CHALLENGES FOR CLIMATE CARE DAIRY FARMING IN THE NETHERLANDS – INNOVATIVE APPROACHES

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Abstract

The successfully development of the Netherlands' Agri & Food sector in the last 70 years by maximizing the production at minimal costs has led to a situation where the Netherlands' animal sectors are now responsible for a high national contribution to environmental impacts. These are acidification of nature areas (mainly by NH3), global warming (CH4) and biodiversity loss. Improvements and reductions have been achieved, to various extents, by single-issue approaches (policy) and solutions in the biophysical production system. Further strong improvements on all environmental aspects are needed, without causing trade-offs and negative side effects. This is a huge challenge for typical highly populated regions as the Netherlands with intensive livestock production and very critical societies. Therefore, the Netherlands' Dairy chain has set goals for 2030 to increase the sustainability on the topics of climate, welfare, grazing, biodiversity, environment, new business model, land based farming and safety in the yard. Also, a coalition of dairy sector organizations have proposed a number of management practices to reduce ammonia emission, i.e. dilution of manure, more grazing and lowering protein in ration. Besides these ambitions, strategic aspects of resilience, needs and best practices of dairy farmers involved in two EU projects will be discussed. Some innovative technical practices dealing with environmental management will be demonstrated.

Keywords: environment, strategy, innovative, good practices, dairy farmer, sector

State of art and policies

The Netherlands is a heavily populated small country. It is at the same time the 2^{nd} agricultural exporter of world: flowers, green house horticulture, dairy, pig meat, eggs. It believes to have a good infra-structure and strong agro-companies to support the agricultural sector. On the other hand, land prices in 2021 were on average euro 62.000 for grassland and 72.000 for arable land. Expanding the animal sectors since World War 2, especially the pig and poultry sectors, did cause nationally high environmental pressure. The animal sectors contribute to the nitrogen and carbon balance: ammonia (ca. 44% of total) and methane (ca. 13.5 ton from agriculture, of which 75% from the dairy sector). The policy motto has become: "Transform" agriculture, realize a "circular agriculture"

The country is faced with a “Land hunger”. Goal is to build 1 million new houses in next few years. Additional place is needed for industry areas, sun parks, windmills, nature, roads, and data centres. At the same time, policies

Presently, there are 15.000 dairy farms with on average 100 cows. Traditionally, the sector is based on family farms, fertile soils and grassland. Focus in agriculture is on efficiency, i.e. low cost, specialization and technical solutions. There has been a shift from Milk quota to Phosphate quota in 2015/16. The P-quota have market value. Since then the dairy sector has become regulated as a land tied agricultural business. This has resulted in a gradual extensification of dairy farming, thus less cows per ha. This is also illustrated by the goal of having more than 82 % of herds performing grazing, and more than 65% of protein to come from own land.

The N (ammonia) deposition on the 166 national nature areas is a huge political problem since 2019 (Juridical court driven). Goal is: N deposition < 0,7 gram N/ha nature land (for comparison: N/ha in Germany < 100 gr N/ha). This has led to a blockade and next in limitations in building and road constructions and in a reduction in speed on all motorways, and pressure on reduction of the dairy sector. The dairy sector is also held partly responsible for climate change (GHG), mainly because of the output of methane. The national policy goal is to achieve the highest % reduction in GHG of Europe. GHG goals for the dairy sector still have to be set more clearly.

Last few years the society has become very critical towards the dairy sector, which trend started in the previous century with focus on animal welfare in the pig and poultry sectors.

Dairy Sustainability program

Cooperative dairy processing companies apply sustainability schemes to their farmer members. The sustainability scheme is described in Figure 1. Each topic is expressed in a measurable goal. The Agricultural Economic Institute annually monitors the progress made. New themes added in recent years are designing “new business models”, “land based dairy” and “safety on the yard”.

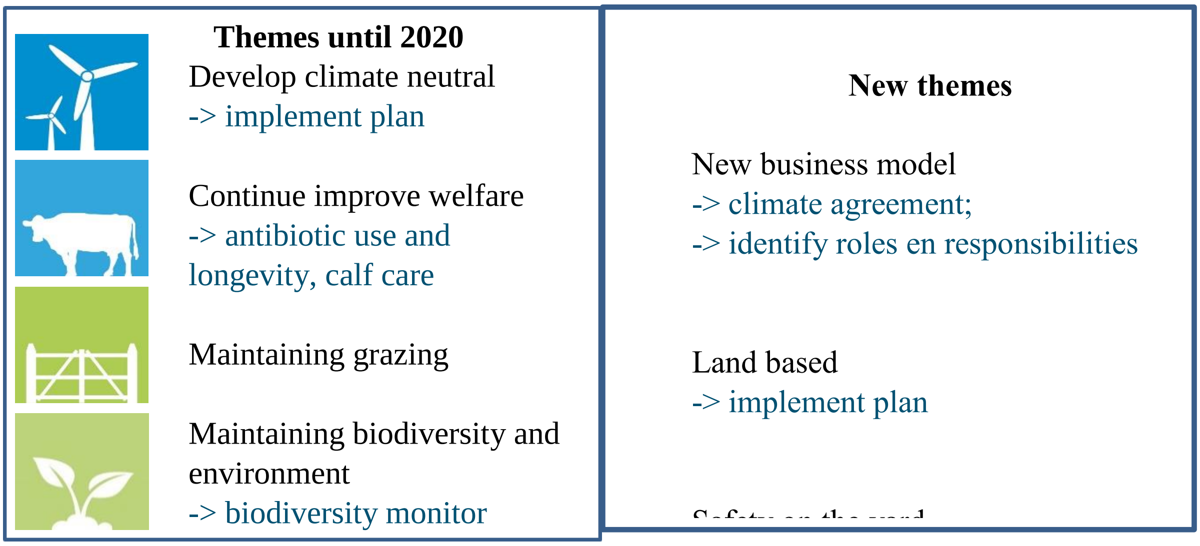

Figure 1. Dairy Sustainability program (Duurzame Zuivelketen) of milk processing chain

Besides the sustainability programs of the dairy companies, the farmers organisations have agreed upon a set of practices in agreement with Ministry of Agriculture to reduce ammonia-emissions, to be realised in years to come:

a. Dilution of slurry during field application (slurry : water = 2 : 1)
b. More grazing (> 720 hours per year)
c. Lower protein in ration (160 gram crude protein per kg DM in 2024)
d. Realize land based farming
e. Realize low emission barns

Strengthen resilience of dairy sector

In the EU networking project R4D (Resilience for Dairy) discussions are held in 15 European countries with farmer and stakeholder groups to discuss topics of resilience and needs of the farming community. Recently, such a meeting took place, as illustrated in below photo (called "day of inspiration"; under Corona conditions). Aspects of resilience that emerged are listed in Table 1a in order of emphasis put on each of the aspects.

The discussion showed that the farmers gave emphasis to personal development and skills, such as adaptability to farm changes (sustainability, soil and circularity actions), seize opportunities, develop own revenue model, and collaborate with business partners and environment. Focus is on making the dairy sector more resilient by improving both the farm and the farmer by improving his skills to adapt and anticipate on threats and opportunities.

Table 1a.Terms associated with resilience as stated by a group of farmers[1], and 1b. Practices to support resilience as scored by farmers (average score > 4)[2]; priority order of terms and practices are listed from top to bottom

1a. Alternative terms for resilience	1b. Practices supporting a resilient farm
Adaptability, adapt, adaptation, change, cope with	Soil care
	Effective communication and transparency to public
Recovering capacity, absorbing shocks, bounce back, survive	Energy efficiency and renewable sources
	Innovative and friendly housing
Robust farm, resistance, own strength	Salary / returns
Flexibility, being flexible	Improve welfare conditions of cows
Anticipating, making a leap forward	Flexibility
Stress resistant	Innovative milking devices
Good revenue model	Easy access to credit
Tipping point	Work life balance

[1] *Workshop of 13 farmers and 4 stakeholders in the Netherlands*
[2] *Scoring from 1 = not important at all to 5 = very important*

Farmers associated to the project were also interviewed about needs and practices on which to build a resilient farm business. The farmers were asked to score each of a list of 45 practices and techniques for improving the resilience of their farm businesses from not important to very important. The answers by the small group of Netherlands' farmers are listed in Table 1b, which give some orientation about their feelings. It appeared that soil care and communication to public were most emphasised.

Environmental practices

In the EU project Climate Care Cattle farming needs and solutions were collected to deal with the environment, i.e. GHG and ammonia emissions. Expert opinions from the eight partner countries are collected. The results are presented in Table 2. It indicates that cattle housing, storage and spreading manure are highly correlated with ammonia emission and soil, water and energy with GHG. Practices mentioned as applicable by three or more countries are less young stock, genetic selection, more concentrates, feed additives, precision feeding, more grazing, reduced tillage, low emission floors, covering manure storage, slurry acidification and energy practices in general. Only experts from the Netherlands mentioned the use of methane blockers.

Table 2. Emission mitigation strategies (for ammonia and GHG) and related practices as proposed by experts from eight European countries (*Practices when affecting ammonia and / or GHG are indicated by X; Practices chosen by country panels as relevant to their region are indicated by ○)*

			COUNTRY							
Mitigation category, and related practices	**NH3**	**GHG**	**Po**	**Lt**	**La**	**It**	**Fr**	**Ge**	**Sc**	**Nl**
Animal - amount										
Less young stock, lower replacement cows (longevity)	X	X	O		O					O
Performance increases, reduction of breeding animals	X	X	O					O		
Animal - breeding										
Genetic selection feed efficiency, health, low emission	X	X	O			O				O
Animal - feeding										
Low protein diets	X				O	O		O		O
Low phosphate in diets	X							O		
Feed more maize	X	X?								O
Feed more concentrates		X?	O		O	O				
High digestable diet	X	X	O				O			
More balanced feed and feed additives	X	X	O	O	O				O	
Use of probiotics in the barn	X			O						
Methane blocker as feed additive		X								O
Precision feeding tools and techniques	X	X	O		O	O				
Grazing and grassland										
More hours grazing	X	X			O		O			O
Mowing younger grass	-	X?								O
Silages of high nutritional value	X	X	O		O					
Crops										
Grow more maize	X									O
Grow own concentrates (sugar beets, grain)	?	X?								O
More self produced protein (e.g. mixture grass and legumes)	X	X			O		O			
Increasing efficiency in work processes in crop farming	X	X?						O		
More efficient roughage production (more output/input)		X?							O	
Covercrops							O			
Soil and water										
Higher goundwater level peat ground		X								O
Wetland management		X		O	O					
Reduced tillage and restored pastures		X		O	O		O			
Housing										
Increasing the scrapping frequency	X	X					O			
low emission floor (e.g. separation feces and urine)	X			O				O		O
Low emission floors (e.g. prefabricated floors with grooves)	X					O				
Slight slope in walking areas	X						O			
Use of straw where manaure stays (with solid manure storage)	X						O			
Freewalk organic bedding	X	-								O
Innovative floors (separation feces/urine) and bedding	X						O			O
Manure acidification	X					O				
Manure additives	X				O					
Storage										
Conversion of manure lagoon to cylindrical storage	X				O					
Lower manure level in liquid storages	X	X					O			
Covering manure storage	X	(X)	O	O	O	O	O	O		
Covering liquid manure tanks with passive methane production	X	X					O			
Composting the manure	X						O	O		
Spreading manure and fertilizing										
Dilution of manure	X									O
Bury slurry <6 hrs after application arable land	X		O		O					
Slurry acidification in field	X	(X)		O		O		O		
More organic and less synthtic fertilizers	X	X				O			O	
Save fuel, reduce fertilizer costs	X	X	O					O		
Improved chemical fertilizers (e.g. UREA)	X		O			O	O			
Apply slurry in soil or close to ground	X	X			O		O	O		
Precision techniques manure and fertilizers	X			O	O	O				
Cooling manure		X								O
Energy, general										
Anaerobic digester		X	O		O	O	O			O
Biofermentor	X	X			O	O				
Burning methane		X				O	O			O
Solar / PV panels, plus solar power applications		X	O		O		O			O
Lesss energy demanding machines, tractors, equipment	X	X				O	O			

Technical approaches and practices dealing with the environment

a. Injection of manure

Dealing with ammonia already resulted in the former century at initiative of the Experimental Station for Cattle Husbandry in the idea of injecting the slurry into the soil. This led to the construction of the manure injector machinery (Figure 2). The application of this technique on grasslands became obligatory in the Netherlands.

Figure 2. Manure injector

b. Separation of urine and faces

Separation of urine and faces is recommended to reduce ammonia emission and for creating different manure products for applying in the field (precision fertilization) or for marketing purposes. Two techniques are illustrated in Figure 3, of which one uses permeable plates on the existing slatted floor and another by using an artificial permeable floor composed of a set of different layers. Robotic manure cleaners are developed and still in stage of improvement to clean the artificial floor types.

Figure 3. Floor separating urine and faeces (left); artificial permeable floor (right)

c. Cow-toilet

The innovative Cow-toilet takes the urine directly from the back of the cow (Figure 4). Thus it principle is also based on the separation of the urine from the manure. The urine is stored in a separate tank. Up to 1/3rd of the urine is picked up until now.

Figure 4. Cow-toilet

d. Air filtering as alternative approach to combat emissions from cattle facilities

Various strategies can be followed to reduce ammonia and methane emissions. One strategy is to adapt the animal to the environment and the other is to adapt the environment to the animal. Practices of the first category are feeding practices, e.g. adding methane blockers to the feed or lowering protein in feed, and genetics, e.g. selecting for low methane animals. We study the filtering of the air belonging to the second strategy.

Air washers are commonly applied in pig husbandry to filter ammonia from the air in barns. The air is sucked into a water basin where ammonia reacts with acid to a solid component. This technique has not been adopted in cattle housings, mostly because those facilities have an open structure and other source oriented approaches prevailed. For methane, the very low concentration in barns (measured on 60 farms spread over Europe from 5 to 80 ppm at 2 m height) and low solubility in water complicates the filtering of methane. In a dairy housing about 20 % of methane comes from the manure and 80 % from the mouth of cows by the natural physiological process of rumination. We study the challenging possibility of simultaneously filtering methane and ammonia from the air in the housing including manure storage facilities. A variety of mostly experimental applications in practice will be demonstrated, which indicate that the filtering of methane from barns and storages forms the biggest challenge to solve.

Note: This paper is supported by EU-projects Climate Care Cattle farming (www.CCCfarming.eu) and Resilience for Dairy (R4D).