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GUIDELINES FOR THE ASSESSMENT OF WELFARE AND BIOSECURITY IN DAIRY CATTLE IN LOOSE HOUSING SYSTEMS

Istituto Zooprofilattico Sperimentale
della Lombardia e dell'Emilia Romagna

CReNBA

Italian National
Animal Welfare
Reference Centre

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Centro di Referenza Nazionale per il Benessere Animale
(Italian National Animal Welfare Reference Centre)

Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia Romagna

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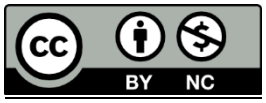

BRIEF PRESENTATION

The present document is a faithful translation of the book “Manuale per la valutazione del benessere e della biosicurezza nell’allevamento bovino da latte a stabulazione libera”, published in April 2014; ISBN 978-88-9097-041-2 by the Italian National Animal Welfare Reference Centre (CReNBA) which is based in the Istituto Zooprofilattico Sperimentale della Lombardia e dell’Emilia Romagna (IZSLER). This book deals with the assessment of welfare and biosecurity in dairy cattle in loose housing systems and reports CReNBA’s related research activities. Such activities began in 2011, when a draft welfare assessment protocol was developed by CReNBA and applied at first in dairy farms located in IZSLER’s geographical competence area (Northern Italy). Later on in 2012-2014 CReNBA’s activities relating to dairy cow welfare assessment covered also biosecurity assessment and were extended to the entire national territory, thanks to the harmonized training of several veterinarians from different Italian Regions. Our aim was to assess the level of animal welfare and biosecurity in several dairy farms, differing in size and geographical region, and to get a picture of the overall situation of animal welfare and biosecurity at present in Italy.

Currently (December 2014) more than 100 veterinarians have been trained as dairy cow welfare and biosecurity assessors and more than 900 Italian dairy farms have been assessed. In this publication, preliminary processing of the data collected during the three-year period 2011 – 2013 can be found.

Such an issue, however, is very complicated and constantly evolving, thanks to the experiences gained during training activities and through the application by several veterinarians of the CReNBA assessment protocol on the field. Our Reference Centre is still involved in studying how to improve dairy cow welfare and this publication should be just the first proof of the activities carried out in Italy. Therefore, while you are reading these pages, we are already working on drafting and publishing a new document, probably available in 2016, which will be more complete and accurate.

The Authors

Luigi Bertocchi and Francesca Fusi

GENERAL INFORMATION ABOUT THE CReNBA ISTRUCTION MANUAL ON THE ASSESSMENT OF WELFARE AND BIOSECURITY IN DAIRY CATTLE IN LOOSE HOUSING SYSTEMS

This document presents the full contents of the CReNBA protocol for the assessment of welfare and biosecurity in dairy cattle in loose housing systems, used in Italy.

It is mainly based on findings provided by EFSA publications (see References at the end), Welfare Quality® assessment protocol for cattle and draft regulation under discussion in Strasbourg ("Draft Revised Recommendations concerning Cattle", revised version No 8, September 2009); also minimum requirements provided by the law in force (Legislative Decree 146/2001, transposition of the Council Directive 98/58/EC and Legislative Decree 126/2011 – transposition of the Council Directive 2008/119/EC) are taken into account.

The following are some points needed to better understand this manual:

- this document is for information purposes only and just reading it does not provide capacity and competence to carry out the CReNBA welfare and biosecurity assessment protocol;
- only veterinarians who have attended the CReNBA training course for welfare and biosecurity assessors can perform this protocol, in order to ensure consistency of evaluations among all assessors;
- the final welfare and biosecurity results are obtained through two phases, the first one consists in observation and recording of data at herd level, performed by assessors on farm, and the second one consists in processing the data collected at central level by the CReNBA Staff;
- in order to get a complete and appropriate assessment of welfare and biosecurity conditions on farm, the entire assessment protocol must be performed;
- anyone (only if veterinarian) wishing to apply this method in farms where he/she works for, or in his/her own farm, may request to attend a training course organized by CReNBA, getting the opportunity to send the assessment data for needed processing activities.

Preface

Only true subject experts can prepare a manual dedicated to a specific theme. The information, assessments and procedures therein must fulfil the requirements of all those who, despite their solid background and specific knowledge, need to study by drawing on concrete facts to solve a given problem.

This is the case of the Guidelines for the assessment of Welfare and Biosecurity in dairy cattle in loose housing systems presented by Dr. Luigi Bertocchi and Dr. Francesca Fusi of the Italian National Animal Welfare Reference Centre. This manual in fact couples the cultured multi-year experience of a passionate cattle specialist with the scientific knowledge of the most recent assessment criteria in the disciplinary animal welfare sector.

These Guidelines fill a publishing gap in favour of the continually evolving subject of "animal welfare" and, consequently, in favour of all those it concerns, whether as part of their job or studies. It thus provides a reference standard amidst interpretative speculation concerning the scientific notion and its application in the world of production. In this context, the manual aims to be a silent consultation guide for the new and difficult role of the cattle animal welfare assessor.

IZSLER is therefore proud of this publication which continues the service publishing activity started in recent years, and recommends it to privileged users, public and private veterinarians, farmers, students of veterinary and agricultural sciences and those who love the subject. We are sure that you will appreciate the sheer abundance of scientific content.

The General Director
Istituto Zooprofilattico Sperimentale
della Lombardia e dell'Emilia Romagna
Prof. Stefano Cinotti

Brescia, April 2014

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INTRODUCTION

THE WELFARE OF FARM ANIMALS

Farm animal welfare is an increasingly urgent and pressing issue as a result of the considerable interest that it generates among the general public and the big attention the media has given to it. Specifically, in the wake of the major health emergencies of recent years (e.g. dioxin-contaminated chicken, BSE, Avian Influenza), consumers focus first and foremost on the quality and healthiness of animal products, and then in second place on the sustainability and ethics of the products, especially those sourced from intensive farming.

Most part of the population places more and more importance on animal rights, probably due to the fact that they mainly live in large urban areas and are therefore a bit out of touch with livestock production systems. Their complete lack of knowledge about animal farming, means that they cannot help but be angry when faced with certain scandalous reports and, in some cases, a general sense of disapproval begins to be perceived at any animal farming practice intended to produce food for humans.

To this end, it should be kept in mind that on the one hand, domesticating and farming animals are legitimate activities for humans, who exploit them for a variety of purposes, such as obtaining food, sustenance and income, but also for company and enjoyment[1]; on the other hand, the Treaty of Lisbon (13 December 2007), identifies animals as "sentient beings", and invites the Union and the Member States to pay full regard to the welfare requirements of animals and breed them without harming them, "while respecting the legislative or administrative provisions and customs of the Member States relating in particular to religious rites, cultural traditions and regional heritage" (consolidated version, First Part, Title II, Article 13)[2].

We cannot overlook the fact that times have moved on and our collective view of animals has radically changed. Livestock production and together with it the way of life of farmers has evolved: it is therefore no longer objectively acceptable to breed animals in unsuitable conditions.

The dual role of Veterinarians should be taken into consideration in this context: on the one hand, they must ensure the welfare of animals and put a stop to farming them in conditions of suffering; on the other, but in no way in contrast, they have to safeguard food safety and public health. This concept is part of the new European food safety approach called "from farm to fork" (Reg.178/2002), which sees the food production chain as a continuum from and including primary production and introduces a principle of responsibility also for the farmer.

Moreover, it is more and more true to state that healthy animals bred in good health conditions produce better and more. Stress factors and poor welfare may cause animals to have a greater exposure to diseases, which could put consumers at risk, as in the case of the most widespread food poisoning caused by *Salmonella* spp., *Campylobacter* spp. and *E. coli*[3].

The connection between animal welfare and animal health was expressly identified in EU Regulation 882/2004 on feed and food control, which stresses that animal health and animal welfare are important factors that contribute to the quality and safety of food, to the prevention of the spreading of animal diseases and to the attempt of a humane treatment of farm animals. The new "Animal Health Strategy (2007-2013)" for the European Union[4] also reads: "The concept of animal health covers not only the absence of disease in animals, but also the critical relationship between the health of animals and their welfare. It is also a pillar for the Commission's policy on public health and food safety." One of the goals of this "strategy" is in fact to "promote farming practices and animal welfare which prevent animal health related threats (…)[4].

While on the one hand the European Community laid down some minimum relevant legal provisions, which everyone must comply with under penalty of fines, on the other hand it has opened the door to an incentive-oriented policy in the bid to become more and more in line with the main goal, that is safeguarding the welfare of farm animals. One example of this was the introduction of minimum requirements for welfare in the "cross-compliance" statutory management requirements which are essential for farmers wishing to access funding from the Common Agricultural Policy (CAP)[5].

Therefore animal welfare becomes first a guarantee of food safety, then of quality. In 2009-2010 the EESC (European Economic and Social Committee) already published its Opinion for animal welfare labelling[6-7], which introduces the possibility of writing on the label of a food that it sources from "certified" farms going beyond the minimum animal welfare requirements established by the law. Animal welfare would therefore assume new significance and, in other words, could be translated into an added value to a quality product, becoming an opportunity to sustain the farmers' income.

Improved animal welfare often results in higher production costs which, in turn, could stand in the way at the start of the process. It is therefore necessary to invest in providing both farmers and consumers with correct and clear information on the characteristics of the products obtained while respecting the welfare of animals and the environment, thus matching supply with demand. This labelling scheme must have positive effects "through the supply chain back to the primary producers, who may be able to receive a premium price for their product and thus recoup a portion of any associated higher production costs[6-7]."

What is more, recent market research in Europe (EUROBAROMETER 2005) has highlighted how important animal protection is for European citizens: 82% of those interviewed stressed the duty to protect them, regardless of the cost involved[8], and in general many of them stated that they were ready to pay more for food products sourced from animal welfare friendly farming systems[9].

However, as the reference framework is not yet complete, there are currently no assessment standards in Italy suitable to ensuring a correct labelling and to introduce an accredited certification system. Thus, today, the Italian consumer standing in front of the supermarket shelf, unable to acquire any clear and honest information on these matters, is mainly influenced by the price alone or by the characteristics that can be directly checked on the product, unknowingly conditioning the market towards a production which, to reduce costs, invests in quantity and not in quality.

Past experience shows that providing the correct information can make all the difference. In the egg selling sector, for example, the obligation to affix *specific terms* concerning the type of production system (eggs from hens, reared in cages, barn, free range or organic systems), together with a huge media and advertising campaign, has brought about a change in consumer habits; they have stopped buying eggs produced in battery cages and moved on to eggs produced using alternative systems, resulting in a significant increase in the production of eggs "from non-caged hens."[6-7]. It should not be forgotten that from 1 January 2012 there has been a ban on the breeding of laying hens in conventional cages, while the use of furnished or enriched cages containing enrichments that allow animals to express their natural behaviour is permitted.

Another example can be drawn from the economic performance of the organic sector: the introduction of a *European brand* on the label, which guarantees compliance of the product with EU Organic Regulations (EC Regulations No. 834/2007 and 889/2008), and the development of advertising campaigns have urged people to buy these products even though the price of them is higher. Despite the economic and financial crisis, the Italian organics market is still growing, which confirms the positive trend which has been underway for several years. ISMEA data[10] for the first six months of 2013 (Famiglie Gfk-Eurisko Panel data) show an 8.8% growth in so-called "organic purchasing" (for packaged products).

Europe already has some examples of animal welfare "labelling". These come from the introduction, by certain private production chains, of special production standards which respect exceptionally favourable farming conditions. These standards had already been set before being provided for by the law, to satisfy the demand of mainly Northern European consumers. Some examples of these are most famously Label Rouge in France and Freedom Food in the United Kingdom. The Label Rouge system concerns poultry farming involving chickens from slow-growing hardy breeds. These animals are farmed in compliance with certain essential requirements, including adequate space to roam around freely during the day, low stocking density and natural light. Freedom Food, on the other hand, is one of the few systems designed and developed by the "Royal Society for the Prevention of Cruelty to Animals" (RSPCA), in which intensive farming practices adopted by the best farms must at the same time comply with many guidelines

safeguarding the main welfare requirements. These standards concern farming of free-range or barn broilers, laying hens, dairy cattle, beef cattle and meat sheep as well as salmon. The implementation of and the compliance with these procedures by the whole production chain (farming, transportation, slaughtering) are controlled by independent external bodies through "auditing" programmes promoted by the processing industry, retailers and multinationals. Consumers can easily identify products belonging to this production chain by the brand on the label. It is important to consider that the Freedom Food brand was filed in 1994, whilst the Italian farmers and the food industry are still finding it difficult to meet this consumer demand and therefore benefit from the demand for high-quality, animal welfare-friendly products. With this in mind, it should be remembered that the feasibility studies contained in the European Commission Report[6-7] show that "labelling is mainly likely to have the desired effects if: a) consumers are adequately informed on the meaning of the label; b) the information provided is readily understandable; and c) consumers (or relevant subgroups) are in principle interested to have this information available for their purchasing decisions. According to Eurobarometer data, this is the case for products sourced from animal welfare-friendly production systems."

There is still an element which cannot be ignored however, which is provided for in the above Report: for labelling to be possible, assessment must be based on sound scientific knowledge which European research (e.g. EFSA opinions and Welfare Quality® research project) has made available as the basis for developing new analysis systems.

DEFINITION OF THE CONCEPT OF ANIMAL WELFARE

The change in public awareness and consequently in the scientific community, concerning factory farming conditions and more generally animal welfare, is rooted in the English-speaking world, about twenty years after the end of the Second World War in the full swing of an economic boom.

As a matter of fact Ruth Harrison published "Animal Machines" in London in 1964, a book that revealed the horrors of the mistreatment of animals in intensive farming. To quote just some of its content, the text attacked farming conditions of laying hens, forced to live in overcrowded battery cages, and male veal calves considered undesirable for dairy farming and raised anaemic to produce white meat, thereby raising questions on the healthiness of food sourced from "unnatural" animal production.

This publication caused such a stir in the public eye and among the politicians of the time that the British government commissioned an investigation, led by Professor Brambell to draft a report on the welfare of intensively farmed animals.

The well-known "Brambell Report" (December 1965)[11] was the result of this work. It defined, maybe for the first time, the meaning of animal welfare (differentiating it from a mere state of health, understood as freedom from disease), by introducing the concept of animal mental health. Animals thus become known all over the world as sentient beings (as opposed to Cartesian denial of their sensitivity) and there was speculation into whether welfare could be scientifically proven:

"Welfare is a wide term that embraces both the physical and mental well-being of the animal. Any attempt to evaluate welfare therefore must take into account the feelings of animals that can be derived from their structures and function and also from their behaviour."[11].

In December 1979, FAWC (Farm Animal Welfare Council) resumed the work of the "Brambell Report" and defined the world-renowned "five freedoms" safeguarding animal welfare[12]:

1. **freedom from hunger or thirst** – by ready access to fresh water and a diet to maintain full health and vigour;
2. **freedom from discomfort** – by providing an appropriate environment including shelter and comfortable resting area;
3. **freedom from pain, injury or disease** – by prevention or rapid diagnosis and treatment;
4. **freedom to express normal behaviour** – by providing sufficient space, proper facilities and company of the animal's own kind;
5. **freedom from fear and distress** – by ensuring conditions and treatment which avoid mental suffering.

Attempts to define animal welfare did not stop there and further claims were made by the scientific world to investigate into the concepts expressed previously. Among the most popular and

recognised definitions are those given by Hughes (1976)[13], according to which "*welfare is a state of complete mental and physical health, where the animal is in harmony with its environment"* and Broom (1986)[14], which states that *"the welfare of an individual is its state as regards its attempts to cope with its environment."*

These claims show how the environment of the farm where the animal lives and its coping ability are essential to its welfare. As a result, welfare becomes a variable and therefore measurable entity with indicators which must assess both the environmental conditions of the farm (management, facilities and weather conditions) and the coping effort of the animal itself.

The scientific community now aims to define how to assess animal welfare, that is how to be successful in objectively analysing it, based on scientific principles.

ANIMAL WELFARE AND ECONOMICAL IMPACT ON FARMING

The consumer has firmly demanded farm animal welfare but it cannot actually come about if this clashes with the economic sustainability of the farm. To achieve this goal it is important to inform chain operators about the positive consequences of improving animal welfare, as it is able to increase the income from the farm. Converting spaces and facilities to improve the living conditions of the animals may bring about an initial increase in production costs, which should not be sustained by the farm alone. Farmers must be persuaded to become sure about making these choices by giving them economic subsidies. With the CAP reform, the European Community has linked the agricultural support funds subject (cross-compliance) with the improvement of animal welfare, too[5]. Further financial aid would be possible if the sales price of animal products were increased, when sourced from animals farmed in welfare conditions better than the minimum standards set forth in current regulations. As mentioned previously, the increase in sales of free-range hen eggs or organic products demonstrates that this is possible. Of course, for these market conditions to be created, it is essential that product labelling provides accurate and clear information to consumers.

In order for the farming to be economically sustainable, it will always be extremely important to be able to explain to and convince the farmer of the production benefits from application of actions aimed at improving animal welfare and reducing stress: benefits in terms of both reducing disease – and corresponding management costs – and increasing production. The farmer should be aware that often all it takes are a few simple precautions aimed at improving the environment, nutrition and health at farm level, to have animals with a strong immune system that can effectively fight the main infectious pathogens, thereby reducing the use of antibiotics. Excessive and improper use of these drugs in veterinary medicine is considered one of the factors responsible for the antibiotic resistance phenomenon, a public health concern at the centre of European debate, which will increasingly hit our farms, encouraging them to prevent this phenomenon by adopting farming practices based on welfare and biosecurity.

For these reasons, many farmers have for a while now been adopting farming solutions which improve the living standards of the animals and, for the same reasons, there is no need to fear assessment of their welfare which in most cases will bring to light the excellent conditions of intensive dairy farming in Italy, disavowing the terrible judgement of those who are not familiar with this production system.

Further financial benefit could result from the outcome of the assessment on the farm, which is carried out from the perspective of the animal and not from the perspective of the veterinarian (analysis of the health aspects) or the farmer (performance analysis). Perceiving and processing the

signals expressed by dairy cows can in fact direct the veterinarian and the farmer in making their decisions to improve the living conditions of the animals, and consequently the profitability of the farm.

The goal shall be to elevate standards of management, facilities and, therefore, the cows to the peak of the curve shown in Figure 1 and achieve the best animal welfare and the best farm income in both intensive or extensive farming.

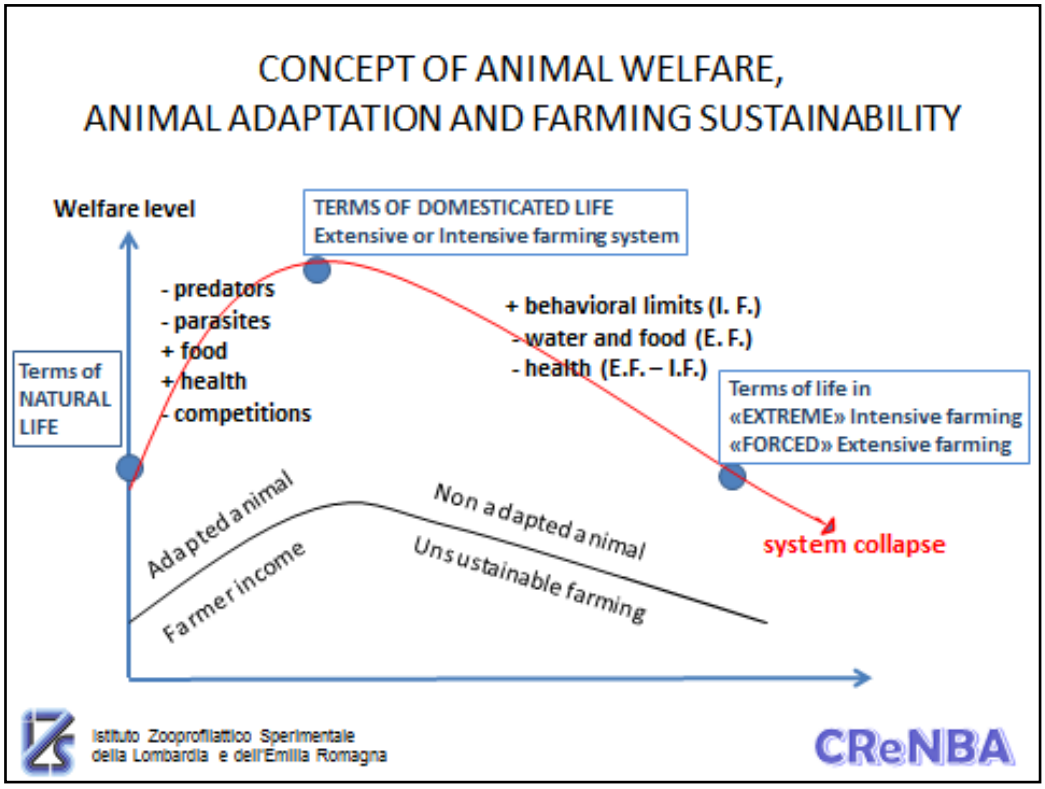


Figure 1–Animal welfare, animal adaptation and farming sustainability[41] (from McInerney, 2013 modified)

MINIMUM REGULATORY PROVISIONS

Article 13 of the Treaty on the functioning of the European Union (C115/4 consolidated version of 9/5/2008)[2] identifies animals as sentient beings and establishes that in formulating and implementing certain EU policies, full regard should be paid to the welfare requirements of animals.

For this reason, some so-called "horizontal" regulations have been issued, defining the minimum mandatory standards for the protection of all animals kept for farming purposes (Directive 98/58/EC transposed into Italian law by Legislative Decree 146/2001)[42], during transportation (EC Regulation 1/2005) and during slaughter (EC Reg. 1099/2009 in force since 1.1.2013). Minimum specific "vertical" rules are defined for certain species and farming types only (calves, pigs, laying hens and broilers). Specific standards have been issued for the beef cattle species (Legislative Decree of 7 July 2011, no. 126, implementation of Directive 2008/119/EC laying down minimum standards for the protection of calves)[43], governing the farming of calves up to six months old while. For adult animals (over 6 months of age), there are no specific standards to be respected and the general criteria set forth in Legislative Decree 146/2001 apply in this case. Both of the decrees mentioned set forth very generic indications which are open to interpretation for some aspects, while other aspects are controlled by very strict and precise limits in term of facilities or management practices.

At EU level, there have been attempts to produce laws in the field of adult cattle farming, but it has not been possible to achieve anything definitive: the eighth and last draft in the European Council's regulations concerning cattle welfare ("Draft Revised Recommendations concerning Cattle")[15] dates back to 24 September 2009. These draft regulations contain 24 articles divided into 5 parts: general provisions, training of stockpersons and inspection of cattle, buildings and equipment; management and lastly a series of general provisions on genetic selection, mutilation, emergency slaughter and research activities.

All these difficulties in formulating a specific legislation protecting the welfare of adult cattle stem from the fact that there are many farming systems in Europe which vary in terms of finished-product destination (milk or meat) or livestock housing system (stall, loose, pasture); each one has different structural and management characteristics, with thousands of variables rooted in a secular culture, and therefore impossible to govern in a single set of complete and final regulations that guarantees the protection of the welfare of the entire cattle population in Europe. The intention of defining limits and conditions therefore clashes with the diversification of the farming systems, with the diversity of weather and geographical conditions in the EU states, with the still inadequate

scientific knowledge and therefore with the risk of unjustly ruling out certain situations in favour of others, having a significant political and economic knock-on effect for the industry.

ANIMAL WELFARE ASSESSMENT

With a bid to protect the environment and animals, the greatest error would be to achieve the set goal by fearfully abiding by regulatory duties only. Given the diversity of the farming systems and weather conditions, there is a concrete, tangible risk of establishing generic standards without fulfilling the aim of protecting welfare.

This is why, having set forth certain essential standards, the goal to be fulfilled must be to define systems and protocols for assessing animal welfare that should be impartial, reproducible and science-based on risk analysis, in the same manner as that already put into place with the entry into force of the "hygiene package" on food safety.

Recalling Broom's concept[14], whereby a state of animal welfare is achieved when the cattle shows positive signs of coping with the environment in which it lives, we can focus concisely on two large areas when performing the assessment[16]:

1. *the environment*: that is, in a broad sense, the farm (including the structural aspects, decisions taken by management, the relationship with man and the other animals) and the transportation, stunning and slaughtering procedures, which are ideally welfare "INPUTs";
2. *the animal*: that is, the individual returning welfare "OUTPUTs", in other words, equally objective signs concerning its adaptation to the environment in which it lives, which can be investigated by performing animal-based observations and measures (for example behaviour, state of health and also, in some cases, productive and reproductive performance).

The first animal welfare assessment application models, for example the TGI 35 L and the TGI 200, created by a concept expressed by Bartussek in1985[17], which proposes an animal needs index (TGI – *Tier Gerechtheits Index* translated as ANI – *Animal Needs Index*) within the context of Austrian regulations for intensive cattle farming, took the time to investigate mainly the structural and managerial aspects of the farm, now defined as "non-animal-based measures" (N-ABMs).

On the other hand, these are the "animal-based measures" (ABMs – e.g. cleanliness of the coat, lameness, mortality etc.), from which the results/consequences ("outputs") of animal-environment interaction can be derived, when trying to establish the effective state of welfare of the animal[3-18.]

In light of these new concepts, within 2005-2009, the European Commission funded an important international research project called Welfare Quality Project® (2004-2009, www.welfarequality.net), to try and achieve an animal welfare assessment system[18] based mainly

on the analysis of the signals given from the animal in response (adaptation) to its living environment. It is in fact believed that the ABMs are able to provide a picture that is closer to the actual welfare state of animals than the use of measures based on the structures and management[19]. Many European researchers took part in the project, with the aim of developing welfare measures (ABMs) for the main farmed species (dairy cows and beef cattle, pigs, poultry).

Moreover, the differences in terms of management and housing in the different European States, resulting partly from the historical and cultural as well as soil and weather conditions, make assessment systems based solely on statistical survey of the facilities and management inadequate. The assessment of the adaptation status and use of "animal-based measures" may on the other hand make it possible to overcome this obstacle, as the "outcome" that the animal gives back from its interaction with its environment is investigated and evaluated, providing an effective universal interpretation as to its state of welfare.

The Welfare Quality® protocols aim to gather information concerning 12 criteria, divided into 4 essential principles of welfare (see Table 1): good feeding, good housing, good health and appropriated behaviour.

Table 1: Welfare principles and criteria in the Welfare Quality® assessment protocols (from Welfare Quality® Assessment protocol for cattle, 2009 - Table 2, modified).

Welfare principles	**Welfare criteria**	
Good feeding	1	Absence of prolonged hunger
	2	Absence of prolonged thirst
Good housing	3	Comfort around resting
	4	Thermal comfort
	5	Ease of movement
Good health	6	Absence of injuries
	7	Absence of disease
	8	Absence of pain induced by management procedures
Appropriate behaviour	9	Expression of social behaviours
	10	Expression of other behaviours
	11	Good human-animal relationship
	12	Positive emotional state

Specific measures have been identified for each of these 12 criteria based on their repeatability, practicality/feasibility and validity.

Following the assessment, the score is calculated: first of all a ranking system groups together the scores obtained for the different measures, on a 0 to 100 value scale for each criterion. The score for each criterion is entered on a 0 to 100 value scale for each of the 4 welfare principles. After the final aggregation of measures an overall score is reached which can be used to assign the assessed farm to one of the four general welfare categories (“not classified”, “acceptable”, “enhanced”, “excellent”)[20].

Actual implementation of the Welfare Quality® protocols, as described, has however demonstrated premature intrinsic limitations in terms of timescales, costs, ease of use and production of useful suggestions to improve the conditions. The analysis performed in a dairy cow farm entails the exclusive assessment of the conditions of lactating animals and does not take into account those of unproductive animals such as calves, heifers and female calves. Moreover, it takes approximately 7-8 hours to obtain a result from protocol implementation in loose housing with 80-100 lactating animals (a size often found in Italy). Such a long period of time brings with it unacceptable costs and reduces the possibility of finding a farmer who is willing to use the protocol. Finally, recording of ABMs alone identifies the state of welfare of the animals, but does not pinpoint the factors which could condition it and therefore the possible environmental and management improvements to be made.

THE WORK OF THE EUROPEAN FOOD SAFETY AUTHORITY (EFSA)

The EFSA Scientific Colloquium held in Parma in 2005 on the "Principles for risk assessment for food-producing animals" (EFSA, 2006)[21] and the EFSA Workshop held in Vienna in 2007 on "Risk Assessment Methodology in Animal Welfare" led the scientific community to draw the conclusion that, until then, there had been no specific standardised methodologies for the conduct of risk assessment for animal welfare[16].

An initial report on the basic information for developing risk assessment guidelines for animal welfare was drafted by the Italian National Animal Welfare Reference Centre (EFSA; 2007)[22] at the Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia Romagna. This report defined risk assessment, described existing models, and reviewed the definitions of animal welfare and the different approaches for assessing it[16].

In this context, the European Commission officially requested EFSA to develop a comprehensive and harmonised methodology for risks and benefits assessment of animal welfare, taking into consideration the different farming systems, the recovery and management systems and the various problems in relation to these, using the methodologies followed in the food safety field[16] for reference purposes.

This goal was achieved in January 2012 when the Guidance[16], aimed at describing a standardised methodology for animal welfare risk assessment, was definitively published. The methodology was planned to be implemented for all animal species and all types of factors/dangers which may affect animal welfare[23].

The methodological framework proposed begins with problem formulation (a process which is important for defining the purpose, range and focus of the risk assessment) and continues through the three essential risk assessment stages:

1- exposure assessment (defining the level and duration of exposure to factors);
2- consequence characterisation (describing the effects that exposure to factors will have on welfare);
3- risk characterisation (estimating the likelihood of occurrence and magnitude of negative welfare effects, including any uncertainties and assumptions related to the risk assessment)[23].

In particular, the text states that during the essential "problem formulation" phase, identification and listing of all the *factors* which could affect welfare should be based on the scientific literature. These factors are defined as any aspect of the environment of the animals in relation to housing and management, genetic selection, transport and slaughter that may have the potential to impair or improve their welfare. A factor with the potential to bring about a negative consequence (health, physiological, behavioural) for animals is called a hazard[16].

In connection to this, in 2009 EFSA already published a first major scientific report[24] on the effects of the most common farming systems on dairy cow welfare and disease, with the aim of establishing an initial analysis and defining the state of play of dairy cow farming in Europe.

Four scientific opinions followed this publication[25-26-27-28],giving the results of the assessment of the potential impact that housing, feeding, management and genetic selection may have on dairy cow welfare. Each of these publications identifies and analyses the consequences of the aforesaid factors on a specific pathophysiological condition in relation to leg and locomotion problems[25], udder problems[26], metabolic and reproductive problems[27], behaviour, fear and pain problems[28]. Lastly, each one was applied to the four main dairy farming scenarios in Europe: loose housing with cubicles, loose housing on deep litter, tie-stalls and pasture.

In these Scientific Opinions, the working group systematically established which factors might have the potential to positively or negatively (hazards) influence dairy cow welfare. Subsequently, the *seriousness/severity* of the effects on the living conditions of the animals was established for each of these (in relation to each of the four dairy cow populations identified) and lastly, the *probability* (risk characterisation) of these actually occurring was determined. Once risks for dairy cow welfare had been identified and estimated, the foundations could be laid for deciding which precautions are able to reduce or eliminate them.

The conclusions of these Scientific Opinions were summarised in a fifth publication[29]"on the overall effects of farming systems on dairy cow welfare and disease." 105 welfare recommendations followed in connection with the conclusions, portraying the natural consequences of the analyses performed, and are a sort of essential guidance to be followed in the different housing systems, to make sure that the welfare of this species is scientifically guaranteed and safeguarded.

Lastly, the European Commission has called for animal welfare indicators to be developed to reinforce the scientific basis of EU regulation in this field. EFSA is therefore still committed to developing a set of scientifically measurable animal welfare indicators to be included in its future conclusions and recommendations[3]. *"These welfare indicators will support decision-making on the acceptable conditions for farmed animals and will be used to underpin monitoring and control programmes, implemented at farm level, to guarantee standards of animal health and welfare and to help control diseases[3]."*

Some Scientific Opinions on the use of ABMs in assessing the welfare of dairy cows, pigs and broilers were published in 2012.

The document on dairy cows[30] states that ABMs identified on the basis of scientific evidence can be effectively used in the evaluation of the welfare of dairy cows on farm in relation to laws, codes of

practice, quality assurance and management. Some of these measures may also be used for ante-mortem inspection and there are additional post-mortem ABMs which can be taken at the slaughterhouse.

Basically, there do not seem to be any animal welfare issues that cannot be assessed using one or more ABMs, but there may be practical constraints that make it difficult to use ABMs, and so it could be preferable using "non-animal-based measures" (N-ABMs).

N-ABMs can be used especially when the association between them and the welfare outcome is strong and when they prove to be more efficient than ABMs as a means to safeguard welfare[30].

The Welfare Quality® protocol provides information on the majority of the welfare outcomes associated with the main hazards (inputs) identified in the EFSA Scientific Opinions, but not those where time limitation prevents it[30].

All the ABMs and N-ABMs which can be used to assess whether each of the 105 welfare recommendations has been met are ultimately listed in the 2012 Scientific Opinion: "the choice of animal-based measures will depend upon the specific objectives of the assessment. The full list is comparable to a *toolbox*, from which the appropriate range of measures can be selected"[30]; and that is what the Italian National Animal Welfare Reference Centre (based in the Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia Romagna) has done by preparing its own welfare assessment system for dairy cows farmed in loose-housing systems.

THE CReNBA AND THE NEW METHOD FOR ASSESSING WELFARE AND BIOSECURITY IN DAIRY CATTLE FARMED IN LOOSE HOUSING SYSTEMS.

The Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia Romagna (IZSLER), through the Italian National Animal Welfare Reference Centre (CReNBA), has been performing technical and scientific support activities for the Ministry of Health and for the competent authority since 2004 and promotes research and training in the animal welfare sector. The CReNBA has introduced a system for assessing cattle welfare, which was officially presented on 29-30 May 2012 at the same Institute as part of a course entitled: "Animal welfare in the cattle species: welfare assessment system in dairy cow farming". This system was then officially presented on 21 January 2014 to the Italian Ministry of health, in presence of some other local Authorities.

An assessment system has been elaborated in order to analyse the average level of welfare of cattle housed on Italian farms, drawing information from the TGI 35L and TGI 200[17] models, mentioned previously, and from many indications obtained in the last years: such as those by the draft regulation on adult cow welfare under discussion in Strasbourg[15]; those by the European Food Safety Authority Reports and Opinions on dairy cow welfare[16-24-25-26-27-28-29-30]; by the European Welfare Quality® research project[18] and finally by the various relevant publications over the past 10 years. The method is based on the analysis of two data groups: the first group consists in the assessment of the hazards occurring as a result of environmental conditions (facilities, equipment, management and microclimatic conditions); and the second group consists in the assessment of the risks, with the concerned adverse effects (consequences), run by animals living in those environments.

The work should proceed with special attention to the following points:

- practical and theoretical training of the veterinarian performing the assessment;
- identification of the major deficiencies of the system and the farming facilities;
- assessment of the most significant aspects with respect to the welfare of farmed animals;
- the connection between farming conditions and effects on the animals;
- issuance of a final score revealing the level of welfare of the animals;
- high repeatability of the score in relation to objective, measurable parameters (inter-operator agreement shown as percentage, Fleiss' Kappa index and free-marginal Kappa, Kendall's W index for each item and the Kappa index for each operator as the mean value calculated on the indicators obtained for each pair of operators for each item);
- ensuring that the work (farm visit and subsequent rating allocation) is performed within a time frame (maximum half a day) that is compatible with the duties of the farmers and the

veterinarian, saving further in-depth consultation for the improvement of animal welfare, where appropriate, to a subsequent visit.

When selecting the aspects to assess, attention was focused on those most studied in the documents mentioned previously, with preference given to the collection of objective data which is easily observed at almost all dairy cattle farms in Italy. The ultimate purpose is to be able to compare different farms based on the same assessments, making sure that a more objective assessment is provided. Moreover, on the basis of the most recent publications, it is impossible to assess the level of welfare of the farm by focusing on facilities and management only; it is also essential to analyse the response given by the animals living in these conditions. These measures (ABMs) must be performed according to accurate and pre-defined observation systems, in order to avoid subjective judgement. To achieve this goal, veterinarians must attend a specific theoretical and practical training course to ensure correct and equal analysis at all farms, regardless of the individual performing the assessment.

In detail, those aspects of the farm considered to be of most importance by the system are stockmanship, the conditions of the facilities and the equipment coming into contact with the cattle on a daily basis, the microclimatic conditions and certain social and health aspects. Of the different cattle farming phases, particular importance has been given to the transition period (21 days before and after delivery) during which cattle are most vulnerable to conditions of welfare or stress.

The system may still have some problems in relation to “dynamic” factors, such as the period (season) of the farm visit or assessment of nutrition and feeding. In the first case, efforts have been made to use assessment parameters that are not very sensitive to seasonal weather changes, while calculation of nutritional components using a specific programme was considered too complex for the feed ration and it was decided to assess management factors (availability, ease of access, handling and distribution of the feed - NABMs) and factors related to the animal’s response (body condition BCS - ABMs).

The system is built around 74 observations, mainly divided into three overall choice options, distinguished as “unacceptable”, “acceptable” and “excellent”, for each single assessment parameter. In borderline situations, the veterinarian performing the assessment must always bear in mind that the worst condition (unacceptable) and the best condition (excellent) should be assigned, respectively, in cases where there is clear negative evidence and clear positive evidence only.

The final outcome of the implementation of the assessment system is that of attributing a numerical animal welfare index to each farm. The index will be obtained from adding up the assessments deriving from the responses for each single item and weighed in relation to the importance that each of these has in defining the state of welfare.

Hazard assessment is performed using parameters divided into three areas, respectively: Area A - "Farm management and personnel"; Area B - "Facilities and equipment"; Area D - "Inspection of microclimatic environmental conditions and alarm systems" in the event of serious negative events (e.g. fire). The assessments are grouped within Area C- "Animal-based measures" for carrying out the assessment of the risk and of the consequent negative effects on cattle.

The partial result of each area also provides an indication of the burden and importance of each of these on the final calculation of the animal welfare value.

The hazard analysis areas assess the farming and management conditions of the farms, but these may have different effects as they are regulated by the animals' ability to adapt and are therefore less important when establishing the final welfare value. The estimation of these areas is instead of greater importance as it pinpoints critical elements where intervention is needed to implement suitable solutions that will improve welfare conditions.

The ABM area is of greater importance as it analyses the actual effects of farming conditions on cattle and therefore contributes to defining an objective animal welfare condition.

Although it could thus seem pointless to perform an analysis of the hazard areas, it is in actual fact essential for at least two reasons. The first reason concerns the objective impossibility of easily and directly assessing certain significant conditions of suffering in animals, such as lack of drinking water. In this case, if we wanted to use animal-based measures, we would have to note the state of dehydration of the skin and the heart rate - a rather complex operation which would be unacceptable to perform on a statistically significant number of subjects in a herd of dozens of animals. It therefore becomes necessary, when evaluating how possible it is for cattle to access drinking water, to use non-animal-based measures, such as the presence, size, placement and handling of water troughs in the cattle shed.

The second reason is instead practical and concerns the possibility of making the whole farmed cattle welfare assessment such that it provides specific indications on how to improve the living conditions of cattle, rather than being an end in itself. If the outcome of the animal-based welfare measures is negative, then it will be necessary to identify which hazard parameter area presents the greater shortfall and advise the farmer on possible improvements to be made.

Finally, the cattle farming welfare assessment system has been integrated with parameters for analysing conditions of biosecurity. To this end, 15 observations were added, with two or three choices, like the others, grouped within a fifth area (area E) called "Biosecurity", to assess the level of prevention against the introduction and/or spread of infectious diseases in the cattleshed.

Although the final value of the welfare and biosecurity index of the farm can be managed at will, it is advisable to identify 3 different levels reflecting the requirements of the single observations, to make it easier to understand:

- **farm with inadequate welfare or biosecurity conditions,** in cases where the final score is in the lowest 33% with respect to the available score;
- **farm with good welfare or biosecurity conditions,** in cases where the final score is between 33% and 66% with respect to the available score;
- **farm with an excellent level of welfare or biosecurity**: in cases where the final score is between 66% and the maximum available score.

Besides simply breaking down the farms into categories, the system also identifies farms which do not comply with legal requirements:

- **non-conforming farms** (failure to comply with legal requirements): if instances of legislative non-compliance with respect to specific regulations on farming veal calves up to 6 months of age (Legislative Decree 126/2011) or with general regulations on the protection of farmed animals (Legislative Decree 146/2001) come to light during the farm inspection, these should be reported regardless of the level of welfare.

As the final result, a welfare certificate will be presented, containing the following:

- the list of shortfalls identified (only in the case of farms having legislative non-compliance);
- the numerical index and the relative welfare assessment level for each of the 4 areas;
- the overall welfare level value at the farm;
- the standard of biosecurity at the farm (area E).

IMPLEMENTATION OF THE SYSTEM IN FIELD

The observations chosen to investigate, verify and measure the welfare of cattle in loose housing take into account both “inputs”, such as facilities and management, and “outputs”, for example the animals’ conditions . The non-animal based measures (N-ABMs) were selected mainly from the previously referenced EFSA guidance, concerning management activities or structural conditions that may have a positive or negative effect on the physiological, physical and mental condition of the animal (for example, the number of farmers and stockmanship and their training, the litter surface area or the size of the cubicles).

The animal-based measures (ABMs) were mainly selected from the works of EFSA and the Welfare Quality® project. There are two distinct types. The first consists in indirect data that are not obtained by observing the animals, but instead concern certain health conditions whose aetiology is usually strongly influenced by the management of the farm. These are usually already present in management or health information collected by the farm to monitor the efficiency of the farming method and can be easily retrieved by the assessor during the audit. These data include, for example, annual mortality rate, mean somatic cell count in bulk milk or the number of mastitis cases treated with antibiotics in the course of one year.

The second-type ABMs are identified as being direct, as they emerge from the observation/assessment of certain conditions of the animals, such as the “Body Condition Score” (BCS) or the presence of cattle with skin lesions in the barn at the time of the inspection. All animals may be observed in the case of farms with fewer than 30 animals per group; where groups are larger, observation should be partial and performed on a statistically representative subject sample. For certain animal health and behaviour parameters, the inspection involves detecting and consequently assessing certain pathological conditions, without this being of use for the diagnosis of specific diseases.

The proposed protocol is used to assess all the barn facilities and the welfare of all cattle present in a dairy farm, both already producing milk (lactating cows) and intended to produce it (calves, maiden heifers and heifers). Therefore, in typical Italian dairy farming conditions, three main animal groups will be assessed: young “non-producing” animals (from the new-born calf to the seven-months-pregnant heifer); dry cows and lactating cows.

In the case of animals belonging to the same group (young, dry or lactating cattle) but farmed in different areas or pens, the final rating (for example, for ABMs) shall be assigned - where possible - using the weighted average of the conditions detected. In the case of certain N-ABMs, for which an

average cannot be calculated, the conditions to which the majority of the individuals are exposed will be assessed.

The system consists in 89 observations, listed in a multiple-choice checklist.

Each item of information is obtained by performing the following actions:

- questions on the main management activities to be asked to the farm manager;
- assessing the facilities and equipment used in the barn – N-ABMs – (measuring spaces, volumes etc.);
- observing the animals and detecting body condition and behaviour-related welfare indicators – ABMs – (cleanliness, skin lesions, lameness etc.).

Data collection is grouped into 5 theme-based areas:

Area A: FARM MANAGEMENT AND PERSONNEL

Area B: FACILITIES AND EQUIPMENT

Area C: ANIMAL-BASED MEASURES

Area D: INSPECTION OF MICROCLIMATIC ENVIRONMENTAL CONDITIONS AND ALARM SYSTEMS

Area E: BIOSECURITY

The welfare assessment inspection should ideally take place at least two hours after milking and other ordinary or extraordinary operations which could disrupt the daily activities of the animals.

To prevent his/her opinion from being influenced, during the visit to the farm the assessor should interact with the farm owner or manager only to perform the activities listed in the audit protocol. The role of the assessor is to inspect only; individual issues identified and any improvement measures thereof may be discussed at the specific request of the farmer, only on completion of the operations.

This manual will only take into consideration animal welfare assessment in housing where cattle are farmed in loose housing, as tie-stall farms have very different environmental factors. Special risk-assessment guidelines for specific facilities and equipment used are required for assessing these farms, as are specific protocols for measuring the degree of adaptation of the animals.

WELFARE AND BIOSECURITY ASSESSMENT OF DAIRY CATTLE IN LOOSE HOUSING SYSTEMS

AREA A. FARM MANAGEMENT AND PERSONNEL

Farm management is essential for animal welfare and consists in all the operations involving stockmanship. Although, the structural features of a farm may, at first glance, appear to be of greater importance in terms of effects on animal welfare, the latter is actually more influenced by day-to-day management of the main routine activities performed by the personnel. As we will see later on, analysis of the data collected using this system proves this link between welfare an management. Actions perform by farmers, either directly on the animal or indirectly, for example feed preparation and tending of resting areas, can even ensure a state of welfare in facilities that are not very suitable or, on the contrary, may create cases of suffering in modern and cutting-edge facilities.

The personnel assessment area evaluates the number of stockpersons working in the barn in relation to the number of animals cared for, and the level of technical training those people have in performing activities with greater influence on animal welfare.

A. Number of stockpersons (1) –Stockperson training (2)

"Animals shall be cared for by a sufficient number of staff who possess the appropriate ability, knowledge and professional competence" (Legislative Decree 146/2001, transposition of the Council Directive 98/58/EC – Annex, paragraph 1).

Stockpersons are those who work full-time or part-time in the barn performing animal feeding and care operations and tend to the surroundings. Milkers - who will be assessed with other inspection items - and farmers working in the fields are excluded. As there is no specific guidance on the maximum number of cows that one stockperson can follow to ensure their welfare, and given the fact that farms have very different facilities and equipment, we have based the assessments on our experience. One stockperson for less than 300 animals (on average over the year) is deemed sufficient; one operator for less than 200 animals is preferable. In case of farms where stockpersons also carry out milking duties, one stockperson to up to 100 animals is sufficient, with a maximum of 50 cows to be milked. The best situation should be one stockperson to up to 80 animals, with a maximum of 40 cows to be milked.

Given that herd size and number of lactating cows are obviously subject to variations over the year, the number of animals cared by each operator can be ± 5% compared to thresholds given.

"In order to develop a positive relationship between human and animal, there shall be appropriate careful handling from an early age..." (EC draft 8/09 Article 4, paragraph 1).

The relationship man-animal is essential for animal welfare. Negative behaviours, such as abrupt, aggressive or violent actions cause fear and therefore stress in cattle. It is important for the personnel to maintain a constant work routine, treating the animals without rushing and in a calm manner, especially during milking and handling.

"Stockpersons should receive training in animal management methods and animal welfare." (Recommendation 102 - EFSA Journal 2012; 10(1):2554).

"Measures for the early detection of disease should be in place and farmers and stockpersons should be well trained to recognise disease at early stages." (Recommendation 90 - EFSA Journal 2012; 10(1):2554).

"A substantial period of training appropriate to their responsibilities, including practical experience, as well as continued training, are considered essential for those engaged in the keeping of cattle" (EC draft 8/09 Article 3, paragraph 2).

Animal welfare is actually still a new topic and requires divulgation. The main principle identifying animals as sentient beings must be adequately explained to people who interact with animals. Moreover, this must not be confused with farming techniques, even if it is often possible to enhance production performance by improving the living conditions of livestock. Personnel must therefore be competent and highly motivated and must receive information and training on animal needs. Practical sector experience is considered to be adequate, while positive assessment requires the attending of specific training courses on dairy cattle farming, proved by a specific certificate. Relevant qualifications are esteemed just as excellent (degree or diploma in agriculture or veterinary sciences and/or similar bachelor's degrees).

The training courses should be repeated regularly throughout the entire period of employment (minimum 1 course every 3 years). Personnel refresher courses should clearly explain animals' main needs and illustrate the basics of cattle behaviour. If more than one stockperson works at the farm, it is sufficient for just one stockperson to take part in such training courses.

Inspection item 1 – Number of stockpersons
One stockperson (without milking duties) for more than 300 animals or one stockperson for more than 120 animals (with milking of about 60 animals)
One stockperson (without milking duties) for more than 200-300 animals or one stockperson for 90/100 animals (with milking of about 50 animals)
One stockperson (without milking duties) for less than 200 animals or one stockperson for less than 80 animals (with milking of about 40 animals)

Inspection item 2 – Stockperson training
The course must be at least 4 hours long (a half-day or 2 evening slots) and completed in the last 3 years by at least one individual, who may be the owner or an employee.
Less than 10 years' experience and no training courses
Minimum 10 years' experience and no training courses
Experience and possession of a qualification or a certificate of attendance of a training course lasting at least ½ day or 2 evening slots in the last 3 years.

A. Group management (3)

In order to meet the physiological needs of the animals and in order to group together subjects at similar age or production period, dairy cattle farming should be broken down, as a minimum, into the following main groups:

- calves (pursuant to Legislative Decree 126/2011 (Directive 2008/119/EC) laying down minimum standards for the protection of calves);
- heifers;
- lactating cows;
- dry cows.

"Feeding systems should allow every individual cow to meet her needs for quantity and quality of feed" (Recommendations 11, 18 - EFSA Journal 2012; 10(1):2554).

"Feeding and management of the dry cow should be designed to prevent metabolic disorders…which has an acute severe effect on animal welfare" (Recommendations 10, 19 - EFSA Journal 2012; 10(1):2554).

As dairy cow welfare is a dynamic concept that is also dependent on specific physiological conditions such as delivery, milk production or dry periods, it is important to handle these animals separately during these different stages of their productive life. In the extremely critical transition phase, starting three weeks before delivery until the three weeks post-delivery, the drastic change in hormone and metabolic profiles make the dairy cow more vulnerable to negative stress factors which could cause severe suffering during lactation. The state of health and welfare of the dairy cow is more greatly influenced by changes in its environment, hierarchical order, availability of space, litter hygiene and comfort, access to feed, and other situations during this period compared to other times in its life. For this reason, while bearing in mind that implementation is a challenge, a structured transition period management planning becomes necessary, creating groups which are separated from the rest of the herd, in order to guarantee space, nutrition and feeding specific requirements. For similar reasons, it is important to divide the animals according to number of deliveries (group of first-calf heifers) or production level (group of fresh cows or those soon to enter the dry period). In case of farms with herd size greater than 50 animals (that is more than 20/30 lactating animals), dividing adult cows into more categories (groups) than the basic ones (dry and lactating cows) will be regarded as very positive and will therefore receive a better judgement. This criterion cannot be used for smaller farms (less than 50 animals overall), because separating adult animals may be counter-productive, since the low number of subjects in the pre- and post-delivery phases would lead to the cow being left alone and, as it is a social animal, it would be subjected to unnecessary suffering. On small farms, the assessor should analyse how the farmer manages transition, milk production and dry periods, and may award the highest judgement if he/she observes very positive care and attention with respect to this.

Inspection item 3 – Group management

Additional groups are contemplated only between dry cows or between lactating cows
No groups or only heifers/cows
No. of groups corresponding to the number of assessment categories (heifers, dry cows, lactating cows)
Several groups (transition cow, first-calf heifers) of lactating or dry animals; or 3 clearly separate main groups in herds with fewer than 50 animals overall

A. Number of inspection visits of animals (4)

"Cattle shall be inspected at least daily, preferably more frequently. Ill or injured animals, animals that do not behave normally and periparturient cows and heifers shall be inspected more frequently than once a day. Tied animals and housed calves shall be inspected at least twice a day; calves in outdoor systems shall be inspected at least daily." (EC draft 8/09 Article 5, paragraph 1).

"Cows should be inspected for disease daily and there should be extra checks around calving and the first three weeks of lactation" (Recommendation 92 - EFSA Journal 2012; 10(1):2554).

The inspections referenced by the draft regulation (draft 8/09) and EFSA recommendation should be understood as supplementary to milking and feed distribution activities and they involve observing all housed animals.

The stockperson who is not responsible for milking must carefully observe all the animals at least twice a day. He/she should perform the operation specifically for this purpose, in order to pay the utmost attention for identifying potential welfare hazards and any abnormal health, behaviour or physiological condition of the animals, enabling swift remedial action. This activity is rated as excellent when the stockperson writes down and records any abnormal behaviour (posture, "facies", animals in heat etc.) rather than just observing it, or when he/she systematically checks the animal activity notifications provided by automatic detection systems (pedometer, activity meter, etc.).

Milkers, on the other hand, must carefully inspect the cows in the milking parlour, with particular attention to their behaviour, skin lesions and teat sphincters as well as any sudden decrease in production.

Inspection item 4 – Number of inspection visits of animals

Daily inspections are understood as additional to milking activities.
1 inspection/day
2 inspections/day
>2 inspections/day, written report of the observations (e.g. animals in heat) or computerized recording

A. Typology of equipment for movement (5) – Moving cows at milking (6)

"…Expect when movements of cattle are supervised, passageways and doorways shall be wide enough to allow cattle to pass each other without difficulties and shall be wide enough to allow free movement. Passageways should avoid sharp turns and also should not terminate in a dead end unless there is sufficient room for animals to turn around and for cattle to pass each other without difficulty…" (EC draft 8/09 Article 9, paragraph 1)

"Suitable fixed or mobile facilities should be provided for unloading and loading of cattle, which should provide a minimal slope." (CE draft 8/09 Article 9, paragraph 8).

Specific equipment is preferable for movement, as stress due to movement may have repercussions on welfare.

Stockpersons must move the animals carefully, avoiding inappropriate use of restraining means and non-conventional tools (electric barriers or prods, sharp instruments) which can worry and frighten the animals.

"Electric cow trainers should not be used and electric goads should not be used on cattle" (Recommendations 52, 103 – EFSA Journal 2012; 10(1):2554).

Moving animals into new groups, when entering the milking parlour or loading into vehicles, should be carried out in a calm and quiet manner, without shouting or acting aggressively. Daily movement into the milking parlour is of particular importance, given the frequency of its occurrence. The way from the dairy cow housing to the milking area and the way out from the milking parlour should be easy to move along, straight, free from obstacles, holes or steps and sharp bends. It is important to have a waiting room with direct access to the milking parlour to prevent any obstacles. Milking room stalls should be suitable for cows, the floor should not be slippery and curves at the exits must not exceed 90°. Before movement, stockpersons must ensure that the way is free from mobile obstacles and escape opportunities and that it is adequately lit with no shadowy areas. Aisles with solid non perforated walls should be used where possible.

Inspection item 5 – Typology of equipment for movement

It mainly concerns day-to-day movement when sending animals to the milking parlour or changing groups.
Using electric goads and sharp instruments
Using only hands or plastic poles

Inspection item 6 – Moving cows at milking

In order to give the best judgment, none of the problems described must be present for at least the majority of the groups milked.
Impediments to the access of the milking parlour or inadequate stalls or slippery floor or tricky exit with curves (180°) or obstacles
Milking parlour easily accessed and exited

A. Diet (7) – Concentrates in the diet (8)

"Animals must be fed a wholesome diet which is appropriate to their age and species and which is fed to them in sufficient quantity to maintain them in good health and satisfy their nutritional needs. No animal shall be provided with food or liquid in a manner, nor shall such food or liquid contain any substance, which may cause unnecessary suffering or injury." - *"All animals must have access to feed at intervals appropriate to their physiological needs."* (Legislative Decree 146/2001, transposition of the Council Directive 98/58/EC – Annex, paragraphs 14 and 15).

"All cattle shall have appropriate access to adequate, nutritious, hygienic and balanced feed each day… Sufficient roughage or other fibrous food shall be provided daily in accordance with the age and the behavioural and physiological needs of the animal." (EC draft 8/09 Article 12, paragraph 1).

"Concentrate feeding facilities should be adequately maintained and diets carefully balanced to maintain optimal rumen fermentation and to minimise negative energy balance." (Recommendations 11, 18 – EFSA Journal 2012; 10(1):2554).

Feeding systems should allow every cow to meet its needs for quantity and quality of feed. The diet should provide sufficient energy, nutrients and dietary fibre to meet the nutritional and physiological needs of the cow in ways that are consistent with digestion. Animals should be fed in accordance to their body growth, their physiological state and their level of production. A specifically calculated diet is therefore needed for at least each animal group in the farm.

All animals must have an adequate amount of fibre to ensure normal rumen fermentation. For this reason, concentrates should not exceed 60% of the ingested dry matter (DM) when diet does not contain corn silage, and 50% of the dry matter when diet is made up of at least 15 kg of corn silage (corn silage DM is traditionally considered as completely made up of forage). The animal's correct

diet is also linked to the quality of the feed ingredients, which origin must be known and which must be stored in suitable environments (trench silos, silos, warehouses and haylofts) to prevent alterations or contamination with toxic-harmful substances. For this reason, there must be a written traceability system for feeds and an adequate storage of them, in order to receive a positive rating. Appropriateness of nutrition and feed for animals can also be assessed by checking their nutritional status using the Body Condition Score, even though it mainly provides an indication of the subject's pathophysiological status (questions 53-54-55).

Inspection item 7 – Diet
The specific diet must be written or attached to the weighing machine. **There must be documentary evidence of traceability.**
Empirical, without calculating nutritional requirements
Specific for each main group (heifers – dry cows – lactating cows)
Calculated by a nutritionist, with a traceability system and correct storage methods

Inspection item 8 – Concentrates in the diet (lactating cows)
More than 60% of DM for diet without corn silage, or more than 50% of DM for diet with corn silage
Less than 60% of DM for diet without corn silage, or less than 50% of DM for diet with corn silage

A. Water availability (9)

A. Cleanliness of water troughs: lactating cows (10) – dry cows (11) – heifers (12)

"All animals must have access to a suitable water supply or be able to satisfy their fluid intake needs by other means." (Legislative Decree 146/2001, transposition of the Council Directive 98/58/EC – Annex, paragraph 16).

"... and all cattle over two weeks of age shall have access to adequate supplies of water of suitable quality all the times..." (EC draft 8/09 Article 12, paragraph 1).

Water must always be available to all groups of animal on-farm. The water trough should allow the cow to lower its head and dip its mouth easily into the water.

Absence of water may be due to problems with the functioning of the water troughs, which therefore have to be monitored. The filling rate should be 20 l/min for standing troughs and 10 l/min for drinking bowls. Water may also be absent as a result of problems with the distribution system.

"All calves over two weeks of age must have access to a sufficient quantity of fresh water or be able to satisfy their fluid intake needs by drinking other liquids. However, in hot weather conditions or for calves which are ill, fresh drinking water must be available at all times." (Legislative Decree 126/2011, transposition of the Council Directive 2008/119/EC– Annex 1, paragraph 13).

A particular consideration should be given to access to water for calves housed in individual pens which, although on a milk-based diet, have no source of water in their pen during the day. Although the percentage of water provided with a milk-based diet is often considered to be adequate, it may not be enough to meet the physiological needs of the calf and maintain the homeostasis of its body in hot summer conditions or during attacks of diarrhoea. Therefore, during the farm visit, the best rating shall be assigned if calves are routinely fed with an appropriate milk-based diet and they can also have access to a fresh and clean water supply every day (from at least the second week of age). If all animal groups in the farm have a permanent water supply, but calves in individual pens can drink only milk, an intermediate rating is assigned; but even if just one animal has no *ad libitum* water supply, the worst rating is assigned.

In reference to the statement above of the Council Directive 98/58/EC (*"All animals must have access to a suitable water supply or be able to satisfy their fluid intake needs by other means."*), the CReNBA staff believes that it is very difficult to exactly define which is an appropriate water supply in quantity and quality for each animal, because these characteristics can change a lot depending on the subject and the environmental conditions. For this reason, only when all the animals in a farm have access to an *ad libitum* supply of water, in order to satisfy their fluid intake needs by drinking whenever they want, a positive rating for the inspection item n.9 can be assigned. Such a condition could happen only when all the water troughs are functioning and linked to the water supply network or, in the case of some water troughs filled manually, they can contain a quantitative of water certainly greater than the overall needs of all animals present in the group (and the welfare assessor must verify that the farmer correctly fills them).

Since access to water is mandatory, pursuant to both Legislative Decree 146/2001 (98/58/EC) and Legislative Decree 126/2011 (2008/119/EC), if the worst answer is selected for the inspection item

n.9, this will be reported on the final welfare assessment certificate as "non-compliance with legislation".

"Dairy cows should be provided with drinking water, whatever their diet. This water should be in sufficient quantity to prevent any dehydration and should be free from repellent odour and taste, harmful infectious agents, toxic substances and contaminants that can accumulate in body tissue or be excreted in milk."(Recommendation 14 – EFSA Journal 2012; 10(1):2554).
Trough water must not contain recent or old dirt (mud, food, faeces) on the surface, bottom or sides of the troughs or drinkers. Assessment of water and trough cleaning must be performed for all groups.

Inspection item 9 – Water availability
Absence of drinking water for one or more animals
Presence of functioning drinkers in all the groups
Water given (in addition to the milk and at least once a day) even to calves in individual pens. Where calves are in mixed conditions, assessment is performed on the situation in which most of them are

Inspection item – Cleanliness of water troughs: lactating cows (10) – dry cows (11) - heifers (12)
See reference photo. The water in the dirty trough is not clear; an intermediate judgment is given if there is a small amount of feed spoilage on the surface or on the bottom of the trough but the water is clear.
There is dirt on the surface and walls of the troughs
There is feed either on the surface or on the bottom. The water must be clear
No dirt, the troughs are clean and the water clear

Figure 2 – Example of a dirty trough.

Figure 3 – Example of a clean trough.

A. Cleanliness of floors: lactating cows (13) - dry cows (14) - heifers (15)

A. Litter management (deep litter or cubicles): lactating cows (16) - dry cows (17) - heifers (18)

"Animals should be maintained in a clean condition that is as free as possible of contamination with manure." (EC draft 8/09 Article 6, paragraph 3).

"Those parts of the accommodation with which the cattle come into contact shall be thoroughly cleansed and, where appropriate, disinfected, every time the accommodation has been emptied and before new cattle are brought in. While the accommodation is occupied by cattle, exposed surfaces and all equipment shall be kept satisfactorily clean and any damage repaired."(EC draft 8/09 Article 17).

"Cows or heifers kept in buildings should be provided with an area bedded with sufficient, dry, compressible, non-slippery material that does not lead to skin lesions" (Recommendation 43 – EFSA Journal 2012; 10 (1):2554).

All walking surfaces, such as paddocks, floors, aisles and passageways, whether dedicated to housing young and non-producing animals or lactating cows, must be clean and dry and must guarantee ease of access for personnel, to facilitate daily cleaning operations and access to litter. Droppings should be removed several times a day (scrapers, etc.) to prevent cows from being tempted to lie down and to ensure that they do not stand for a long time with their feet in manure. The latter condition puts the health of the foot at risk and makes the litter dirtier.

The materials used for litter must be kept sufficiently clean and dry. In order to guarantee a good management of the litter, besides providing a sufficient amount of material, it is also necessary to keep the litter dry by regulating the flow of air, to allow an adequate ventilation inside the barn. The litter must be attended to on a daily basis (restoring, cleaning, levelling and rearranging the material), and completely replaced at intervals not greater than 6 months. Given that dairy cows spend between 9 to 14 hours a day lying down, if there are poor hygiene conditions and the material used for the bedding is very damp, this could increase the risk of udder infections.

Litter management assessment must take into account both level of hygiene which can be perceived and the routine and organisation of the litter maintenance operations. Please note that this inspection item does not involve assessing the type of litter material, which is contemplated in questions 26-27-28. In the same way, the level of cleanliness of the animals (ABMs) will be specifically assessed in questions 59-60-61.

Inspection item – Cleanliness of floors: (aisles and passageways): lactating cows (13) - dry cows (14) - heifers (15)
Examine not only the cleanliness of the floors but also that of the lower part of the limb. Take into consideration the conditions in which the majority of the individuals live.
Prevalence of dirty areas in all groups
Areas sufficiently clean in almost all groups
All areas properly managed, clean and dry

Figure 4 – Example of very dirty flooring.

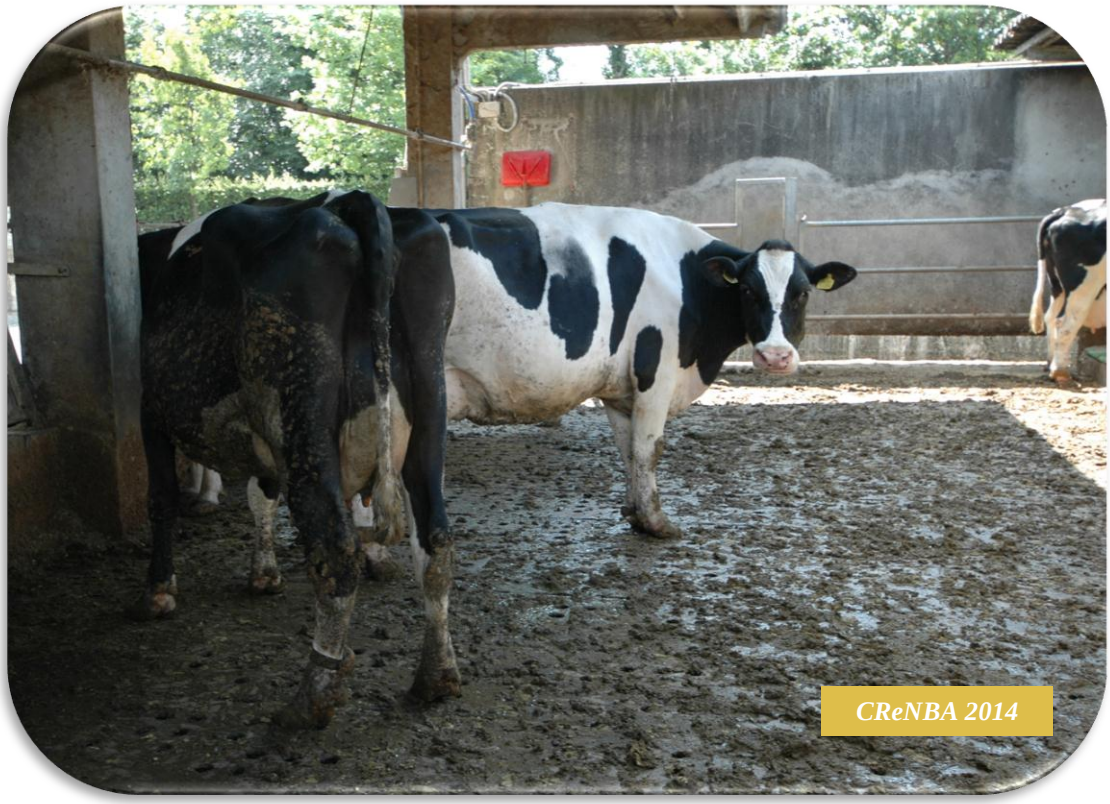


Figure 5 – Example of slatted flooring with an intermediate level of management and cleanliness.

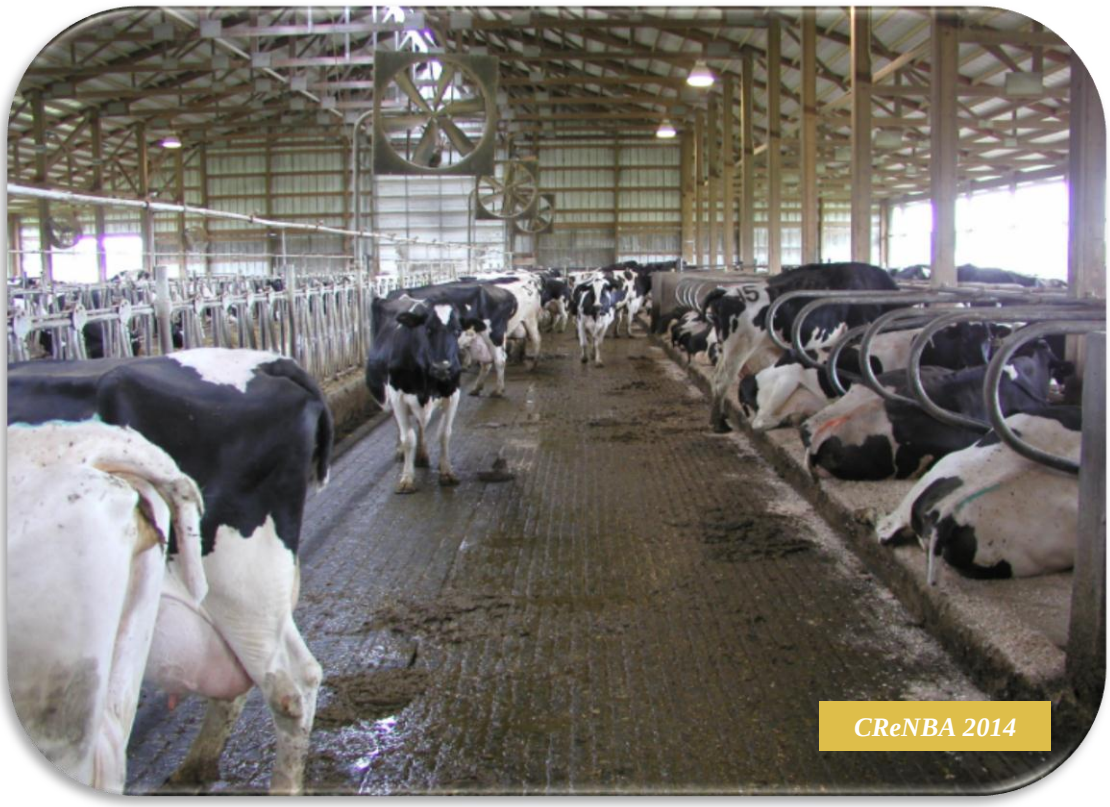


Figure 6 – Example of a clean and dry environment.

Inspection item – Litter management (deep litter or cubicles): lactating cows (16) – dry cows (17) - heifers (18)
Examine litter hygiene (not the type of material used) and take account of restoration and replacement management. In the case of groups belonging to the same category, consider the living conditions of the majority of subjects.
Dirty litter
Litter not very clean and managed sufficiently
Clean litter, topped up or attended to daily and renewed regularly

Figure 7 – Example of dirty litter.

Figure 8 – Example of litter that is not very clean, managed sufficiently.

Figure 9 – Example of clean litter, an indication that it is attended to daily and renewed regularly.

A. Prevention of foot disorders (19)

"…The feet of the animals shall be inspected regularly and trimmed if necessary by a trained person. Where foot problems are identified an assessment of casual factors shall be made and corrective action taken." (EC draft 8/09 Article 6, paragraph 3).

"Foot inspection with trimming as necessary should be carried out at intervals not greater than 6 months." - *"There should be attention to foot hygiene of dairy cattle on a weekly basis, followed by proper treatment, as necessary."* (Recommendations 75, 76 – EFSA Journal 2012; 10(1):2554).

Just like udder infections, foot disorders are one of the major problems in dairy cattle. Lameness indirectly causes weight loss, a reduction in milk production and decreased fertility. As with mastitis, this pathology is also strongly linked to many management factors and poor interaction of the animal with its environment, namely: unsuitable housing facilities, poor hygiene standards with accumulation of faeces, inadequate flooring (slippery or abrasive), poor foot care, failure to use foot baths, unbalanced diet, selection and genetics.

The main rules for preventing the problem (besides the general guidance, pertaining to management and housing) concern the proper disinfecting and trimming of the hooves. Foot bathing must be used regularly to care for the feet and prevent foot disorders, and functional trimming of the hooves should be carried out at least once a year.

Inspection item 19 – Prevention of foot disorders

No trimming programmes and no foot bathing
Yearly trimming programmes and regular foot bathing
Six-monthly trimming programmes and weekly foot bathing

A. Hygiene in the milking parlour (20) – Management of milking operations and udder hygiene (21)

"Milking equipment should be designed, constructed, managed, cleaned and disinfected so that the risk of injury, pain and disease in dairy cows is minimised" (Recommendation 55 – EFSA Journal 2012; 10(1):2554).

"Cleaning of udders should take full account of the risk of transmission of pathogens" (Recommendation 58 – EFSA Journal 2012; 10(1):2554).

"Milking equipment/machines should be used and maintained to manufacturers' specifications to avoid trauma to the teat and udder" (Recommendation 57 – EFSA Journal 2012; 10(1):2554).

The hygiene of the equipment and milking operations is of outstanding importance, both for the animal's health and for the safety and hygiene of the milk. With this in mind, we recommend keeping the milking parlour clean by removing faeces daily from the mechanical parts of the milking cluster and from the floors and walls of the room.

Before milking, the teat must be cleansed with water or specific products and then dried completely and thoroughly. After these operations , 2 or 3 streams of milk should be milked from each teat to activate the release of oxytocin and enable the milker to look for any physical abnormalities in the secreted liquid.

We also recommend disinfecting the teat before and/or after milking ("pre-dipping" and "post-dipping"). The containers for spraying the teats with the disinfectants should be used in an appropriate manner, keeping them as clean as possible by carefully emptying, cleaning and drying them at the end of each milking session.

In the case of milking robots, the hygiene of the robot and of the area surrounding it will be assessed (question 20). Subject to particular exceptions, milking robot can be considered an excellent parameter for milking and udder hygiene (question 21), given the frequent washing and rinsing to which this system, and in particular the teat cups, is subjected.

Inspection item 20 – Hygiene in the milking parlour

Assess the general hygiene of the parlour and not its level of technology.
Presence of faeces on the milking clusters and on the walls
Adequate cleaning of clusters, but faeces on the floors and walls
No faeces present and good general hygiene

Figure 10 – Faeces on a milking cluster

Figure 11 – Milking parlour with good general hygiene (no faeces on the flooring, walls and milking clusters).

Inspection item 21 – Management of the milking operations and udder hygiene
Milking is "inadequate" when performed incorrectly and when clusters are prepared and attached in the wrong order, leading to overmilking in the majority of cows milked.
Milking unit used incorrectly and clusters incorrectly attached and detached (lack of hygiene or failure to observe oxytocin lag times)
Correct management of milking operations and equipment (adequate cleaning and observance of lag times)
Adequate cleansing, observance of lag times and use of pre/post-dipping with a spray or clean dip cups

Figures 12 and 13 – Dirty dip cups for pre/post-dipping. Presence of organic material, due to poor hygiene, degrades the active ingredients in the detergent and disinfectant.

AREA B. FACILITIES AND EQUIPMENT

Just like management and environmental hygiene, farming facilities and equipment also represent an animal welfare hazard. For this reason, many works, research projects, recommendations and scientific opinions link cattle welfare assessment to the suitability of cattle housing. Since the ability of cows to cope with their environment comes between farming conditions (both housing and management) and their actual welfare state, the operator assessing the suitability of farm facilities must therefore focus attention on the welfare hazard that they can represent, paying less attention to barn efficiency or even to its architectural appearance.

Cattle should be able to interact with one another and show patterns of behaviour aimed to social structure maintenance, regardless of the farming system used.

As well as separating into conventional groups, the farm should have extra suitable structures for managing particular conditions, such as areas for sick animals, breeding bull areas, calving pens and an isolation/quarantine area.

B. Type of housing system (22)

"Loose housing systems are preferred and the use of permanent tethering as a husbandry system should be avoided in new buildings or when existing systems are refurbished." (EC draft 8/09 Article 9, paragraph 6).

"Animals not kept in buildings shall where necessary and possible be given protection from adverse weather conditions, predators and risks to their health." (Legislative Decree 146/2001, transposition of the Council Directive 98/58/EC – Annex, paragraph 12).

"The area available to the cattle when group housed shall be calculated in relation to the whole environment, the behavioural needs of the animals, their age, sex, live weight, breed or physiological condition, taking into account the size of the group and whether any of the animals have horns. It shall at least allow all cattle to lie down at the same time, rest and get up normally, turn around freely and walk. (EC draft 8/09 Article 11, paragraph 1).

"In loose housing systems except those with cubicles, as a guideline, dry cows or cows nursing a single calf should have at least 4.65 m² lying area and a total area of at least 6.5 m²." (EC draft 8/09 Appendix C, paragraph 3).

"Cows and heifers that are loose housed and do not have daily access to pasture should be given the opportunity to go outside to an exercise yard, preferably every day. – Cows and heifers that are tethered should be given exercise daily." (EC draft 8/09 Appendix C, paragraph 4 and 4 bis).

Animals must not be tethered unless this is required for specific sanitary reasons. Presence of any tethered animals will receive a negative rating, even if the latter are non-producing animals (calves more than 8 weeks old, heifers and female calves). In the case of the housing of calves younger than 8 weeks of age, reference can be made to the specific assessment included in inspection item n. 32; they should therefore not be taken into consideration in this item.

"When possible, dairy cows and heifers should be given access to well-managed pasture or other suitable outdoor conditions, at least during summer time or dry weather." (Recommendation 50 – EFSA Journal 2012; 10(1):2554).

A positive judgement shall be assigned if use of an exercise area (at least 4 - 5 m^2/animal) or, better still, of an area of pasture, is possible, at certain times of the year only and in good environmental conditions. However, this only applies if the surfaces do not present any welfare risks, which could be stem from quality and ease of access to water sources, protection from adverse weather conditions, or transmission of infections as a result of mixing different herds.

Inspection item 22 – Type of housing system (with the exception of calves up to 8 weeks of age)

The observation should be performed on all animals (excluding calves up to 8 weeks of age).
Even just one animal group is tethered
All animal groups are loose housed
Adult dairy cows are loose housed and can have access to an exercise yard or pasture. The total surface area of the exercise yard must be at least the same as the total surface area of the indoor resting area, regardless of whether said area has cubicles or deep litter

B. Surface area provided for lying down: lactating cows (23) – dry cows (24) – at calving (25)

"The housing of dairy cows should be designed in a way so that they can lie down comfortably in order to get the amount of rest, lying and ruminating that they need. All cows should be able to lie down at the same time." Recommendation 41 – EFSA Journal 2012; 10 (1):2554).

"In cubicle houses there should be at least as many cubicles as there are cows in the house" (Recommendation 24 – EFSA Journal 2012; 10(1):2554).

"In loose housing, the number of animals housed should not exceed the number of cubicles available. In order to better meet behavioural needs of animals (or if injuries have been noted under the housing conditions set out above) at least 5% of supplementary cubicles should be available in relation to the number of animals housed." (EC draft 8/09 Appendix C, paragraph 1)

Many studies have underlined that reducing the required lying down area (i.e. less than 6-7 m²/animal) may reduce resting times and increase the dirtiness of the animal, bringing with it the risk of udder infections, in both lactating cows and dry cows. For this reason, the minimum surface area of the resting area for cows in loose housing deep litter should be at least 6 m^2/animal (preferably 6 - 7 m^2/animal), excluding passageways and the aisle leading to the feeding area. A positive judgment can be assigned when assessing this parameter if the surface area noted is bigger than the abovementioned unit surface area (> 7 m^2/animal).

In the case of loose housing with cubicles, it is considered sufficient to have as many cubicles as animals present, while the presence of at least 10% cubicles more will be judged positively, provided that the cattle can actually benefit from these.

Inspection item 25 concerns assessment of the surface area for lying down available to cows close to delivery. Negative judgement will be assigned if the farm does not have an assigned pre-calving area, (as deliveries take place in the dry cow area). However, if there are only a few dry cows (maximum 5 or 6 animals), the judgement may coincide with the one assigned in inspection item 24.

Inspection item – Surface area provided for lying down: lactating cows (23) – dry cows (24) – at calving (25)
The assessment should be performed on indoor deep litter used for lying down. The surface areas of aisles, exercise areas or areas giving access to the feeding trough are excluded.
Less than 6 m^2/animal or no. of usable cubicles < 90% of the animals
Between 6 and 7 m^2/animal or as many usable cubicles as animals
More than 7 m^2/animal or no. of usable cubicles > 110 % of the animals

Figure 14 – Insufficient surface area available to cattle (overcrowding).

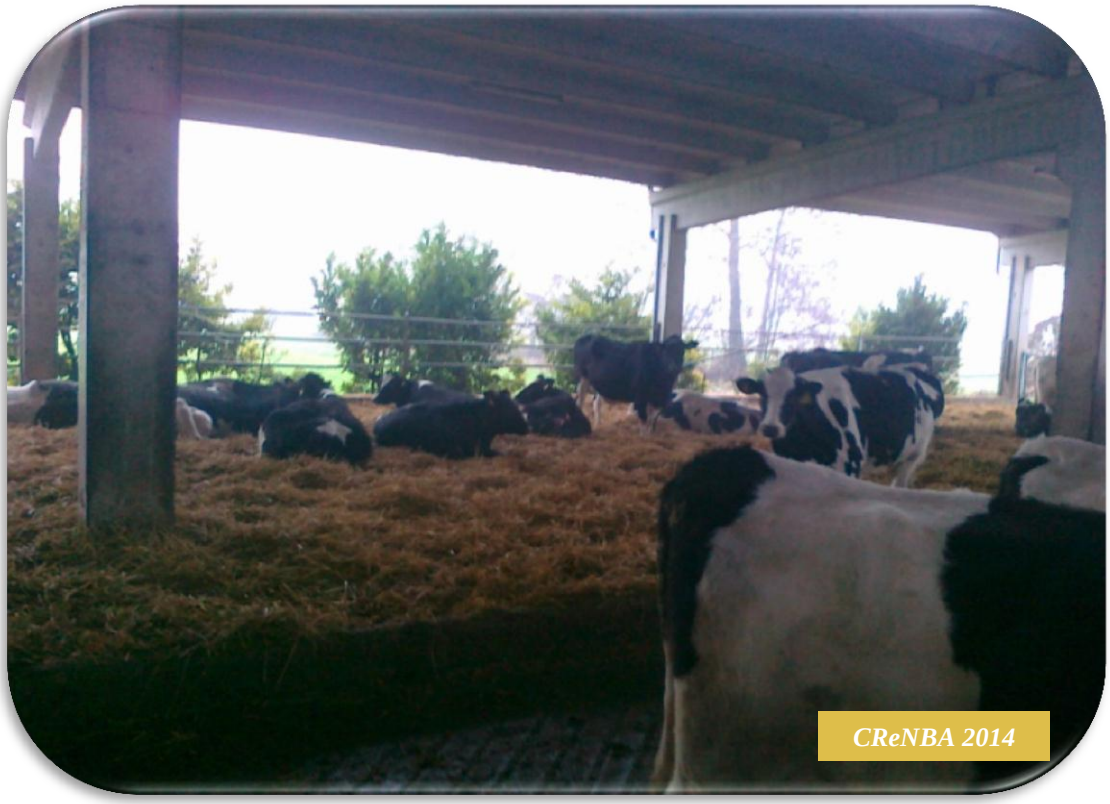


Figure 15 – Wide space available for each animal.

B. Litter material: lactating cows (26) – dry cows (27) – heifers (28)

"*A lying area should be available which consists of a floor covered by rubber mats, straw or other suitable soft bedding in order to ensure comfort and reduce the risk of injuries."* (EC draft 8/09 Appendix C, paragraph 3).

The resting area (deep litter or cubicles), must be covered with plenty of litter material at all times, in order to prevent lesions or pressure sores and ensure that the animal maintains a good state of cleanliness. Sufficient material should be used such that it does not move when the cow lies down. Straw, sawdust, rice husks, and other substances of vegetable origin which, like these, do not tend to compact, creating uneven surfaces, will be looked highly upon. The material should be renewed to ensure a dry surface preferably at least twice a week.

Surfaces which are hard by nature (some types of mats) or not very hygienic (dry manure) may be considered sufficient if they are maintained in an efficient condition and kept clean and dry through regular care. Use of hard, dirty or damp surfaces, such as slatted or cement flooring, should be considered unacceptable.

Inspection item – Litter material: lactating cows (26) – dry cows (27) - heifers (28)

Do not contemplate the hygiene conditions of the litter material, but just which type of material is used and the damage that it could cause (e.g. lacking, inadequate, mouldy, abrasive, etc.).
No litter material present whatsoever
Presence of mats or inappropriate material (e.g. lacking, mouldy, abrasive, etc.)
Presence of appropriate material

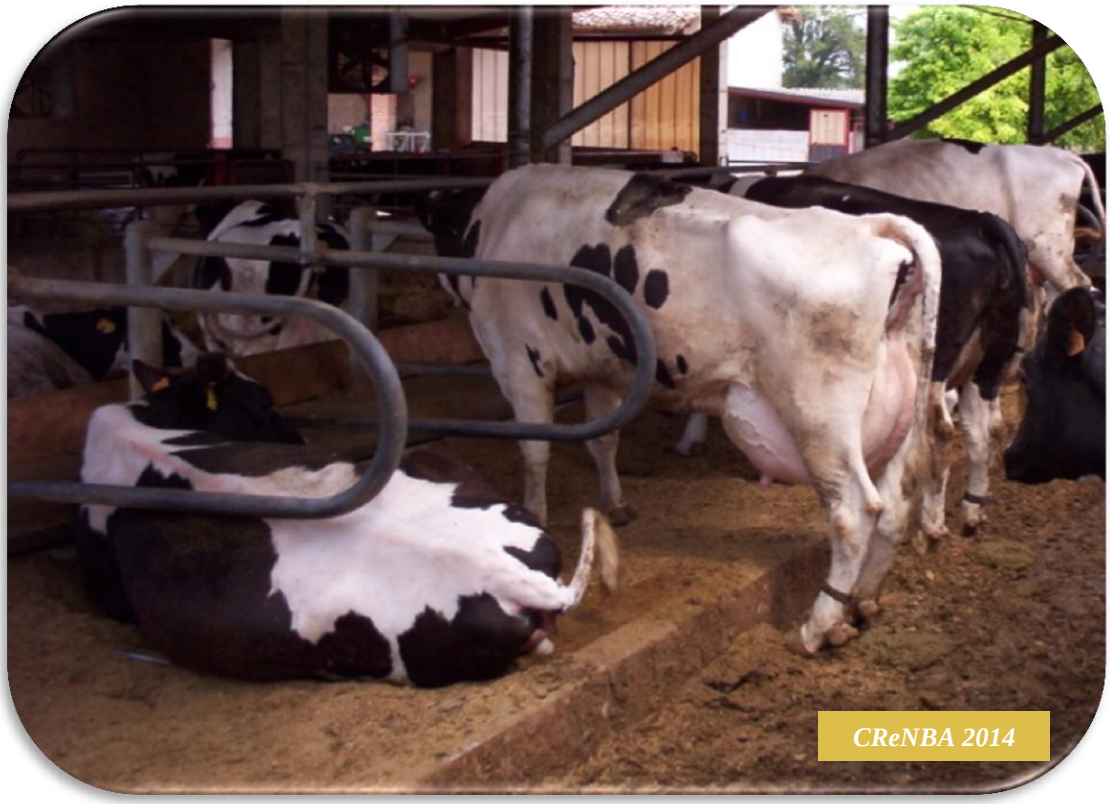


Figure 16 - No litter material present whatsoever on the cubicle flooring.

Figure 17 - Presence of plenty of appropriate litter material (straw).

B. Suitability of the resting area (29)

"*Cubicles should be designed in such a way that the forward movement of the body of the cow is not thwarted when changing position from lying to standing*" (Recommendation 20 – EFSA, Journal 2012; 10(1):2554).

"*Where cubicles are used, they should be wide enough, in relation to the size of the cows, to minimise any movement difficulties or teat trampling.*" (Recommendation 21 – EFSA, Journal 2012; 10(1):2554).

"*Cubicles which force the cow to stand up with the front legs first should not be used.*" (Recommendation 22 – EFSA, Journal 2012; 10(1):2554).

"*Cubicle width should be at least 1.8 times cow hip width*" (Recommendation 23 – EFSA, Journal 2012; 10 (1):2554).

"*Cubicle design should be such that no standing, lying or defecation movement is difficult for a cow and should not cause injuries to the cow*" (Recommendation 27 – EFSA, Journal 2012; 10 (1):2554).

"*All cubicles for dairy cattle should be long enough and have an appropriate neck rail positioning to enable each animal to stand comfortably with all four feet in front of the rear kerb*"(Recommendation 28 – EFSA, Journal 2012; 10 (1):2554).

As the correct amount of rest is essential for the daily welfare of the cow, the surface area and size of the cubicles or deep litter should have the correct dimensions so that they can be fully utilised by the animals, thus guaranteeing the utmost in comfort and hygiene. A design or dimension error means that less cubicle or litter is used, thus reducing lying down times and increasing the risk of injury and foot and udder disorders. As there are now many types of cubicle on the animal husbandry market, it has become difficult to provide standard measurements setting forth the correct size for all conditions. Cubicle suitability can therefore be assessed by measuring the dimensions (N-ABMs), or by noting the percentage occupied by the animals (ABMs). In the latter case, for a sufficient assessment rating to be assigned, the cubicles must be occupied by 50-70% of the animals present; the observation should be performed at least 2 hours after feeding or milking operations.

The remaining 30-50% of the cows should be at the feeding trough or water troughs or on the routes to and from the same and should not be standing still in the cubicle (for example in the so-called "perching position").

If it is not possible to carry out this assessment correctly (e.g. if animals are disturbed), the assessor may, as an alternative, measure the three-dimensional space defining the cubicle volume (see Table 2).

As for the cubicles, it is also worth assessing the exploitation of deep litter. Regardless of the surface area/animal, deep litter positioned in poorly lit and ventilated areas that are hard to access and present obstacles, forces the animals to use only a part of the space available. This situation is highlighted by a high concentration of cattle on certain sections of the litter only. In contrast, easily accessible resting areas that are uniformly ventilated and lit are occupied in a complete and uniform manner. For exploitation of deep litter, too, to be deemed sufficient, 70% of the available space should be found to be occupied.

Table 2 – Minimum technical parameters for cubicle sizing

Parameter	**Dimension (m)**
Length	2.30 / 2.50
Width	1.20 – 1.30
Area (outline) for lying down	1.80
Neck rail height	1.15-1.25
Space for lowering head	0.70 – 1.00
Height of the divider	1.00
Height of the access step	0.10 – 0.25

Inspection item 29 – Suitability of the resting area

The number of animals lying down should be counted at least 2 hours after operations such as feeding or milking. In case of an uncertain number, assess the activity and the way in which subjects are standing, or the cubicle design.
Poorly exploited cubicles or deep litter (< 50%) / or cubicles with incorrect dimensions
Partial use of cubicles or deep litter (between 50 and 70%) / or cubicles with sufficient dimensions
Complete and uniform use of deep litter and/or cubicle resting spaces, or with ideal dimensions

Figure 18 - Example of a resting area which is inadequate due to the divider being too low, thus preventing the cattle from lying down comfortably.

Figure 19 - Example of well-occupied cubicles; some animals go to feed, while others, having walked to the cubicle, lie down there in a few minutes.

B. Heifer housing (30)

There should be available at least 3.5 m^2/animal for heifers (in pre-puberty age, fertilized or pregnant animals) on deep litter (excluding passageways and alleys leading to the feeding area); whereas the considerations made previously for lactating cattle apply for cubicles.

Inspection item 30 – Heifer housing

Assessment should be made on indoor deep litter used for lying down. The surface areas of alleys, exercise areas or areas for accessing the feeding trough are excluded.
Less than 3.5-4 m^2/animal or insufficient cubicles
3.5-4 m^2 /animal or as many cubicles as heifers
More than 4 m^2/animal or surplus cubicles

B. Calves (31-32-33-34)

"No calf shall be confined in an individual pen after the age of eight weeks, unless a veterinarian certifies that its health or behaviour requires it to be isolated in order to receive treatment. The width of any individual pen for a calf shall be at least equal to the height of the calf at the withers measured in the standing position (about 0.80 – 0.85 m). *The length shall be at least equal to the body length of the calf, measured from the tip of the nose to the caudal edge of the tuber ischii (pin bone), multiplied by 1,1* (about 1.30 – 1.35 m).

Individual pens for calves (except those for isolating sick animals) must not have solid walls, but perforated walls which allow the calves to have direct visual and tactile contact. Appropriate bedding must be provided for all calves less than two weeks old.

For calves kept in groups, the unobstructed space allowance available to each calf shall be at least equal to 1,5 m^2 for each calf of a live weight of less than 150 kilograms, at least equal to 1,7 m^2 for each calf of a live weight of150 kilograms or more but less than 220 kilograms, and at least equal to 1,8 m^2 for each calf of a live weight of220 kilograms or more.

Calves must not be tethered, with the exception of group-housed calves which may be tethered for periods of not more than one hour at the time of feeding milk or milk substitute."

(from Legislative Decree 126/2011 – transposition of the Council Directive 2008/119/EC– laying down minimum standards for the protection of calves).

As the welfare of calves under 6 months of age is regulated by specific European and Italian legislations, if negative ratings are given for these inspection items (no. 31-32-33-34), these will appear as "non-compliance" on the final welfare certificate. Presence of an automatic milking

machine will receive a positive judgement. This is similar to the calf's natural behaviour, allowing it to choose when to feed and providing a more consistent diet, thereby reducing problems with digestion.

Inspection item 31 – Litter for calves younger than 2 weeks

It is enough to find the presence of a single calf, younger than 2 weeks, housed in conditions not conform to the law requirement (lack of litter or litter harmful for the calf) to assign the pejorative judgment.
Lack of litter
Litter used in a way that allows the calf to lie down fully on suitable material

Inspection item 32 – Surface area for calves housed in individual pens

Legal dimensions are a length of 130 cm and a width of 80 cm. It is enough to find the presence of a single calf housed in conditions not conform to the law requirement to assign the pejorative judgment.
Dimensions smaller than legal limits or presence of calves which are tethered at all times
Dimensions in compliance with legal limits (= o > 10%)
Dimensions greater than legal limits

Inspection item 33 – Possibility of contact with other calves

The front of the adjacent feeding trough is not to be considered as contact. It is enough to find the presence of a single calf housed in conditions not conform to the law requirement to assign the pejorative judgment.
No
Yes

Inspection item 34 – Surface area for calves housed in multiple pens

Assess calves under 6 months of age in multiple pens. The surface area is to be understood as the total surface area of the pen(< 150 kg l.w. = 1.5 m^2/animal; between 150 and 220 kg l.w. = 1.7 m^2/animal; > 220kg l.w. = 1.8 m^2/animal).It is enough to find the presence of a single calf housed in conditions not conform to the law requirement to assign the pejorative judgment.
Dimensions < legal limits or absence of litter or calves over 8 weeks of age still in individual pens
Dimensions in compliance with legal limits (= o >10 %) milk fed manually
Dimensions > legal limits (over 10%) and automatic milk feeding

B. Calving area management (35)

"Where any cows which are calving are kept in buildings they should be kept:

a) in a pen or a yard which is of such a size as to permit a person to attend cows, and

b) separate from the other livestock other than calving cows. There should be at least one calving pen per 30 cows.

As a guideline, a calving pen for a single cow should be at least 10 m², and its shortest side should be at least 3 metres. The environment in such pens, e.g., floors, bedding, temperature and hygiene, shall be appropriate to ensure the welfare of newborn calves." (EC draft 8/09 Appendix C, paragraph 8).

"*Dairy cows calving in buildings should be moved to individual calving pens with some contact with other cows before calving in order to minimise welfare problems*" (Recommendation 69 – EFSA Journal 2012; 10(1):2554).

The calving area must meet the practicality, safety, comfort and hygiene requirements of the cattle and may be composed of shared or individual pens. In both cases, deep litter is preferable, while cubicles are to be considered less appropriate, even if they are adequate enough to ensure the cattle's comfort. The shared pen must be able to house animals at least 10-12 days before the due date. Animals must not be moved near calving as the cows will not be able to adapt to their new environment and may become stressed which can result in a drastic reduction in consumption, consequently increasing the risk of difficult births and postpartum metabolic disorders. Where possible, in shared pens, animals should be moved in groups and not individually. Presence of an individual calving pen (for one or two subjects), for delivery only, can be rated positively, provided it is only used in the 12 – 24 hours prior to birth and that is next to the dry group in order to allow contact with the other cows. Cattle are a sociable species and thus separating them from other cows for prolonged periods, may cause a great deal of stress for the animals.

The areas must have litter which is easy to remove, freshened regularly, kept clean and dry, and which prevents muddy or slippery floors. In any case, the calving area must be comfortable, allowing adequate shelter for adverse weather conditions, as well as permitting easy access to water and feed. There should be no confined spaces or mixing with sick subjects (hospital pens).

As recommended in the draft regulations, the individual pen should be at least 10 m^2, deep litter in a shared pen should be at least 7 m^2/animal, and, in case of cubicles, there should be a greater number of these than the number of animals due for calving.

Where there is no assigned calving area, only farms with an average of 5-6 dry cows will not be assigned a worsen judgment.

Inspection item 35 – Calving area management

The calving pen may be individual or multiple. Take into account the animal moving time before calving. If there are only 5-6dry cows and there is lack of an identified calving pen, answer the question assessing the dry cow area as the calving pen. In cases where the calving pen is the same area used as hospital pen, only one of the two uses should be assessed.
No calving pen; in stalls with more than 5-6 dry cows
Calving pen with deep litter or with cubicles which comply with minimum space requirements (< 7 m^2/animal), acceptable animal moving time and litter hygiene management
Presence of spacious single or multiple pen with deep litter that is optimally managed with respect to timing and hygiene

B. Hospital pen (36)

"*…Where necessary, sick or injured animals shall be isolated in suitable accommodation with easily available fresh drinking water and feed, appropriate climate and dry comfortable bedding, unless otherwise required by veterinary advice*"(EC draft 8/09 Article 6, paragraph2).

"Suitable and sufficient accommodation and equipment shall be available for the separation, and where necessary for isolation, handling and examination of cattle and for the treatment of ill or injured cattle." (EC draft 8/09 Article 9, paragraph7).

"*Dairy farms should have facilities for severely ill or injured animals and such animals should be moved to these facilities as soon as possible.*" - "*Facilities for sick animals with infectious diseases should not be used for calving.*" (Recommendations 96, 97 – EFSA Journal 2012; 10(1):2554).

The performance of a dairy cow, and in particular a high-yielding dairy cow, allows it to be compared to an athlete: although exceptionally talented and with a great physique, it is always prone to stress and, as a consequence, potential physical injuries. To prevent such situations from getting worse and to treat subjects with more serious health problems, every farm must have a separate area away from the rest of the herd: the hospital pen. This pen must be suitable for caring for and separating injured and sick animals, or, in any case, those temporarily not suitable for milk production; it must be separate from the other housing areas and may be composed of either multiple or individual pens, preferably with deep litter. The overall capacity of the hospital pen must be no less than 3% of the number (mean) of adult cows. Animals must have easy access to a sufficient quantity of feed and water. Milking admitted animals must be facilitated so that animals do not suffer due to difficulties walking. The hospital pen must therefore be close to the milking parlour or equipped with specific machinery (mobile milking unit).

It is desirable to keep a duly completed hospital pen record to take note of sick animals admitted, the health problems and any treatment carried out.

Inspection item 36 –Hospital pen

Cubicles are not recommended in a hospital pen. Only an intermediate rating can therefore be assigned where there is a hospital pen with cubicles.
Lack of hospital pen
Presence of hospital pen, with cubicles or acceptable managed deep litter
Presence of hospital pen, with optimally managed deep litter and the possibility to milk cows using a mobile milking unit, or hospital pen located close to the milking parlour

B. Waiting and milking parlours (37) – Milking parlour maintenance (38)

"*Waiting times in collecting or milking areas before milking for each cow should be short and never more than one hour*"(Recommendation 60 – EFSA Journal 2012; 10(1):2554).

The waiting parlour should be spacious with a wide entrance. Animals should be able to move naturally from the waiting room to the milking parlour. The last cows to be milked should not have to wait more than 90 minutes in the waiting room, or, better still, more than 60 minutes. Farms with loose housing systems in which cows are milked tethered (e.g. tie stalls barn that were later converted into loose housing) must also comply with these times. The surface area of the waiting room should be assessed by taking account of all the space available to the animals, regardless of where such area is contained (e.g. feeding alley).

The assessment will be performed on three parameters: dimensions, how easy it is to enter the milking parlour and waiting times. A pejorative judgement is assigned if none or just one of the three parameters is satisfactory. A more favourable judgement is assigned if all the parameters are satisfactory and there is a waiting time of < 60 minutes.

A positive judgment can be given if there is a robotic milking system, as this system enables the animals to be milked in accordance with their own personal needs, with no or minimal waiting time, despite the milking station being continually occupied.

More than two milking sessions per day performed by milking robots is definitely better for milk production and animal welfare.

Inspection item 37 – Waiting and milking parlours

Assessment of the waiting area concerns how easy it is to access the milking parlour, the surface area/animal and maximum waiting time for the largest cattle group.
Small waiting area (<1.6 m^2/animal) or difficult to enter the milking parlour or wait > 90 min.
Adequate waiting area (1.6-1.8 m^2/animal), normal entry with waiting times between 90 and 60 min.
Spacious waiting area (> 1.8 m^2/animal) with waiting times < 60 min. or robotic milking system

"Good milking techniques should be applied and milking equipment should be maintained in good condition to prevent mastitis and udder injuries. Special attention should be paid to the vacuum level, pulsation rate and quality of materials in direct contact with teats e.g. rubber, silicone." **(**EC draft 8/09, Appendix C paragraph 5).

"*Milking equipment should be designed, constructed, managed, cleaned and disinfected so that the risk of lesions and injury, pain and disease in dairy cows is minimised.*"(Recommendation 55 – EFSA Journal 2012; 10(1):2554).

A correctly operating milking unit is essential both for the cow welfare and to optimise production and keep the udder healthy. A malfunctioning unit, for example following mechanical breakdown or lack of maintenance, drastically increases the risk of teat lesions and incomplete milking, leading to overall udder damage. To this end, it is important for the barn stockperson to be familiar with and check the basic milking unit operation parameters (vacuum, air inlet tubes, etc.), through regular inspections. Regular servicing of the unit (e.g. checking the functioning of the regulator and the pulsation system and changing the teat cup sleeves, etc.) by sector specialists is also essential; the latter should leave documentation for each operation performed.

Inspection item 38 – Milking parlour maintenance

Basic parameters not known (vacuum level – how often sleeves are changed) and there is no service schedule
Regular general checks are carried out and specialist servicing is only performed in case of breakdown, or absence of documentation certifying careful regular servicing
There is a servicing programme and there are records taken by stockpersons

B. Flooring: lactating cows (39) – dry cows (40) – heifers (41)

"*Floors shall be made of appropriate materials that are not harmful, shall drain freely and be easy to keep clean and to disinfect. They shall form a rigid, smooth and stable, but not slippery surface. Floors shall be suitable for the weight of the cattle housed and the size of their claws so as to minimize the likelihood of trapping, discomfort, distress and injury whilst standing or walking*."(EC draft 8/09 Article 9, paragraph 3)

"*Dairy cattle should be housed so that they can walk without having to change their normal gait or speed because of slippery or bad flooring, or bad design of the housing system*." - *"Dairy cattle should not be caused to stand or walk for prolonged periods on concrete floors or floors that are wet or covered in slurry."*(Recommendations 45, 51 – EFSA Journal 2012; 10(1):2554).

Flooring is understood as floors used by the animals to go to the different areas of the barn: feeding alleys, resting and exercise areas. Ideally, flooring should be rough enough to prevent the cattle from slipping when running or in heat, in order to prevent fear and unnecessary risks of lesions after falls. Slatted floors should also meet the same requirements and the distances between the joists or

the diameters of the holes should be such that the foot cannot become stuck. The edges of the joists must not be sharp.

Flooring with the above features on at least 50% of the available surface will be deemed sufficient, whereas positive judgement will be assigned when the whole surface is in compliance.

Inspection item – Flooring: lactating cows (39) – dry cows (40) - heifers (41)
The animals must be able to move about, even quickly, without slipping.
Inadequate, smooth and slippery slatted or solid concrete flooring
Adequate slatted or solid concrete flooring over at least 50% of the surface area
Adequate slatted or solid concrete flooring on the overall surface area

Figure 20 - Example of grooved concrete flooring which allows animals to move about without slipping.

B. Space at the feeding trough: number of places available at the feeding trough: lactating cows (42) – dry cows (43) – heifers (44)

B. Feeding place width per cow (45)

"Feeding and watering equipment must be designed, constructed and placed so that contamination of food and water and the harmful effects of competition between the animals are minimised." (Legislative Decree 146/2001, transposition of the Council Directive 98/58/EC – Annex, paragraph 17).

"If roughage is not provided ad libitum, there shall be sufficient eating space for all animals to eat at the same time. Automatic feeding systems should be designed so as to provide at least as much information to the stockman as would be available under manual feeding systems and in particular whether or not an individual animal has consumed all its feed." (EC draft 8/09 Article 9, paragraph 5)

"*The feeding area should be designed in such a way and with sufficient space that all cows can feed with minimal aggression or other interference. In loose-house systems, when food is not ad libitum, there should be sufficient space at the food source for all cows to feed at the same time."*(Recommendation 29 – EFSA Journal 2012; 10(1):2554).

The cattle feeding equipment and areas should be of sufficient size and constructed using suitable materials, in order to guarantee easy access by the animals and the possibility of ingesting the necessary feed for their own requirements. The feeding trough facilities should be commensurate to the number of animals, their size and the type of feed used.

The main dimensional features of the feed racks and the number of feeding places to provide for are shown in Table 3. In case of self-catching feed rack, it is important that there is an anti-suffocation lifesaving system. If feedstuffs are not provided "*ad libitum*", and roughage and concentrates are fed separately, then the feeding area should have sufficient feeding spaces to allow all animals to feed at the same time. If, on the other hand, all the feed ration is supplied "*ad libitum*" (for example, as total mixed ration - TMR) alternate access to the feeding trough by the animals is acceptable, as the feed is usually available 24 hours a day and has the same nutritional characteristics; for this reason, the number of places at the feed rack are deemed sufficient when they are at least 70% of the subjects present.

Positive judgement is assigned to barns which make accessing the feed very easy and convenient, as in the case of a very high number of places in relation to the number of animals present or in the case of feeding troughs allocated to two different barn areas (for example on the two opposite sides of the barn). Also, provided there are no risks to the health or welfare of the animals, it would be important to allow the cattle access to pasture (60 days/year).

Inspection item – Number of places available at the feeding trough: lactating cows (42) – dry cows (43) - heifers (44)

The places must be at least 68 cm each (50 cm for heifers), therefore, if they are lacking, a cow should have 68 cm space at the feeding trough (50 cm for heifers).
Number of feeding places equal to < 100% of the animals in case of conventional feeding or equal to < 70% of the animals in case of total mixed ration
Number of feeding places equal to 100% of the animals in case of conventional feeding or equal to > 70% of the animals in case of total mixed ration
Feeding troughs on two different barn areas and number of feeding places greater than the number of animals or possibility (even for a period of 60 days/year) of access to pasture

Table 3 – Minimum technical parameters for sizing the cattle feeding trough rack

Parameter	**Measurement**
Width of rack for each animal, with defined places:	
- cows	≥0.68 m/animal
- unweaned calves	≥0.26 m/animal
- weaned calves	≥0.34 m/animal
- other replacement cattle	≥0.50 m/animal
Number of places at the rack with defined places:	
- animals fed with conventional feeding system (not "*ad libitum*")	≥no. animals
- animals fed with TMR feeding system ("*ad libitum*")	≥70% no. animals

Inspection item 45 – Feeding place width per cow

Consider the whole feeding place width per cow, including the feed rack width for cow shoulders.
Size < values in the table
Size equal to or > values in the table
Size equal to or > values in the table with anti-suffocation lifesaving system

B. Source of drinking water (46)

B. Size of drinking troughs: lactating cows (47) – dry cows (48) – heifers (49)

"The capacity of the water supply and the trough size should be appropriate for a sufficient number of animals to drink at one time e.g. in the case of dairy cows to allow for at least 10% to drink at the same time. Water bowls and troughs shall be kept clean and checked daily to make sure they are not blocked or damaged, and the water is flowing freely.

The water supplies shall be constructed and located in such a way so that every animal is able to use them when they need to drink." (EC draft 8/09 Article 12, paragraph 2).

"*Where water troughs are provided, the number and position should be such that the animals do not need to wait too long or to compete for water.*"(Recommendation 13 – EFSA Journal 2012; 10(1):2554).

There should be enough drinkers in relation to the capacity of the barn or individual pen. One single-access drinker (water bowl or ball drinker) for every ten adult animals is permitted for dairy cattle in loose housing, although preference should be given to water troughs with constant water level and at least 6-7 cm space/animal positioned in all areas of the barn and not jutting out into the passageway of the animals; the reference values showing the maximum number of animals per drinking point unit are given in Table 4.

When assessing whether the drinking points are sufficient, both of the abovementioned situations can be analysed, i.e. the presence of troughs with dimensions equal to 6-7 cm/animal, or a drinking point for every 10 animals; in both cases, it should be ascertained, as recommended in EC draft 8/09, that at least 10% of subjects can drink at the same time.

As cattle need to drink more water after being milked, a trough should be placed at the milking parlour exit to allow milked subjects to drink. It is also advisable to have at least two water supply sources (for example, mains and well) or a reserve tank to keep the risk of water shortage to a minimum. The water troughs must be in good working order and duly cleaned and the water installation should be checked on a regular basis to swiftly troubleshoot any malfunctioning or leaks.

Table 4 – Maximum technical parameters for sizing drinking points for cattle in loose housing, in pens.

Parameter	**Standard**
Number of animals per single-access drinker:	
- lactating cows or dry cows	10
- calves	14
- other cattle	14
Number of animals per 1m width of shared drinker:	
- lactating cows or dry cows	14
- calves	24
- other cattle	20

Inspection item 46 – Source of drinking water
From one source only(well or mains) without reserve tank
From mains or well with a large tank sufficient for some hours
From more than one source (mains and well or two wells)

Inspection item – Size of drinking troughs: lactating cows (47) – dry cows (48) - heifers (49)
There must be at least one drinking bowl every 10 cows (15 heifers), or 6-7 cm/animal (5 cm/animal for heifers) in case of water troughs.
Insufficient no. of drinkers or size < minimum size provided for
No. and size equal to the minimum size provided for
No. and size > size provided for, well-diversified in terms of positioning

AREA C. ANIMAL-BASED MEASURES

Up to this moment, risks to animal welfare for dairy herds in loose housing have been assessed through the analysis of management factors and barn facilities.

However, an animal's welfare depends on how well it is able to adapt to its environment and therefore, for a correct evaluation, in addition to analysing the housing areas, it is also necessary to evaluate the effects that these have on the animals. A cow that is not in good conditions will in fact show physical signals that can be caught, interpreted and evaluated in order to understand its state of discomfort. Warnings of discomfort are frequently linked to pathological conditions (lameness, mastitis), abnormal behaviour (stereotypy) or alterations in physiological conditions (body condition).

Beyond the best or worst farming conditions, the main element of the assessment system is the animal; observation and evaluation of its status are therefore crucial. Welfare is not like a disease that can be diagnosed through the presence of specific symptoms, but it is rather characterized by a set of expressions from animals that may be treated as signals. To measure them correctly, the assessor must necessarily learn to identify, evaluate them in terms of their severity and assign a judgment to them (ABMs). For this reason, and to have the same approach and the same weighing procedure for all assessors, it is necessary that all of them are properly trained and qualified to detect an animal's state.

In any case, it should be clarified that this assessment does not use a diagnostic system for disease identification; it is rather a tool to detect a wide range of problems, and not just those that are health-related, that may affect animals not living in a state of well-being.

The conditions of the animals should be assessed only in accordance with the rules learned during the course; therefore it is recommended that, during the procedure, assessors not consult or interact with the stockpersons regarding the causes or symptoms of the various diseases affecting the herd.

As the condition of a cow is the ultimate expression of its welfare, the importance of these measurements (ABMs) in determining an animal level of well-being is greater than that assigned to the management and housing risk factors.

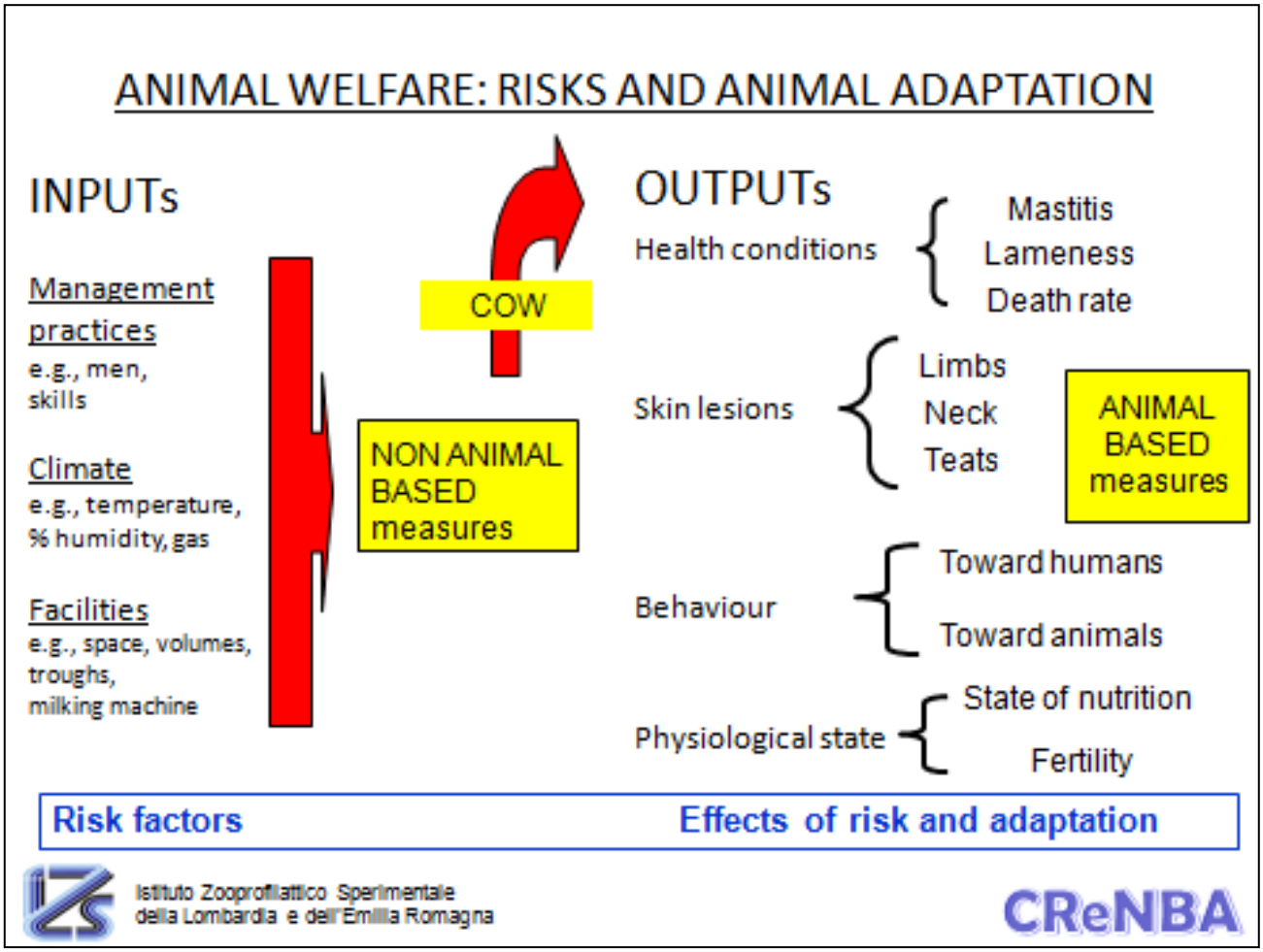


Figure 21 – Graphic explanation of the relationship between risk factors (inputs) and their consequences on animal welfare (outputs).

C. Flight from humans test: lactating cows (50) - dry cows (51) - heifers (52)

The animals must be able to develop a normal behaviour, showing correct socialization patterns among members of the same species, no stereotypies, and a good interaction with humans. Bovines have been a domesticated species for 5000 years and as such do not flee humans instinctively; indeed, if they are not in conditions of discomfort, they tend to allow closeness and physical contact.

To assess this condition, as recommended by the European Welfare Quality® research project, we run the test of flight/avoidance (6.1.4.3 Good human - animal relationship; avoidance distance) on some animals for each group.

The minimum number of animals to be observed must be defined according to Table 5.

The test is conducted facing the animal standing free in the rack, at a distance of 2 meters and making sure to be seen. At this point one must approach the cow with a speed of one step (about 60 cm) per second, with one arm extended forward and tilted downward at an angle of 45° from the body and the palm of the hand facing upwards. The test requires that one continues to walk until the animal shows no signs of stepping back, or until it can be touched.

The final assessment will be determined by quantifying the following:

- the percentage of animals that cannot be approached and start stepping back at a distance equal to or greater than 100 cm;
- the percentage of animals that can be approached up to a distance of 50 - 100 cm and won't let themselves be touched;
- the percentage of animals that can be touched or approached up to a few cm away.

The test will be considered successful if at least 70% of the test subjects can be approached or touched.

Table 5 - Minimum number of animals to be observed for the assessment of ABMs

Herd size	**Minimum number of animals to be observed**
Up to 30	All
From 40 to 100	Proportionally from 30 to 40
From 100 to 200	Proportionally from 40 to 55
From 200 to 300	Proportionally from 55 to 70
From 300 to 500	Proportionally 80
Over 500	Proportionally 100

In practice, in order to facilitate the determination of the final result, especially if one has the checklist in a paper format, one must assign a number for each of the three behaviour types, decided by convention as follows:

- animals that cannot be approached and start stepping back at a distance equal to or greater than 100 cm get a 1;
- animals that can be approached up to a distance of 50 - 100 cm and won't let themselves be touched get a 2;
- animals that can be touched or approached up to a few cm away get a 3.

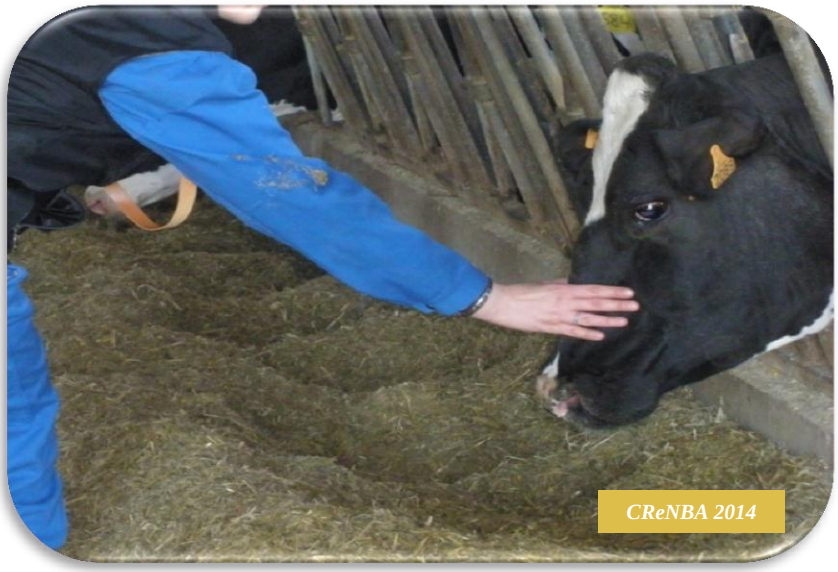
At this point, one calculates the average of the scores given to the animals observed, rounding off any fractions to the nearest whole number. A negative judgment is assigned to averages close to 1; a positive judgment is assigned to averages close to 3.

During this step, the cows must also be observed in order to detect the possible presence of stereotypies: such as playing with the tongue or with water; empty mouth opening and closing with head upward; insistently licking walls, other parts of the housing or the body; rocking; biting fittings of the housing repeatedly; sucking objects or body parts of other cows; pica (craving and eating of non-food substances); chewing and ruminating with an empty mouth[31]. If such behaviours are limited to a single subject per group, the observation has no bearing on the final result, since it is not reliable to consider individual circumstances for a comprehensive assessment of overall welfare. If stereotypies are instead expressed by several subjects per group, the observation should be considered valid and negative for the evaluation of the flight test.

Inspection item - Flight from humans test: lactating cows (50) - dry cows (51) - heifers (52)

The final score is obtained by calculating the average of the scores given to each animal, rounding off to the nearest whole number.
Difficulty approaching and presence of stereotypies
Curious animals that can be approached and do not show stereotypies
Curious animals that can be approached and let themselves be touched

Figures 22, 23 and 24 - Flight from humans test: check if the assessor can get close to the animals, standing at a distance of 2 meters with arm outstretched with a 45° angle from the body, and touch their muzzles.



C. State of nutrition: lactating cows (53) - dry cows (54) - heifers (55)

"Concentrate feeding facilities on dairy farms should be adequately maintained and diets carefully balanced so as to maintain optimal ruminal fermentation and to minimise negative energy balance." - "Strategies for feeding and management of the dry cow should be designed to prevent metabolic disorders, such as parturient paresis (milk fever), which has an acute severe effect on animal welfare." (Recommendations 18-19 - EFSA Journal 2012; 10(1):2554).

The animals must be healthy and fed properly, and, therefore, have proper body condition. A cow must eat 10-12 times a day an adequate feed ration that will enable it to produce milk, get pregnant and deliver without problems. If all this happens in the best way, the fatness of an animal during the different phases of its life will fluctuate within well-defined limits that can be measured through guided observation of the animal. The assessment of body condition must be performed by applying the BCS system (Body Condition Score - Dr. James Ferguson, University of Pennsylvania)[32], which uses a 1 to 5 scale, where 1 means a very thin animal (cachectic) and 5 a very fat animal (obese).

As shown in Table 5, one must evaluate a representative number of subjects in all groups of animals (with the exception of animals housed in the hospital pen) starting from female calves (over 150 kg). The animals must score on average between 3 and 4, with the exception of cows in the first 100 days of lactation, which may have minimum thresholds of 2.5 due to physiological reasons.

The final assessment is given by the percentage of subjects which score beyond the 2.5 minimum and 4.25 maximum limits. There is a maximum tolerance of 10% for subjects with values higher or lower than those expected for each group.

Inspection item - State of nutrition: lactating cows (53) - dry cows (54) - heifers (55)

BCS values lower than 2 and greater than 4.25 are beyond acceptable limits.
> 10% of the animals with BCS beyond set limits
< 10% of the animals with BCS beyond set limits
< 5% of the animals with BCS beyond set limits

Figure 25 - Example of cattle with BCS 1.

Figure 26 - Example of cattle with BCS 5.

C. Udder health (56) - No. of treatments for clinical mastitis in a year (57)

*"To improve cow welfare, the prevalence of mastitis should be reduced by the treatment of clinical and subclinical disease, dry cow therapy, identification and elimination of carrier cows, prevention of transmission of infection from cow to cow or through the environment, and improvement of the immune system, by minimizing stress factors and by a controlled and nutritionally-balanced feed intake" (*Recommendations 84 - EFSA Journal 2012; 10(1): 2554).

"Food business operators must initiate procedures to ensure that raw milk meets the criteria of somatic cell count (per ml) ≤ 400,000 (rolling geometric average)."

(EC Regulation No. 853/2004 laying down specific hygiene rules for food of animal origin).

The simplest and most used method to assess udder health in a group of cows is the somatic cell count in bulk milk. An increase (more than 100,000 cells/ml) indicates rising infection rates. As mastitis is a typical multifactorial disease, it is easy to understand that an increase in cell count correlates not only with the presence of mastitis-causing bacteria, but also with the worsening of management conditions and especially of milking hygiene. For this reason, the law (EC Regulation 853/2004) requires SCC contents (geometric average) lower than 400,000 cells/ml, but it is desirable that this parameter does not exceed 300,000 cells/ml.

A lower content of somatic cells is an indicator of cow welfare when it is achieved by means of good farm management and certainly not through a massive use of antibiotics. For this reason, farms that perform antibiotic treatments on less than 40% of lactating cows over a year will be assessed positively; whereas farms that either perform antibiotic treatments on more than 80% of lactating cows or are not aware of the number of treatments they performed will be assessed negatively.

Inspection item 56 - Udder health

SSC geometric average > 400,000 cell/ml
SCC geometric average between300,000 and 400,000 cell/ml
SSC geometric average < 300,000 cell/ml

Inspection item 57 - No. of treatments for clinical mastitis in a year
No. of mastitis treatments than the no. of lactating cows. The answer can be verified through the register of drugs.
No. of mastitis treatments more than 80% of lactating cows number or data unavailable
No. of mastitis treatments between 40 and 80% of lactating cows number
No. of mastitis treatments less than 40% of lactating cows number

Figure 27- Emblematic situation in a farm where large number of mastitis treatments are performed.

C. Lameness (58)

"There should be systems for monitoring the prevalence and severity of lameness, by scoring locomotion and foot lesions, every 3 to 6 months in all dairy herds."

"Lameness should be prevented, although in practice this can rarely be achieved at present. Clinical cases should be given proper veterinary care. When systematic monitoring indicates an increasing prevalence, appropriate corrective measures should be taken at the herd level. On farms with a high prevalence of recognisable locomotor difficulties (e.g. approaching 10 %) there should be improvement of housing conditions, genetic strain and management practices."(Recommendations 74-78, EFSA Journal 2012; 10(1):2554).

According to the conclusions from the risk assessments performed by EFSA, locomotory disorders are the main cause of poor welfare in modern dairy barns. They are in fact considered to be the ultimate expression of very bad management or housing conditions, which we have already assessed for risk analysis as outlined above. Among the main causes of lameness, we can include: inadequate fibre intake, difficult access to food, poor hygiene of stalls and floors, the flooring of the passageway areas.

Lameness or gait disorders are associated with states of discomfort and pain; they affect animal welfare adversely and undermine the main physiological expressions such as rest, mobility, food intake or the expression of specific behavioural characteristics, such as the oestrous cycle. These situations also have serious repercussions on the productive and reproductive performances; in fact, according to numerous studies, lameness is also the main factor for removing dairy cows from the herd[33].

The evaluation of gait disturbances was performed by analysing their prevalence. The indicators are the following: irregular footfall, shifting weight away from the concerned limb, asymmetry of gait rhythm and a buckled spine.

Lameness can be detected by the DairyCo Mobility Scoring system[34] that breaks down the gait of the animals into four point score ranging from 0 to 3:

0. normal gait with weight properly distributed on all four limbs, spine straight;

1. imperfect pace with irregular timing of steps (rhythm and weight distribution) or shortened stride;

2. altered gait, shifting the weight away from the unhealthy limb, shortened stride and buckled spine;

3. severe lameness, unhealthy limb can be set on the ground with difficulty and much buckled spine.

Animals with a Mobility Score greater than or equal to 2 are considered lame; for the parameter to be acceptable, the number of lame animals must be between 4 and 8%. Farmers may declare how many lame animals are in the barn and assessors must confirm this data through analysis of the animals' gait, during their observation of the animals and the barn facilities. In case of dubious situations, assessors must actually count all the lame cows by means of accurate observation and evaluation of all available individuals or in any case of a statistically significant number of them (see Table 5).

Inspection item 58 – Lameness

No. of lame lactating and dry cows (including those in the hospital pen)/actual no. of lactating and dry cows.
> 8% lame cows
Between 8 and 4 % lame cows
< 4 % lame cows

C. Cleanliness of animals: lactating cows (59) - dry cows (60) - heifers (61)

"Animals should be maintained in a clean condition that is as free as possible of contamination with manure."(EC draft 8/09 Article 6, paragraph 3)

"Cows or heifers kept in buildings should be provided with an area bedded with sufficient, dry, compressible, non-slippery material that does not lead to skin lesions" (Recommendation 43 - EFSA Journal 2012; 10(1):2554).

As stated in the related questions of area A, in order to better investigate the actual hygienic conditions in which animals live, assessors should not only judge the state of the facilities and the bedding (N-ABMs), but also continue their analysis by observing the cleanliness conditions of the animals' coats (ABMs), which is an objective clue hard to hide.

The state of cleanliness of the animals also provides a measure of how comfortable rest areas are; in combination with the assessment of skin lesions, it gives an indication of the problems arising from faulty design of the stalls or cubicles, the degree of overcrowding, the lack of enough bedding/cubicles per animal, the use of unsuitable bedding or lack of care in the daily management of the cows' rest areas.

If the position, surface area (sq. m/head or number of cubicles/head), design and cleanliness of a stall's rest area are correct, it is highly likely that no animal will lie down on the concrete passageways or aisles (except for specific problematic situations) and that the cows' degree of cleanliness will be optimal.

The assessment is performed on a number of animals proportional to the size of the group (see Table 5): they are to be observed from the side, considering the cleanliness conditions of the following: hip, thigh, hind limb and udder.

Inspection item - Cleanliness of animals: lactating cows (59) - dry cows (60) - heifers (61)

Over 20% of the animals are dirty
Over 10% of the animals are dirty only in some groups
Less than 10% of the animals are dirty in all the groups

Figure 28 – Animal with dirty hip, thigh, and udder.

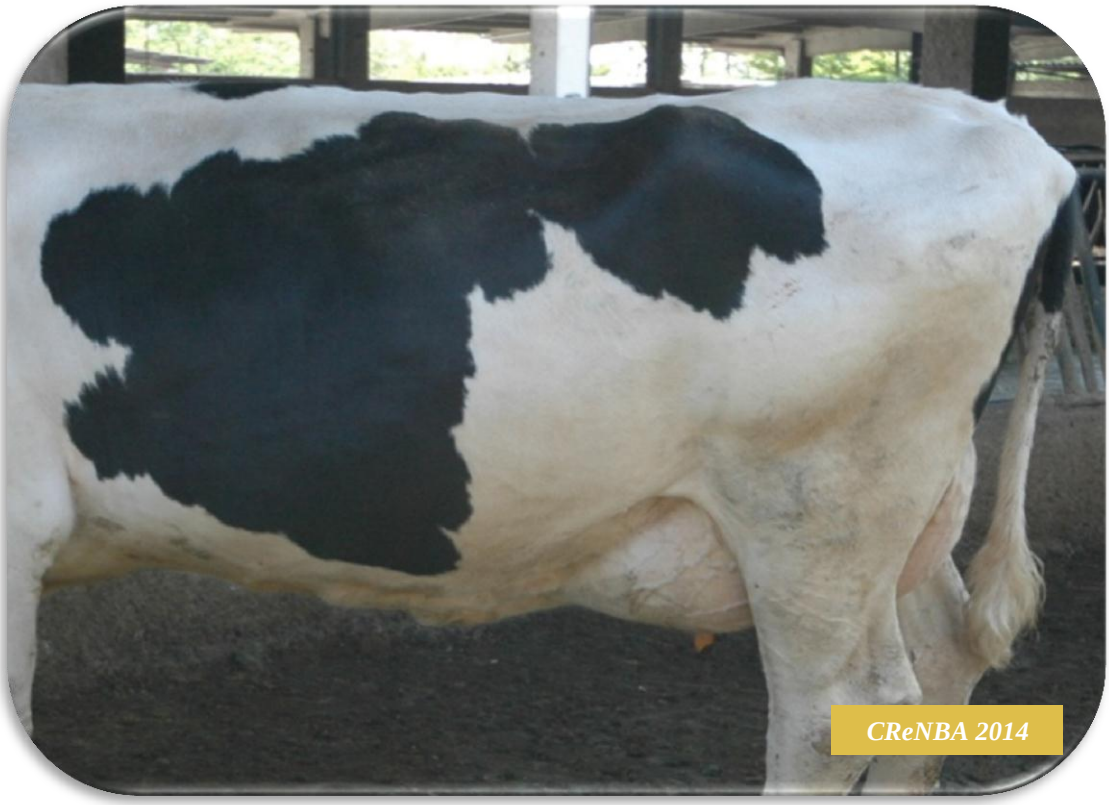


Figure 29 – Animal with clean coat.

C. Skin lesions: lactating cows (62) - dry cows (63) - heifers (64)

"Cows or heifers kept in buildings should be provided with an area bedded with sufficient, dry, compressible, non-slippery material that does not lead to skin lesions." (Recommendation 43 - EFSA Journal 2012; 10(1):2554).

"Hock, knee and skin lesions should be used as an indicator of the quality of bedding for dairy cattle." (Recommendation 44 - EFSA Journal 2012; 10(1):2554).

The (ABMs) parameter applies to adult animals (lactating and dry cows) and to heifers, and allows one to investigate whether the facilities of the barn and/or rest areas show (acute or chronic) risk factors for the safety of the herd.

Lesions are assessed on the basis of the indications contained in the Welfare Quality® project (6.1.3.1 Absence of injuries - Integument alterations), with regard to their number and severity. The following are considered: skin changes represented by areas of alopecia (including alopecia caused by fungal and parasitic agents, and hyperkeratosis); swelling and sores (udder and teat sores, lesions on tuberosities and joints, etc.).

Cows must be observed at a distance of about 2 meters, from head to tail, as follows:

a- head and neck region (injuries connected to low troughs can easily occur);

b- forelimb region and medial aspect of the contralateral side:

c- spine and tail area;

d- hip, hind limb and medial aspect of the contralateral side;

e- udder and teats.

Based on the skin lesion type and its evaluation, the animals are considered as follows:

- individuals without lesions: up to 10-15 very small alopecia spots (<2 cm) or a single small alopecia spot (> 2 cm < 4 cm) are present;
- individuals with minor lesions: more than 15 very small alopecia spots (<2 cm) or from 2 to 10 small alopecia spots (> 2 cm < 4 cm) or one average sized alopecia spot >4 cm but <10 cm are present;
- individuals with serious lesions: 10 or more small alopecia spots (>2 cm <4 cm), or a large alopecia spot with the size of the palm of your hand (10 cm), or swelling, scars from cuts or open wounds (including teats or scars from surgery).

A statistically significant number of animals must always be observed (see Table 5); when calculating the overall percentage of individuals with lesions, an animal with serious lesions counts as three animals with minor lesions.

After having converted the no. of animals with serious lesions in animals with minor lesions, the farms that have less than 15% of individuals with minor skin lesions in each group will be given a positive judgment; a negative rating will be reserved for those that come up to more than 30%.

Inspection item - Skin lesions: lactating cows (62) - dry cows (63) - heifers (64)
Lesions are assessed by observing the cows starting from the head and moving toward the tail: sternum, shoulder, forelimb, pelvis, thigh, hind limb (lateral and medial) and udder
Over 30% of the animals have minor skin lesions on hocks, tuberosities and soft tissues
From 15% to 30% of the animals have minor skin lesions on hocks, tuberosities and soft tissues
Less than 15% of the animals have minor skin lesions on hocks, tuberosities and soft tissues

Figure 30 - Just 1 lesion from 2 to 4 cm in size and a second one smaller than 2 cm are not considered lesions.

Figure 31 - 3/4 alopecia spots 2-4 cm in size are evaluated as minor lesions.

Figure 32 - Serious lesion

C. Mortality in adult cows (65) - Mortality in calves (66)

Dead animals in the barn, both calves and adults, are the consequence not only of extremely serious health problems, but also of poor animal welfare conditions. From a theoretical point of view, it might seem appropriate to use longevity as an indicator of dairy cattle welfare, but from a practical point of view this parameter is very difficult to correlate with conditions of discomfort. For example, the longevity of cows in tie-stalls is higher than those in loose housing, but the animals are deprived of basic freedom of movement and therefore the ability to express their normal behaviours. The number of animals culled in a year is also difficult to correlate to welfare conditions, as dairy replacement heifer management is often linked to specific economical market conditions (e.g., availability of heifers, impossibility to increase the number of animals in production, negative market for young animals compared to that of adult cows for beef production). For these reasons, rather than average longevity in a barn or replacement heifer rates, we chose to assess the percentage of cows and calves that died in a barn within a year due to natural or accidental causes, or as a result of euthanasia or urgent slaughter, considering this event as the ultimate expression of negative welfare and disease management conditions. The pertinent data shall be provided by the farmer himself or taken from farm records. It will be considered as follows: sufficient, if the mortality rate is <5% for adult animals and between 10% and 4% for calves; positive, if <2% for cows and <4% for calves. In the case of calves, we evaluate the individuals that die from the 2nd to the 30th day of life, excluding those that died at birth.

Inspection item 65 - Mortality in adult cows

Determine the no. of adult cows naturally dead in the barn / euthanatized / urgent slaughtered i the last 12 months.
>5%
≤5%
<2%

Inspection test 66 – Mortality in calves

Determine the no. of calves dead from day 2 to day 30 of life, excluding stillbirths, during the last 12 months
>10%
From 10% to 4%
<4%

C. Mutilations (67)

"Disbudding in calves is allowed within the first three weeks of life ... and must be performed under veterinary supervision" (Legislative Decree 146/2001, transposition of the Council Directive 98/58/EC – Annex, paragraph 19).

"... Tail docking in cattle is forbidden, unless for certified and properly recorded therapeutic purposes ... and must be performed under veterinary supervision" (Legislative Decree 146/2001, transposition of the Council Directive 98/58/EC – Annex, paragraph 19).

"The tails of cattle, including dairy cows, should not be docked" (Recommendation 107 - EFSA Journal 2012; 10(1):2554).

All sorts of treatments, including non-therapeutic ones, which involve bloodletting, must be performed with sterile or disposable materials in such a way as to avoid causing pain and prolonged or unnecessary suffering to the animal. Except for the application of markings or nose rings on bulls, all sanitary practices must be performed by a veterinarian or other appropriately trained person, using anaesthesia and/or analgesia. Complete absence of mutilation on all of the animals is considered positively; mutilations that are not authorized or performed by unsuitable personnel are considered inadequate.

Failure to comply with these provisions of the law will be highlighted on the animal welfare certificate.

"... Mixing of horned and dehorned animals in group housing systems should be avoided." (EC draft 8/09 Annex C, paragraph 3)

Farms where cows with and without horns live together in the same group are considered non-compliant. Assessors must understand if dehorning is performed in a casual manner (which is not suitable and non-compliant), or if a small number of animals with horns (<10% in each group) is to be related to a single management error or the momentary presence of newly purchased animals.

Herds on pasture are excepted, thanks to the wide surface area that subordinate individuals have at their disposal to escape from dominant ones.

Inspection item 67 – Mutilations

Mutilations not authorized by law and/or cows with and without horns mixed together
Mutilations authorized by law
No mutilation

AREA D. INSPECTION OF MICROCLIMATIC ENVIRONMENTAL CONDITIONS AND ALARM SYSTEMS

This area considers two types of risk to the animal welfare. The first one is very important because it affects the cattle's quality of life daily and it includes the analysis of the main microclimate conditions of the stall such as temperature, humidity and air quality. The second one, championed by the much discussed European draft regulation on adult cattle welfare and by Legislative Decree 146/2001 on the protection of animals, is not about daily welfare; it evaluates some big risks, such as fire, capable of causing serious damages, including the death of the animals.

D. Temperature and humidity (68)

"Housing design and ventilation should be able to provide air speeds around housed animals in hot summer conditions (for example, more than 26° C) of at least 0.6 meters per second)." (Recommendation 33 - EFSA Journal 2012; 10(1):2554).

"Cows outdoors should be provided with shelter from excessive solar radiation in the summer, wind and precipitation during cold periods." (Recommendation 34 - EFSA Journal 2012; 10(1):2554).

Dairy cows prefer temperatures between 5 and 25° C, therefore, the risk of heat stress is higher in Italy's environmental conditions. The animals respond to excessive heat with a series of physiological adaptation responses that have a negative impact on the intake of dry matter, milk production, fertility and the immune system, thereby favouring the onset of conditioned diseases. To limit damages due to heat stress, it is therefore essential that a farm takes measures to reduce heat, by implementing natural ventilation with suitable lateral holes, providing adequate protection from direct sunlight (e.g., curtains, shades), and installing active cooling systems that act directly on the animals (fans and sprinklers). Fans help thermoregulation by moving air around, whereas sprinklers are useful when heat waves occur but should always be combined with fans to facilitate evaporation and thermoregulation. The sprinklers-fans combination is useful both in the feeding area and in the waiting area before milking, whereas only fans should be used in the rest areas so as not to get wet the bedding material of the cubicles and/or litters.

Lack of ventilation systems or closed farming environments with poor air circulation will be assessed negatively, whereas farms equipped with active cooling systems featuring temperature and humidity (THI) detection control units will be assessed positively.

Inspection test 68 – Temperature and humidity

A barn without walls on all 4 sides is considered open, or when there is only one closed side, without this limits a good ventilation of the barn.
Closed buildings or semi-open barns without adequate air circulation
Ventilation / air circulation systems without THI detection control units / open barn
Cooling systems with THI detection control units

D. Harmful gases (69)

"... As a guide, cattle should not be exposed permanently to levels that exceed the following values: ammonia - 20 ppm, carbon dioxide - 3000 ppm, hydrogen sulphide - 0.5 ppm."

"The facilities for storing and handling manure on cattle units shall be designed, maintained and managed so that the cattle are not exposed to gases, such as ammonia, carbon dioxide, carbon monoxide, hydrogen sulphide in concentrations detrimental to their welfare, including health." (EC draft 8/09 Article 13, paragraphs 1-2).

"Gas concentrations in dairy cow houses should not exceed 10 ppm ammonia, H_2S as a measurable amount (e.g. 0.5 ppm), 3,000 ppm carbon dioxide." (Recommendation 37 – EFSA Journal 2012; 10(1):2554).

"Care should be taken not to stir manure or slurry containers in a way that increases H_2S or NH_3 to harmful levels in cattle buildings." (Recommendation 38 – EFSA Journal 2012; 10(1):2554).

The assessor shall measure harmful gases during the test procedure; they must be below the limits set by the draft regulation or by EFSA. The measurement shall be conducted by means of a portable gas detector at the centre of the stall where the cattle rest and feed.

Inspection item 69 – Harmful gases

$NH_3 > 20$ ppm; $CO_2 > 3000$ ppm; $H_2S > 0.5$ ppm
NH_3 from 20 to 10 ppm; CO_2 from 1500 to 3000 ppm; $H_2S < 0.5$ ppm
$NH_3 < 10$ ppm; $CO_2 < 1500$ ppm; $H_2S < 0.5$ ppm

D. Lighting (70)

"The artificial lighting regime shall be such as to prevent health and behavioural problems. It shall follow a 24-hour rhythm and include an uninterrupted period of light of no less than 8 hours and an uninterrupted period of dark or dim night-time lighting of no less than 8 hours except where natural light/dark prevent this.

All buildings shall have light levels sufficient to allow all cattle to see one another and to be seen clearly, to investigate their surroundings visually and to show normal levels of other activities.

During the "light-period" of a 24-hour lighting cycle cattle shall not be kept permanently in light intensity lower than 40 lux measured at the eye level. Artificial light sources shall be mounted so as not to cause discomfort to the cattle." (EC draft 8/09 Article 18, paragraphs 2 - 3).

"When distinct activity of the cows is required during night time, a light intensity of more than 30 lux is required." (Recommendation 39 – EFSA Journal 2012; 10(1):2554).

As they are constrained by natural lighting, the light-darkness cycles during the day are generally correct for dairy cattle farming.

However, it is important to understand artificial lighting levels during the night and in the twilight hours, especially when the cows are forced to move, for example to reach the milking room (especially in the winter season, when the period of darkness is longer).

In this case, the measurement can be empirical and indirect; the approximate level of emanating light is evaluated by observing the number, placement, and cleanliness (e.g., layered dust or cobwebs) of light sources.

In any case, if so desired, lux may be measured by means of a lux meter, or empirically, considering that reading the paper in the light of a street lamp at night is equal to 30-40 lux.

Inspection item 70 – Lighting

No artificial lighting
Artificial lighting available
Correct artificial lighting (at least 40 lux)

D. Noise (71)

"The animals shall not be exposed to unnecessary sudden or constant noise. Ventilation fans, feeding machinery, milking machinery or other equipment shall be constructed, placed, operated and maintained in such a way that it causes the least possible noise, both directly inside the accommodation and indirectly through the structure of the accommodation itself." (EC draft 8/09 Article 14, paragraph 1).

The animals must not be exposed to excessive and especially sudden noise. Noise can disrupt the lives of cattle whether it is constant or extemporaneous, because it tends to scare them and can trigger accident causing breakaways or gatherings.

Inspection item 71 - Noise

Excessive noise
Normal noise

D. Ventilation system alarm (72) - Fire alarm (73) - Backup power generator (74)

"All automated or mechanical equipment essential for the health and well-being of the animals must be inspected at least once daily. Where defects are discovered, these must be rectified immediately, or if this is impossible, appropriate steps must be taken to safeguard the health and well-being of the animals. Where the health and well-being of the animals is dependent on an artificial ventilation system, provision must be made for an appropriate backup system to guarantee sufficient air renewal to preserve the health and well-being of the animals in the event of failure of the system, and an alarm system must be provided to give warning of breakdown. The alarm system must be tested regularly." (Legislative Decree 146/2001, transposition of the Council Directive 98/58/EC – Annex, paragraph 13)

"Arrangements and facilities should be made to enable the evacuation of animals in case of emergencies, such as outbreak of fire." (EC draft 8/09 Article 13, paragraph 3).

Automatic systems that can affect animal welfare (automatic milking, feeding, ventilation etc.) should be equipped with alarm systems in case of failure or malfunctioning.

Assessors must check if there are records of inspections and maintenance work performed on automatic systems. These records must deal especially with the operation of the alarm systems.

One should also check that the barn is equipped with a power supply, to ensure automatic and mechanical systems are powered back on in case of power failure. Barns with fewer than 10 lactating cows (milkable by hand) are not subject to this requirement.

Inspection item 72 - Ventilation system alarm

No
Yes
Alarm regularly checked

Inspection item 73 – Fire alarm

No
Yes
Alarm regularly checked

Inspection item 74 – Backup power generator

Lack of backup power generator
Presence of backup power generator /or lack of backup power generator but herd has fewer than 10 lactating cows (milkable by hand)

AREA E. BIOSECURITY

Introduction

The term biosecurity includes both the measures to be applied in order to prevent the introduction of new diseases/infections in a healthy population and, if infections are already present, the necessary steps to limit their spread. Regardless of its aetiology (viral, bacterial, or parasitic), the spread of disease in a population occurs often through the same transmission routes, thus setting up a good biosecurity system has an all-around preventive value. Such a system must provide a clear set of operations to deal with risk factors and treatment procedures, including measures for prevention, preventive care, control and eradication. The following terms, often treated as synonyms, refer to different things and objectives:

- prevention: necessary measures to prevent the introduction of new diseases/infections in a healthy population;
- preventive care: measures taken to prevent the spread of diseases/infections in a population;
- control: measures to decrease the frequency of a disease/infection in a population;
- eradication: measures to eliminate a pathogen from a population.

As described above, biosecurity on cattle farms is a set of strategies, resources and management procedures designed to prevent or limit the introduction and spread of biological and chemical risks that could cause disease in cattle. The purpose of these measures is not just the safety of food like milk and beef, but also the prevention of all diseases that can affect animals and that can be a source of risk to public health, cause economic damage to farmers, or otherwise worsen the welfare of the animals.

The debate over biosecurity measures to be adopted in cattle farms has increased remarkably over the last few years. Much of this is due to the awareness of the serious economic harm to the cattle production sector caused by health problems that have been most widespread in the last decade, such as Bovine Spongiform Encephalopathy (BSE), or some exotic diseases such as Foot-and-Mouth and Bluetongue, which have appeared in Europe only recently. Of great importance to the farmer, but less important to the overall system, are the most common diseases that affect Italian cattle farms, because they cause serious economic damage with production contraction and loss of milk and meat value.

They are, for example, mastitis (infectious and not), foot diseases, viral and bacterial infections - causing enteric, respiratory, and reproductive/infertility (IBR, BVD-MM, Paratuberculosis) pathologies - and parasitic infestations. Poor biosecurity measures in a farm not only contribute to a

greater likelihood of disease, but also increase the severity of outbreaks, possibly leading to considerable costs for the public health system.

Therefore, prevention through the implementation of biosecurity measures is the best solution to protect animals from diseases and ensure farm productivity and profitability, not only from a health perspective, but also from an economic one. Farmers and vets have always chosen strategies to reduce health problems in farms, as do public veterinary services during outbreaks of epidemic diseases, which are provided for by the Rules of animal health. However, both the initiatives of individual farmers, taken in conjunction with the company's veterinary, and those of health care companies, adopted in geographical areas affected by reportable diseases, have often been impromptu, non-homogeneous and scarcely codified. In contrast, the real future challenge will be producing, implementing, monitoring and adjusting predefined, accurate, and complete biosecurity plans, so as to be more effective in preventing and controlling diseases.

The big differences visible in Italian cattle farms – in terms of production (meat, milk) density (intensive animal farming, cow-calf operation or single-suckler herd), housing (loose, tie-stalls), product's final destination (raw milk, cheese), and especially geographical area (plains, mountains) – require the implementation of specific biosecurity plans for different situations. Furthermore, defining a proper plan requires placing professional experts in epidemiology, infectious diseases, animal husbandry and nutrition alongside the company's veterinarian.

An efficient biosecurity plan requires a complete and accurate picture of all cattle management related risks: from the origin, storage, conservation, and distribution of food to the cleanliness and sanitation of the rooms, and ending up with the health management of specific diseases.

Although we are aware that no biosecurity measure can prevent each and every eventuality, identifying each farm's individual hazards and determining their level is considered essential.

Once the risk assessment has been performed, it would be ideal to establish a plan of action for specific diseases, farm's characteristics, farming procedures, and the most frequent pathologies.

Below is a list of operations to consider when coming up with a biosecurity plan for a cattle farm:

- determine the health status of the livestock in relation to the diseases identified;
- study the risks related to the farm and the geographic area where it is located;
- assess the management level for each area of operation;
- analyse the management of groups and the movement of animals;
- analyse the management of cleaning, hygiene and sanitation of the rooms;
- analyse the management of prophylaxis and implemented treatments;
- analyse the management of milking, feeding etc.;
- check the specific actions taken to control individual diseases.

An approach of this kind would indeed identify a goal and a plan for the following:

- preventing the introduction of new infections;
- eradicating an infectious agent from the farm or one of its sections;
- reducing the prevalence and incidence of an infectious disease;
- estimating the time and costs required to achieve the desired result.

General biosecurity rules for dairy cattle farms

The general rules of biosecurity should always be applied, since they constitute a comprehensive barrier to the introduction of new diseases and their spread through the herd.
They involve a number of guidelines to be applied both during routine operations (such as the introduction or movement of animals) and during everyday activities (such as cleaning, sanitizing and maintaining the housing areas).

MANAGING LIVESTOCK MOVEMENT

In cattle farming, the management of livestock movements breaks down into two activities:

- introducing individuals from other farms or moving the animals outside for markets or grazing;
- moving the animals inside the farm.

The typical Italian dairy cattle farm often uses its own heifers to replace lactating cows, which avoids the introduction of new animals, in many cases. It is an ideal condition that by itself eliminates many risks of introducing new infections in the farm.
However, if it becomes necessary to buy new animals, a few simple rules - unfortunately often disregarded - become crucial. First, it is essential to check the health status of the animals against infectious diseases that, although not provided for by law, can cause health problems, such as infectious bovine rhinotracheitis (IBR), bovine viral diarrhoea (BVD), contagious mastitis, paratuberculosis, and neosporosis. If possible, the animal's health status should be checked at the farm of origin. Once on the farm, the animals should be housed in separate areas (quarantine) for a period of at least 21-30 days, and if necessary further subjected to a new health check, paying special attention to those infectious agents that need more controls to make sure they don't come up positive.
The management of cattle movement within the farm is certainly less important for the prevention of new diseases coming in, but it is essential to reduce the spread of infections already present in the herd. Facilities that can separate infected animals, or suspected of being infected, from healthy ones may be especially useful to control or eradicate diseases transmitted through normal daily operations, such as contagious mastitis or paratuberculosis.
Equally important for the control of infections present in the farm is the possibility of setting up a separate group of animals in the first 15-30 days after calving. This time is the most stressful and delicate during the life of a cow, as the pathophysiologic post-partum condition, characterized by much compromised energy balance, causes a general inflammatory and immunodepressive state

that exposes the animal to infections and diseases. For the same reason, first-calf heifers should also be housed in a separate group.

GENERAL HYGIENE OF THE BARN AND UTILITY ROOMS

Animal housing areas must be kept clean and periodically disinfected. Regular disinfections are difficult to be enforced in dairy cattle farms, except in some specific areas such as the milking room, calving area, and calf cages; it is in fact impossible to evacuate animals from other housing areas. As a result, removing, refreshing and periodically replacing bedding material, which must always be clean (no or little faeces) and dry, is of great importance in these areas. However, it should be considered that any operation of this type loses effectiveness if these areas are overcrowded. Particular attention should be paid to calving areas (risk of udder and reproductive infections) as well as milking areas and equipment.

Bedding (deep litter or cubicle) materials must be supplied daily after faecal removal, whereas a complete replacement, preceded by disinfection where possible, should be performed every 4/6 months. There are many products on the market for bacteria "control" in bedding material, but their effectiveness is usually tested under specific conditions that have few parallels in the field. The use of these products is therefore complementary to preventive actions, but it certainly cannot replace the good practices necessary to have clean and dry bedding.

The situation is different for the milking room, sick pen, and calving area, and for the housing areas or cages/pens for calves, where disinfection and evacuation procedures can be normally performed. Standard disinfection procedures to be performed for the housing areas and equipment should include the following:

- evacuating animals and removing all feed and gear;
- removing organic material (feed, bedding, soil, etc.) from the facilities and equipment;
- initial washing with water to remove most of the dirt (pressure washers are very effective in removing encrusted dirt) and subsequent cleaning with high power detergents and sanitizers;
- if possible, it is always advisable to respect a downtime period before reintroducing animals, feed or equipment; otherwise, one should at least wait until the disinfected surfaces are dry.

In addition to cleaning and disinfecting, it would be appropriate to periodically paint the walls white (after removing whatever cobwebs and deposits on walls and surfaces) and keep troughs, windows, lamps, doors, etc. clean. Warehouses and feed storage rooms must be cleaned regularly, so as to prevent the proliferation of molds and bacteria. Each farm must have specific plans for rodent, pest (especially flies), and bird control.

THE STAFF

Farm staff should work exclusively for one farm and never spend time on other farms to avoid acting as carriers. Staff members should also be appropriately trained in their respective duties.

Each task should be associated with specific written operating procedures, to be provided during training and updated in accordance with company targets. Livestock personnel should however have general skills and know-how, such as the following:

- the animal's normal physiology, biology and behaviour;
- the general management and care procedures for animals at birth, administering drugs, animal handling, loading and unloading them on and from vehicles;
- recognizing signs of illness, injury, stress and suffering;
- feed and nutrition needs and feed and water hygiene;
- requirements of cattle farm buildings and facilities;
- the hygiene of the areas, facilities and equipment, disinfection methods and other methods to prevent the spread of disease;
- the basics of current cattle farming legislation;
- handling people and vehicles entering the farm;
- handling emergencies.

ASSESSING BIOSECURITY LEVELS

Biosecurity is an issue that must address primarily the precautionary principle and the multiannual programming of activities.

In order to achieve these objectives, knowing, assessing and managing risks pertaining cattle diseases is paramount. A comprehensive examination of all the diseases that can affect cattle farms and all the factors that may pose a health risk would require a large number of assessments and, as a consequence, too much time and money.

In this biosecurity assessment manual, similarly to what done for animal welfare, we decided to extrapolate a series of observations to help veterinarians to identify the major risks coming from farm health conditions. These observations, either of a general nature or more specific for the most important infectious diseases, are easy to apply and allow one to assess the biosecurity level of a cattle farm, classify it as per risk group, and come up with ad hoc improvement programs.

E. General biosecurity procedures/1 (75) - Rodents and insects control

Rodents and insects are important sources of risk with regard to the introduction and spread of infectious pathogens in the farm. They can carry diseases both biologically and mechanically, and promote above all the spread of faecal-oral infections; in fact rodent droppings can contaminate cow feed. It should be remembered that even a single rodent, even occasionally and sporadically seen, may indicate the presence of an entire population.

Rodent and insect control must be performed according to a written and documented pest control plan, which may be entrusted to a specialized company or handled internally. It is essential to provide for the orderly management of the warehouse, the removal of dirt, the proper placement of baits and traps and avoid the accumulation of material in the barn area. As for insects, it would be advisable to plan operations, scheduled more frequently in the summer-autumn period, aimed at the control of both adults and larvae.

Inspection item 75 - General biosecurity procedures/1 – Rodents and insects control

An interim judgment is assigned if there is a definite and comprehensive plan for combating rodents and insects (flies)
No procedures (to fight undesired animals)
Extant procedures are approximate and not formalized (no written plans)
Comprehensive written procedures in place or available from a biosecurity manual

E. General biosecurity procedures/2 (76) - Strangers entering the premises

Persons and vehicles entering the farm are a major way for infectious agents to be introduced as well. Therefore, it becomes essential to deny access to strangers, especially if they have contacts with other farms, by displaying clear warning signs and installing physical barriers such as gates or bars. If entry is agreed upon, it should be recorded in a register that documents all visits to the farm.

Inspection item 76 - General biosecurity procedures/2 - Strangers entering the premises

An interim judgment is assigned if there is a registering procedure and there are clear and respected warning signs forbidding entry to strangers
No procedures (men and vehicles entering the premises)
Extant procedures are approximate and not formalized (no written plans)
Comprehensive written procedures in place or available from a biosecurity manual

E. Handling visitors (77)

Considering the above, all usual business visitors to a cattle farm can be vehicles of contamination. Particularly professionals who visit occasionally should leave their vehicles outside the farm and have access to the office areas without passing through the operational areas. In the case of consultants or veterinarians, who for obvious reasons must be able to access the facilities and animals, their vehicles should be left in an area that is in any case not in contact with the animals and can be easily washed and disinfected.

Finally, all visitors must be required to wear farm-provided disposable clothing. For those who have constant access to the farm (e.g., veterinarians, nutritionists, APA technicians, etc.), there should be a special room where they can change and wear personal protective clothing and boots that remain on-site.

Inspection item 77 - Handling visitors

Visitors include veterinarians, farm consultants in general, etc.
No precaution regarding clothing
All “visitors” wear disposable boot covers
All “visitors” must go to through a dressing area and are required to wear disposable gowns and boot covers provided by the farm or clothing that remains on-site (e.g., the farm’s veterinarian)

Figure 33 – A farm with excellent access management has signs prohibiting access and a changing room.

Figure 34 – A farm with good access management has signs prohibiting access.

E. Disinfecting vehicles at the entrance to the farm (78) - Possibility of contact between outside vehicles and farm animals (79) - Collecting animal carcasses (80) - Loading live animals (e.g., for sale) (81)

Vehicles and people entering the farm is one of the main routes for the introduction of new diseases; this is why it is necessary to restrict and control their access, especially if they can have contacts with other farms. Transport vehicles, whether feed or animal trucks, present a very high risk for the introduction of infectious agents, especially when they come from other farms and have not been properly cleaned and disinfected. Therefore, it is necessary to have physical barriers in place along with washing and disinfection procedures.

For example, it is important to create barriers outside farm facilities and disinfection areas where vehicles have access.

The ideal solution would be for a farm to be built and arranged in such a way as to minimize the entry of vehicles, ensuring that operations (for example, for feed supply, milk collection, loading and unloading live animals and carcasses of dead animals, loading animals for slaughter, etc.) are performed outside its borders. In the case of milk trucks, the collection area should be easy to clean and disinfect, and staff should not enter the farm while milk is being loaded.

Inspection item 78 - Disinfecting vehicles at the entrance to the farm

No controls
There are protective sanitizing procedures but they are not employed routinely (only for emergencies)
There are protective sanitizing procedures and they are always used

Inspection item 79 - Possibility of contact between outside vehicles and farm animals

Do feed and milk trucks transit through areas that allow direct or indirect contact (< 20 m) with the animals?
Yes
No

Carcass collecting and live animal loading trucks should not enter the farm but perform their operations on the outside.

Inspection item 80 - Collecting animal carcasses

Do trucks for the collection of dead animals transit through areas that allow direct or indirect contact (< 20 m) with the live farm animals?
Yes
No, the vehicle is stopped at the farm's border, where carcasses have been previously collected

Inspection item 81 - Loading live animals (e.g., for sale)

Animals are loaded inside farm premises (20 m)
Animals are loaded outside farm premises (20 m)

E. Other animal species inside the farm (82)

Some bovine pathogens can be transmitted also from other domestic or wild animals and vice versa; this is why a herd coming in contact with other animals susceptible to the same infectious agents may present an important risk factor. This could occur, for example, with infections such as leptospirosis (pigs, mice), brucellosis (dogs, sheep), neosporosis (dogs) and chlamydiosis (wild or synanthropic birds).

In the event that animals of other species are also bred in the same farm, it is important to ensure a clear separation between them and the dairy cows housing areas, avoiding the shared use of equipment. Similar precautions need to be taken also when breeding beef cattle.

The farm should also include enclosures to prevent the uncontrolled access of undesired animals such as rodents, stray dogs and cats and, in some cases, grazing sheep or wild animals. In geographical areas where sheep farming is widespread, it is best to avoid having the sheep graze on land where forage for cattle feeding will later be harvested.

Finally, even one's pets (dogs and cats) can be an exposure factor, if they may visit other cattle farms, or synanthropic wildlife, and at the same time be in direct contact with the farm's cattle.

Inspection item 82 - Other animal species inside the farm

Are there other species inside the farm area such as farm animals (pigs, sheep and goats), and/or beef cattle and/or domestic animals (dogs, cats, poultry, columbiformes, etc.)?
Yes
No

E. Purchasing and/or moving animals outside the farm (83) – Quarantine (84)

The purchase of a new animal, as well as the reintroduction of cattle after fairs, exhibitions or markets, is one of the moments of greatest risk for the introduction of new diseases in the livestock. In these cases, it is necessary to have a quarantine area, as a primary biosecurity measure. The room for it should be separate from the rest of the farm, with appropriate hygienic microclimatic conditions, its own equipment (milking machine, feeders, etc.), and ways to restrain animals for veterinary examination and collecting biological samples.

When new animals need to be introduced, it will be useful to verify that they come from herds that are not subject to specific health restrictions and are in possession of documents pertaining to National Health Service certified plans. It is equally important to verify that they come from farms where internal biosecurity plans have been adopted to deal with major diseases (e.g., IBR, BVD, neospora, contagious mastitis and paratuberculosis) and that they come with certificates of analysis showing the absence of such infections. In the case of non-certified farms, it is recommended to request a test of the animal's health status and/or of the herd of origin.

All purchased animals, and those that have been in contact with individuals from other barns (animals back from fairs, pasture, etc.), must be placed in quarantine for a period of 21 to 30 days. During this time, they should be seen by a veterinarian and sampled for blood, milk and faeces to check their health status; it would be advisable to lodge them in individual stalls and, if necessary, use dedicated equipment, one's own milking groups, and when possible, one's own staff. These measures should be undertaken also for the time when the cattle are outside the farm.

An additional preventive measure, to be adopted where possible, is the vaccination of animals to be moved, analysing preventatively the feasibility, effectiveness, health risk, cost/benefit, and regional and national health policies. It should be emphasized, however, that vaccinations protect against the clinical signs of disease, but is unlikely they completely protect against infection; therefore, on entering back into the farm, all the animals must undergo a quarantine period whether they were vaccinated or not.

With regard to the movement of animals inside the farm area, it should be possible to separate into groups all the cattle in loose housing, not only according to the pregnancy period and the

production level, but also to any extant infections. Groups should be separated in a flexible way; therefore the surfaces of the separate areas should vary according to need.

The strong increase in the size of herds has made it necessary to have an identified sick pen. Few, unfortunately, are the farms that provide for one and even fewer those that do have one and run it properly. The sick pen should be used strictly for sick animals undergoing therapy or awaiting diagnosis; it should be separate from the farm's other departments, especially from the delivery room; it should be carefully managed (place and animals), cleaned and disinfected only after routine activities on the rest of the herd.

A special mention goes to the farms that still use natural mating: the infections that can be transmitted by a bull to the cows through coupling are varied, and appropriate precautions should not be overlooked. Therefore, if the bull was purchased, make sure that the farm it came from has a certification of health status equal to or greater than that where it is going, isolate it for at least four weeks, and at the same time provide for daily clinical examination and the following diagnostic tests: campylobacteriosis, trichomoniasis (bacterial culture from smegma samples or preputial washings), IBR (serological testing, best if done at the beginning and the end of the quarantine), BVD (serological test and detection of the virus in the blood), leptospirosis (serological test), chlamydiosis (serological test) and bluetongue (serological test). In addition, the bull should not be used for service if clinical signs of sexually transmitted diseases are suspected or exist in a group of cows; in this case, the bull must be vaccinated with the same immunizing protections used in the rest of the herd.

Inspection item 83 - Purchasing and/or moving animals outside the farm

Purchasing and moving animals (fairs/shows/markets) as a routine
Purchasing only in an emergency (last 3 years) and not moving animals
Neither purchasing nor moving animals for over 3 years

Inspection item 84 - Quarantine

No quarantine of any kind
Yes, partial: quarantine performed in an empirical and not formalized way (dedicated area adjacent to the other animals/things done in a short time/no biological test)
Yes, correct: no animals purchased for years, or compliance with an adequate quarantine in terms of time and facilities, complete with biological tests on the purchased animals

E. Mastitis control and prevention (85)

Bovine mastitis is the main health problem in farming dairy cows and is now the leading cause of direct (loss of milk production and related therapeutic costs) and indirect (drop in milk value) economic losses. Somatic cell count (SCC), detectable at different stages (from the milk of each quarter to the milk in the milking tank), has proven to be a good indicator of infections in barns. In fact, a correct SCC reading may lead to a suspicion of infection in the herd, but it can definitely not provide a bacteriological diagnosis. The bacterial sources that can give mammary infection have been divided into two groups for some time: those that come mainly from infected cows (reservoir) - which transmit the infection during milking (*S. aureus, Str. agalactiae and M. bovis*) - and those that originate mainly from the environment (*E. coli, Str. uberis, E. fecalis, Klebsiella spp.*, etc.).

In the case of infectious bacteria, a colonization of the teat occurs, mostly during milking; subsequently, in the time interval between two milking sessions, the udder is invaded. As regards environmental bacteria, a colonization of teat skin, which occurs between milking sessions, is followed by a penetration past the teat sphincter, both during milking and subsequently while the sphincter is patulous. In recent years, it has been shown that, for this group of mastitis-causing bacteria, a high percentage of new infections occurs during the dry period (first and last phase) and at the time of delivery.

After reading all of the above, it is not difficult to understand that the border between infectious and environmental bacterial agents is very thin and that, in both cases, hygiene, milking methods and a properly functioning of the milking machine play an absolutely primary role.

So as to minimize the exposure of teats to bacterial agents, milking operators must attain to the following:

- have no contact with animals from other farms;
- wear clean and suitable work clothes, preferably with a protective plastic apron washable with a simple jet of water;
- use washable gloves (latex, rubber, or nitrile rubber) and plastic forearm covers. Hands, gloves and forearm covers (if not new) should always be thoroughly washed before milking and must remain clean at all times during operations.

In addition to the hygiene of the operator, it will be necessary that the udders be adequately prepared with a thorough pre-milking cleaning, using water or paper or a special cleaning product. If water is used, care must be taken to wash the teats primarily (and not the entire udder), always spraying from top to bottom. Whether using water or a detergent, the teats must be thoroughly dried. Only at this point can one disinfect the teats with specific and authorized products, taking

care to remove the disinfectant before attaching the milking unit, which must be within 60-90 seconds after stimulation (proper milking setup).

Therapeutic intrammamary treatments, performed whether the cows are lactating or not, must be made with the utmost care. The teat, the milker's gloves, and all surfaces that come in contact with the intramammary tube should be thoroughly cleaned and disinfected. The tube should go no more than 5 mm past the sphincter (antibiotic administration to a potentially infected quarter could be the first source of infection risk), and the concerned area should be massaged to help the progress of the antibiotics. After administering the drug, the teat should be disinfected with surgical equipment and the cow left standing for at least half an hour after the therapy, preferably in the milking room. The treated animals must be properly identified to avoid selling their milk before the end of the suspension period.

Cows with high leukocyte numbers or with signs of chronic and relapsing mastitis should be monitored and milked after the ones considered not to be infected. Finally, animals in the colostral phase must be milked before the others or in any case before cows that are infected or suspected to be.

Pre- and post-milking teat disinfection, either by spraying or dipping, is of great importance for the prevention of mastitis. However, its effectiveness relies mainly on accurate execution and the hygiene of the teat dip cups: they must be washed routinely with water after use with 8-10 cows, and additionally, whenever dirt gets in accidentally.

The following are most important for the proper operation of the milking machine:

- the milking system must be checked regularly (at least every 6 months) by technical specialists and subjected to scheduled maintenance;
- all parts at risk (teat cups, rubber parts, milking unit components, flow regulator and meters) must be checked weekly by farm staff according to a protocol established by the specialists;
- the milking machine must be washed and disinfected after each session with microbiologically pure water, preferably from an aqueduct. If well water is used, it must be tested annually for chemical and microbiological agents;
- the milking room and waiting area must be washed after each milking session.

Only after making sure that the above steps have been successfully implemented can one then verify the implementation of specific biosecurity measures for the containment of contagious and environmental bacterial infections.

BIOSECURITY STANDARDS FOR THE CONTROL OF UDDER INFECTION CAUSED BY ENVIRONMENTAL BACTERIA

The above operations for the proper milking and the smooth functioning of the milking machine will not be very effective if the udder and teats of the animal to be milked are excessively dirty. Therefore, in order to prevent this type of mastitis, the care and cleanliness of the animal's housings is crucial.

Indeed, the management and design of the housing systems can affect the risk of mastitis: if the rest areas are not appropriately sized or are uncomfortable or the bedding is poor, the cattle may reject them and lie down instead in passageways or other external areas where they will get excessively dirty.

Overcrowding, poor ventilation, leaking water troughs, access to wetlands or muddy areas, shaded areas – where animals congregate, defecate and urinate – are some factors that increase exposure to pathogenic bacteria.

Beddings should be taken care of daily, starting from the frequent removal of manure down the aisle and in rest areas up to the constant renewal with suitable material. The effectiveness of bacterial flora controllers in the beddings is still doubtful: the large amount of organic matter inhibits or greatly reduces the effectiveness of many products designed for such operations. It should also be emphasized that no product can ever replace the care of keeping beddings clean and above all dry.

The type of bedding material chosen is very important. The best types are those made of inorganic material such as sand and synthetic mats, because they do not constitute a good substrate for bacterial proliferation. In this case, one must make sure that the cows will like the solution, and not lie down in unexpected areas. Straw is one of the preferred organic materials because, thanks to its structure, it manages to keep bedding dry, whereas sawdust, wood shavings, dry manure, and solid waste compost are more at risk.

The appearance of environmental mastitis is strongly affected by the seasons, since humidity and high temperatures promote the exposure and growth of micro-organisms; therefore, environmental hygiene operations must be more attentive during the seasonal periods most at risk.

From the cow's point of view, however, sensitivity to infection from environmental bacteria is greater in the moments just before and after delivery, as the udder is devoid of many defences normally present in the lactation period. In this phase, low animal density and the cleaning and hygiene operations of the housing areas are crucial.

BIOSECURITY STANDARDS FOR THE CONTROL OF UDDER INFECTIONS FROM CONTAGIOUS BACTERIA

Contagious mastitis can be caused by the introduction of infected animals and, therefore, the foremost fundamental rule is to check all the animals introduced into the farm through bacterial culture test of the milk. In order to avoid being misled from a single negative result (there are many causes that can affect the outcome of a single test), this operation needs to be repeated at least two or three times at a 30 days interval.

Furthermore, since for certain bacterial pathogens, such as *S. aureus*, the infected udder is not their exclusive reservoir (as is the case instead for *Str. agalactiae*), a periodic bacteriological analysis of bulk milk is always important in order to avoid the spread of infection within the herd.

If the infection from contagious bacteria is already present in the herd, examining the individual milk of each lactating animal in order to identify those infected becomes crucial. Once again, in order to reduce the risk of false negatives and also sample the cows that were not lactating at the time of the first test, it is important to repeat the examination after one month for at least three times. Those infected should be separated and milked after the healthy ones; to eradicate the infection, appropriate therapy should be provided during both lactating and dry periods, or otherwise culling can be agreed upon on an individual basis. Treated individuals that are not microbiologically cured must be culled.

The colostrum and milk of infected cows should not be used for feeding calves; for this reason, it could be useful to establish a frozen colostrum bank from healthy animals (colostrum should be collected from animals free from contagious pathogens of the udder, in addition to BVD and Paratuberculosis).

Ultimately, regardless of contagious or environmental infection, as well as in the case where there are no serious issues with SCC or clinical mastitis, it is important to maintain bacteriological monitoring constant in order to discover early infections and take rapid control measures.

To achieve these results, precise protocols should be applied for bacteriological investigation, such as the analysis of bulk milk performed at least every 6 months, and the analysis of mammary secretions collected from all the mastitic quarters (except in the case of chronic recurrent mastitis), to be periodically frozen and sent to a laboratory for bacteriological diagnosis and an antibiogram. This simple survey, in addition to identifying potential problems early, allows one to pay more attention to specific biosecurity rules and choose the most suitable active principles for antibiotic therapy in lactating and non-lactating cows.

In order to fill out this assessment questionnaire, it is considered sufficient that the farmer runs a check on bulk milk once every 6 months to detect agents of infectious mastitis (*Str. agalactiae, S.*

aureus, Prototheca spp.). A higher rating will be assigned to farms that also perform tests on the individual problematic animals to implement specific programmes for the eradication and control of contagious mastitis.

Inspection item 85 - Mastitis control and prevention

The farmer must be in possession of a recent analytical microbiological result (last 12 months) from bulk milk or individual milk samples, indicating the risk of mastitis
No analysis
Only bulk analysis for contagious mastitis monitoring
Analysis on problematic individuals and consequent eradication and control plans

E. Control and prevention of major infectious diseases (86)

An effective biosecurity plan cannot be separated from the knowledge of the main diseases and infection status of the single dairy cattle farm.

Assessors must test the knowledge of farmers for certain diseases such as Infectious bovine rhinotracheitis (IBR), Bovine viral diarrhea (BVD), Paratuberculosis (PTBC) and Neospora.

As for **IBR**, a control and eradication programme includes vaccination and the strict application of health measures to limit and prevent the risk of infection, both in herds known to be free and in those that are proceeding with eradication. The same goes for the fight against **BVD** for which the control's focal points, aimed at possibly eradicating the infection, are the search, identification and elimination of persistently infected individuals. The situation is different for **Neospora** and **Paratuberculosis**, for which no vaccines exist to limit the spread of infection in the herd. For these diseases, it is necessary to implement specific measures of direct control and it is important that the farmer establishes a system of analysis in order to identify infected individuals and program their elimination.

The best rating is assigned to the farmer who proves to know 3 of these diseases and implements control or eradication programmes on at least 2 of them.

Inspection item 86 - Control and prevention of major infectious diseases

Based on knowledge of the major diseases and implementation of relevant control plans (IBR/BVD/PTBC). To get the maximum score, a farmer must know all 3 diseases and implement control plans on at least two of them
No knowledge
Partial knowledge and undefined control plans
Knowledge of infection status and operational prevention plans in place

E. Health condition pertaining to Infectious Bovine Rhinotracheitis (87)

Infectious bovine rhinotracheitis, or IBR, is caused by the virus *Bovine herpesvirus* type 1 (BoHV-1), whose DNA has an envelope, meaning faint survival in the external environment and easily attacked by chemical and atmospheric agents. This infection is spread mainly through the inhalation of aerosols from infected nasal secretions. From here follows the fundamental characteristic of IBR infection, i.e., the necessary presence of an infected bovine (latent carrier) excreting in direct contact with another healthy cow. However, the role of mechanical vectors in spreading the infection cannot be overlooked, although they seem to be less important in spreading the infection.

In general, this infection presents high morbidity (rhinotracheitis and abortion) and very low mortality. However, in the case of secondary bacterial complications, the clinical picture can also significantly worsen.

The characteristics of the disease are known; it appears evident that the introduction of the infection in a healthy population is attributable to the arrival of one or more infected animals, already excreting or latent carriers, in the absolute absence of biosecurity measures and controls. Nevertheless, since the virus can withstand a few days in the environment (up to 30 days during the winter), contact with contaminated people or vehicles is to be considered a possible source of infection as well.

IBR is a worldwide reported disease considered to cause significant economic losses both to individual farmers and international animal integrations. Some European countries - Austria, Denmark, Finland, Norway, Sweden and Switzerland - have achieved the status of Officially Free; in other words, they have eradicated the infection and allow neither the use of vaccination nor the introduction of vaccinated animals.

In Italy, this infection is present throughout the territory, with the exception of the Autonomous Province of Bolzano, the only one considered Officially Free by the EU (Directive 64/432/EEC, Art. 10); eradication programmes approved by the EU (Directive 64/432/EEC, Art. 9) are present in Friuli Venezia Giulia and the Autonomous Province of Trento.

Previous experiences have shown that control and eradication of this infection are possible, as long specific prevention and biosecurity measures are implemented.

First of all, before making any decision, it is necessary to know (or at least estimate) that the infection is present in the herd. An optimal condition would be to investigate the state of health by testing all the animals on the farm for antibodies. Otherwise, in an initial screening phase, it is possible to estimate the presence of infection through a sample survey: assuming a 5% prevalence threshold, one must take a representative number of blood samples on animals over 12 months old, according to Table no. 6 (excerpt from Lombardy Region Decree No. 5080 of 17 May 2007).

Table 6 – Assessment of the presence of IBR infection in farmed cattle (IC 95% - expected prevalence ≥ 5%) (excerpt from Lombardy Region Decree No. 5080 of 17 May 2007)

NOTE: in the event that one or more samples are positive for IBR, the only conclusion that can be drawn is that the infection is present in the farm with **≥ 5%** prevalence.

(*In order to establish the actual health status of the herd it is necessary to carry out serological tests on all the animals (for example within an eradication programme).*

HERD NUMBER	**NO. OF ANIMALS TO BE SAMPLED**
Up to 0	All
20	19
30	25
40	31
50	34
60	37
70	39
80	41
90	42
100	44
200	50
>200	55

If the prevalence of the infection is known, control/eradication programmes can be devised according to the different scenarios:

1) if the herd tests negative for IBR, the application of direct strict prevention measures can be considered (as already thoroughly described in the previous biosecurity items) without carrying out the vaccination: this solution can only be applied in areas (provinces, regions, States) where a low prevalence of the infection is registered and which are trying to eradicate the infection. If the farm, on the other hand, is embedded in a scenario characterised by a strong viral circulation, to avoid the outcome of new infections within the healthy population it is recommended to carry out the vaccination using a vaccine marker (gE deleted) in order to quickly distinguish the infected animals from those that have been vaccinated and show little evidence of viral circulation;

2) if the herd has a low prevalence of infection (< 5%), it is advisable to remove the infected animals from the rest of the cattle as quickly as possible (for example by means of early slaughter)

and apply strict biosecurity measures. Once the elimination of the infected animals is completed, the previous considerations apply;

3) if the herd has a high prevalence of infection (and thus might be considered a permanent source of infection, which poses a risk to oneself and others), besides the main biosecurity measures it is necessary to apply the vaccination using a marker vaccine on all of the cattle.

The value of the vaccination, as we know, is not to prevent the infection – for example in the event of an active viral circulation – but to reduce the seriousness and duration of the clinical symptoms and therefore the quantity of viral particles excreted from the infected individual. The vaccination can also avoid the risk of viral reactivation from latency and therefore reduce the amount of infected aerosol that circulates in the air. With specific reference to the disease spreading rate (R_0), field tests[35] have shown that for non-vaccinated animals $R_0 = 5.6$, in the case of animals vaccinated with inactive gE vaccine this falls to $R_0 = 2.6$, whilst for animals vaccinated with live attenuated gE vaccine $R_0 = 1.5$. Therefore, marker vaccine allows the reduction over time of viral circulation in livestock and as a result the infection in new animals.

It should be noted that in order to determine the health status of livestock, it is necessary to confirm the number of animals not infected by means of two negative controls carried out after 5 – 7 months. After that, it is paramount to carry out a check on all of the cattle on a yearly basis.

For the animals that have never been vaccinated, the first vaccine must be received after the 3rd month of life (priming) and then after 3 weeks (booster). The following doses have to be administered to all of the cattle every 6 months (excerpt from the Lombardy Region Decree No. 5080 of 17 May 2007).

<u>DIRECT PREVENTATIVE MEASURES – BIOSECURITY:</u>

As previously described, the main source of IBR infection is represented by the presence of virus-excreting animals with clinical symptoms, and those with a reactivated latent infection, whilst mechanical vectors seem to be lesser causes. For this reason, biosecurity procedures should be aimed at limiting the contact between healthy and infected animals and/or any passive carriers of the infection (people and vehicles). The following is therefore highly recommended:

- to carefully apply the considerations set out in the previous inspection items (from 75 to 84) of this manual for the assessment of welfare and biosecurity;
- in the event that some animals participate in shows, exhibitions and/or go on pasture, to isolate them from the rest of the cattle on their return (quarantine) for at least the time necessary to carry out two serological checks; the first on their return to the farm and the second at least after

21-28 days. If the animals test negative for both glycoprotein E (gE) antibody detection, then they can re-join the group;

- to not introduce animals or, if this is necessary, to introduce animals from farms that carry out disease control plans and have a certified health status equal to or greater than the destination farm. In particular, the **animals moved should be subject to serological checks 30 days before they are moved; these should be kept in isolation in the destination farm and serologically tested again at least 21 days after their arrival;**
- to use disposable syringes for vaccination and administration of drugs;
- to appropriately treat suspected abortion material;
- to isolate seropositive animals until they are slaughtered;
- to avoid the use of cortisones in animals that are seropositive;
- to avoid mating until eradication;
- to use safe semen and embryos. The cows need to be inseminated with semen produced in accordance to Directive 88/407/EEC or by bulls tested seronegative from farms which are officially free. The embryos used need to be obtained from donors belonging to farms free from BoHV-1, or be treated with chymotrypsin (excerpt from Lombardy Region Decree No. 5080 of 17 May 2007);
- to finally perform a thorough cleaning and disinfection of the housing.

Inspection item 87 – Health condition pertaining to IBR

What is the biosecurity level concerning the prevention of IBR in the farm? The monitoring needs to be supported by diagnostic tests carried out in the last 12 months
High-risk farm: the livestock are positive or the farmer does not know the situation of the own livestock, or during the last 12 months the farmer introduced animals of unknown health status without carrying out any serological tests.
Controlled-risk farm: the livestock are positive, but a vaccination using a marker vaccine is carried out and at a serological control carried out in the last 12 months, all of the animals under 36 months tested negative; no animals have been introduced in the last 12 months or only seronegative animals have been introduced and their negativity has been controlled whilst in quarantine.
Low-risk farm: the livestock give a negative reaction to a serological test carried out in the last 12 months on all of the animals or on a statistically significant animal sample (IC = 95%; PA ≥ 5%); no animals have been introduced in the last 12 months or only seronegative animals have been introduced and their negativity has been controlled whilst in quarantine.

E. Health condition pertaining to Paratuberculosis (88)

Paratuberculosis, an infectious and contagious disease caused by *Mycobacterium avium* subsp. *paratuberculosis* (Map), is spreading amongst cattle herds at an alarming rate, mainly due to the trade of infected animals. The damages caused to livestock and the export restrictions, in some countries, of products of animal origin from infected farms require the adoption of intervention measures.

Control, prevention and above all eradication measures are difficult because of Map's remarkable resistance in the environment and the lack of diagnostic tests for detection of subclinical infected animals.

Paratuberculosis is a typical disease of ruminants, but not limited to them. Other non-ruminant animal species are in fact susceptible to both natural and experimental infection and in some cases they can show clinical signs of the disease.

The calf is the animal on which the control of this disease is focused; in fact the possibility of succumbing to the infection is at its peak in this period of life to then decline with age. Clinical signs of the disease usually first appear in adult age especially in individuals which became infected when they were young.

Since the infection is confined to the intestine, the most important infected material is represented by faeces, but when the infection reaches advanced stages Map can spread to various organs and apparatus and be present also in other organic liquids like milk and colostrum. The primary source of infection is the contact with the environment and/or infected animals (udders, litters, water and feed contaminated with the faeces of infected animals), swallowing infected colostrum or milk, but the transmission can also be of the congenital type, with Map being able to cross the placenta and infect the foetus when it is still in the uterus.

The biosecurity plans have to consider two aspects:

- external biosecurity;
- internal biosecurity or bio-containment.

EXTERNAL BIOSECURITY

External biosecurity measures are aimed at preventing the introduction of the infection into healthy livestock and are mostly linked to checking the animals entering the stable. Unfortunately, while for many other diseases this obstacle can be easily overcome with preventative tests on incoming animals, in this case, as already mentioned, the various diagnostic tests available are not able to give the assurance that the cow with negative tests is healthy. For this reason it is an absolute

priority that the receiving farm requests guarantees concerning the animal's entire farm of origin. With this aim, the National Guidelines (see below) provide for certifications (corresponding to level of decreasing risk according to the number of yearly checks with negative result), which the farms can join voluntarily. However, the only attention paid when purchasing the animal is not sufficient to avoid the risk, therefore other specific biosecurity measures need to be adopted taking into account other management factors, such as the use of shared equipment (scrapers, tractors, mixing trailers contaminated with infected faeces), the use of colostrum and/or milk from infected herds, the purchase of forage dung with the faeces of infected cattle or the promiscuous pasture with infected farmed/wild animals.

INTERNAL BIOSECURITY (BIO-CONTAINMENT)

It is important to apply bio-containment measures aimed at preventing the infection transmission in the event of infected cattle, by reducing new cases of infection and gradually reaching the negativity of all the animals. The control strategies are based on the simultaneous adoption of two types of measures: to eliminate the infected animals and avoid any contact of calves and young heifers with adult animal's faeces.

Clinical infected animals should be immediately isolated and treated as soon as possible.

Subclinical infected animals, identified by laboratory tests (serology, PCR on faeces), should be preferably eliminated or, when this is not possible, separated at calving from negative animals. In order to prevent the spread of paratuberculosis, it is fundamental to put in place all those measures that can avoid the direct or indirect contact of calves and young heifers with the faeces of adult animals. In this way, the following is advisable:

- the early isolation of the calves at birth and breeding them in homogenously aged groups up to adult age;
- the protection of the feeding and drinking troughs from faecal contamination;
- the administration to calves of colostrum from cows that repeatedly tested negative, considering the likely contamination of milk and colostrum from infected animals;
- the use of contaminated milk only after heat treatment, at least at 65°C for 30 minutes, only if necessary;
- the feeding of calves and young heifers only with safe forages, not those harvested in fields where infected sewage and manure have been spread, unless this is done under safety conditions needed to ensure the complete absence of this pathogen in such feeds (storage and fermentation of the manure before spreading, completely burying the manure under the soil through ploughing);

- the use of different equipment for calves and young heifers and adult animals both for cleaning the housing and administering feeds;
- rejecting to feed heifers with rests of feed of adult animals;
- improving grazing management, with the aim of avoiding contact with infected animals and their faeces.

Data available in literature also shows that a better health-hygiene management of calves and young heifers, which is achieved through careful planning of interventions and documented with a detailed collection of data, is more effective over time than the culling of positively tested animals (even if always advised).

Of course, the combination of both strategies (culling of positively tested animals and biosecurity) guarantees quicker results over time.

The methodical approach proposed, based on criteria of correct health-hygiene management of farmed cattle, is a useful tool not only to control paratuberculosis but, more generally, also for the correct biosecurity cattle management, with advantages also for other diseases.

In particular, for paratuberculosis the Italian National Reference Centre has drafted the "Guidelines for the adoption of paratuberculosis control programmes and identifying the herd health-level within a voluntary herd certification program", that were sanctioned by the Agreement between the government, the regions, and the autonomous provinces of Trento and Bolzano during the Regions/State Conference of 17 October 2013 and published in the Official Gazette No. 271 of 19.11.2013.

The text of the Guidelines[36] is available in the IZSLER portal. The Guidelines include the manuals concerning the control of the disease in both dairy farms and beef cattle farms (cow-calf operation).

Similarly, as much as the Lombardy Region is concerned, the "Regional plan for the control and certification of bovine paratuberculosis" (Decree 6845/2013 – Official Lombardy Region Bulletin of 24 July 2013)[39] was published. As can be seen in the presentation available in the IZSLER portal, "the plan is particularly aimed at providing guidelines relating to the methods of herd certification, whose milk-derived products are to be exported to third States." Additionally, thanks to the implementation of this plan, the following objectives are aimed:

- collect data on the onset of clinical cases of paratuberculosis in national cattle farms;
- ensure an aware animal and animal products trade certification through a farm classification based on the risk;
- provide farmers with tools to prevent the introduction of infections caused by *Mycobacterium avium* subsp. *paratuberculosis* in their farms;
- provide farmers with tools to control the infection in their farms.

Inspection item 88 – Health condition pertaining to Paratuberculosis

What is the biosecurity level concerning the prevention of ParaTBC in the farm? The monitoring needs to be supported by diagnostic tests carried out in the last 12 months.
The farmer does not know the situation of his own farm, or the farmer introduced animals of unknown health status during the last 12 months or the farm has a > 5% infection percentage.
The farm tested negative (<5% seroprevalence) to a serological test carried out on all the animals according to the S1-type protocol[A] and no animals have been introduced in the last 12 months (or only animals coming from farms with equal health level have been introduced).
The farm gives a negative reaction to at least a serological test carried out according to the S2-type protocol[B] and no animals have been introduced in the last 12 months (or only animals coming from farms with equal health level have been introduced).

A: **S1-type protocol** provides serological testing of all male breeding cattle over the age of 24 months, all cattle aged over 24 months purchased within the last 12 months and on a sample of cattle female older than 36 months born on the farm (See Guidelines for more details).

B: S2-type protocol provides serological testing of all female cattle older than 36 months, of all male breeding cattle over the age of 24 months and all breeding cattle over the age of 24 months introduced in the last 12 months.

E. Control and analysis of the water sources (89)

Water should always be available to all animal groups present in the farm. To ensure a good quality of water, especially if it comes from the farm's well, a periodic chemical and microbiological analysis (at least every year) needs to be carried out (pH, hardness, presence of nitrites and nitrates and ammonia).

It should be noted that there is no national regulation that establishes the characteristics of drinking water for farm animals whereas drinking water for human consumption is regulated by Legislative Decree No. 31 of 2 February 2001 (amended by Legislative Decree No. 27/2002).

The water quality for animals is essential to ensure both the homeostasis of the cow's physiological and metabolic functions as well as to prevent and avoid even considerable damage to the equipment and facilities. For example, very hard water (i.e. with a high salt content such as carbonates, bicarbonates, calcium and magnesium sulphates) may lead over time to limescale being formed within the pipes or drinking troughs, with a consequent reduction of the water flow and, in extreme cases, blockage of the water network.

A decline in the microbiological quality of drinking water might pose a health risk to animals (digestive problems and transmission of infectious diseases) and consumers.

With regard to the drinking trough for calves, total and faecal coliform bacteria should be < 1 CFU/100 ml of water sampled and faecal streptococci < 3 CFU/100 ml water. For adult cows, the limits of total and faecal coliform bacteria should be < 15 and < 10 CFU/100ml water respectively and faecal streptococci < 30 CFU/100 ml[40]. Total bacteria should constantly be < 200 CFU/100 ml water; water sources with a total bacteria count > 1 million CFU/100 ml water should never be given to animals[40].

The ratio between faecal streptococci and faecal coliforms can particularly give an indication regarding the source of contamination: if the faecal streptococci are much higher than the faecal coliform content one can suspect the contamination source is of animal origin; if faecal coliforms exceed faecal streptococci it can be presumed that the contamination source is of human origin[40].

Inspection item 89 – Control and analysis of water sources

The analysis is valid even if only microbiological
Lack of water analysis
Yearly analysis/municipal aqueduct water

COMPUTER PROGRAM TO ASSESS WELFARE AND BIOSECURITY IN DAIRY CATTLE FARMS

SYSTEM IMPLEMENTATION – WELFARE AND BIOSECURITY LEVEL CALCULATION

The assessment of animal welfare and biosecurity on farm can be performed using two different devices: paper and tablet.

In both cases a check-list is used which is composed of 89 items divided into 5 areas:

- Area A: Farm management and personnel
- Area B: Facilities and equipment
- Area C: Animal-based measures (ABMs)
- Area D: Inspection of microclimatic environmental conditions and alarm systems
- Area E: Biosecurity.

Each item has three (negative, acceptable, positive) or two (negative and positive) choice options. Not all the inspection items have the same weight in determining the final welfare score: some assessments have a multiplication or division algorithm that increases or reduces the importance, when determining the final welfare score. In the A, B and D Areas, the weights tend to be reduced, as they refer to the assessment of the risks for animal welfare and, as such, are only potential causes of adverse effects and can be deleted by the animal adaptability to its environment.

In Area C, the assessment of the animal's conditions is based on direct welfare indicators like the state of nutrition (BCS), cleanliness and presence of lesions. In this case, the outcome of the analysis (positive or negative) does not represent a risk, but a true indication of the animal welfare status. Therefore, such assessments will have a greater weight, through the application of a higher multiplication algorithm. In fact, the score of Area C, even if composed of 24% of the items, has a 40% impact on the final welfare score.

The Area E – biosecurity assessment – (with 15 items) consists of, like the rest of the assessment protocol, a two and three-choice analysis. This has been set out to analyse the biosecurity risk of the farm with regard to the main dairy cattle diseases. However, considering that to carry out the risk assessment of all the potential diseases that could infect the cows, a high number of assessments would have been necessary, we decided to concentrate on the main ones. Even in this case the assessments did not always have the same weight, which increases for the most important risks (for example the routine purchasing of animals) and decreases for those considered to be the most marginal.

The final calculation of the scores in the various areas and those of the overall welfare and biosecurity is not carried out by the assessor, but by specific software of the Italian National Animal Welfare Reference Centre (CReNBA), available through the website http://213.26.0.211/ (Figure 35).

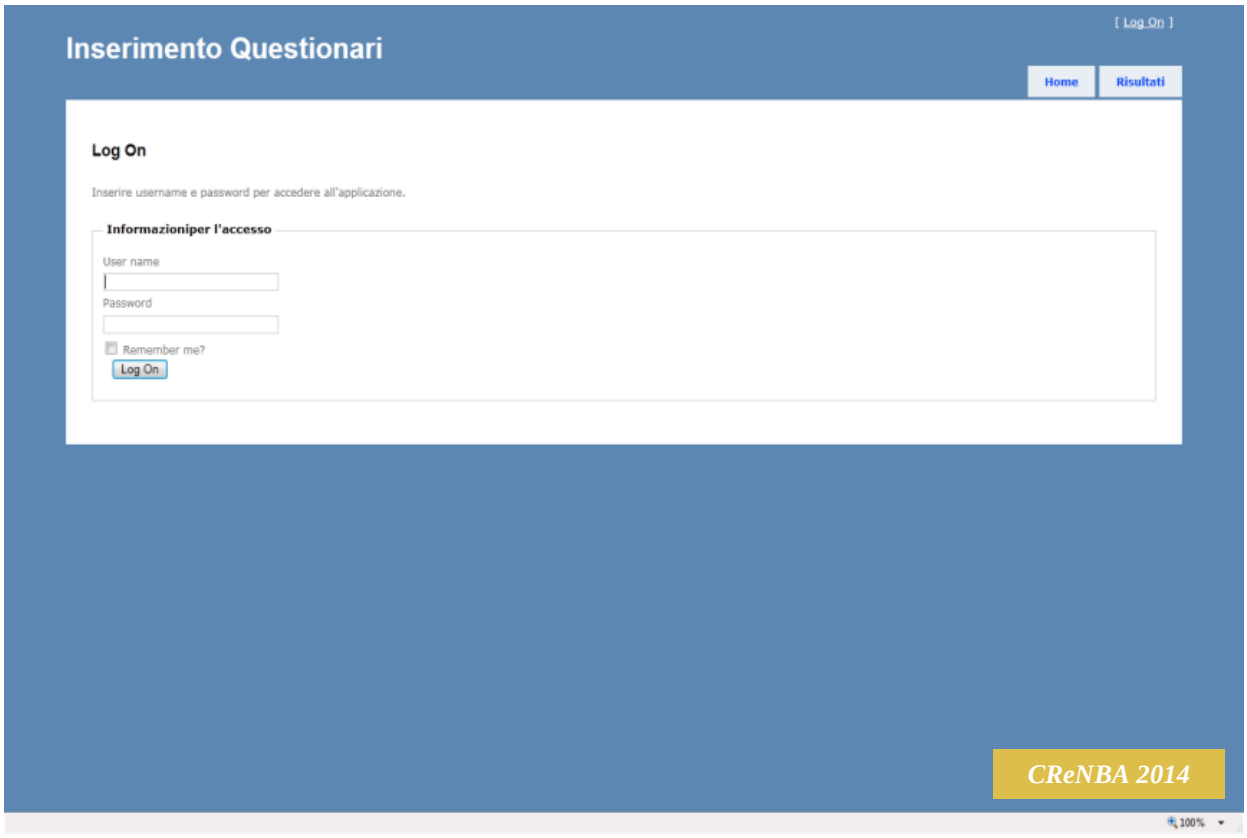


Figure 35: Home page of the web application

Web application (in which to enter the paper checklist data) and mobile tablet application (that registers the scores and sends them directly to the web application) have been developed thanks to the cooperation between the Italian National Animal Welfare Reference Centre and a private company that deals with customized information technology solutions.

Access to the web application is allowed only to vets who have taken the CReNBA training course for becoming welfare assessor, at the Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia Romagna (IZSLER) in Brescia, or at other Experimental Zooprophylactic Institutes (II.ZZ.SS), run by veterinary managers with the "trainer" qualification issued by the Reference Centre itself. This training course is not only necessary to harmonise, among the assessors, how to perform the CReNBA welfare assessment on farm, but also to learn how to use the necessary fixed and mobile IT tools.

Each user, by entering their own username and password supplied by the CReNBA (Figure 35), accesses the web application and can view their own profile, manually enter the paper checklist (if chosen) (Figure 36) and view the farms assessed.

If the mobile tablet application has been chosen, the assessor has to register the identification data of the farm and start filling out the checklist on the tablet during the farm visit; then proceed with

the automatic transcription (synchronization) of the data to the web program through an internet connection.

FARM							
WELFARE ASSESSOR NAME							
DATE				NO. LACTATING COWS			
ALLEVIX CODE				NO. TOTAL ANIMALS			
APA CODE					milk kg/ animal/day		
AREA	**A**	**FARM MANAGEMENT AND PERSONNEL**					
Inspection item	**1**	**Number of stockpersons**					
One stockperson (without milking duties) for more than 300 animals or one stockperson for more than 120 animals (with milking of about 60 animals)							
One stockperson (without milking duties) for more than 200-300 animals or one stockperson for 90-100 animals (with milking of about 50 animals)							
One stockperson (without milking duties) for less than 200 animals or one stockperson for less than 80 animals (with milking of about 40 animals)							
Inspection item	**2**	**Stockperson training**					
The course must be at least 4 hours long (a half-day or 2 evening slots) and completed in the last 3 years by at least one individual, who may be the owner or an employee.							
Less than 10 years' experience and no training courses							
Minimum 10 years' experience and no training courses							
Experience and possession of a qualification or a certificate of attendance of a training course lasting at least ½ day or 2 evening slots in the last 3 years.							
Inspection item	**3**	**Group management**					
Additional groups are contemplated only between dry cows or between lactating cows							
No groups or only heifers/cows							
No. of groups corresponding to the number of assessment categories (heifers, dry cows, lactating cows)							
Several groups (transition cow, first-calf heifers) of lactating or dry animals; or 3 clearly separate main groups in herds with fewer than 50 animals overall							
Inspection item	**4**	**Number of inspection visits of animals**					
Daily inspections are understood as additional to milking activities.							
1 inspection/day							
2 inspections/day							
>2 inspections/day, written report of the observations (e.g. animals on heat) or computerized recording							

Figure 36 – Paper checklist home page.

Both in the paper and IT checklists, the observations are identified with 5 different colours corresponding to 5 different work areas that aim to simplify and facilitate the checklist compilation:

a) Yellow: the questions to be asked to the farmer or the farm keeper;
b) White: the observations to be made on lactating cows;
c) Green: the observations to be made on dry cows;
d) Red: the observations to be made on calves and heifers;
e) Blue: the observations that are to be mediated with the farmer's answers (that is observations to be asked to the farmer and then to be tested during farm visiting).

Figure 37 – An example of a tablet device

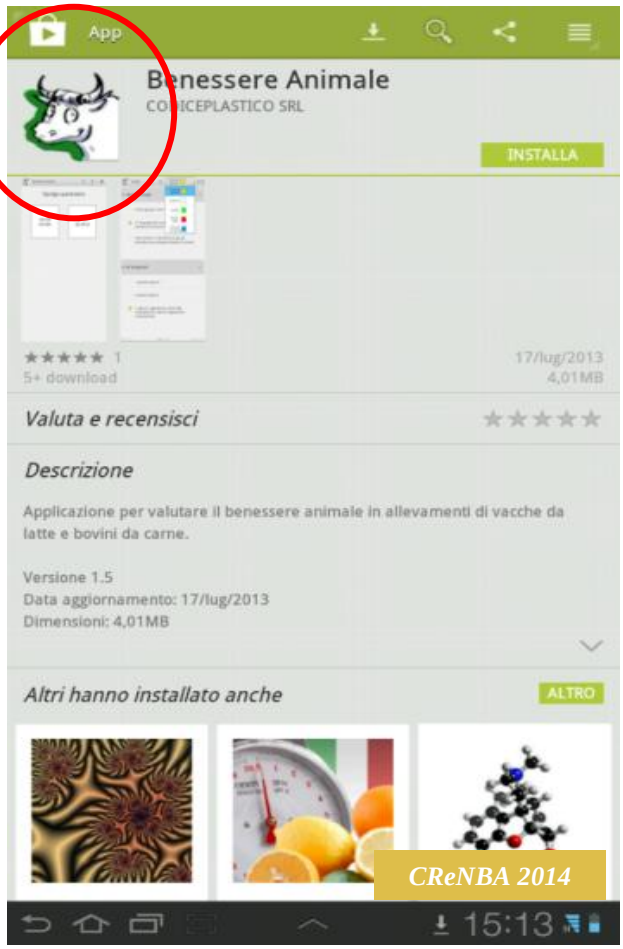


Figure 38 – Installation of a mobile application on a tablet device.

To carry out the welfare assessment by using the IT checklist, a tablet device (Figure 37) is required with the following technical features:

- 3.2 Android operating system or above;
- 7.0” screen with WSVGA (1024 x 600) PLS LCD resolution;
- Wi-Fi connection or SIM card suitable for traffic data.

Furthermore, to download the “Animal Welfare” application, access the virtual Google’s Play Store (https://play.google.com/store?hl=it), click on the “App” menu and look for “*IZSLER”:* the application icon  (Figure 38) will appear. By clicking on this the download will begin.

To have full access to the application, the username and password will be requested, previously supplied by the CReNBA during the training course.

After the access procedures, an identity record can be compiled, where farm data and single items are registered.

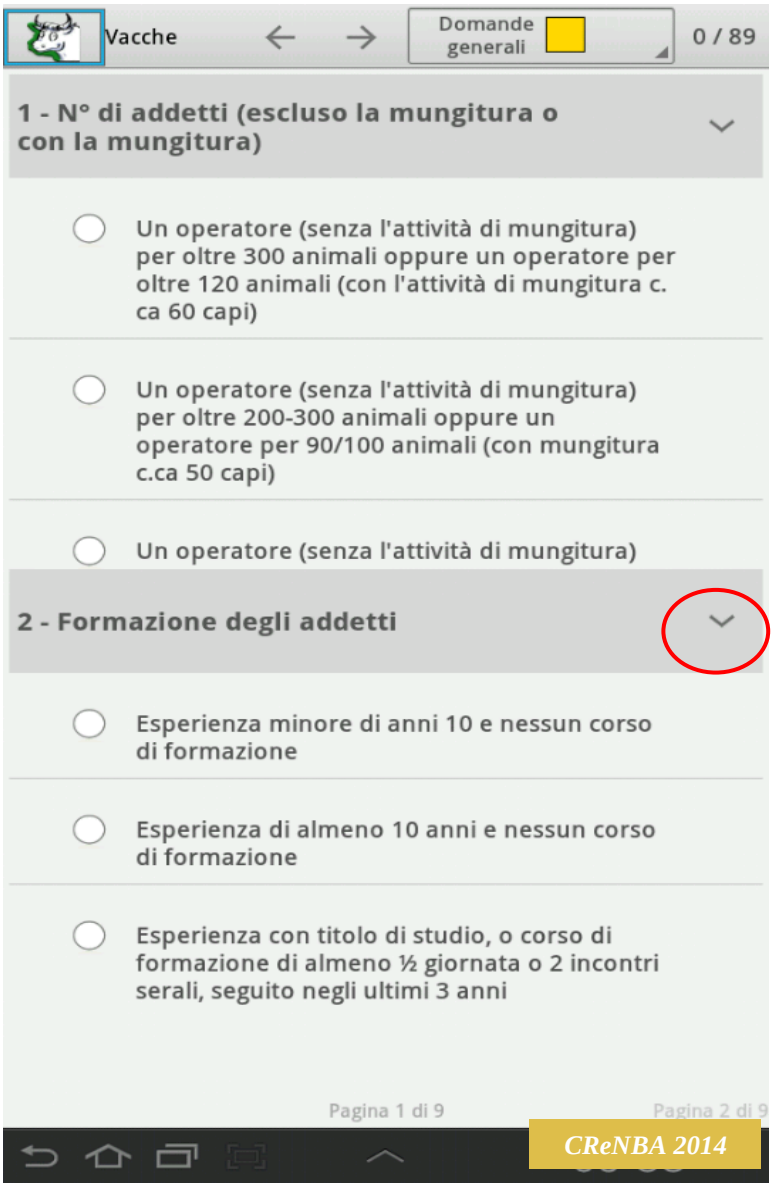


Figure 39 – Operational screen of the mobile tablet application

Each screen of the mobile application includes 2 items in the colour corresponding to the working area (Figure 39).

For all of the items there are also 4 service icons available, which can be accessed by clicking on the arrow, located in the question section (Figure 39).

These are:

- the calculator: to facilitate any calculations, such as the housing surface area or the percentage of dead animals in the farm in a year;
- the camera: allows particular images to be taken of difficult situations to be assessed. The photographs will remain attached to that item and will be available to the CReNBA vets, for any comparisons in the event of the most difficult choices;
- a "notes" section: allows notes to be taken regarding that particular observation. This enables a note to be filed of dubious situations that can then be discussed with other assessors or CReNBA staff;
- the "tooltip": or a brief explanatory note that reports the main and necessary information to assess the situation, thus helping the operator to make the right choice.

Once the assessment has been completed, when the tablet is connected to internet (Wi-Fi or SIM card), it is possible to send all the data via the "synchronize" function, directly to the web application, which processes the questionnaire answers and the welfare outcome.

At this point simply access the web page (http://213.26.0.211/), log on, enter the "Scores" menu (translated in Italian "Risultati", see Figure 35) and instantly view the outcome of the welfare assessment carried out on farm. The scores will then be made official in the Certificate of Animal Welfare and Biosecurity Assessment which will be given to the assessor (Figure 40).

THE FARM WELFARE AND BIOSECURITY CERTIFICATE

Besides the welfare outcomes made readily available to the assessor through the web application, the final welfare and biosecurity scores can also be supplied as a hard copy official document. The latter defined as the "the Animal Welfare and Biosecurity Assessment Certificate" can be used whenever a document is needed which confirms that such assessment has been carried out and which are the animal welfare and biosecurity levels reached by the farm assessed.

As Figure 40 shows, the certificate shows:

- IZSLER: the logo of Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia Romagna;
- CReNBA: the logo of the Italian National Animal Welfare Reference Centre;
- The general data of the farm;
- The name of the welfare and biosecurity assessor who carried out the assessment;
- Any "non-compliances" (where the minimum requirements have not been met according to Legislative Decree No. 146/2001, Legislative Decree No. 126/2011 and EC Reg. 853/2004, limited to the content of somatic cells in tank milk);
- The partial score reached for each area (with reference to the minimum and maximum score and relative percentage);
- The final score of the overall animal welfare assessment;
- The final score of the biosecurity assessment;
- The signature of the CReNBA manager for the bovine sector;
- The signature of the veterinary assessor who carried out the assessment on farm.

It is important to remember that the certificate is issued only by the web application administrator, which is the CReNBA, who provides to send it to the veterinary assessor.

Figure 40 – The following page has an example of the Animal Welfare and Biosecurity Assessment Certificate.

Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia Romagna

CReNBA Italian National Animal Welfare Reference Centre

Animal Welfare and Biosecurity Assessment Certificate

Dairy cows in loose housing system

Dairy Farm name	----------
VAT No.	----------
Address	----------
City	----------
Farm code	----------
APA code	
Breed	Holstein Friesian
Number of animals	270
Number of lactating cows	114
Average daily milk production (kg/cow/day)	25
Assessment date	30/12/2013
Veterinary Assessor	----------
Notes	

Important: the following answers indicate legislative non compliances:

- [C - ANIMAL-BASED MEASURES] C - Items area C - 56 – Udder health

ANIMAL WELFARE ASSESSMENT	**Score**	**(Min - Max)**	**Percentage**
FARM MANAGEMENT AND PERSONNEL	40.64	(15.15 – 50.95)	71.20%
FACILITIES AND EQUIPMENT	44.09	(15.3 – 58.9)	66.03%
ANIMAL-BASED MEASURES	62	(16 - 75)	77.97%
INSPECTION OF MICROCLIMATIC ENVIRONMENTAL CONDITIONS AND ALARM SYSTEMS	11.5	(5 – 14.5)	68.42%
OVERALL ANIMAL WELFARE ASSESSMENT	**158.23**	**(51.45 – 199.35)**	**72.20 %**
BIOSECURITY	**38**	**(14.5 - 52)**	**62.67 %**

CReNBA Bovine Sector Manager

Dr. Luigi Bertocchi

_____

The Veterinary Assessor

Dr._____

_____

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PRELIMINARY PROCESSING OF THE DATA RESULTING FROM ANIMAL WELFARE AND BIOSECURITY ASSESSMENT OF DAIRY CATTLE KEPT IN LOOSE HOUSING SYSTEMS DURING THE THREE-YEAR PERIOD 2011 - 2013

THE DATA COLLECTION AND PROCESSING CONDITIONS

After an earlier phase of experimental testing during 2010, in January 2011 the assessment of the dairy cow welfare began through implementation of the system.

The number of assessed farms gradually increased, and by the end of 2013, the data collected concerned around 600 farms throughout Italy.

The assessment method, before being applied on a large scale by the veterinary assessors, who had taken a specific training course, was subject to a statistical validation of the repeatability of the results: 6 vets, who had been previously trained, assessed 11 different farms over the same period of time, without any possibility of discussing their results.

The statistical processing of the collected data showed that the system ensures a high level of repeatability of the score, since a certain agreement level was reached among the operators, expressed as a concordance percentage, Fleiss' Kappa index and free-marginal Kappa, Kendall's W index for each item and Kappa index for each operator, as an average value calculated on the indexes obtained for each pair of operators on each item.

Furthermore, thanks to the described test it was possible to highlight the observations that were assessed slightly differently among the different operators. The analysis of the results and a series of meetings among the vets who carried out the tests, helped identify the reasons for the differing judgements and, therefore, correct the modules of the training course, further improving uniformity of the assessment by the assessors.

THE ASSESSORS

To guarantee that the assessment method (therefore the result) is applied consistently, its use is restricted to vets who have attended and passed the specific training course, held by fellow veterinary trainers in cooperation with the CReNBA.

The vets nowadays qualified as "Animal Welfare Assessors" for dairy cattle in loose housings are 53: 27 colleagues from the Experimental Zooprophylactic Institutes who deal with the implementation of the system mainly for research purposes; 24 veterinary practitioners or cooperative employees, who deal with the implementation of the system to monitor the farms with different purposes (for example the need to identify the most lacking aspects, the possibility to obtain public financing to restructure barns, the attempt to label food products etc.) and 2 Official Veterinary Inspectors (ASL) have been trained to categorize the controlled farms.

ASSESSED FARMS

In the period between 1st January 2011 and 17th December 2013, 557 dairy cow welfare assessments were collected from all over Italy.

For obvious reasons linked to the CReNBA headquarters, most farms assessed were located in the Lombardy region. However, in recent months, thanks to the increasing number of vets from all over Italy, interested in taking the course to apply the system, the geographic localisation of the assessed farms is changing and taking on a broader scope.

Particularly, at the end of the 3 work years, the breakdown of the farms assessed for the welfare of dairy cow is as follows:

Table 7 – BREAKDOWN OF ASSESSED FARMS BY REGION

(1 January 2011 -17 December 2013)

REGION	**FARMS ASSESSED**
LOMBARDY	432
EMILIA ROMAGNA	35
PIEDMONT	27
VENETO	17
TRENTINO - ALTO ADIGE	15
FRIULI - VENEZIA GIULIA	9
ABRUZZO	1
CALABRIA	3
SARDINIA	6
SICILY	12
TOTAL	**557**

Out of 557 farms, 290 (52%) are from the province of Brescia; 59 (10.5%) from the province of Mantua; 42 (7.5%) from the province of Bergamo; 25 (4.7%) from the province of Cremona; 15 (2.7%) from the province of Trento; 14 (2.5%) from the province of Turin; 12 (2.2%) from the province of Ragusa.

The remaining 100 farms, equal to 18%, come from the provinces of Cuneo, Alessandria, Lodi, Milan, Sondrio, Verona, Vicenza, Padua, Rovigo, Treviso, Parma, Piacenza, Reggio Emilia, Modena, Bologna, Cosenza, Vibo Valentia, Oristano, Pordenone and Teramo.

There are many reasons that led the vets and farmers to subject the animals to the animal welfare assessment. Most farms have been selected as part of two important national research projects, named Riprowel (Metagen) and Filigrana, which have been financed by the Ministry of Agriculture, Food and Forestry, for which the IZSLER of Brescia is one of the operational units. In this context, animal welfare data will be compared with other information collected (on animal health, hygiene, genetics, etc.) in order to understand the existing correlations and what influences these variables can have on the life of the animals and the quality of the milk produced.

Another large collection of data was possible thanks to a research project developed under an agreement between IZSLER and the Centre for Milk and Meat Improvement in Brescia, to analyse the animal welfare in farms that supply milk to cooperative dairies in the province of Brescia producing Grana Padano cheese. The objective was to bring together animal welfare data with those from self-tests, thus obtaining a more complete picture of the origin of the milk from a farm perspective.

Other fairly large assessments were also carried out at the request of some dairies, willing to obtain further information on the conditions (management, facilities and animals) of the farms of their milk supplier’s. A subsequent set of data was collected at the request of some farmers, with the aim of improving the production performance of their animals, through an increase of their welfare level. Finally, some farms were subject to assessment at the request of the farm vets, who wanted to add a new professional aspect to their work that complemented the services to be offered to the clients.

Table 8 – Size characteristics of the first 557 farms assessed

	Minimum number found	Average number found	Maximum number found
TOTAL NUMBER OF ANIMALS	12	263	1413
NUMBER OF LACTATING COWS	10	120	644
Average MILK production (kg/animal/day)	11	28.16	41

RESULTS OBTAINED FROM THE WELFARE AND BIOSECURITY RATING ASSESSMENT

The welfare assessment system is divided into four areas that contribute to the determination of the final score. A fifth area for biosecurity assessment has recently been included with the aim of collecting information on the health risk in cattle breeding.

Below are the individual areas and the minimum and maximum scores that define them:

Table 9 – Minimum and maximum scores of each area

AREA	**TITLE**	**MINIMUM SCORE**	**MAXIMUM SCORE**	**AVAILABLE SCORE**
Area A	Farm management and personnel	15.15	50.95	35.42
Area B	Facilities and equipment	15.3	58.9	43.60
Area C	Animal-Based Measures (ABM)	16	75	59
Area D	Inspection of microclimatic environmental conditions and alarm systems	5	14.5	9.5
	Overall Animal Welfare Assessment	51.45	199.35	147.90
Area E	Biosecurity	14.5	52	37.5

As can be seen in Table 9, the minimum welfare score that a farm can have (in the event of all observations of the system being negative) is 51.45, the maximum (in the event of all observations being positive) is 199.35 and the average score is 125.4.

The assessment of the 557 farms produced an average welfare score equal to **153.72 points,** well above average rating (125.4) of the system. **This average rating is set at69.15% of the score available.** The minimum score recorded was 96.76 and the maximum score was 185.53.

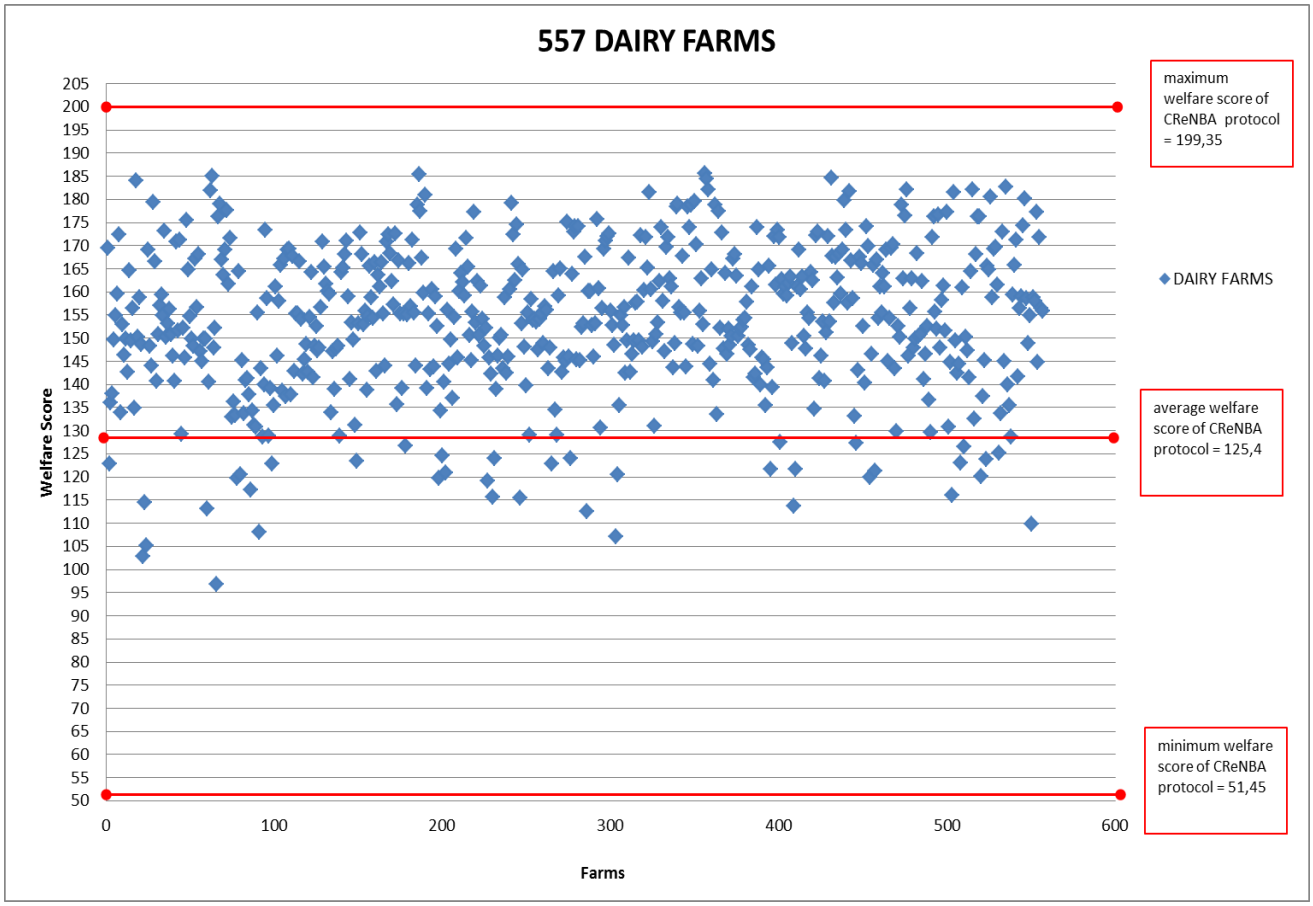

Figure 41 – Breakdown of the overall welfare scores of the 557 farms assessed (1 January 2011 - 17 December 2013).

The breakdown of farms by 33° - 66° - 100° percentage is the following:

Table 10 – Breakdown of farms by <u>overall rating range</u>

	RATING RANGE	FARMS	% FARMS
1°-33° percentage	51.45 – 100.75	1	0.18
34°-66° percentage	100.75 – 150.05	215	38.60
67° - 100° percentage	150.05 – 199.35	341	61.22
	TOTAL	557	100

The breakdown of farms by percentages for each area is as follows:

Table 11 – Breakdown of farms by AREA A rating range

	RATING RANGE (AREA A)	FARMS	% FARMS
1° -33° percentage	15.15 - 27,08	2	0.36
34°-66° percentage	27.08- 39.01	122	21.90
67° - 100° percentage	39.01 – 50.95	433	77.74
	TOTAL	557	100

The average rating for area A, obtained from the farms, was **41.82, equal to 75.2% of the available score and to 82.08% of the maximum score** (see Table 9).
The minimum rating recorded was 25.65; the maximum rating was 50.95.

Table 12 – Breakdown of farms by AREA B rating range

	RATING RANGE (AREA B)	FARMS	% FARMS
1° -33° percentage	15.3 – 29.83	8	1.44
34°-66° percentage	29.83 – 44.36	305	54.76
67° - 100° percentage	44.36 – 58.9	244	43.80
	TOTAL	557	100

The average rating for area B, obtained from the farms, was **43.11, equal to 63.78% of the available score and 73.19% of the maximum score** (see Table 9).
The minimum rating recorded was 25.78; the maximum rating was 55.07.

Table 13 – Breakdown of farms by AREA C rating range

	RATING RANGE (AREA C)	FARMS	% FARMS
1° -33° percentage	16 – 35.66	7	1,26
34°-66° percentage	35.66 – 55.33	209	37.52
67° - 100° percentage	55.33 - 75	341	61.22
	TOTAL	557	100

The average rating for area C, obtained from farms, was **57.23 equal to 69.88% of the available score and 76.3% of the maximum score** (see Table 9).
The minimum rating recorded was 27; the maximum rating was 75.

Table 14 – Breakdown of farms by AREA D rating range

	RATING RANGE (AREA D)	FARMS	% FARMS
1° -33° percentage	5 – 8.16	9	1.62
34°-66° percentage	8.16 – 11.32	169	30.34
67 - 100° percentage	11.32 – 14.5	379	68.04
	TOTAL	557	100

The average rating for area D obtained from farms, was **11.55, equal to 68.95% of the available score and 79.65% of the maximum score** (see Table 9).

The minimum rating recorded was 7.5; the maximum rating was 14.5.

Within this rating system, there are 7 observations laid down in the national regulations for the animal welfare on farm (Legislative Decree 146/2001 and Legislative Decree 126/2011). If during a farm visit non compliances with the legislation should be noted, as well lowering the area rating and the overall one, these will be clearly reported on the Welfare Assessment Certificate.
Below are the results obtained:

Table 14 – Breakdown of legislative non compliances (557 farms assessed; 1 January 2011 - 17 December 2013)

NON COMPLIANCES	NO. OF FARMS	% FARMS
Water availability	57	10,23
litter for < 2 weeks old calf	34	6,1
Single-pen area for calves	47	8.43
Possible contact with other calves	247	44.34
Multiple-pen area for calves	31	5.56
Udder health	13	2.3
Mutilations	143	25.67

Table 15 – Breakdown of farms that were non-compliant (557 farms assessed; 1 January 2011 - 17 December 2013)

NO. OF NON COMPLIANCES	NO. OF FARMS	% FARMS
0	195	35
1	215	38.6
2	99	17.8
3	36	6.5
4	9	1.6
5	3	0.5
6	0	0
7	0	0
	557	100%

AREA E - BIOSECURITY

In April 2013, the Ministry of Health requested that the welfare assessment system is combined with the dairy cattle farm biosecurity assessment. With the contribution by other IZSLER veterinary managers, a new area has been added, relative to the data collection and biosecurity analysis.
For this reason 113 are the farms that up until now have received this type of assessment.

Table 16 – Breakdown by region of farms that have had the biosecurity assessment (3 July 2013 - 17 December 2013)

REGION	**NO. OF FARMS ASSESSED FOR BIOSECURITY**
LOMBARDY	53
EMILIA ROMAGNA	6
PIEDMONT	12
VENETO	8
TRENTINO - ALTO ADIGE	0
FRIULI - VENEZIA GIULIA	9
ABRUZZO	1
CALABRIA	3
SARDINIA	6
SICILY	12
TOTAL	**113**

Previously, some observations concerning biosecurity had already been implemented into the assessment system; they were then transferred to the new Area E, together with the recently created questions. For this reason, the ratings were recalculated.
Biosecurity is an important factor that can significantly influence animal welfare on farm and for this reason it is expected in the future that its rating, once properly processed, can also influence the welfare rating.

Table 17 – Breakdown of farms by AREA E rating range

	RATING RANGE (AREA E)	FARMS	% FARMS
1° -33° percentage	14.5 - 27	32	28.32
34°-66° percentage	27 – 39.5	66	58.41
67° - 100° percentage	39.5 - 52	15	13.27
	TOTAL	113	100

The average rating for Area E, obtained from 113 farms assessed, was **30.44, equal to 42. 51% of the available score and 58.75% of the maximum score** (see Table 9).

The minimum rating recorded was 16.5; the maximum rating was 48.

STATISTICAL ANALYSIS OF DATA FOR THE WELFARE ASSESSMENT OF DAIRY CATTLE IN LOOSE HOUSING

The statistical analysis of the data collected in 2011-2013 period can be carried out with different calculation methods to achieve two objectives:

1. to develop descriptive statistics, relative to the main variables that affect the consistency and productivity of each farm;
2. to test the correlation and association between the area ratings that relate to the risk assessment – that is farm management and personnel (area A), facilities and equipment (area B), inspection of microclimatic environmental conditions (area D) – and the area C rating, which assesses the risk effects, through the assessment of the cows psychophysical status.

This second objective is fundamental as it indicates which and how many management and housing factors can influence the welfare of the animals.

Only after this assessment, that underlines the association between the cattle farming system and cow welfare conditions, it will be possible to understand the planning and implementation of management and/or structural changes, which can tangibly improve the living conditions of the animals.

The mathematical data processing requires, by itself, much more time than the mere up-dated collection; therefore at the time of drafting this manual (even if nearly 600 farms have been assessed) the statistical analysis refers to the first 507 farms that were visited and not to the 557 farms that were considered in the previous chapter. For this reason, some data and information could slightly differ from those previously reported.

1 – DESCRIPTIVE ANALYSIS

During the preliminary phases the most important variables were discovered:

- total number of cows for farm;
- number of lactating cows for farm;
- kilograms of milk produced by animal per day.

As illustrated in Table 19, the average size of the farms is equal to 265 (SD = 197.11) animals. The high level of standard deviation indicates a strong diversification among the farms, confirmed by the smallest farm with a total of only 12 animals and the biggest one with a total of 1413 animals.

Each farm has an average of 121 lactating cows (SD = 86.40). The found maximum number is 644 lactating cows.

Finally, the average milk production per day expressed in daily kg per animal was equal to 28. 24 kg (SD = 3.96). Even in this case, the variability among the farms is quite high: the largest quantity of daily milk produced per animal was equal to 38 kg, whilst the least amount was 15 kg.

Table 18 – Descriptive statistics for the variables linked to the size and productivity of the farms (507 farms assessed).

Statistics/Variables	Total number of cows	Number of lactating cows	Kg of milk per animal a day
Average	265.00	120.66	28.24
Median	200.00	95.00	29.00
Mode	180.00	80.00	30.00
Standard Deviation	197.11	86.40	3.96
Range	1401	634.00	23.00
Minimum	12	10.00	15.00
Maximum	1413	644.00	38.00
First quartile	135.00	62.00	26.00
Third quartile	340.00	160.00	30.00
Interquartile range	210.00	98.00	4.00

Below there are the descriptive statistics for the score obtained for the four areas and the overall score (taken from their sum) relative to the first 507 farms assessed.

Table 19 – Descriptive statistics for the overall animal welfare score and scores for the four assessment areas (507 farms assessed).

Statistics /Variables	Total Rating	Area A	Area B	Area C	Area D
Average	153.67	41.76	42.90	57.45	11.55
Median	154.37	42.13	43.,09	58.00	11.50
Mode	135.41	43.80	44.75	53.00	12.50
Standard Deviation	15.82	4.17	5.64	8.57	1.21
Range	88.77	25.30	28.96	47.00	6.50
Minimum	96.76	25.65	25.78	28.00	7.50
Maximum	185.53	50.95	54.74	75.00	14.00
First quartile	145.06	39.47	39.25	52.00	1100
Third quartile	165.22	44.47	47.25	64.00	12.50
Interquartile range	20.16	5.00	8.00	12.00	1.50

As illustrated in Table 20, the total average score was equal to 153.67 (SD = 15.82) with a minimum score equal to 96.76 and maximum to 185.53.

For area A, the average score is equal to 41.76 (SD = 4.17). The minimum score given is equal to a 25.65 whilst the maximum to 50.95.

For area B, the average score is equal to 42.89 (SD =5.65). The minimum score obtained is equal to 25.78 whilst the maximum to 54.74.

For area C, the average score is equal to 57.45 (SD = 8.57). The minimum score obtained is equal to 28.00 whilst the maximum to 75.00.

Finally for area D the average score recorded is equal to 11.55 (SD = 1.21). The minimum score obtained is equal to 7.50 whilst the maximum to 14.00.

Through the box plot (Figure 42) it is possible to view the median value (horizontal line within the box), the quartiles, the variability (length of the box) and the outliers (dots) of the scores obtained for each area.

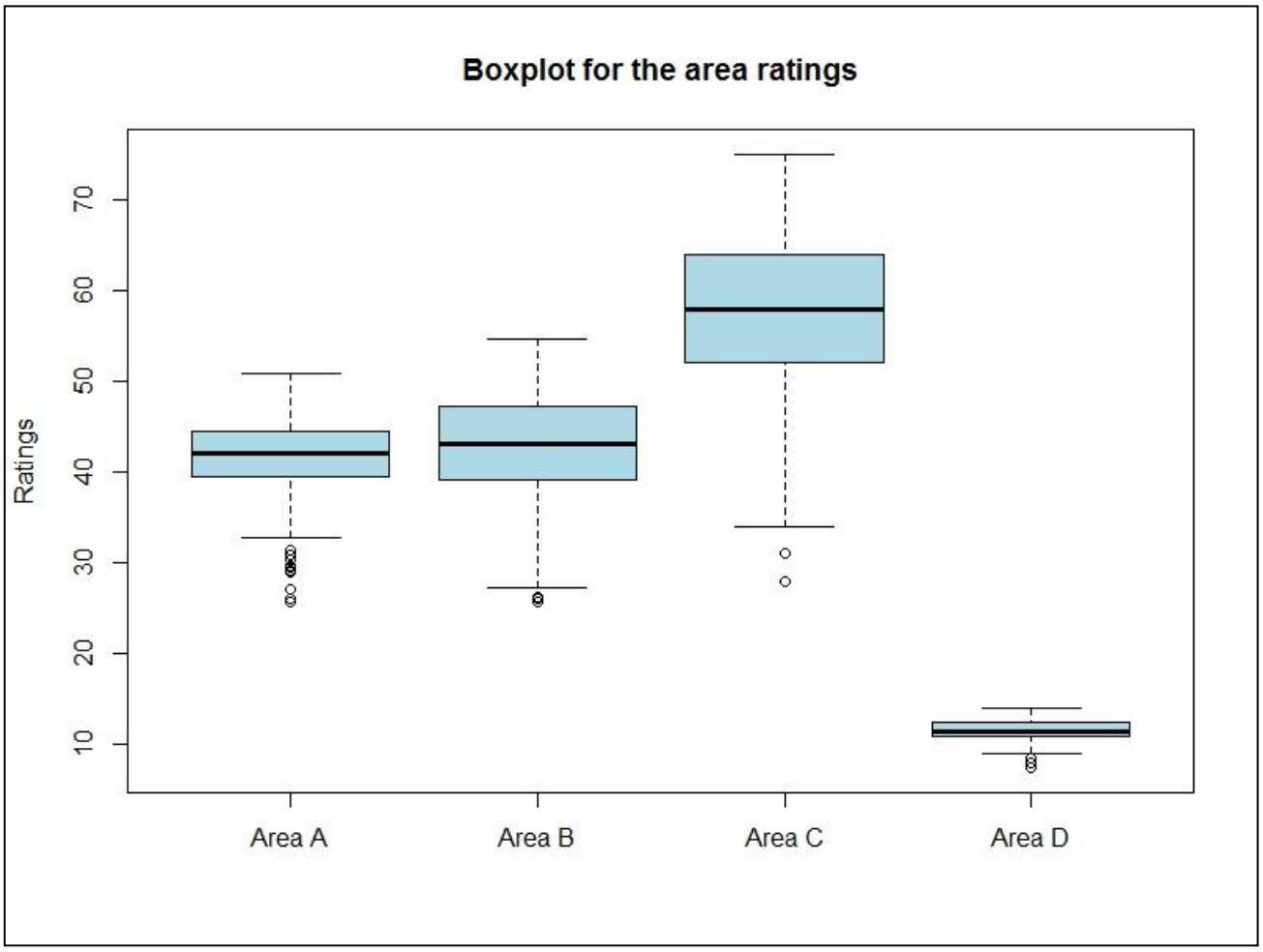

Figure 42 - Box plot for the area ratings

2 – ANALYSIS OF THE CORRELATION BETWEEN RISK FACTORS AND EFFECTS

First of all, for each of the 507 farms analysed, a questionnaire has been compiled (check-list) with the aim of describing and comparing the farms for their management, facilities, environmental conditions and animal welfare. A higher score indicates a farm with better living conditions.

For sake of clarity, the questions that make up the assessment questionnaire have been divided into four "areas of competence".

In particular:

- Area A: includes observations that relate to the farm management and personnel for each farm. For example, through the interview questions, it was possible to define the experience of the personnel and the management forms of the herd and the routine activities. A higher score indicates a farm with a better farm management;
- Area B: includes the observations that relate to the facilities and equipment available in each farm. A higher score indicates a farm with better facilities and equipment;
- Area C: includes the observations that relate to the welfare of the animals from each farm. A higher score indicates better conditions for the animals, and therefore better health, behaviour and general appearance;
- Area D: includes the observations that relate to the environmental conditions (for example noise) and the prevention of big risks (for example, fire) that characterise each farm. Even in this area, a higher score indicates a farm with better environmental conditions and better protection from potentially serious risks.

The aim of this processing was to show if there is an association between the score (rating) of the area, i.e.: the farm management and personnel (area A), the facilities and equipment (area B), the environmental conditions/risk prevention (area D) and the area that describes the health and welfare of the animals (area C). In other words, to verify if there really is an association among the areas that describe the causes/risk factors for the animal welfare (areas A, B and D) and the area describing the effects/consequences on the animals themselves (area C).

In fact, the point is: is there a correlation between the score obtained in the three areas (A, B and D) and the score obtained in area C? Is it statistically sustainable that the farms with worse management, facilities and environmental conditions have animals with lesser health and welfare?

To answer to these questions, two types of analysis were used:

A. Univariate analysis using correlation index ρ and univariate linear regression;

B. Multivariate statistical analysis through the use of multivar linear regression.

A – UNIVARIATE ANALYSIS USING CORRELATION INDEX ρ AND UNIVARIATE LINEAR REGRESSION.

The linear correlation coefficient ρ (also known as Pearson correlation) is usually used in statistics to test the relationship between two quantitative variables.

Such an index assumes values between $-1 \le \rho \le 1$ where, in particular:

- if the value is $\rho = 1$ then the correlation between the two variables is perfectly linear. In other words, the two variables are directly proportional. Typical values of ρ greater than zero exist when by increasing the X variable the Y variable also increases. For example, when by increasing the height (X) the weight (Y) also increases. The $\rho = 1$ value occurs every time you calculate a correlation between a variable and itself;
- if the value is $\rho = 0$ the two variables are uncorrelated**.** Or there is no association between the couple of variables under examination. Statistically, this always happens when the variables are independent;
- if the value is $\rho = -1$ the two variables are linked by an inverted linear association. In other words, the two variables are inversely proportional. A ρ value which is usually less than zero occurs in the economic field. For example, with the increase in prices (X) the consumption falls (Y).

The correlation matrix *R*, on the other hand, is a square matrix (number of lines are the same as the number of columns), symmetric and has value 1 on the diagonal since each variable is perfectly correlated to itself. The matrix correlation synthesises the different ρ values into one single matrix.

Figure 43 shows the *R* correlation matrix, where for illustrative purposes $\rho(X_1, X_2)$ indicates the value of the correlation between the variable X_1 and X_2.

$$\mathbf{R} = \begin{pmatrix} 1 & \rho(X_1, X_2) & \cdots & \rho(X_1, X_n) \\ \rho(X_1, X_2) & 1 & \cdots & \rho(X_2, X_n) \\ \cdots & \cdots & \cdots & \cdots \\ \rho(X_1, X_n) & \rho(X_2, X_n) & \cdots & 1 \end{pmatrix}$$

Figure 43 – Theoretical R correlation matrix

In the case under analysis**,** the correlation matrix is showman Table 21:

Table 20 – Correlation matrix between the areas

Area	A	B	**C**	D
A	1	0.598	**0.518**	0.430
B	0.598	1	**0.465**	0.424
C	**0.518**	**0.465**	**1**	**0.277**
D	0.430	0.424	**0.277**	1

All the ρ coefficients are higher than zero: this indicates a direct linear correlation link.

The aim of the analysis is to understand the correlation between the areas (A, B and D) with area C. For this reason, the line (and column) of interest is the fourth (in bold).

The highest correlation can be found in the Area A rating, that assesses the management (0.518), than in the Area B rating for facilities and equipment (0.465); finally, in the area D rating, that describes the control of environmental conditions and big risks (0.277).

For all of these values a statistical test has been carried out where the entire coefficient matrix is statistically different from zero ($p < 0.05$).

A limitation of the linear correlation coefficient ρ is often calculated even if the relationship between the two variables is not linear.

To understand whether between areas A, B, D and C there is a linear relation, scatter plots were created with univariate linear regressions. The scatter plots show the ratings obtained in a Cartesian graph for each possible variable couple.

The scatter plots for the ratings for the areas A and C, B and C, D and C are shown in Figure 44, 45 and 46.

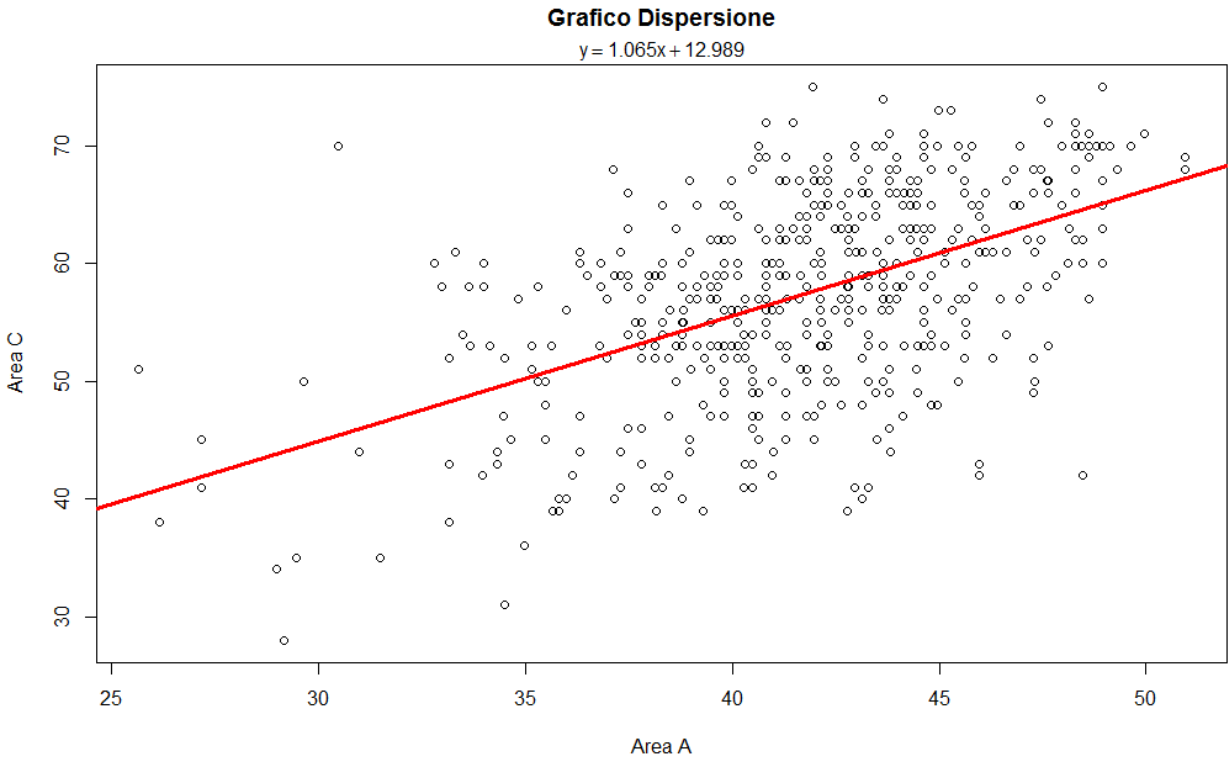

Figure 44 – Scatter plot between area A (a axis) and area C (ordinary) rating

Figure 44 shows a linear relation between the ratings of the two variables. This relation can be summarized by a linear regression line whose equation is shown in the graph. The index adjustment line to the data, shown by R^2, is equal to 0.267. Such figure is included between zero and one. If the R^2 index is equal to zero, the line has a bad adjustment to the data.

The interpretation of the equation of the line is defined as follows; with an increase for the area A rating, the area C rating increases on average by 1.065 times.

In other words, an improvement in the rating concerning farm management and personnel that are tested by the system, improves the health and welfare of the animals.

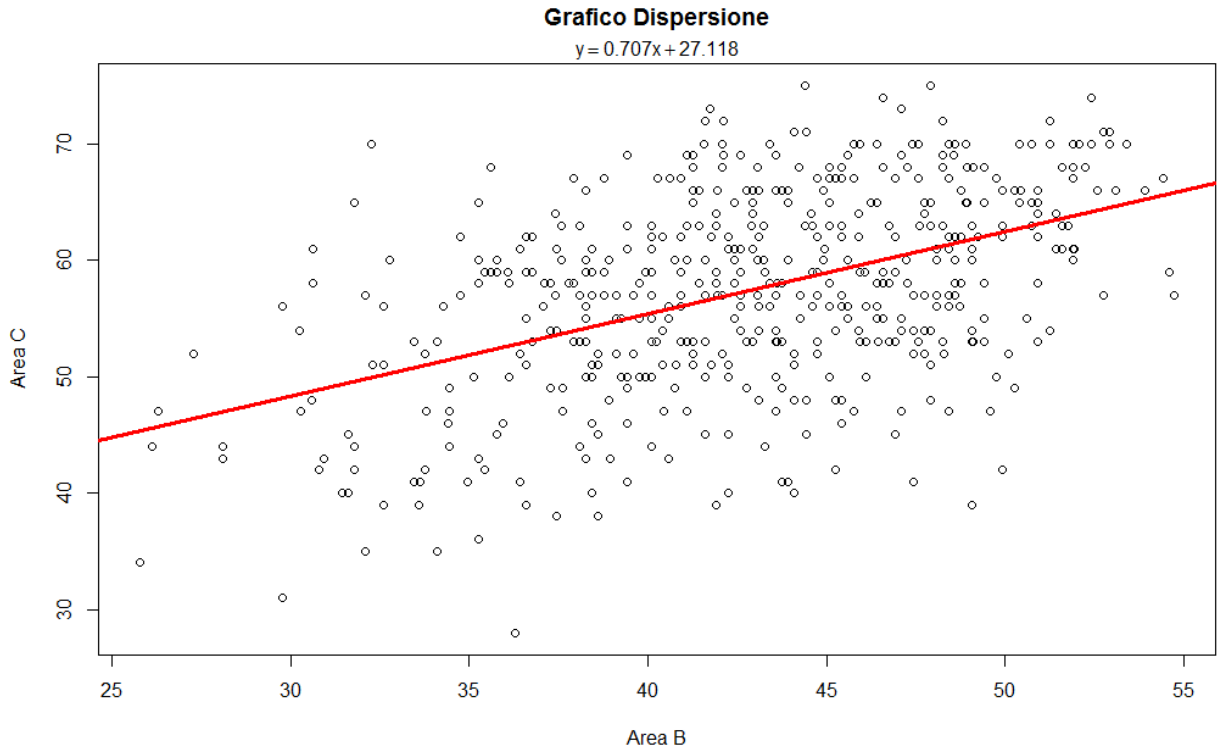

Figure 45 – Scatter plot for area B (a axis) and area C (ordinary axis) ratings

Figure 45 highlights a linear connection between the ratings of the two variables. This linear relation can be summarized through a linear regressive line whose equation is shown in the graph (R^2= 0.215). With an increase by one unit in the area B rating, the area C rating rises on average by 0.707 times.

In other words, an improvement in the facilities and equipment rating of the farm improves the health and welfare of the animals.

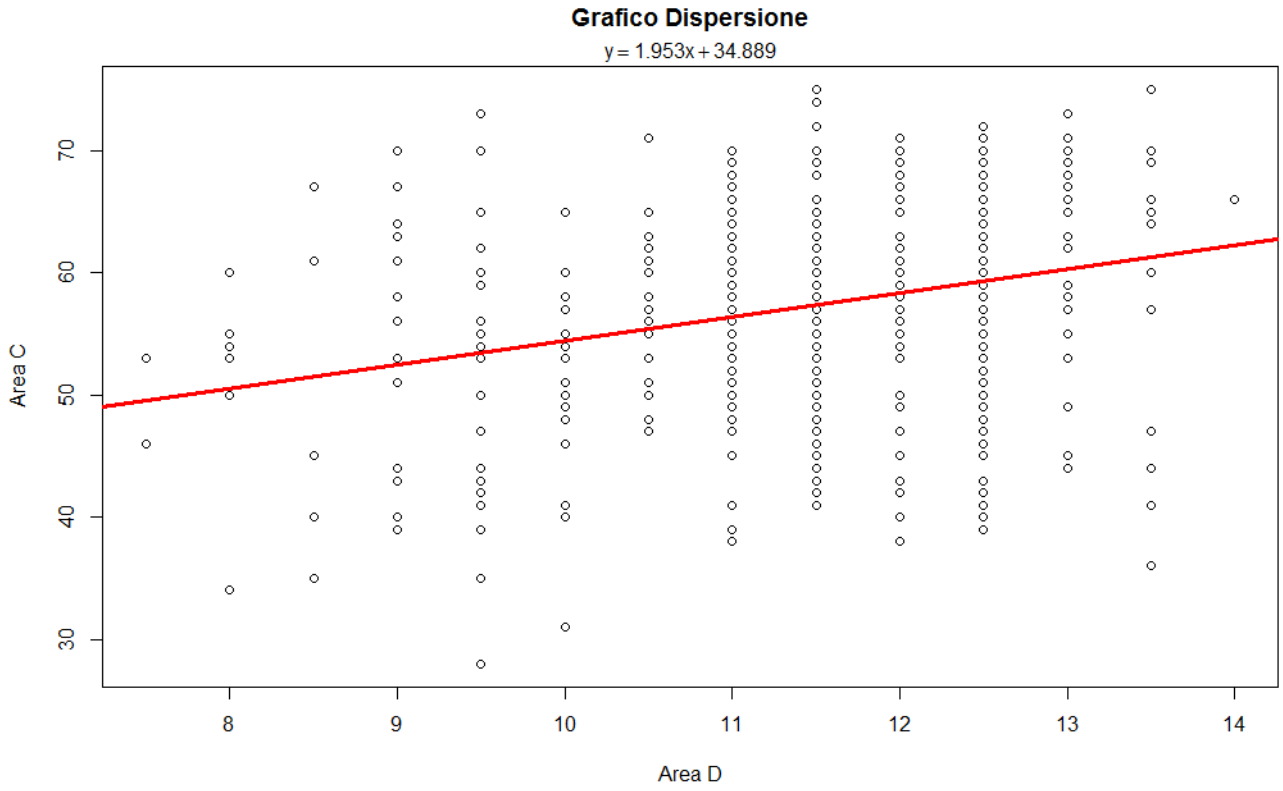

Figure 46 – Scatter plot for area D (a axis) and area C (ordinary axis) ratings

Figure 46 highlights a non-linear connection between the ratings of the two variables. This relation can be summarized by the linear regressive line whose equation is shown in the graph. In fact, the non-linear adjustment index to the data is lower than in the two previous figures. The R^2 value is equal to 0.07 and indicates a worse adjustment of the line to the data. Therefore it makes no sense to interpret the parameters of the line.

A similar evaluation of the Pearson linear ρ correlation coefficient can be carried out using the Spearman *r* correlation index calculation, which is less sensitive to abnormal values (outliers). This is also a value between [-1 and 1]; and is a non-parametric coefficient, based on the ranks.

Table 21 – Spearman *r* correlation matrix

Area	A	B	**C**	D
A	1	0.579	**0.486**	0.399
B	0.579	1	**0.423**	0.393
C	**0.486**	**0.465**	**1**	**0.252**
D	0.399	0.393	**0.252**	1

The correlation matrix including the Spearman correlation coefficients is shown in Table 22.
By comparing the tables, it is possible to see how the Spearman *r* coefficients (Table 22) are lower than the Pearson one (Table 21); this is because the Spearman correlation is less affected by the outliers, since it is calculated on the basis of the ranks.

B – MULTIVARIATE STATISTICAL ANALYSIS THROUGH THE USE OF A MULTIVARIATE LINEAR REGRESSION.

With the multivariate linear regression it is feasible to explain the possible relation between a phenomenon called dependent variable (generally, Y variable) given a set of other phenomena($X_1, X_2, X_3, ..., X_n$ variables, also known as explanatory variables) through the following equation:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + ... + \beta_n X_n + \varepsilon \qquad (1)$$

where ε is the casual error.
With this mathematical analysis, on the contrary to the ρ Pearson method, the correlation between a single rating (area C) and a set of variables (area A+B+D) is evaluated. Statistically, the use of a multivariate regression increases the power of the analysis and helps to understand which are the phenomena that can explain the variable of interest, rejecting those less useful and not statistically important (principle of parsimony).
In the case study, the explanatory variables are the A, B and D area ratings, whilst the variable in question (the dependent variable) is represented by the area C rating.

Table 23 shows the multivariate linear regression (F = 74.02; df = 3; $p < 0.001$).

Table 22 – Multivariate linear regression

Variables	**Estimated coefficients**	**Standard errors**	**t value**	**p value**
Intercept	8.903	3.698	2.408	0.016
Area A	0.757	0.098	7.713	< 0.001
Area B	0.361	0.072	4.984	< 0.001
Area D	0.126	0.298	0.422	0.673
$R^2=0,30$				

When increasing by one unit the rating relating to farm management and personnel (area A), the score relative to the welfare of the animals (area C) improves on average by a 0.757 score ($p < 0.001$).

When increasing by one unit the rating relating to the facilities and equipment (area B), the score relative to the animal welfare improves on average by a 0.361 score ($p < 0.001$).

Finally, as verified by the correlation index calculation and the univariate regression, the parameter concerning the inspection of environmental conditions (area D) is not statistically significant ($p = 0.673$).

According to the principle of parsimony, the variables that explain the score obtained for area C are the scores for A and B.

CONCLUSIONS

The future of our farms will be even more linked to the environment from which they arise and the ethical quality of their products. For this reason the biosecurity and animal welfare of the farms will be essential conditions for the sustainability of dairy farms. The vet will be of essential importance for these conditions; therefore he will have to be prepared to correctly assess the biosecurity and welfare requirements in line with the regulations, and the recent field research results, through the use of coded systems which are based on scientific risk analysis and therefore are repeatable and objective. In other words, the assessment concerning the biosecurity and animal welfare levels of the farms cannot reflect a personal opinion, but has to come from a full and serious assessment of many factors that embrace the whole bovine subject. Only in this way it will be possible to ensure a reliable judgement, and most of all repeatable, among the various assessors, regardless of the size and geographical location of the farms assessed.

In order to satisfy these fundamental principles, the biosecurity and welfare analysis procedures proposed in this book have been applied by 50 colleagues, in very different farms both in terms of herd size (from a minimum of 12 to a maximum of 1413 animals), production level (from a minimum of 15 to a maximum of 41 kg of milk/animal/day), and geographic distribution (from Calabria to Trentino - Alto Adige, including Sardinia and Sicily). Despite such diversity, the statistical analysis described in the previous paragraph fully supports the assessment system. The repeatability of the rating relative to objective and measurable parameters was ensured by the agreement among the operators, expressed as an agreement percentage through the Fleiss' Kappa and free-marginal Kappa indexes, Kendall's W index for each item and the Kappa index for each operator. These considerations are an essential prerequisite for the assessors' preparation, who allow for the comparison of data among the different farms, by ensuring a high repeatability of judgment.

The final result from the welfare assessments and the following data processing show without any doubt that Italian farms breed dairy cattle in good conditions. The average welfare score (153.67) of all the 557 assessments carried out (obtained from the risk assessment, the related effects and therefore the adaptability of the cows to the different farming conditions) reached nearly 70% (69.15) of the system available score, which is well above the average level, represented by the score of 125.4. Of the 557 farms assessed, only 35 (equal to 6.28%) were given lower ratings, whilst 522 (equal to 93.72%) showed ratings higher than the average level. By splitting into 3 sections the available overall welfare score, only 1 farm was given a poor rating, ranking in the third bottom percentile (a rating from 51.45 to 100.75), whereas in the third best percentile (from 150.05 to 199.35), that represents good welfare levels, there are over half of the farms (341 farms equal to 61.2 %).

Of great practical importance is also what emerges from the statistics correlation between the variables derived from the areas of analysis. The correlation indices and the scatter splots clearly highlight a positive association between the areas of farm management and facilities with the animal welfare conditions area. The analysis of the data has shown that an increase by one point of the rating in the A and B risk areas corresponds on average to the improvement of ratings for area C by 1.065 and 0.707 respectively; this indicates how the animals adapt favourably to the farming conditions stated in the two risk areas. This result provides specific indication to the farmers who would like to develop management or housing changes with the aim of improving the welfare of the animals.

In connection with these results, it can be said that anyone (farmers, cooperatives, vets, supply chains, etc.) who wants to improve the welfare of the animals, can take advantage of the rating system described in this book, knowing that the correlation between the main management and housing points, stated in the area A and B assessments, will bring an increase in the welfare level of the farmed cattle.

As well as on the assessment system for the welfare and biosecurity of dairy cattle kept in loose housing systems, the Italian National Animal Welfare Reference Centre is working also on determining analysis systems which are applicable to other types of cattle farming. Even in these cases, the risk factors will be identified, weighed up and entered into software for the management of the assessments. The future aim is to complete this manual with new chapters for *"biosecurity and welfare assessment of dairy cattle kept in tie-stall housing systems", "biosecurity and welfare assessment of cattle kept for beef production", "biosecurity and welfare assessment of veal calves"* and finally for *"biosecurity and welfare assessment of cow-calf farms."*

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