minus METHAN in der Landwirtschaft

Deutsche Umwelthilfe

Methane reduction strategy for agriculture

prepared within the framework of the NKI project **Minus Methane** in agriculture

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1 Preface

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Dear Readers,

The year 2018 has shown how present climate change is in many areas of life. Agriculture was hit particularly hard by long periods of drought and heat. It becomes clear that agriculture plays a dual role in climate change. On the one hand, it is a sector strongly affected by climate change and has to struggle with the consequences of climate change. On the other hand, it is an emitter of greenhouse gases and thus contributes to climate change. In particular, the production of dairy products and beef produces emissions of the greenhouse gas methane, which has a strong impact on the climate.

In order to achieve a reduction of methane emissions in Germany, Deutsche Umwelthilfe e.V. (Environmental Action Germany, DUH) demands a comprehensive and cross-sector reduction plan. In the area of agriculture, there is great potential for reduction and thus a great need for action. This is why DUH is becoming increasingly involved in this area and has discussed various methane reduction measures in agriculture during the two-year project period of the „Minus Methane“ project funded by the National Climate Initiative (NKI). Thanks to support by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, it was possible to discuss various reduction measures and their locally implementation with experts from the field in multiplier workshops. The discussion focused on the preconditions for implementation, obstacles, political initiatives and demands as well as instruments of funding and regulatory law for a nationwide application of the respective measure in Germany. Through this methodical innovation and the target-group-specific approach, more information should reach the target group and thus open up a new field of action for climate protection in Germany.

It is expected that in the course of the increasingly urgent climate debate the implementation of the proposed measures will be pushed by multipliers and an intensive public debate. It is important to debate this together with agriculture. In addition, politicians and consumers need to assume responsibility. The present methane reduction strategy provides approaches for this debate and should serve as a basis for short and medium-term measures for methane reduction in agriculture.

Barbara Metz
Deputy Executive Director of Deutsche Umwelthilfe e.V.

2 Methane reduction potentials in the value chain from agriculture to the customer

1 Stable

Agricultural methane emissions are mainly due to cattle farming. Dairy cows are the most important emitters. Methane is produced by the digestion of the feed in the rumen and is mainly released by burping. Possible aspects for a reduction of methane in the stable are climate-optimized husbandry methods and feeding methods as well as adapted herd management.

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2 Biogas plants

Biogas plants collect climate-damaging gases, especially methane, which would escape into the atmosphere if the residues were stored open. During the storage of farm manure, microbial degradation processes produce i.a. methane. In biogas plants, this fermentation process is used specifically to produce biogas.

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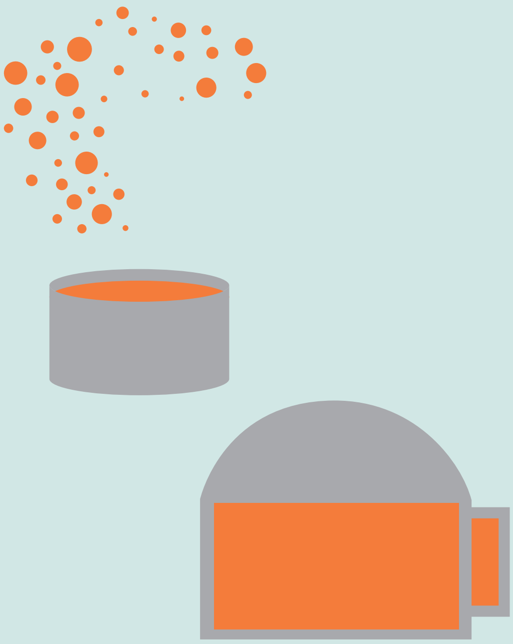

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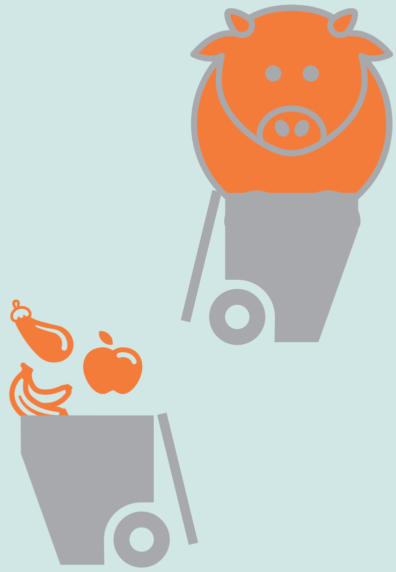

3 Food waste

Influence on methane reduction in agriculture can be exerted along the entire value chain: By reducing food waste at each link of the value chain and increasing efficiency, a lower production capacity of animal products is required as a first step and thus less methane is emitted through fermentation.

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4 Retail

Retail is an important player with high potential to avoid food waste. Main reasons for waste in this area are the best-before date, aesthetic standards, packaging defects, packaging dimensions and excess stocks. Such causes can be reduced by targeted optimization measures. Reducing the waste of high quality dairy and meat products in the trade sector also reduces methane emissions from the production of these foods.

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5 Consumer

3 Methane: definition, climate impact, origin, sources

What is methane?

Methane (CH_4) is listed as one of the most important greenhouse gases in the Kyoto Protocol since 1997. In 2016, methane accounted for about 10 % of all greenhouse gas emissions in the EU 28, taking second place behind CO_2 in terms of quantity and effect. The formation of methane is an important process in the global carbon cycle. Methane is the main component of natural gas and is present as a gas hydrate in marine and permafrost soils. In addition, methane is produced during rotting and fermentation processes under anaerobic conditions (under exclusion of oxygen). Preferred habitats for methanogenic bacteria and thus natural methane sources are the stomachs of ruminants.

Photochemical oxidation processes in the atmosphere produce carbon monoxide (CO) and ozone (O_3) from methane. Due to its relatively short atmospheric residence time (less than 20 years), methane is one of the short-lived climate pollutants (SLCP).

Why is methane a problem?

SLCPs cause about 50 % of the global warming not induced by CO_2 (EESI 2013). Methane is therefore an important climate driver. With a global warming potential (GWP100) of 28, methane has a 28 times stronger warming effect over 100 years than CO_2 (IPCC 2014).

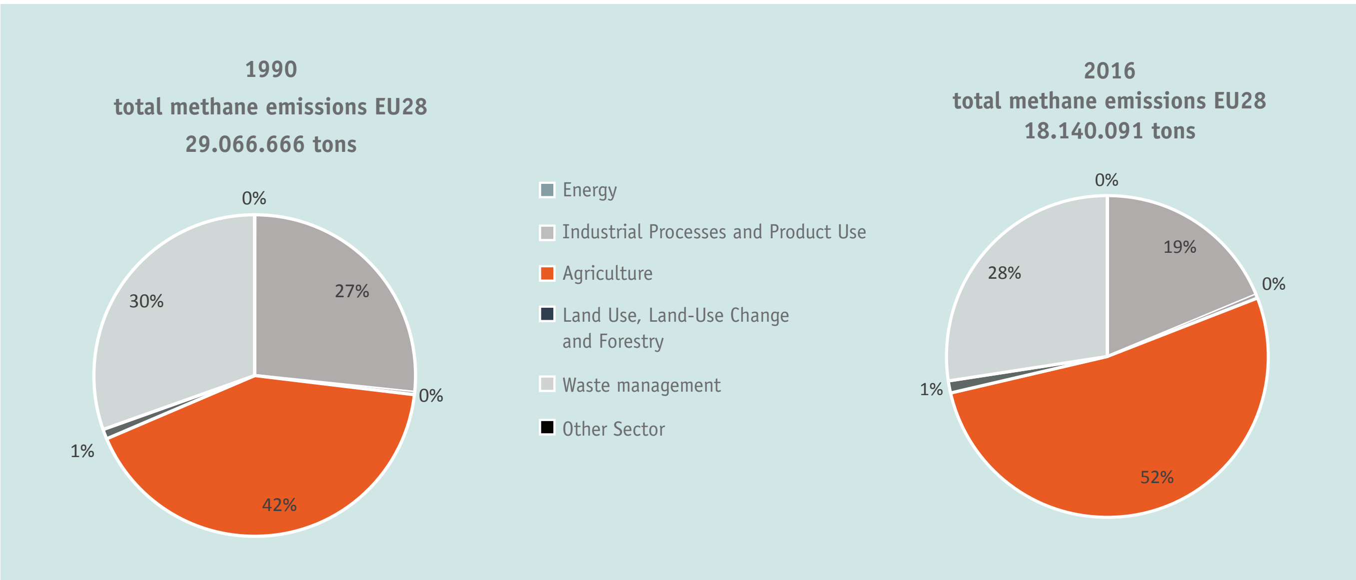
In addition, methane is an important precursor for the formation of ground-level ozone (EESI 2013). Ground-level ozone is one of the most important air pollutants in Europe with negative health effects (EEA 2016). Ozone also impairs the production capacity of natural, agricultural and forestry ecosystems. It damages agricultural crops and forests by limiting their growth rates (EEA 2016). Exposure during the flowering phase leads to severe changes in plant composition and a reduction in biological diversity (Fuhrer et al. 2016).

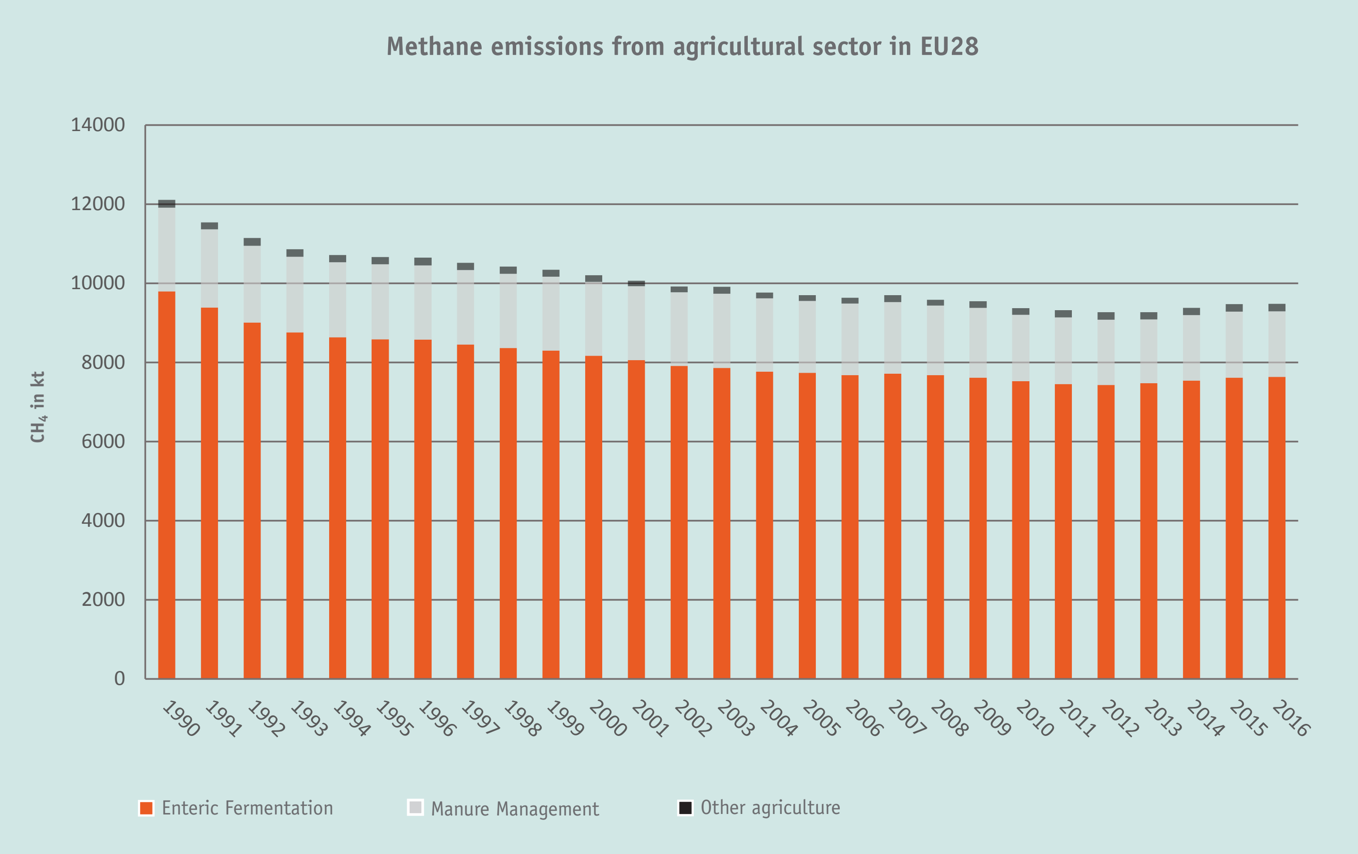
Where do the methane emissions come from?

Anthropogenic methane in Europe comes largely from agriculture. Other relevant methane emitters are waste management and the energy sector. These three essential sectors for methane emissions have contributed to methane reduction to varying degrees since 1990. Between 1990 and 2016, methane emissions decreased by 11 million tons to 18 million tons (equivalent to a reduction of about 39 %). Emissions in the energy sector fell significantly for about 56 %, also the emissions by waste management (minus 44 %) were reduced considerably. (EEA 2018) With the adoption of the Landfill Directive 1999/31/EC, the European Union has provided an effective instrument to reduce methane emissions by reducing the amount of biodegradable municipal waste, for the collection and incineration of landfill gas.

The main driver for absolute decrease in agricultural methane emissions (minus 22 %) in EU 28 was the reduction of ruminant livestock numbers, particularly in newer Member States. Accordingly, the share of sources in total methane emissions in Europe has shifted significantly. Since greater savings have been achieved in the other areas, agriculture increased its share to more than half of methane emissions, accounting for around 52 % in 2016.

Decrease in total methane emissions leads to increased dominance of methane emissions from agriculture (Eurostat 2018)





Development of methane emissions from European agricultural sector (EU 28) (Eurostat 2018)

Since the 1990s, agricultural methane emissions decreased steadily until 2012, with an increasingly slowed decline. In recent years, methane emissions from EU 28 agriculture have stagnated at a constantly high level and have recently shown a slight upward trend.

Most of the methane produced by agriculture is released in livestock farming. With regard to EU28 agricultural methane emissions in 2016, 81 % come from the animal fermentation process (fermentation processes in the stomach of ruminants), 17 % escape during the storage and spreading of manure (solid manure and slurry) and further 2% can be attributed to other agricultural emitters (rice cultivation and field burning of agricultural residues).

France is the largest emitter of agricultural methane. Emissions alone from France enteric fermentation are higher than total agricultural methane emissions of the second largest emitter (Germany) within EU 28. Germany and United Kingdom are the following main emitters. Due to mainly used types of livestock, their numbers and regional distinctive features like climate, agricultural methane emissions may vary. (Eurostat 2018)

Methane reduction in agriculture

From a purely quantitative point of view, agriculture has the greatest methane reduction potential. Although numerous cost-effective measures to reduce methane emissions, such as closed storage and recycling of liquid manure, are known, they are not applied widely. Further incentives and reduction targets are urgently needed to reduce the constantly high methane emissions.

So far, there are no binding reduction targets or binding limit values for methane throughout Europe. For this reason, methane has only been considered indirectly via the group of greenhouse gases in the form of CO_2 equivalents until now. This leaves a lot of reduction potential unused. The revision process of the National Emission Ceilings Directive (NEC) did not take the opportunity to set a binding, individual methane reduction target for all European Member States.

The Effort Sharing Decision (ESD) defines greenhouse gas reduction targets for sectors not covered by European emissions trading, such as agriculture. Germany, for example, must reduce greenhouse gas emissions in these sectors by 38 % by 2030 compared with 2005. The German Climate Protection Plan 2050 of the Federal Government provides the long-term goal of greenhouse gas neutrality by the middle of the century. By the time this target is reached, the agricultural sector will have reached a reduction milestone of -34% to -31% in 2030 compared to 1990.

With the „Minus Methane" project, which is funded by the National Climate Protection Initiative NKI, we are providing approaches for short- and medium-term methane reduction measures. Enabling agriculture to play its part in reducing greenhouse gas emissions.

4 Methane reduction potentials with biogas plants

Biogas plants collect climate-damaging gases, especially methane, which would escape into the atmosphere if the residues were stored open. During the storage of farm manure, microbial degradation processes occur, resulting in methane, among other things. In biogas plants, this fermentation process is used specifically to produce biogas.

Reduction potential

In order to reduce methane emissions in the area of manure management, closed storage and fermentation of excrements in biogas plants and closed storage of fermentation residues are required. The energy recovery of residues from livestock farming, in particular bovine animals (approx. 8,881 million animals/EU 28), can significantly reduce methane emissions from fertilizer management (Eurostat 2019). The current use of the potential of manure fermentation in Germany is about 25 % (FNR 2016b). If the fermentation potential in farmyard manure management is fully exploited, further high amounts of methane could be avoided per year.

Measures for methane reduction with biogas plants

Optimization of manure management

A further reduction potential is the optimization of the handling of liquid manure in the stable. For this purpose, the liquid manure must be supplied to the fermenter as quickly as possible in order to minimize methane emissions during open storage, since a large proportion of the methane release from fresh manure takes place within one week. For this purpose, it should be ensured in stable construction that the manure can be continuously and quickly fed into the fermenter through the manure removal system.

Optimization of biogas plants with gas-tight covering of the fermentation residue store

There is a methane reduction potential in biogas plants that do not have a mandatory gas-tight fermentation residue storage facility. The climate protection report of Federal Ministry of Food and Agriculture Germany (BMEL) recommends a gas-tight covering of all open fermentation residue stores. Assuming practical conditions (storage at 10°C to 25°C), the reduction potential in Germany is 80,000 tons of methane per year (BMEL 2016).

Increase in the proportion of fertilizer in the substrate input

The BMEL climate protection report emphasizes the reduction potential by increasing the proportion of farm manure in biogas plants. If the fermentation of farm manure is increased from currently approx. 21% to 50% or 70% by increasing the proportion of farm manure in substrate use, the potential savings for German Agriculture is between 60,000 and 180,000 tons of methane per year (BMEL 2016).

How can this be achieved?

Promoting methane-reducing stable construction concepts

In usual stable construction concepts, it is not possible to use manure quickly. Such so-called slurry cellars must be avoided in future consultations and plans. Stable construction concepts with direct transfer of the manure to the biogas plants must be financially supported, taking into account species-appropriate animal husbandry.

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Biogas plants collect greenhouse gases, especially methane, which would escape into the atmosphere if the residues were stored open.

Conveying gas-tight fermentation residue storage – for new buildings and existing plants

In the case of liquid manure storage facilities that do not have to be gas-tightly covered due to licensing requirements, financial support can support the construction of gas-tight fermentation residue storage facilities as a first step. In order to be able to define legal regulations for existing plants in a second step, disadvantages for biogas plant operators, that make the continued operation of existing plants unattractive, should be avoided. All manure stocks should be taken into account and incentives for implementation should be provided.

Increase of fertilizer as substrate content

In order to bring more farm manure into fermentation, the use of manure should be made more flexible to allow higher output based on farm manure. This could, on the one hand, promote the use of manure in biogas plants and, on the other hand, prevent methane and other greenhouse gases from escaping from insufficiently dimensioned plants due to overpressure events.

Increase of economic fertilizer as substrate share - through slurry bonus

Since liquid manure fermentation generally leads to higher electricity production costs compared to the fermentation of renewable raw materials (NawaRo), competition could lead to plants using less liquid manure and more renewable raw materials instead. A financial bonus for plants with a very high proportion of liquid manure (at least 80%) provides the necessary incentive to change from NawaRo/existing liquid manure plants to liquid manure plants.

Increase of economic fertilizer as substrate share – through promotion of community biogas

In order to ensure efficient plant operation, it must be possible to supply fresh manure at all times. A biogas plant operated jointly by several small livestock farms, e.g. at community level (150 kW & 95 % slurry share), could tap up to 80 % of cattle manure (BMEL 2016). The design of the support must not create incentives to intensify livestock farming.

Increase of fertilizers as substrate – through information and advice

Information and advice on the legal and financial starting position for the construction of a biogas plant must be improved. Potential operators of biogas plants must be comprehensively informed about the opportunities, but also about the financial risks. Appropriate training and information material must be made available for this purpose.

Increasing the efficiency of small biogas plants

The trend towards the construction of small-scale biogas plants must be taken up and supported by research and development. The aim must be to make these plants attractive through improved efficiency, practicability and adjusted costs, especially for plants with an electrical CHP output of around 30 kW. It must be clarified whether own standards can be developed for these plants in order to increase the proportion of liquid manure in biogas plants.

5 Methane reduction potentials through livestock adaptation

Reduction potential

Fifty two percent of the methane released in the EU 28 results from agriculture. Of these, 98 % originate from animal husbandry and the associated storage or further processing of residual materials. This shows that the greatest potential for methane reduction lies in animal husbandry. The reduction potential in the EU 28 is illustrated by the analysis of various events since the beginning of the 1990s.

A significant reduction in methane emissions from agriculture went hand in hand with German reunification. In the first years following the fall of the Iron Curtain, the number of ruminants in the new federal states of Germany fell. This also reduced methane emissions and is one aspect for the reduced agricultural methane emissions in EU 28 (1990 vs. 1992 reduction by 8 % CH_4) (EEA 2018). This is an example for the general reduction of ruminant livestock numbers particularly in newer EU Member States. The relaxation of the milk quota in the second quarter of 2015 stopped the slight decline in methane emissions since the mid-1990s. Since then, methane emissions have risen slightly again. These events show that a change in the number of livestock can also lead to a change in methane emissions, especially in the case of ruminants. Thus, it can be concluded that a reduction in methane emissions in agriculture can be achieved by adjusting the number of ruminants.

Reduction measure

Reducing ruminants is one of the most promising approaches to reduce agricultural methane emissions. By combining cross-cultural aspects (consumer behavior, reduction of food waste, change in agricultural export strategy), a first step towards adjusting ruminant numbers can be taken. Taking into account socially acceptable instruments and models for securing employment in rural areas, a permanent adjustment of the number of ruminants will result in a large number of positive synergies in the areas of water protection, biodiversity, air pollution control and animal welfare.

How can this be achieved?

Increased efficiency of use

A social consensus leads to a reduction in animal products such as beef and dairy products. To achieve this, current patterns of dietary consumption must gradually be changed in the direction of sustainability. Adapting our eating habits at least to the requirements of the German Society for Nutrition (DGE) is the first step towards a change in diet. In addition, the appreciation of the food produced must be increased. A fundamental revaluation

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Reduction of production volume

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Reduce export of methane-intensive agricultural products

At the same time as the demand for animal products is reduced, the production capacity freed up must be reduced. This capacity may not be used for the export of animal foodstuffs. In principle, the export capacity for animal products must be reconsidered and limited. In a sustainable agricultural export strategy, the export of completed products is replaced by the export of agricultural know-how in order to increase efficiency in terms of decreasing methane emissions in other regions.

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Exploring substitute products

Targeted research funding will be used to influence the future protein supply of consumers with substitutes (cell culture-based meat/milk, vegetable protein, insects and a possible supplementation of nutrients). Combining this diet, which contributes to climate protection, with other measures should lead to a long-term reduction in the number of ruminants.

Enabling structural change

A reduction in the number of ruminants can only be achieved through acceptance by society as a whole. This requires support during implementation. With the help of socially acceptable instruments, politicians should strive for a reduction in the number of ruminants based on greenhouse gas reduction. Different ways appear possible. The reduction of cattle farms (e.g. during the transfer of farms) or the reduction of ruminants through land use must be accompanied in a targeted manner so that there are no regional shifts in production capacities. With the help of socially acceptable models, structural change must be made possible in rural areas and secure income security in rural areas.

6 Methane reduction potentials through reduced food waste

Reduction potential

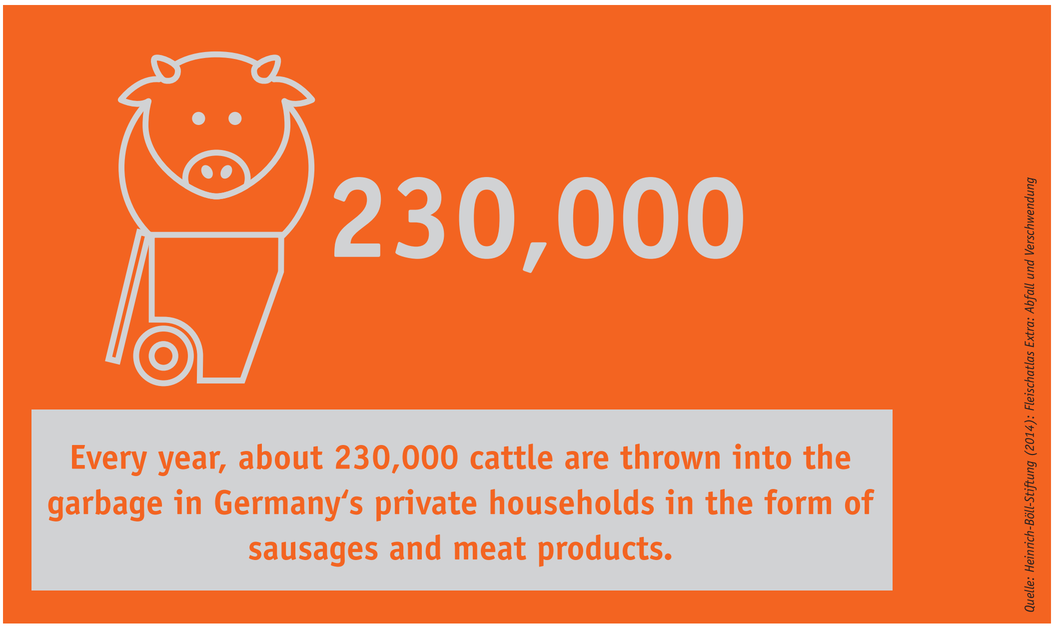
The following chapter on methane reduction potentials through reduced food waste describes the discussion of the topic at the example of Germany. However, many of these aspects can also be extended to other EU Member States and at least additionally applied. This could also increase the potential for reducing food waste and the resulting unnecessary methane emissions from agriculture.

Every year, around 18 million tons of food are lost along the entire value chain in Germany. For the production of discarded food, 20 percent of the agricultural land in Germany is used and there are climate gas emissions of the equivalent of 48 million tons of CO_2 per year (Noleppa and Cartsburg 2015). The waste of milk and meat products is particularly serious, as their resource- and methane-intensive production has a major impact on the environment and the climate. The waste of meat and sausage products corresponds to 230,000 cattle, which are reared and slaughtered uselessly. This produces 109 million kilograms of methane, which corresponds to about 30.5 million tons of CO_2. The 1.41 million tons of milk products thrown away each year, with the equivalent of 9 million tons of CO_2, also have an enormous impact on the climate (Heinrich Böll Foundation 2014, Noleppa and Cartsburg 2015). Meat and dairy products, which end up unused in the garbage every year, alone account for over 6% of German methane emissions.

One of the main reasons for the waste is the low esteem for food in our mass-producing consumer society. The lack of reference to the origin of a food leads to an increasing alienation of the consumer from the food (Wilk 2010). Many foods are packed in a complex way, as appearance and image of a product play an increasingly important role. The food becomes a „completed product“ that is available at all times and where the kind of production is hidden. For example, foodstuffs that can still be eaten are repeatedly disposed in retail due to aesthetic requirements, the expiry of the best-before date, packaging defects or excess stocks. Milk and fresh meat products in particular are often thrown away prematurely as a result of uncertainty about the exact shelf life (Kreyenschmidt 2014). Along the entire value chain, it is estimated that the approximately 18 million tons of food waste could be halved, which could save approximately 22 million tons of $CO_{2\,eq}$. More than half of the emissions from meat and milk production could be saved in this way (BMEL 2016; Noleppa and Cartsburg 2015). In order to better exploit this reduction potential in the future, Germany has committed itself to reducing food losses in the retail trade and among consumers by half by 2030 within the framework of the United Nations Sustainable Development Goals (SDG).

Measure to reduce food losses through improved shelf life labelling

Improved labelling of the shelf life of packaged foods is seen as one way of reducing food losses in the trade and among consumers. When assessing the shelf life of packaged foods, the shelf life expiration date (MHD) and the consumption date (VD) in particular serve as a basis for decision-making for processors, retailers and consumers. The imprint of a best-before date is mandatory for almost all packaged foods. Exceptions are certain dry goods such



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According to a study by the Gesellschaft für Konsumforschung (Society for Consumer Research), around 7 % of unnecessarily disposed food products are discarded because they have exceeded the best-before date (GfK 2017).

as sugar and salt and beverages with an alcohol content of ≥ 10 % and unpackaged goods such as fresh fruit and vegetables. This is regulated in Annex X of the so-called Food Information Regulation (LMIV - EU Regulation No. 1169/2011). The manufacturer shall determine the date of minimum durability. Similar products may therefore have different best-before dates, for example because of different marketing strategies. The best-before date is not an expiration date, but a guarantee given by the producer that the product will retain certain characteristics such as taste, smell and color. Although the majority of consumers state that they understand the best before date correctly, it still seems to serve as legitimation for certain consumer groups to dispose of food prematurely (VZ NRW 2012, Waskow and Blumenthal 2016). Especially for younger people, the orientation towards shelf life information on products plays an important role (Körner 2011). As a result, food with an expired best-before date is disposed even though it would still be edible. According to a study by the Gesellschaft für Konsumforschung (Society for Consumer Research), around 7 % of unnecessarily disposed food products are discarded because they have exceeded the best-before date (GfK 2017). The best-before date thus represents an important basis for consumer decisions on the disposal of food in certain - often particularly environmentally relevant - product groups, such as dairy and finished products. Many foods, such as fruit, vegetables and bakery products, do not usually have a best-before date. According to the study, these product groups account for almost 50 % of avoidable food waste.

How can this be achieved?

In order to reduce food losses through improved shelf life labelling, it is primarily necessary to gain a better understanding of the importance of shelf life claims to the consumer and to enhance the appreciation of food. This could be achieved by intensifying information campaigns and educational work. Knowledge about sustainable food practices should be anchored in school curricula. In addition, manufacturers could use explanatory texts on packaging or retailers to draw attention to the fact that food may still be edible even after the best-before date has expired by displaying information signs on the shelves. Similarly, a better distinction between the date of minimum durability and the date of consumption and a renaming of the usual spelling of the date of minimum durability „at least durable until..." to the term „best before..." used in the English-speaking world could also contribute to a better understanding. For dry foods such as rice or pasta, the obligation to indicate a date of minimum durability should not apply. Such products have an almost unlimited shelf life when properly stored, which may make a shelf life claim misleading. Deleting the date of minimum durability for other products does not appear to be appropriate, as the date of minimum durability is an important source of information for the majority of consumers. The absence of a shelf life indication carries the risk that consumers who are not confident enough to assess the edibility of food themselves will increasingly dispose of edible food. In principle, manufacturers should indicate the shelf life information on packaging more realistically. Many products have an unnecessarily short shelf life, often for marketing reasons. A precise indication of the shelf life is however not to be expected, since this depends crucially on the temperature after the purchase. For example, cooling bags and batteries are not used continuously, uncooled food is given to chilled food, refrigerator temperatures are set differently or distances between supermarket and household are travelled at different speeds.

In order to counter food loss in the retail trade and among consumers, the use of innovative packaging is being discussed in addition to improved shelf life labelling.

Measure to reduce food losses through innovative packaging

In order to counter food loss in the retail trade and among consumers, the use of innovative packaging is being discussed in addition to improved shelf life labelling. In the following, innovative packaging will be described as active and intelligent packaging. While active packaging interacts with the product to extend its shelf life, intelligent packaging provides information about the shelf life of a product.

Typical components of active packaging are oxygen and moisture absorbers, so-called scavenger systems. The absorbent substances are either contained in the films of the packaging material or added to the products as inserts or sachets. Longer shelf live allow larger marketing windows and longer transport distances, but often does not lead to less food loss. For example, the amount of plastic packaging has increased by about one third in the last ten years and even though many products already use water or oxygen absorbers, food waste has not decreased. For example, the longer shelf life of food can tempt people to buy larger quantities, which are not consumed afterwards or simply do not taste good.

How can this be achieved?

Intelligent packaging can use integrated time-temperature indicators to illustrate a food's cold chain compliance, or to identify interim temperature increases that may have negative impact on the shelf life of the product. Such changes are indicated, for example, by a change of color of the indicators. Particularly in the case of meat products, there is often uncertainty in retail about the exact shelf life, for example after brief interruptions in the cold chain, which can result in premature disposal. Intelligent packaging can help to eliminate ignorance about the condition of a product by measuring it directly on the product. It is assumed that 12 % of the poultry meat produced along the value chain is lost due to this lack of knowledge. Active and intelligent packaging could prevent 35 % of these losses (Kreyenschmidt 2018). In the case of methane-intensive products such as beef or dairy products, this packaging could also help to reduce unnecessary losses in retail, as premature disposal is avoided.

Intelligent packaging has so far not been widely used in Germany, in particular due to higher prices and concerns among manufacturers and retailers. Consumer groups and initiatives against food waste also tend to be critical of intelligent packaging, as there are fears of further alienation of consumers from food. Time-temperature indicators suggest absolute certainty in the assessment of products and mean that consumers have to rely even less on their own senses to evaluate the shelf life of a food product. In particular, the use of RFID tags (radio-frequency identification) or NFC chips (near-field-communication), which are affixed to the packaging or incorporated into the foils and can provide information about the history of the food, are critically assessed for data protection reasons, as they are partly able to record the purchasing behavior of individual consumers (BSI 2005).

When using active and intelligent packaging, other environmental aspects such as higher resource consumption or poorer recyclability should also be taken into account. Additives, additional foils or metals contained in the product make it difficult to recycle high-quality materials. In multilayer composites, active components are usually inserted between other layers and can therefore hardly be detected and separated. There is also a risk that parts of the multi-layer composites, mixed plastics or additives may be transferred to the recycled materials at insufficient melting temperatures (UBA 2017).

Further measures to reduce food waste

In principle, the ever-increasing amount of packaging and the greater proportion of innovative packaging seems to lead to a greater alienation of consumers from food and thus potentially to waste. Measures against food waste should therefore focus primarily on the appreciation of food rather than on the excessive use of packaging. However, freshness indicators could be useful for sensitive foods such as meat or fish, which should no longer be consumed after the consumption date has elapsed. Initial findings also show that retail pays more attention to the cold chain when products have intelligent packaging. A revision of shelf life descriptions and in particular, a better understanding of shelf life descriptions is considered a valuable tool to reduce food waste. Awareness raising and information campaigns on packaging should be enhanced in the retail sector, for example to inform consumers about the purpose of the best-before date.

However, improved shelf life labelling and consumer understanding can only be one part of tackling food waste. It is important that binding reduction targets for food waste are set along the entire value chain. A basic requirement for this is the obligation to document food losses. Supermarkets should also be obliged to pass on surplus edible food free of charge. In many cases, the collection and distribution of food by volunteers is seen as a commercial act. This results in a legally uncertain situation for donors and recipients, as they can be held liable for possible damage to health caused by spoiled food (UBA 2016).

In order to support the transfer of food, donor establishments should be better protected against liability risks and recipients should be given greater responsibility for the examination of the accepted food.

Supermarkets should be obliged to pass on surplus edible food free of charge. In order to encourage the transfer of food, donor establishments should be better protected against liability risks and recipients should be given greater responsibility for chekking the food accepted.

7 Methane reduction potentials through adapted husbandry methods

A possible factor for the reduction of methane are the different types of husbandry of dairy cows, fattening cattle and offspring. The kind of husbandry has an influence on the storage of animal excrements and can lead to more or less methane emissions. For example in Germany, the following different kind of keeping cattle are common (Hartmann, Eurich-Menden 2018):

- **Cubicle stable** (slatted floor with liquid manure, level-fixed walkways with liquid manure, level-fixed walkways with solid manure), can be combined with run-out / runway yard
- **Fully slatted floor** (one or two-surface bay)
- **Deep litter stable** (one or two-surface bay)
- **Pedal manure stable** (one or two-surface bay)
- **Tethering** (short stand with solid manure, short stand with liquid manure, medium long stand)
- **Year-round free-range husbandry**

Reduction potential

It is currently very difficult to make well-founded and reliable statements about methane emissions in the various cattle husbandry methods. Further results from ongoing measurement projects must be generated and evaluated.

Due to the lower emitting surface, tethering is associated with lower GHG emissions. However, year-round tethering is not suitable for animals.

The release of methane in manure stalls is higher than in bedding systems (KROMER 2012). In straw stables, however, approx. 10 times more N_2O is emitted (KROMER 2012), depending on the amount of bedding and manure removal interval.

There are several reasons for the emission-reducing effect of pasture farming in comparison with stabling methods. This results in less liquid manure for storage. The NH_3 and CH_4 emissions of pasture farming are lower than those of stable farming, but the N_2O emissions are usually higher. Grazing is considered rather positive from the point of view of animal welfare and animal health.

Overall, the operational factors influencing the GHG balance are so varied (bedding method, type of housing, feeding, frequency of manure removal, temperature control, etc.) that ultimately operational management seems to be more important for reducing emissions than the choice of type of housing (FLESSA et al. 2012). It is therefore not possible to derive a more precise reduction potential for different types of husbandry.

Even if it is currently not possible to derive a more precise methane reduction potential for different types of husbandry, there are several reasons for the emission-reducing effect of pasture farming compared with stable farming methods, e.g. less liquid manure is required for storage.

8 Methane reduction potentials through adapted feeding and herd management

Methane is produced by the digestion of the feed in the forehead, the rumen, and is released mainly by burping, the so-called ructus, as well as from manure and slurry. Cattle cause almost 90 percent of methane emissions from livestock farming (German Federal Statistical Office 2012).

Reduction potential

The level of methane emission in cattle depends on the composition of the feed. Methane excretion increases when feeding coarse fodder and fiber-rich feed (silage, hay, straw). A high proportion of concentrated feed, on the other hand, reduces the methane emissions of the animals per unit of food produced.

Feed additives such as tannins or fats have the potential to reduce digestion-based methane emissions from cattle. However, there is still a considerable need for research in this area. Concrete statements or figures on the methane reduction potential through adapted feeding and modified rations or additives are currently not possible.

Measures to reduce methane through feeding and herd management

Change in feed composition

The lower the proportion of fibrous fodder (grass, hay, straw), the lower the methane production in the digestive tract of ruminants. However, the deliberate reduction of the fiber-rich basic feed content is currently not practicable, as milk yield and animal welfare can be negatively affected.

Use of fats and additives in animal feed

The use of other fat sources has a depressive influence on methanogenic microorganisms (FLACHOWSKY 2007). However, there are limits to use due to the effect of the additional fat sources on the milk composition. Chemical feed additives are also researched and used in the course of methane reduction via feeding. However, their methane-reducing potential has not been sufficiently confirmed. Accordingly, its use is so far only a theoretical option (FLESSA et al. 2012).

Improvement of milk yield/reduced reproduction rate/ reduction of animal losses

The most frequent causes of dairy cows losses are fertility disorders, udder diseases, metabolic disorders and diseases of the foundation (limbs and claws). When it comes to extending the service life of dairy cows, these disturbances and diseases should be avoided.

How can this be achieved?

High basic feed quality

An important measure is to increase the quality (nutritional value and feed value) and quantity (grass, hay) of basic fodder through targeted management and cultivation (e.g. species and variety mixing, fertilization, cutting time and number of cuts, grazing, etc.).

Strengthening advice on extending the service life of dairy cows

The service life of dairy cows in Germany stagnates at approx. three years. The extension of the useful life is directly linked to a higher life expectancy. To this end, specialist advice for farmers must be significantly strengthened. This reduces the emission of greenhouse gases in general and methane per liter of milk in particular.

Promotion of dual-purpose breeds

Cows with a high milk yield produce less meat than by-products. A study by the Bavarian State Institute for Agriculture (Rosenberger et al. 2004) showed that for the production of the same amount of meat with separate husbandry of milk and meat breeds, around 15% more CO_{2eq} per kg of milk is emitted than in comparison to classic two-purpose breeds. Accordingly, the keeping of dual-purpose breeds should be promoted and agricultural expert advice on this point should be strengthened.

The reduction measures in the area of feeding and breeding show a need for further research and have so far promised only a rather low methane reduction potential compared with the above-mentioned measures. Therefore, in the short and medium term, it is more appropriate to start there and in the long term to take in account measures for feeding and breeding.

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10 Project Minus Methane and Imprint

The project „Minus Methane“

The Minus Methane project (methane reduction for cost-effective climate protection in agriculture) promotes the nationwide introduction of cost-effective measures for methane reduction in German agriculture. Multiplier workshops develop concrete and practicable solutions for implementation.

The project was initiated to shed light on unexploited potential for climate protection in agriculture. It aims to reduce methane emissions from agriculture in Germany by 2020 and thus make an easy to implement contribution to climate protection.

Farmers, their associations and organizations as well as public authorities from the areas of environment and agriculture were addressed. Suitable communication measures were also used to inform the public about agriculture's contribution to climate protection.

As a result, a methane reduction strategy was developed that presents concrete measures to address the hitherto unexploited climate protection potential in agriculture.

The project was funded by the National Climate Initiative (NKI) of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). It started in February 2017 and runs until January 2019.

minus
METHAN
in der Landwirtschaft

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