

EuroDairy

Alternative housing systems for dairy cows -
report on best practice



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About EuroDairy

EuroDairy spans 14 countries, from Ireland to Poland, and from Sweden to Italy, encompassing 40% of dairy farmers, 45% of cows and 60% of European milk output. EuroDairy is an international network to increase the economic, social and environmental sustainability of dairy farming in Europe. EuroDairy fosters the development and dissemination of practice-based innovation in dairy farming, targeting key sustainability issues: socio economic resilience, resource efficiency, animal care, and the integration of milk production with biodiversity objectives. EuroDairy is funded by the EU Horizon 2020 research and innovation programme under Grant Agreement No 696364.

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1. Introduction

The housing system, sometimes integrated with the option of outdoor grazing, impacts on cow health, productivity, welfare and the ability to exhibit normal behaviour. The ability to be able to demonstrate animal-friendly systems for housing cattle is also essential to retrain consumer confidence, addressing some societal concerns over current systems of production. Providing a good housing environment for dairy cows is becoming even more critical, as an increasing proportion of cows are being housed on a continuous basis.

Optimising the housed environment is a sub-theme within the EuroDairy Work Package on Animal Care, and fits into the overall objective to support economic, social and environmental sustainability of European dairy farming.

2. Standard housing systems for dairy cattle

Standard housing systems are usually based on the provision of free stalls (often referred to as 'cubicles'), which define where cows can choose to lie. The remainder of the shed is made up of passageway, for movement, loafing and feeding.

In recent years, a considerable body of information and management guidelines has been collated on welfare-friendly and cow-centric building design for free stall systems. This material has not been replicated in the current report but can be found from North American (e.g. <https://thedairylandinitiative.vetmed.wisc.edu/>), or European sources (e.g. <http://dairy.ahdb.org.uk/dairy-housing-best-practice-guide#.XDONXuS7JYc>).

Within the Animal Care work package, we chose to focus mainly on alternative and innovative housing systems, which aim to improve cow welfare.

3. Alternative housing systems

To improve cow comfort, pioneering farmers have invested in developing an alternative housing system, characterised by a barn where cows are free to wander, stand and lie in a soft-bedded lying area - so-called 'Free Walk' barns. Based on a questionnaire distributed among EuroDairy partners, it is estimated that more than 100 European dairy farmers have invested in new Free Walk barns, with the majority in the Netherlands (60+), followed by Spain (12+) and France (10+). In addition, some farmers in Denmark, Sweden, Belgium and Germany have invested in alternative housing systems. In countries such as France, many farmers still use traditional straw yards or beds, but mostly for herds of less than 80 cows.

The definition of 'Free Walk', is a housing system for lactating dairy cows with a large, open and soft-bedded lying area. In free walk systems, there are no stalls, no concrete floors, and greater space allowances per cow. Concrete floors are generally only used near the feed alley, and in the milking parlour. Traditional deep litter straw yards could also fit these criteria, and could be considered as a Free Walk barn. These have generally gone out of fashion as herd sizes have increased over the years, and due to concerns over environmental mastitis pathogens. If these barns are adapted for better cow comfort, and improved efficiency, this could also be considered as innovative. 'Free Walk' concepts and management options are described in a video produced in 2014 in Dutch, with English sub-titles, by EuroDairy partner Wageningen University. (<https://www.youtube.com/watch?v=UgPc7C659xl>)

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3.1 Developing and exchanging knowledge on Free Walk systems

EuroDairy has tried to intensify knowledge exchange on Free Walk systems across borders, using a number of routes: connecting with or coordinating relevant Operational Groups, running a workshop, organising a webinar and participating in other projects and networks, which aim to generate scientific data on this system of housing.

While this report focusses on the central aspects of Free Walk systems, the EuroDairy project has also been probing even more innovative thinking around enhancing the housed environment for dairy cows. In 2017, UK farmers, researchers and advisors undertook a study tour to visit the 'Cow garden' experiments at the Dutch Dairy Campus¹. Ammonia emission reduction was the subject of a follow-up tour in 2018². Reports from both visits can be found on the EuroDairy website at www.eurodairy.eu.

3.2 Operational Group activity

Netherlands

Many of these Free Walk farmers are operating independently, outside of a formal network and/or an 'official' Operational Group. Progress can be more rapid where farmers come together as a group, to share ideas and experience with researchers, advisors and other farmers. In the Netherlands, the network "Vrijloopstallen³" (Free Walk barns) has been operating for more than 10 years and is one of the 'unofficial' Operational Groups affiliated to EuroDairy. In this group, around 15 dairy farmers with Free Walk barns meet regularly to discuss progress and exchange knowledge. An advisor, funded for a period by the Government under an initiative to support Sustainable Cattle Farming, acts as a facilitator. Dutch farmer Mark Havermans is a EuroDairy pilot farmer, and member of the Vrijloopstallen network. Mark regularly hosts national and international visitors to his farm⁴ to look at his management system.

Italy

EuroDairy partner, CRPA, coordinates an Italian Operational Group - Compost Barn⁵, funded by the Rural Development Programme in Reggio Emilia. The aim of the project, which runs from June 2016 until May 2019, is to understand how the Compost Barn housing technology can be successfully applied to dairy farms producing Parmigiano Reggiano cheese. The project hopes to define design and management guidelines customised to local conditions.

3.3 EuroDairy Workshop

To synthesise some of the existing knowledge, EuroDairy organised an international workshop in Lille, on the use of bedded pack and compost barns for dairy cattle, bringing together researchers, farmers, advisors and students⁶. Proceedings from this workshop can be found on the EuroDairy website.

3.4 ERA-NET

Two EuroDairy partners (University of Ljubljana, WageningenUR) are also participating in an ERA-NET SUSAN funded project specifically on Free Walk systems⁷. Within this project, detailed data are being collected on 20 commercial Free Walk barns and 20 conventional free-stall cubicle houses, to provide more quantitative information and insight into the relative performance of both systems, particularly in relation to cow comfort and welfare. In October 2018, EuroDairy partner, the University of Ljubljana, facilitated a visit by Slovenian farmers to

¹ <https://eurodairy.eu/case-studies/exchange-visit-british-to-dutch-dairy-farmers-alternative-housing-systems/>

² <https://eurodairy.eu/about/news/video-low-ammonia-emission-in-dairy-cow-housing/>

³ www.vrijloopstallen.nl

⁴ <https://www.youtube.com/watch?v=CJnClxtAkFM>

⁵ http://compostbarn.crupa.it/nqcontent.cfm?a_id=14673

⁶ <https://eurodairy.eu/about/news/eurodairy-shows-new-solutions-to-bedded-pack-and-compost-barns-lille/>

⁷ <https://www.freewalk.eu/en/freewalk.htm>

look at the application of Free Walk systems in the Netherlands⁸. The report of the visit can be found on the EuroDairy website.

3.5 Webinar

EuroDairy also looked beyond the borders of Europe to capture relevant information which could be customised, or interpreted in a European context. In the USA, many dairy farmers, mainly in Minnesota and Kentucky, have gained experience with compost bedded pack barns. US experience was captured by EuroDairy in the form of a webinar presented by experts Bewley and Joseph Tabara from the University of Kentucky⁹.

4. Emerging results and critical success factors

4.1 Costs and benefits

Though improvements can be made to free stall systems with cubicles, Free Walk barns herds tend to perform better in terms of health, welfare, production and longevity of cows. An important aspect is that the cow can lie down and stand up unhindered, which – in combination with the soft floor – leads to less skin injuries and less leg and claw problems. However, this comes at an additional cost - higher capital investment in buildings, and higher annual running costs. Additional costs relate to the greater space allowance per head required, extra requirements for the foundation, and provision for good ventilation, the cost of bedding materials (dependent on availability and price), and labour input for correct management of the bed.

“Animal wellness and managing of the cows was definitively the most important reason for us to choose this Free Walk system”. Mark Havermans, Dutch dairy farmer.

These general points are supported by experience from the USA, which indicates that the main advantage of the compost bedded pack barns is the excellent cow comfort, including greater freedom to express natural behaviour. Negative effects on hygiene and mastitis were not evident, despite the cows being exposed to higher levels of bacteria in the composted bedding.

In an Austrian study¹⁰, seven compost barns were monitored and analysed on management practices and animal behavior. Forest and wood industry sawdust, woodchips and residual wood materials were used as bedding. Assessment of cow behaviour and welfare concluded a positive impact on joint lesions and lameness, and no clear negative impact on cleanliness.

4.2 Building design

Building design and bedding management and are the key factors to cope with heat and moisture production by the cows, and to facilitate an effective composting process. This is essential for good hygiene, and mastitis control.

As urine (and faeces) is continuously added to the bedding, and the composting process produces water, the challenge in Free Walk barns is to keep the top layer sufficiently dry. In Israel, Free Walk barns with dried manure bedding is the predominant system - made possible because of the hot and dry climate. Under Western European climatic conditions, it is a challenge to get the manure dry enough. The composting process itself produces heat. Evaporation can be enhanced by raking the bedding and/or forced ventilation, blowing or sucking air through channels beneath the bedding. In the absence of cultivation, moisture can also be absorbed by adding materials,

⁸ Exchange report will be published at www.eurodairy.eu

⁹ The recorded webinar and the presentations are available at the EuroDairy website <https://eurodairy.eu/resources/webinar-compost-bedded-pack-barns-for-dairy-cows/>. For further information about features and management considerations see the publication https://www.uky.edu/bae/sites/www.uky.edu/bae/files/id206_0.pdf

¹⁰ Joop Lensink and Elfriede Ofer-Schröck, EuroDairy workshop February 23 2017 Lille (France)

like in (traditional) straw yards. A sand or an artificial floor separates the faeces and the urine, and so the moisture is drained.

Dutch farmer Rik Lagendijk built a Free Walk barn with artificial aeration. This video (in Dutch) shows how this barn (with wood chips, aeration and an air cleaner to reduce ammonia emissions) was constructed and functions <https://www.youtube.com/watch?v=3dmBRSCzKJY>.

4.3 Space allowance

The space allowance per cow will vary depending on how many times a year the bedding is replaced, the quantity of the initial bedding, quality of ventilation and frequency of raking or cultivation. Though there is a lot of farm to farm variation in practice, most farmers in the Netherlands start in November and remove the bedding once a year, stir the bedding daily and allow about 12-15 m²/cow in the lying area. Others remove the bedding two to four times a year and have 8-9 m²/cow.

4.4 Choice of bedding material

Dutch experiments¹¹ investigating different bedding materials concluded drainage with sand is not a good option in a Free Walk barn as it is too difficult to keep the top layer (and therefore the cows) clean enough by removing the faeces. In addition, in sand beds drainage does not always work well enough.

Composting materials like wood chips, saw dust and straw gave better results. Looking at overall sustainability, these beddings score better than the cubicle housing system when it comes to animal health and welfare expressed in a higher longevity and less culling.

A supplementary report has been prepared in cooperation with the project Free Walk on 'French bedded pack barns'¹². This gives an extended description of experiences and bedding materials used in France, where a large proportion of dairy farms (approx. 40% in 2016¹³) use straw yards. The trend towards an increase in cubicles housing is driven by structural changes in the industry - straw yards being more labour intensive and less suited to bigger herds, higher risk of increased mastitis and reduced milk quality. Because of an increasing awareness of the advantages of a free bedding area (e.g. better comfort, less lameness, better manure) some farmers are investing in new Free Walk barns and/or improved straw yards.

In a French study, three commercial farms with Free Walk barns¹⁴ using different litter materials (vegetable compost, saw dust and miscanthus (elephant grass) were monitored. Preliminary results suggested some difficulties in hygiene management and cleanliness of animals during the winter and periods of high humidity. Where space allowance is reduced below that recommended for Free Walk systems, this must be counteracted by greater mixing, switching to another bedding type, and/or more frequent replenishment of bedding material. It was also suggested that regular measurement of bedding temperature at 10cm, depth could be a useful indicator to better manage litter quality, control bacterial development and date of replacement/cleaning out.

To keep the surface clean it would be beneficial if manure and urine could be excreted outside of the bedding area. An 'electronic dog' <https://www.youtube.com/watch?v=1eVOynHHNGk> could be one approach to move animals periodically. However, any trade-offs in terms of reduced lying time or cow behaviour would need to be considered.

¹¹ Paul Galama EuroDairy workshop February 23 2017 Lille (France) and <http://www.vrijloopstallen.nl/english/>

¹² The report French bedded pack barns of Cecile Levraut can be downloaded from the EuroDairy website <https://eurodairy.eu/resources/alternative-housing-bedded-pack-barns/>

¹³ Jean-Luc Menard EuroDairy workshop February 23 2017 Lille (France)

¹⁴ The report French bedded pack barns of Cecile Levraut can be downloaded from the EuroDairy website <https://eurodairy.eu/resources/alternative-housing-bedded-pack-barns/>

In an important contra-indication, Dutch processors have prohibited the use of off-farm composted green waste material as bedding, due to the risk to product quality. This is due to the risk to some dairy product with long shelf life becoming contaminated with spores produced by extreme Thermophilic Spore forming bacteria (X)TAS¹⁵. Composting in the barn is allowed.

4.5 Emissions to air and water

A good composting process is essential to avoid risks to milk quality, increased Green House Gases (GHG) and ammonia emissions.

Moisture control in the pack is the most important. Bedding should absorb all the water from urine and faeces which cannot be evaporated. Effective composting depends on the frequency of 'cultivation' of the bedding, good ventilation and management of stocking density.

An important topic for Dutch farmers is ammonia legislation. New buildings, including Free Walk barns, have to comply with maximum ammonia emissions per cow. Because of the higher space allowance per cow compared to a cubicle housing system, this is not easy to achieve. On the other hand, Free Walk barns produce a low emission manure (compost) when spread, so total emission per farm may be lower. However, this is not recognised in regulation, because of separate legislation for housing and spreading. Better quality manure can also lead to additional fertility benefits, when applied to land.

Further research is being conducted into management of surfaces to reduce ammonia losses. Three commercial farms in the Netherlands have invested in an artificial floor, where the urine is drained and the faeces is picked up by a cleaning robot. This system is also tested in an experiment at the Dairy Campus research facility. The results will inform whether this innovative system will be able to keep the surface sufficiently clean.

Mark Vlaming built a Free Walk with an artificial floor at the end of 2017. The urine is drained and the faeces are picked-up by a robot. <http://veeteelt.nl/video/kunststof-vloer-vrijlooptal>. This avoids scraping which could leave a thin layer of manure on the floor surface.

¹⁵ (X)TAS are (Extreme) Thermophilic Aerobe Spore formers.

5. Conclusions

Many innovations are not totally new but inspired by and/or adjusted 'copies' of existing developments in other countries/other sectors. Knowledge on Free Walks systems has been 'imported' from Israel and the USA and is now being adapted under European conditions.

Free Walk barns could be an alternative housing system for a greater number of farmers. The potential advantages are:

- a more comfortable and lower risk housed environment
- better manure quality
- greater potential acceptability for consumers.

However, careful management of the bedded area is required, to ensure the system can work satisfactorily.

Management guidelines will become more refined as farmer experience, and research data available, expand. While improvements to cow comfort may be seen from an early stage of adoption, some of the factors impacting on cost v benefit e.g. cow longevity, will take longer to emerge to enable potential advantages to be compared with the additional costs.

6. Implications for R&D and policy formulation

6.1 Further research and development

Current information gaps include optimal building design and management to ensure good cow hygiene and ammonia losses, across a range of bedding materials and building designs.

Research into emissions should be integrated, to encompass positive and negative impacts in the shed, during storage and in the application of manures produced.

Options for potential multifunctional use of building should be explored, to help ameliorate the overall cost. If cows are outside grazing during the summer, is it possible to use the building efficiently and safely for other short-term enterprises.

Further innovation may be possible taking learnings from commercial companies who process bio-waste into valuable bio-based products, such as compost. This approach may shed new light on how to overcome some of the practical challenges experienced when implementing Free Walk systems.

As Free Walk systems produce different types of manure (from organic substrates, or from artificial beds with a separation of liquid and solid fractions), further information on the quality of the manure for soil improvement and implications for carbon footprint is required.

6.2 Policy

Though further research and development is necessary to monitor and quantify results, farmers can continue to learn most from each other. This has been exemplified in terms of the development of Free Walk systems to date.

The EuroDairy project is about identifying innovation, developing and demonstrating best practice through the involvement of farmers, researchers and advisors. Operational groups are a good tool to stimulate innovations in practice, enabling commercial farms who invest in a new innovation to further develop and adapt their innovative system by:

- exchanging knowledge between themselves, and cross-border

- interacting with researchers to exchange knowledge, and to identify demand driven needs for further research.

Operational Groups funded by Rural Development Programmes operate in the Netherlands in twelve different provinces. For this reason, it is (almost) impossible to get funding for a national Operational Group - let alone an international group. Knowledge exchange should not stop at province or national level, therefore (inter-) national operational groups should qualify for funding.

Analysis and experiences showed it was difficult to attract dairy farmers to participate in workshops and webinars. Within EuroDairy, exchange visits were highly valued by farmers as a tool to exchange knowledge (directly hearing, seeing, feeling). It should be possible that part of the budget for Operational Groups is spent for those organisations organising and/or hosting an exchange visit.

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