could be described: 1) the highest, when the newly acquired animals are not purchased from outside and own are not presented on exhibitions and fairs, 2) relatively high, when the newly acquired animals are not purchased from outside, but own are presented on exhibitions and fairs for the sale, 3) high, when the newly acquired animals are purchased from other farms, but kept in quarantine before introduction into the herd, and 4) the lowest, when the animals are purchased from other, often different sources and are not placed in quarantine on arrival, but are directly introduced into herd, where at the farm in situ is isolation barn, as well as those farms where the staff serves their own and newly acquired animals as well. The lowest biosecurity level does not accomplish necessary function of isolation, but only acclimatization of newly purchased animals (Anon., 2008). Oversights, failures and mistakes in necessary biosecurity level maintaining usually lead to diseases outbreaks, production decrease, higher mortality and loss of income, thus endangering the survival of entire herd (Stanković et al., 2007). These factors indicate the biosecurity status of a farm, but their

mutual interaction and thorough action must be emphasized as well (Hristov et al., 2013).

Benefits of biosecurity planning motivated many countries to establish Biosecurity Standards and/or Strategies for general purpose or for certain specific issue which has important impact to a national dairy production, making its international competitiveness enhanced (Hristov et al., 2011; Stanković et al., 2013, Anon., 2013). Intention is to enable sustainable dairying, balancing profitability with environmental responsibility, trough environmental solutions that are practical and work on-farm, reducing farmers' costs, and improving their efficiency and productivity.

Hoe and Ruegg (2006) found out that producers from large herds adopted more biosecurity practices than those from small ones, although biosecurity risks were common. The frequency of diagnostic testing and examination of purchased cattle increased with herd size. Also, producers minimized risks with which they were most familiar. Bigger farmers had more knowledge of personal health risks related to zoonotic pathogens. Overall, most management practices are associated with herd size, but many beliefs regarding important dairy farm issues were consistent.

Different sizes of production require different levels of protection, and hence control; it should be developed a system where the most secure biosecurity protection facilities, which are exposed to the greatest risk, are best protected (Uhlenhoop, 2007; Stanković et al, 2013).

Instructions and bylaws concerning biosecurity issues must be clearly defined, consistently and systematically applied, and achieved results analyzed in order to improve failures. Stock-keeper should define and write the plan in close cooperation with veterinarian and other professionals, when necessary, experts and technical persons who are engaged in providing advice on production technology – especially engineers of animal husbandry. At least once a year, it is necessary to reconsider the plan and supplemented by current scientific knowledge and new practical experience.

Conclusion

According to presented facts, it could be concluded:

- benefits for dairy stakeholders include improving animal health and welfare, keeping out new diseases, cutting the cost of disease prevention and treatment and reducing the use of medication, producing safe and high-quality products and increasing consumer

and buyer confidence, collecting useful data documenting good work, minimizing the potential income losses, enhancing the value of the herd;

- dairy industry benefits through: decrease of economic losses from some diseases that cannot be treated or controlled using vaccinations or other management strategies, preventing and controlling the introduction of foreign diseases, negotiates more favourable global trade policies and maximizes genetic export markets by the prevention of disease; the effort to preserve the health safety of food products of animal origin and their best quality is of great importance to the health and welfare of consumers, better animal health and increasing their productivity, higher efficiency and profitability, and ultimately, the preservation of a healthy environment; prevention and control of contagious diseases such as FMD are being planned and implemented at the state level, while the individual farms solving health problems provides biosecurity plan based on risk assessment;
- Breeders have the primary responsibility to protect their own herds regarding introduction of the disease, control of movement, proper procedure and group housing of animals and sanitation;
- Employees on the farm and visitors must be aware of their role in the preservation of safe health status farms;
- Results obtained through the questionnaire indicate the current state of biosecurity one farm, but must always bear in mind the interaction and the totality of the operation parameters of biosecurity.

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Održivost i efikasnost planova biosigurnosti na farmama mlečnih krava

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Sažetak

U ovom preglednom radu su prikazani osnovni principi stvaranja i inplementacije planova biosigurnosti. Ovo uključuje i listu ciljeva koji da budu ostvareni i odnose se na specifičnosti tehnologije proizvodnje, izbor mera koje treba primenjivati, njihov redosled i način primene, kao i razloge za moguće neuspehe u izvršenju plana. Efikasnost i održivost u primeni planova biosigurnosti je moguće izmeriti kroz razlike između utvrđenog nivoa biosigurnosti pre i posle početka primene planova primenom upitnika o indikatorima biosigurnosti kao što su: 1. stepen izolacije farme i njena organizacija, 2. karantin i način uvođenja novonabavljenih grla u stado, 3. odnos prema posetiocima, 4. način eksploatacije opreme, 5. kontrola štetočina, 6. efikasnost postupaka sanitacije i 7. uticaj farme na životnu sredinu. Odgajivači treba da u saradnji sa veterinarima i drugim stručnjacima u vezi organizacije i tehnologije proizvodnje definišu i razviju plan da zadrži očuvanje zdravlja stada i bezbednosti proizvodnje. Najmanje jednom godišnje je potrebno preispitati plan i dopuniti novim elelmentima.

Ključne reči: biosgurnost, farma mlečnih krava, efikasnost, plan

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