

Bedded pack barns for dairy cattle in the Netherlands



November 2014



WAGENINGEN **UR**
For quality of life

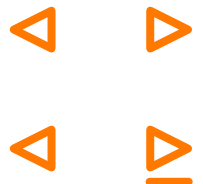
History

In 2007 a group of Dutch dairy farmers started looking for a barn in which cows can become older without problems and out of which excellent fertilizer for the land proceeds. In that year researchers inspired dairy farmers through experiences from Minnesota, USA with Compost Dairy Barns. There they used a bedded pack consisting of wood chips and sawdust, but the sawdust was becoming more and more expensive. Therefore, a number of Dutch farmers went on a study trip to Israel in 2008, searching for a cheaper bedding material. In the Israelian climate farmers succeed to keep the cows clean on a bedded pack of dried manure. However, that is not possible in the humid climate in the Netherlands. Therefore, at the end of 2008, experimental farms of Wageningen UR started to experiment with three principles of drying the top layer of the bedding, namely: drainage, evaporation and absorption of moisture. Moreover, limiting the emissions was also a significant challenge.

Research with pioneers

From late 2009 pioneering farmers started with the first bedded pack dairy barns in The Netherlands. Through many workshops and seminars more farmers became enthusiastic about this type of farm as an alternative to housing in cubicle barns. Initially, they were sceptical whether it would be possible to keep the top layer dry

in the humid Dutch climate, however, soon they saw that it was possible to house cows on a bedded pack of natural materials and to keep them clean. The space for the cows and the soft bedding appealed to them and they also noticed the value of the bedding material in the barn as soil improver for the land. In 2010 an observational study was carried out at three pioneering farms and this extended to ten pioneering farms in 2013. These pioneers work with different types of beddings. Researchers of Wageningen UR and NIZO food research performed measurements on various sustainability aspects at these farms e.g. welfare, health, emissions, milk quality. Meanwhile, in early 2014, about 40 bedded pack barns have been built in the Netherlands.



Types of bedded pack

The results of the study at the three experimental farms in 2008 on a draining sand bedded pack, a composting bedded pack with wood chips and sawdust and an absorbing bedded pack with dried dredging and reed are described in the report 'Prospects for bedded pack barns for dairy cattle' (see website www.vrijloopstallen.nl). Drainage of urine by the sand layer was disappointing and as a consequence the ammonia emission was too high. The composting bedded pack is comparable to the bedded pack of the Compost Dairy Barns in the USA. By working the bedded pack daily, wood chips and sawdust are composted. It was difficult to manage the composting process well. Absorption of moisture with the dried dredging worked well, but supplementation with reed was necessary for a good bearing capacity of the bedded pack for moving around and for the cleanliness of the cows.

Five out of the ten pioneering dairy farmers of the 2013 study have wood chips as bedding material. They compost wood chips in various ways. By using aeration through tubes from underneath the pack (blowing) the composting process can be controlled better. This is done at two farms. Besides active aeration by blowing there are also two farms at which the bedded pack is aerated by sucking air through the bedded pack. The idea is to control the composting process on one hand and on the other hand to limit emissions. One farm has no additional aeration. On all farms the top layer is worked daily which also enriches the bedded pack with oxygen and by which manure is mixed with the bedding material. The heat development in the composting bedded pack results in evaporation of a lot of moisture. Another way of drying the top layer is absorption of moisture by using organic waste compost or straw. The difference with deep litter housing systems using straw is that these bedded packs are cultivated.



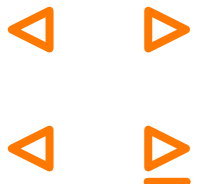
Wood chips



Organic waste compost



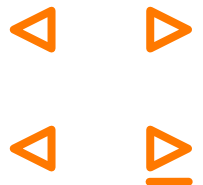
Straw



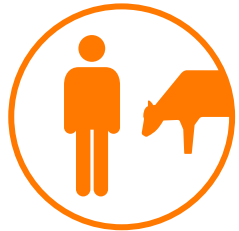
Sustainability aspects

The research focuses on different sustainability aspects. The results are summarized in a diagram from the perspectives of the dairy farmer, the cow, the environment and the public.

For each sustainability aspect it is indicated what the conclusions are based on current research and what the perspective is based on expected improvement possibilities. This is carried out for bedded packs consisting of wood chips and organic waste compost and it is represented in relation to a conventional free stall barn system.



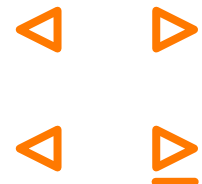
Conclusions based on current research and the future perspective based on expected improvement possibilities



The dairy farmer

= wood chips
 = assessment current situation
 = organic waste compost
 = assessment future perspective

Sustainability criteria	Score compared to free stall barn	Explanation assessment current situation	Explanation assessment future perspective
Management bedding	<p>worse equal better</p>	Less labour, however more professional knowledge is needed	More knowledge becomes available
<i>Economy</i> Investment costs		building costs are equal or somewhat higher, especially more mechanization	Additional costs remain high due to mechanization costs
Annual costs		More litter costs	Litter remains expensive, or becomes even more expensive
Cow health, welfare		Higher production per cow and less replacement	Less young stock remains rewarding
Total economy		Benefit of improved longevity is substantial	Benefit of improved longevity must be verified by proof





The cow and the product

= wood chips

= organic waste compost

= assessment current situation

= assessment future perspective

Sustainability criteria

Score compared to free stall barn

Explanation assessment current situation

Explanation assessment future perspective

Welfare and health

worse equal better

Welfare



Less lesions,
more comfort,
less claw problems

More years of experience
will elucidate the benefit

Health



Less mastitis and
use of antibiotics,
less claw problems

More years of experience
will elucidate the benefit

Longevity



Less culling at some farms

10% less culling of cattle
seems achievable

Spore formers



Mainly a problem in compost

Ban on compost, possible
perspective wood chips in
controlled composting process

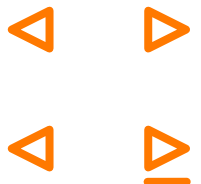




The environment

= wood chips = organic waste compost
 = assessment current situation = assessment future perspective

Sustainability criteria	Score compared to free stall barn	Explanation assessment current situation	Explanation assessment future perspective
	worse equal better		
Supply of N, P		May result in more losses of nitrogen, especially with compost	With wood chips less problem of more nitrogen losses
Supply of C		Additional organic matter	Especially on long term beneficial for soil fertility
<i>N-loss</i>			
In the barn		Considerably more than in free stall barn	Improving management of bedded pack results in less losses
On the land		Nihil, remaining N is organically linked	No change
Barn + land		No loss on land compensates higher loss in barn to great extend	There is perspective in farm context





The environment

= wood chips

= organic waste compost

= assessment current situation

= assessment future perspective

Sustainability criteria

Score compared to free stall barn

Explanation assessment current situation

Explanation assessment future perspective

Manure quality

Availability N



Nitrogen is released slower, improves in the long term

A problem especially in the first years

Organic matter



Material is mainly soil improver

No change, but benefit differs per soil type

Ammonia emission in barn



With compost higher than with wood chips

Controlled composting process and a better management of the bedded pack offers perspective

Greenhouse gases

Nitrous oxide in barn



Shift between ammonia and nitrous oxide, especially with wood chips

Possible improvement with aeration





The public

= wood chips

= assessment current situation

= organic waste compost

= assessment future perspective

Sustainability criteria

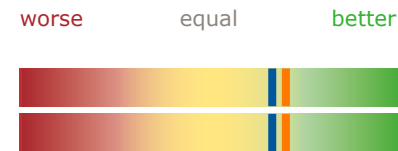
Score compared to free stall barn

**Explanation assessment
current situation**

**Explanation assessment
future perspective**

Odour and fine dust

Odour



More odour emission,
but seems less troublesome

Fine dust



Equal (low)

Barn in the scenery



More spacious,
but more open

More attention for
barn architecture

Public perspective



Animal friendly environment
is appreciated

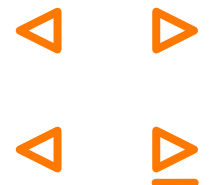


Is the bedded pack barn an integral sustainable barn or can it become one?

Not yet sustainable at all points

The colours in the diagram indicate that the bedded pack barn is not (yet) an integral sustainable barn and that there are important areas for improvement at a number of sections. The main reason for farmers to start with bedded pack barns is the improved animal welfare. The bedded pack barns that have been studied all meet that expectation. Particularly the good lying comfort and the few skin lesions are positive. Although sometimes hard to determine objectively the experience of all farmers (and

their cows) is that the soft lying area and the increased space mean an obvious improvement for animal welfare. This also results in better animal health, although in this respect the number of farms is too small and the duration of the measurements is too short to make harsh statements about for instance claw health and longevity. Furthermore, often other changes in farm management are practiced as well. Nevertheless, all farmers have the expectation that longevity as well as animal health are positively influenced by the bedded pack dairy barn.



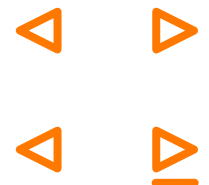
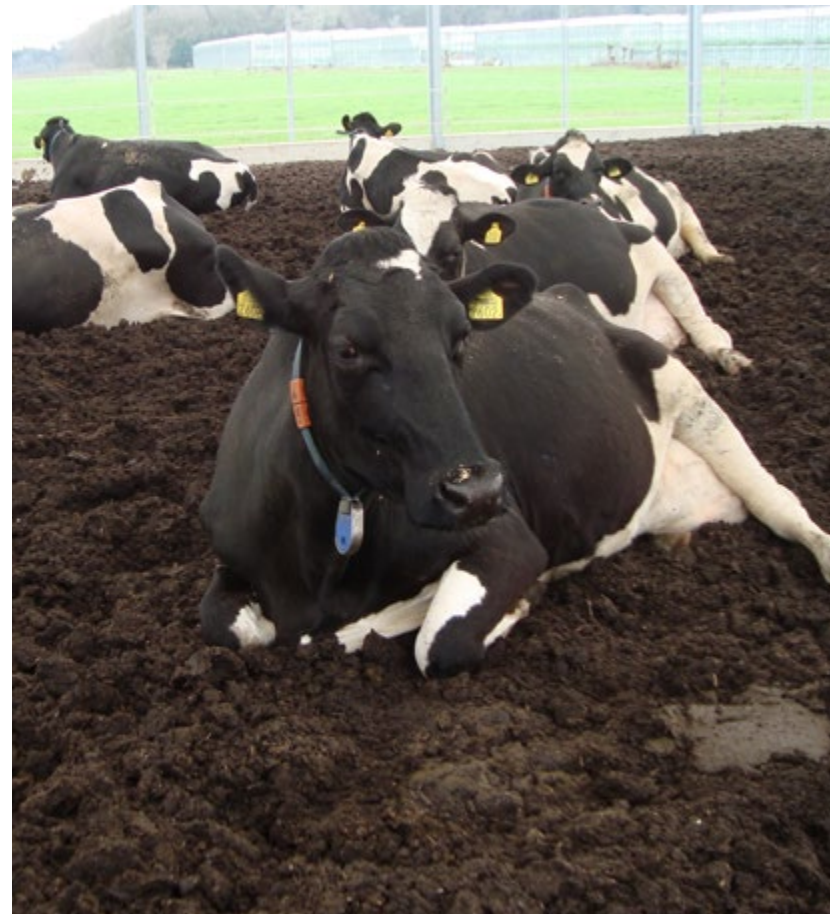
An improved animal health and increased longevity also ensure that the additional costs of the barn, the supply of bedding material and additional costs of mechanization are outweighed.

However, the bedded pack barn is not sustainable at all points. The use of organic waste compost as bedding material initially seemed very positive. Dairy farmers started using it from 2009 on, since it is cheap material and it contributes to the supply of additional organic matter to the farm. However, due to the increased concentration of traces of Thermophilic Aerobic Spore formers (TAS) the biggest dairy company in the Netherlands (Friesland Campina) prohibits the use of compost starting January 1, 2015, since it is a risk for spoilage problems of commercial sterile dairy products. The TAS is supplied to the farm by the organic waste compost. That does not apply to the use of wood chips. The concentration of TAS in wood chips is low. To keep it low in the bedded pack with manure it is important to keep the temperature low. How low, is point of research.

Good bedding management is crucial

It is well known that a farmer is a craftsman. In case of the bedded pack barn another aspect is added to that craftsmanship: management of the bedded pack. Especially when farmers are working with a bedded pack of wood chips, then they need to control a composting

process, which has never been a task of a dairy farmer before. It requires knowledge of and experience with the composting process to keep the bedded pack 'in progress'. Buttons to turn are aeration, ventilation and cultivating the pack. With a bedded pack consisting of compost the time of adding new material is crucial to keep the bedding dry. That should be done in due time.

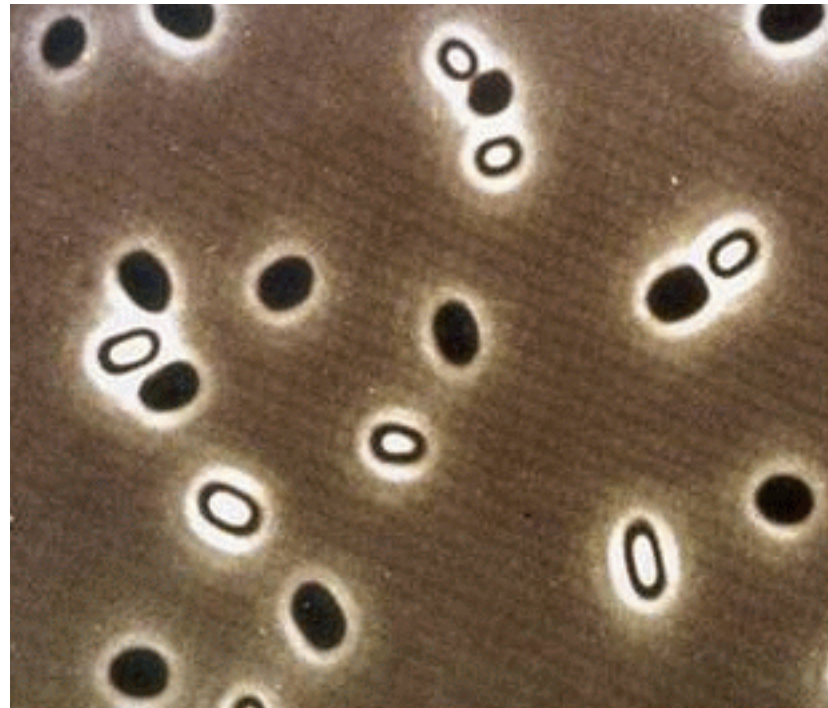


The fertilising value of bedding material

The bedding material enriched with manure has advantages and disadvantages. It is primarily a soil improver as it adds more organic matter. That is an important advantage for the improvement of the soil fertility. However, the nitrogen is released more slowly. For the short term this is a disadvantage, because the crop yield will decline. For the longer term a portion of the nitrogen will still be released. In addition, part of the active nitrogen is permanently lost due to the higher nitrogen losses from the barn.

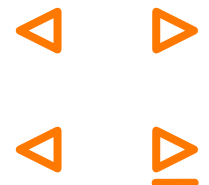
Compost bedded packs are disappointing

Compost bedded packs have a higher risk on spore forming bacteria in the milk (TAS). Besides that, the environmental measurements show that nitrogen losses from barns with compost are higher than those from barns with wood chips. For both types of bedded packs the nitrogen losses are higher than in a free stall barn. This is due to the additional supply of nitrogen via the bedding material and because of more m² emitting surface than in a free stall barn. In the Netherlands legislation to limit ammonia emission from barns will be tightened in the coming years. That will require additional efforts to reduce the emission.



TAS is a major concern

The research carried out by NIZO food research shows that compost bedded packs contain high levels of TAS spores. The high levels of TAS spores were already present in the compost that was supplied to the farms. In the barns little or no increase took place anymore. In the production of compost by compost companies the formation of these micro-organisms is probably unavoidable.





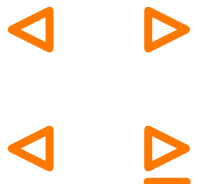
The levels of TAS spores in composting wood chips bedded packs were on average lower than in compost bedded packs, but higher than in straw or sawdust bedding. In the farms with a composting bedded pack in particular the concentration of TAS spores varied a lot from farm to farm. The variation was probably caused by differences in intensity of composting and thus bedding temperature.

Due to an increased concentration of these micro-organisms (TAS) in compost the dairy company Friesland Campina decided in March 2014 to ban the use of

compost or composted material from January 1, 2015. The reason is that an increased level of spores of thermophilic bacteria may cause spoiling problems of sterile dairy products. Materials that can be composted in the barn, such as wood chips, are not covered by that ban. There will be further research on TAS in relationship to composting wood chips in 2014. Furthermore, we are studying alternative bedding material that can absorb moisture or that can be composted in the barn, but not at too high temperatures (probably less than 45-50 degrees Celsius).

Bedded packs with wood chips better than expected

The conclusions and the prospects for bedded packs with wood chips are still positive because there is less risk of TAS and less N-losses in the barn. The benefits of improved animal welfare, animal health and longevity also apply here. Although the emitting surface in this barn, equal to the organic waste compost, is higher than in a free stall barn the emission per cow is even less than in a free stall barn on one farm. The reduction of the ammonia emission in farm context provides perspective for the bedded pack barn, since the bedding material does not emit in the field in contrary to slurry. On the other hand a lower emission of ammonia can result in a higher emission of nitrous oxide in the barn, a shift which is not desirable.

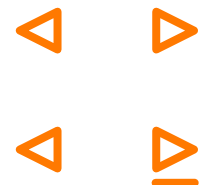


Bedded pack barn appreciated by the public

On a demonstration day on one of the farms, it appeared that the public really appreciates the animal friendliness of the bedded pack barn, especially the space and soft bedding. In addition they appreciate the openness of the barns. When the development of bedded pack barns continues in the Netherlands this will be beneficial to the image of the sector. However, the bedded pack barn is not considered as a replacement for grazing, which the Dutch public remains to favour.

Summarized

The bedded pack barn offers good perspective on animal welfare, animal health and public perception, but has disadvantages in terms of mineral management (nitrogen losses and fertilising value) and the presence of TAS (Thermophilic Aerobic Spore formers). Bedded packs with compost have a too high ammonia emission in the barn and lead to too high concentrations of TAS in sterile dairy products and therefore have no perspective. A controlled composting process with wood chips may have more future perspective. However, the availability and/or the price of wood chips can be a bottleneck if demand is increasing. The search for alternative TAS-poor bedding materials deserves continuation.



More information

Website

www.vrijloopstallen.nl

Project manager

Paul Galama, Wageningen UR Livestock Research,
Wageningen, The Netherlands

paul.galama@wur.nl

Project team

Wageningen UR Livestock Research

Paul Galama

Herman de Boer

Hendrik Jan van Dooren

Wijbrand Ouweltjes

Judith Poelarends

NIZO food research

Frank Driehuis

Graphic design

Communication Services, Wageningen UR

Photography

Project Vrijloopstallen

Communication Services, Wageningen UR

Paul Galama

