Best practice guide on the use of (sensor)technology to improve grassland management in European Dairy Farms

This best practice guide outlines different (sensor) technologies available to support dairy farmers in their management of grassland. Management of grassland deals with monitoring of the grass growth and the decisions around grazing and harvesting. Interesting new developments are also covered.

Grazing on dairy farms

Grass is the cheapest forage available, and optimizing the growth stage at which grass is harvested/grazed will lead to more milk produced from forage, and more profit. But grazing management is rather complex. Dairy farmers that apply grazing on their farm have to cope with a daily variation in grass offer, grass quality and the grass intake of their cows. Also changing weather conditions and soil conditions have to be taken into account. Working with different parcels at the same time it is important to support dairy farmers in making more data driven decisions on when to mow the grassland or to start grazing on that specific parcel.

Within Europe there are a lot of different grazing systems that can be practiced on dairy farms.
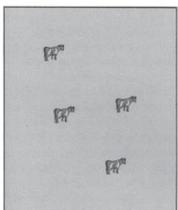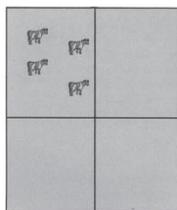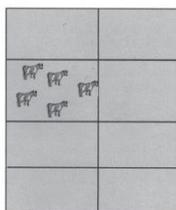

Figure 1: Grazing Systems Handbook Regents of the University of Minnesota.

In all of these grazing systems there is a need for objective measurement and prediction of grass growth. In this best practice guide we focus on tools and systems to measure and predict grass growth.

How to measure grass production

Nowadays you can use several kinds of modern technologies to measure the grass production of a parcel. There are more expensive innovations like hyperspectral camera's in satellites (GNNS) and drones, but there are also modern technologies which almost everyone could use, for example dry-matter-content-testers (after harvesting grass) or ground based measuring instruments like a plate meter. We are going to highlight four grassland measuring instruments.

Table 1 and 2 shows some key performance indicators (KPIs) to support the decision on grazing and harvesting. Remember that not all of these KPIs are carved in stone, and that they will vary with different farm systems, soil conditions, grass varieties and climatic circumstances.

Table 1. KPIs for grazing decisions (for common West European circumstances)

KPI	Target
Grass length	>11 cm
Dry matter content (DS)	900-1700 kg/ha
Feeding frequency	Depends on the grazing system

Table 2. KPIs for harvesting

KPI	Target
Grass length	>24 cm
Dry matter content	3000-4000 kg/ha 40-50% DS/ha harvesting grass 85% DS/ha harvesting hay
Cuts a year	minimal 3
Feeding frequency	Depends on the feeding system

Grass Heights CM	Yield grazing DS/ha	Yield harvesting DS/ha
9	675	825
10	785	935
11	900	1050
12	1020	1170
13	1145	1295
14	1275	1425
15	1410	1560
16	1550	1700
17	1695	1845
18	1845	1995
19	2000	2150
20	2160	2310
21	2325	2475
22	2495	2645
23	2670	2820
24	2850	3000
25	3035	3185

Figure 3: guideline for the estimation of the Yield (Graslandsignalen)

• Grass height meter

The grass altimeter (Figure 2) measures the height of the grassland. There is a relation between grass height and amount of grass. When using a simple plate meter you have to use a graph or a formula to know the grass amount (figure 3). More sophisticated meters with an integrated sensor can deliver directly the grass production for a specific field. Sometimes even the location of the measurement can be send to your smartphone. You can check and analyze the growth curve of the grassland.

• Pasture reader

The Pasture Reader (Figure 4) is a system that includes a sensor to measure grass yield and makes a location determination system by using GPS signals. This system can be built on every vehicle, for example on a mower. It has a sensor that measures the grass height. Before mowing, it is possible to insert the name/number of the pasture and the acreage. After mowing the pasture, the Pasture Reader shows the amount of kg dry-matter per ha for that pasture.

Figure 2 Grass altimeter (Source: Verantwoorde Veehouderij)

Figure 4 Pasture Reader

• NIRS

NIRS is short for Near-Infra-Red-Spectroscopy. NIRS can measure the dry-matter-content of grassland site-specific. NIRS is used on silage machines and therefore used for harvesting processes. With a deviation of 2% the NIRS-system is very accurate on measuring grass yield. The results are send wireless to a server, and software puts all the different data together in just one yield-overview.

Figure 5: NIRS on the front of the Schuitemaker Rapide (Schuitemaker)

• Nedap Eating Monitoring

The Nedap Heat Detection with Eating Monitoring (Figure **6**) also can be used outdoors to measure eating behavior and thus an indicator of the grass intake. The Nedap Eating Monitoring is a major innovation in the automatic tracking of each individual animal's health and welfare. The sensor records the time of the cows roughage intake or grazing. If there are changes in the eating behaviour, it can tell you that there may be something wrong with the animal and that the animal needs further attention.

Figure 6 Nedap Eating Minitoring Sensor (Source: Nedap)

Advantages and financial aspects of monitoring systems for grassland management:

- It saves time
- It reduces labour intensity
- Overall overview of all your pastures
- Insight in the quality of forage
- Able to control rations for individual animals.

Table 3 shows how much a system will cost as investment, and in table 4 there are summed up benefits and considerations on investing on different systems.

System	Investment
Grass altimeter	€750
Pasture Reader	€5.000
NIRS	€22.500
NEDAP system	??

Table 3. Costs of the systems shown in this BPG. The real investment depends to the offer of the supplier

System	Benefits	Cons
Grass altimeter	✓ Measuring quality of grass ✓ Daily use ✓ Results direct available	- Time-consuming
Pasture Reader	✓ GPS ✓ High reliability ✓ Accurate ✓ Applicable to different implements ✓ Relatively good price	
NIRS	✓ Low drift rate ✓ Harvest results direct available	- Only available on choppers and Schuitemaker Rapide - Price
NEDAP system	✓ Combined with heat detection	

Table 4. Overview benefits and cons on systems in this BPG.

Which technology should I buy?

Before purchasing technology to improve grassland management, you should make sure it is appropriate for your management practices. Guidance from your veterinarian or other professional advisors is recommended. Before finally committing to a technology investment here are some questions you might like to ask the supplier:

- Which system or sensor suits my farm?
- What are the full costs (hardware, devices, maintenance, data storage)?
- How easy is it to use the system?
- How long will the system last?
- How reliable are the alerts?
- What is your warranty policy?
- What percentage of devices fail per year?
- What support is available?
- What is the longevity of the battery?
- What is your policy for upgrading to new versions?
- Can my farm advisors or veterinary access the information?
- Who owns the data generated from the sensors?

Best practice tips

It is important that technology is seen as an extra tool, and not as a replacement for good stockmanship.

- The grass altimeter is accessible for everyone to use;
- The Pasture Reader is convenient to use in many different pastures;
- NIRS is a good solution when you harvest a lot of different pastures and store it in the same silo;
- Before buying a system or sensor look at the other functionalities that would best suit your farm needs;
- Combining data will improve grassland management instead of only single parameters;
- In conjunction with your nutritionist, use the data on individual cows to improve graze and feed efficiency;
- The early identification of potential management challenges helps maximize efficiency and productivity, reducing potential milk production losses and improving animal health.