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INNOVATIVE DAIRY CATTLE MANAGEMENT DEVELOPMENT STRATEGIES UNDER ENVIRONMENTAL AND PUBLIC RESTRICTIONS

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Abstract

This paper illustrates how future oriented dairy farmers and researchers in Western Europe work on the farm business towards 2030 by presenting examples of innovative practices and techniques, which deal with efficiency and public demands. Future orientation of farmers was analyzed. Cow housing systems, especially dealing with animal welfare demands will be described, and a successful antibiotic case will be presented. Interest in grassland is in revival in Western Europe, stimulated by the economic reason of utilization of permanent grassland areas by ruminants, and the societal wish of having the animals grazing outside. As show-case a city – cow farm interaction project will be presented.

Keywords: Future orientation, dairy farming, innovation, techniques

Introduction

Developments in agriculture from European view in general depicted a period focusing on the elimination of food security after the Second World War to a period of increasing awareness about the environment, animal welfare and antibiotics to a present period of focus on sustainability and technology (see Figure 1). These periods are not passing by in the same speed in all continents but are thought to represent a global trend. More specifically, developments in the dairy sector in Europe are increasingly affected by price changes due to globalization of production and the abolition of EU milk quotas in 2015. As can be seen in Figure 2, prices in USA and Europe more or less fluctuate at the same level, while prices in Canada are higher and prices in New Zealand are lower. The number of cows is stable in USA and Canada over time, decreasing in Europe although at a diminishing rate, and increasing in New Zealand. Societal debate about animal husbandry is ever increasing in Western Europe affecting the policies and mindset.

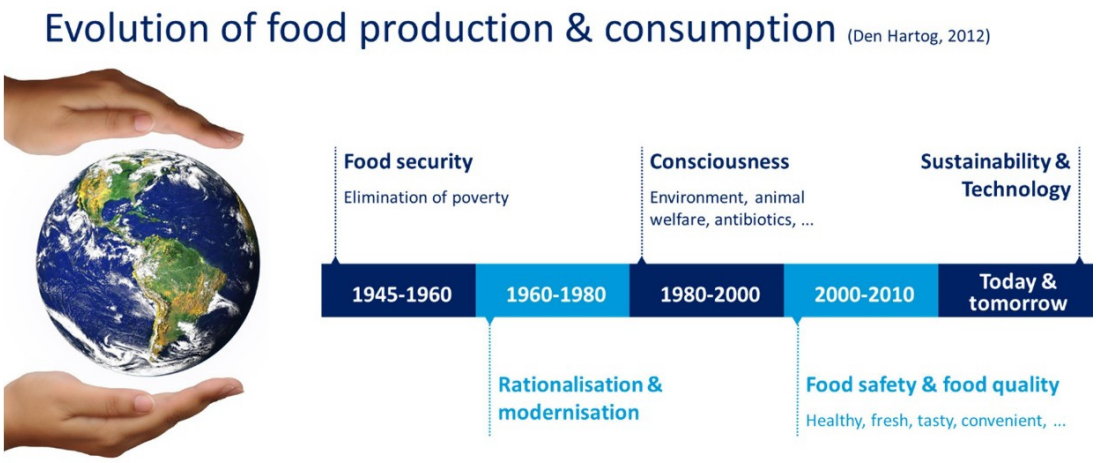

Figure 1: Global focus fields in agriculture from 1945 to present and towards future

The goal of this paper is to illustrate, under above listed circumstances, how future oriented dairy farmers and researchers work on the farm business towards 2030 by presenting some examples of innovative practices and techniques, which deal with efficiency and public demands. First the degree of future orientation of farmers will be described based on a survey. Then cow housing and manure handling systems, especially dealing with animal welfare demands will be shortly described. Also the antibiotic case will be presented. Attention for grassland is in revival in Western Europe, stimulated by the economic reason of utilization of permanent grassland areas by ruminants, and the societal wish of having the animals grazing outside. Finally a city – cow farm interaction project will be presented, called the floating farm.

Farmers Strategies

From 2011 to 2016 a group of dairy farmers in four European countries has repeatedly been questioned about their strategic choices for their farm development. The study was based on 11 questions addressing various possible development paths. Similar questions were combined in components by a Principal Component Analysis (PCA) procedure. Next clustering of respondents took place on th e basis of these components. The five resulting clusters, i.e. strategic farmers' groups each representing a certain development path are expressed in Table 1. The three Central- and Eastern European countries (Poland, Lithuania and Slovenia) are combined under CEE, and the Netherlands was included in the survey and analysis as a Western European country.

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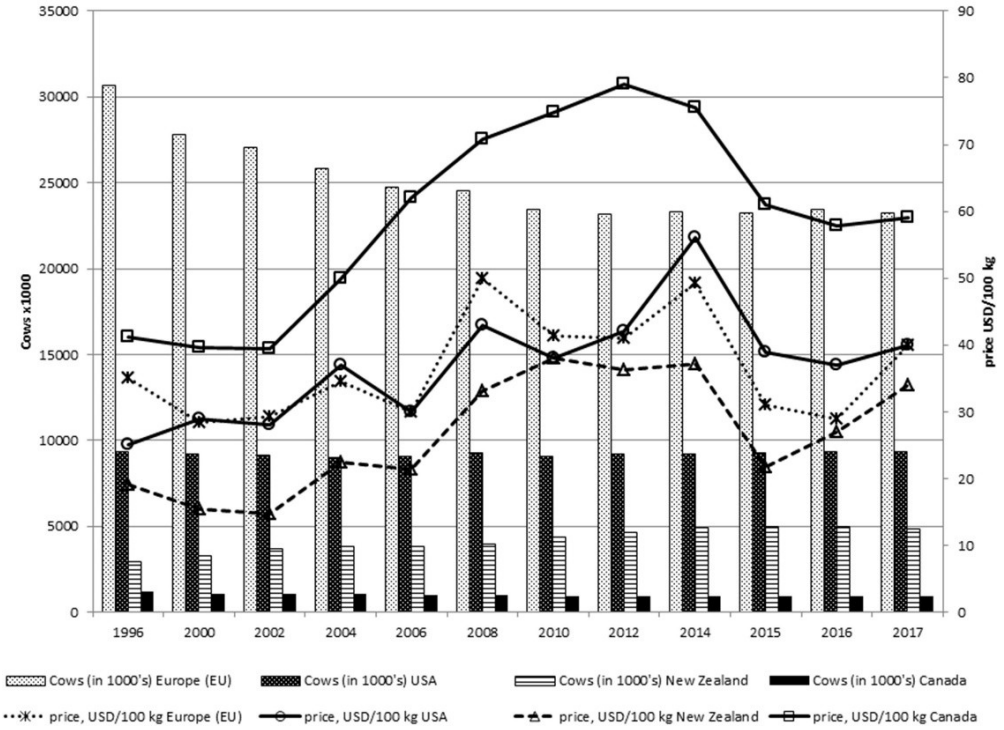

Figure 2: Trend in number of dairy cows and milk prices in four selected world dairy regions from 1996 to 2017

The so called Growers & Specializers represented the largest group, however, diminishing in number over the period 2011 to 2016. At the same time the Wait & See group of farmers increased over time, especially in the Netherlands. Diversification of the farm business, i.e. including other agricultural branches or non-agricultural activities like agro-tourism and production of special local products in the work package, stayed at a rather constant level and was most popular in the CEE countries. Interest for cooperation and chain integration was increasing in the CEE countries,

Table 1 . Strategic groups of farmers in three CEE countries and the Netherlands over the period 2011 to 2016 - number and % of farmers (in brackets)

Year	Farmers' strategic groups									
	Growers & Specialisers (+ Movers)		Diversifiers		Wait & See		Co-operators		Chain integrators	
	CEE	NL	CEE	NL	CEE	NL	CEE	NL	CEE	NL
2011	48.2		16.5		11.0		11.0		13.3	
2013	43.1	31.9	17.9	12.5	10.6	29.2	8.7	20.8	19.7	5.6
2016	32.1	26.4	18.8	8.3	17.0	41.7	14.2	19.4	17.9	4.2
N	311		131		135		103		118	

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although it remained at a higher interest level in the Netherlands. It appeared that the strategic choices and also other perceptions of the farmers towards opportunities and threats from the market and public environment were highly correlated to the level of the milk price: in 2011 there was a relatively moderate milk price, in 2013 rising to a very good price, and in 2016 the price had dropped to an extremely low level. Nevertheless, the high percentage of dairy farmers in the Netherlands opting for a Wait & See strategy was surprising to all concerned. Obviously, the bad milk prices in 2016 demoralized around 40% of Netherlands' farmers to plan business action towards coming years.

Innovative management practices

Housing

Keeping cattle in cubicle housing systems (freestalls; see picture1) as at present is considered as less animal friendly. Housing systems with more space per cow and environmentally friendly, imitating in some way the grassland environment are emerging. For instance, the use of composted beddings (picture 2) and artificial floors (picture 3) are examined and demonstrated as so called freewalk barns. An EU-project FreeWalk www.freewalk.eu compares the different systems. A srengths and weaknesses expert overview of the compost bedding system, i.e. bedded pack barn compared to the traditional cubicle housing system is depicted in Scheme 1 (based on research on commercial farms in period 2013-2017). The functioning of the artificial floor is illustrated in pictures 3 and 4. The artificial floor is composed of 6 layers with an artificial carpet on top meant to make separation of faeces and urine possible. The robot manure cleaner has a pick-up technique to take away the manure slurry instead of the traditional scraping routine.

Picture 1: Cubicle housing

Picture 2: Bedded pack barn

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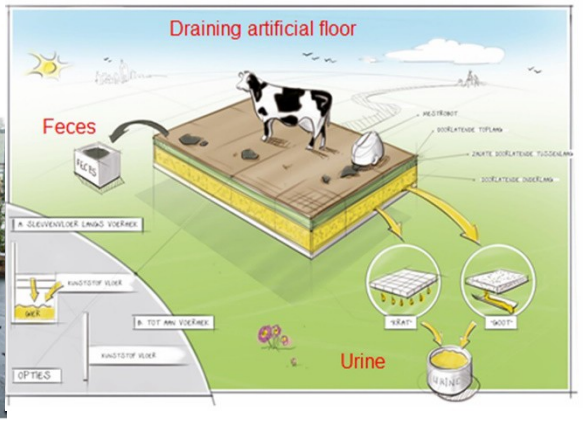
Sustainability aspect	Criteria	Bedding material		
		Compost Wood chips	Compost from Households	Straw
Economics	Investment			
	Yearly costs			
	Longevity			
Cow	Production, health			
	Welfare			
Milk Quality	Thermophile bacteria			
Environment	N losses stable			
	N losses land			
	Ammonia emission stable	Lower, in prep		
	Nitrous oxide emission			
Manure quality	Soil improver			
	N mineralisation			

	Better
	Attention needed
	Worse

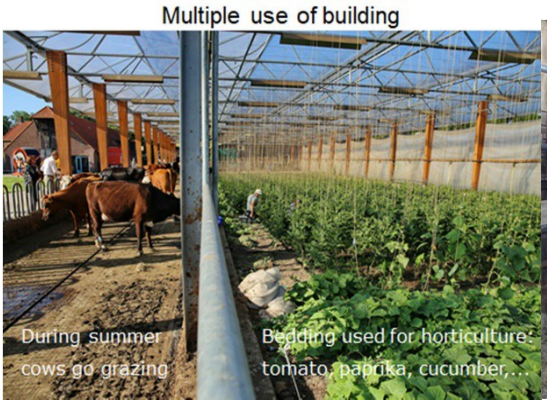
Scheme 1: Plus and minuses of a bedded pack barn with composting material as bedding (Galama et al., 2012)

Integration of composted beddings during the summer months when cows are grazing with horticultural produce or pig fattening is illustrated respectively in pictures 5 and 6.

Picture 3: Artificial floor



Picture 4: Layers composing artificial floor



Picture 5: Integration of bedded pack with horticulture; Picture 6: Integration with pigs

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Antibiotic use

In the period 2004-2005, dairy stakeholders in The Netherlands discussed that it was desirable to try make better use of veterinary medicine data. Verhees et al. (2008) noticed a great interest of consumers in transparency in medicine use on farms. During the following years, data on medicine use were collected from farms comprising a total of 94 dairy herds out of a total of 18,682 herds. These data covering the period 2005-2012 together with experiences over that period provided the source material for the presented study. In this study, the number of Animal Defined Daily Dosages (ADDD) was used as the indicator for antibiotic use. When applied to cows, the number of daily dosages indicates how many days per year an average cow in the herd is under treatment with antibiotics. The analysis was done by calculation of the average number of daily dosages per cow per herd during the period 2005 till 2012. The aver age number of daily doses was calculated on a yearly basis (Kuipers et al. (2015).

In the period 2007 to 2013, The Ne t h e r l a n d s Ministry of Agriculture, Nature and Fisheries (now the Ministry of Economic Affairs) in cooperation with the Ministry of Public Health, sent 21 official letters to the Netherlands' Parliament, explaining the problems and proposing solutions. A Memorandum of Understanding was signed in December 2008 between the Ministry of Agriculture, Nature and Fisheries, the Ministry of Public Health, the animal sector representatives and the Veterinary Association to monitor antibiotic use in the cattle, pig and poultry sectors and develop actions to reduce it. In December 2010, targets of a 20% overall reduction in 2011 and a 50% reduction in 2013, taking 2009 as base year, were added to the memorandum. From 2011 onwards, efforts focusing on awareness raising have been undertaken by farmers' organizations, the Veterinary Association and Practices, and Dairy Processing Cooperatives and Companies. Since the year 2012, $3^{rd}/4^{th}$ generation drugs (modern antibiotics) are restricted in application and can onl y be applied only by veterinarians. These last drugs are essential for treating human patients who do not react to the traditional antibiotics and have serious health problems. Human medicine authorities and doctors focus their criticisms mainly at the use of those drugs for animal application.

Housing systems

In addition to herds housed in in cubicles, 24 freestall (bedded pack barn) herds were included in the study from 2012 on. The trends in the average number of cows in the herd and in ADDD for the 2 housing systems are illustrated in respectively Figure 3 and 4. The farmers in this study represent the future oriented farmers. They increased the herd size considerably after 2012. The antibiotic use results for the cubicle farmers can be presented in four phases: the first phase 2005 to 2007, farmers were still increasing antibiotic use; the

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second phase 2008 to 2010 was a period of growing societal awareness and the start of a reduction in antibiotic use by some farmers; then the phase from 2011 to 2014 was a period of diminishing use, and the fourth phase from 2015 to presently a period of stabilization at a relatively low level of use. The bedded pack barn farmers used significantly less antibiotics than the cubicle housing system farmers. The ecological farmers show the minimum use currently.

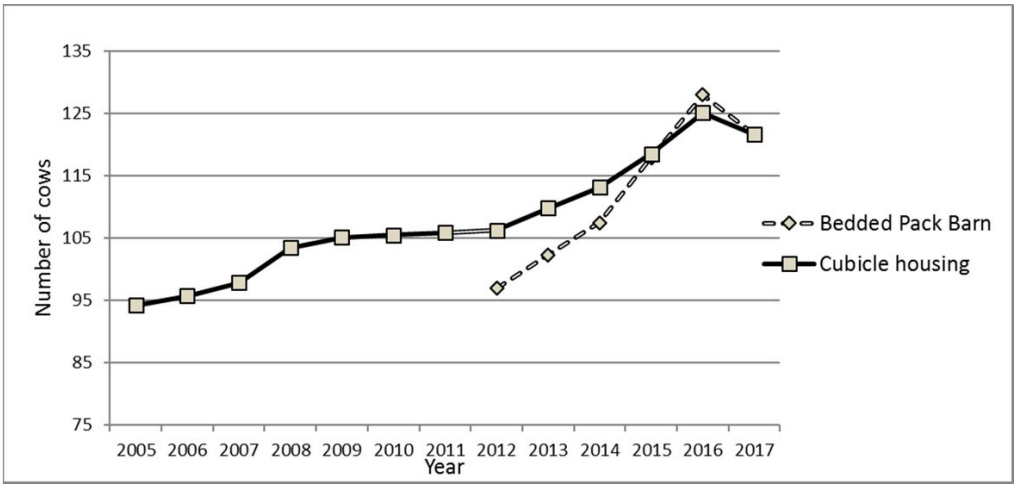

Figure 3. Number of cows compared between cubicle housings and bedded pack barns in period 2005 to 2017

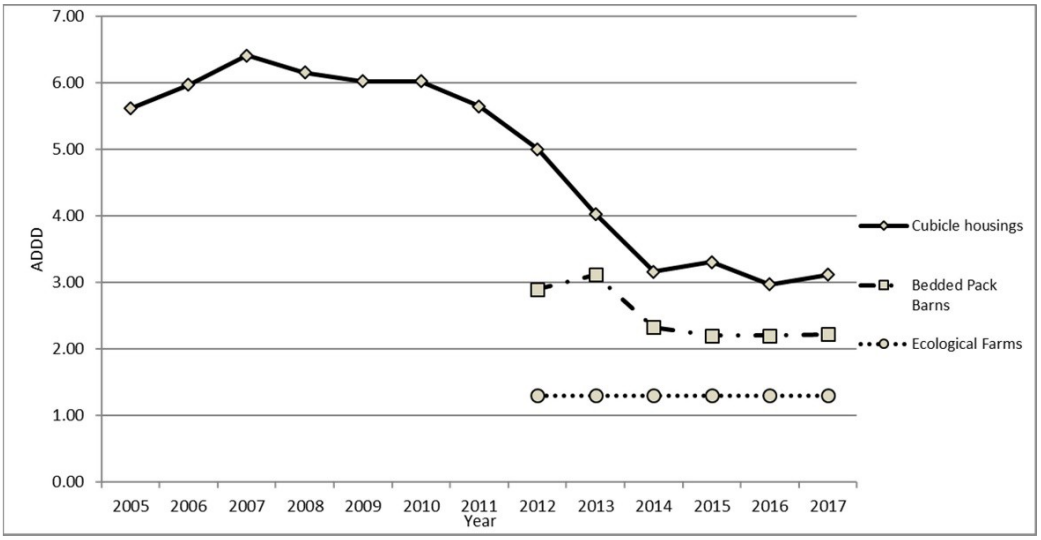

Figure 4: Number of daily dosages per cow per year compared between cubicle housings, bedded pack barns and ecological farms (estimate) in period 2005 to 2017

Rogers theory of innovation.

The trends in use of antibiotics for the groups of farmers were also described by applying the diffusion of innovations theory of Rogers (1995). Diffusion relates to the process in which an innovation is communicated through certain channels over time among members of a social system. In our case we applied it to a farmers' community.

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Newness of an innovation may be expressed in terms of knowledge, persuasion or a decision to adopt. In this study it applies to the notion of a responsible antibiotic use. Usually there is an upward trend of adaptation. However, when we applied it to antibiotic use in this study, a downward trend was expected to occur. If public pressure is to reduce antibiotic application, first a small group will react, resulting in a small overall reduction in use. When this is seen to be feasible, more farmers will follow resulting in a larger overall reduction in use. Finally, the remaining conservative farmers will adopt the practice. Rogers indicated five categories of system innovativeness: Innovators, Early adapters, Early majority, Late majority, and Laggards. The adaptation process in this study did indeed follow the principle of Rogers's theory. The trend in antibiotic use from 2007 on shows a progressive downward trend, however, also effected by policy measures in 2012.

Management factors.

Improvements in responsible medicine use can be achieved by applying good cow management practices and improved herd conditions. The farmers who were considered more "successful" tended to have a higher level of antibiotics use (Kuipers et al., 2013). More successful is defined as having a higher health herd status, a lower average cell count of the herd (indicator for mastitis) and a higher milk return per cow. This also tended to coincide with somewhat younger farmers and a higher level of education. Clearly the environment the farmers lived in stimulated a higher use of antibiotics to keep the herd healthy. However, in a follow up study it was shown that these farmers were also able to change their attitude towards the application of antibiotics faster than others. After three years of public attention for antibiotic use in animal husbandry, they decreased their level of use substantially.

"Amazing grazing" practices

So called "amazing grazing" initiatives have started in Western-Europe. It is associated with the public wish to see animals in the fields. It is considered as animal welfare positive and decorating the landscape. In the Netherlands, this has resulted in a 1 to 2 euro cent per kg price premium for grass milk (when at least 160 days outside). For the larger farms, and especially for robot milking farms, grazing of the cows creates a big challenge. Several practices are studied to organize regular grazing at larger farms. One of the techniques to assist in efficient grazing of cows is virtual fencing (see Figure 5). It helps in managing cows outside without solid fences and moves cows to certain grass fields without physical labor. The technique is still in development. It may also be of help in the management of animals in nature protected areas, and perhaps for dealing with the increasing predator treat by wild animals, also in Europe.

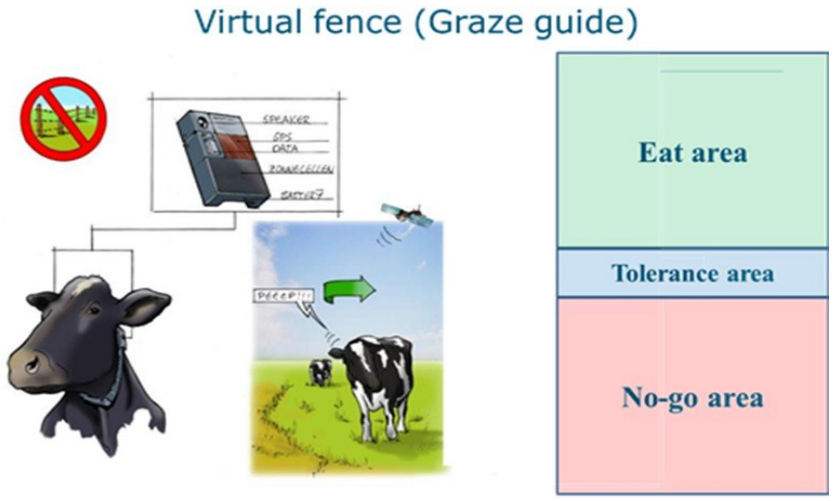

Figure 5: Virtual Fence

City agriculture: case of floating farm

Agriculture close to or within the city is a new concept. Urban farming and vertical farming receive attention these days. To shorten transport and bring back agriculture to the people are the main goal of such initiatives. This is practiced in the city of Rotterdam by building a dairy farm in the harbour (Figure 6). The dairy farm is planned to recycle all inputs as much as possible and utilize water plants and grass from city fields and household litter as bedding and feed. A city-shop on board sells the dairy produce. The interest by public and tourists for visits is overwhelming, while the construction is not yet even completed.

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Figure 6: Floating farm

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