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NDS Dynamics

NDS Grazing Assessment Tool

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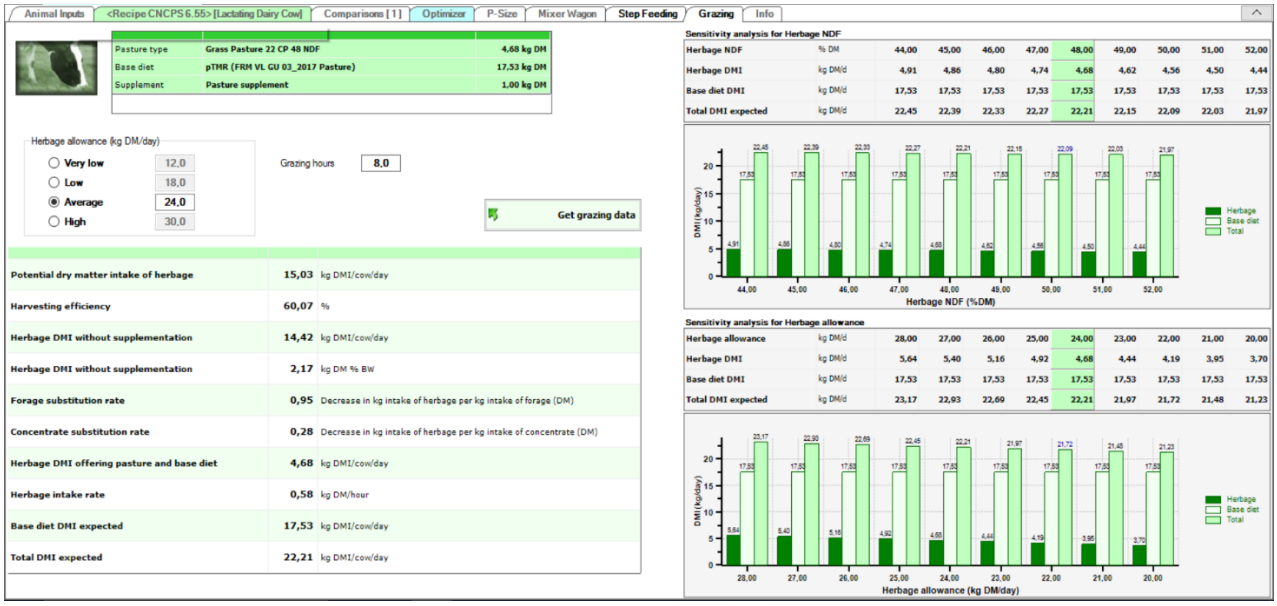
Accurate estimations of total dry matter intake (**DMI**) and pasture DMI (**PDMI**) are fundamental aspects in determining the performance of livestock on grazing systems. Grazing systems increase the difficulty in estimating DMI compared with confinement feeding systems.
Several models have been developed to predict DMI based on animal characteristics alone or with feed nutritive factors. However, most of these models have been developed under confinement feeding conditions, where forage selection is limited.
The estimation of PDMI has been a subject of much research, and many factors have been identified that influence intake, including pasture allowance, herbage mass, supplementation, herbage digestibility and animal body weight, among others.

Starting from the consideration that grazed pasture is the cheapest source of nutrients for the animal so that it should form the basis of profitable and low-input animal production systems, and given that, at least in most countries where the milk price is low, the management of efficient grazing systems allows to achieve low production costs, the development group at RUM&N designed and developed a new tool called **NDS Grazing Assessment Tool**.



The tool is designed to combine theoretical and empirical equations developed to predict the daily DMI for cattle grazing either grass, legume or mixed based-pastures, and offered differing levels of partial TMR (**pTMR**) or with or without concentrate and/or extra-forages supplementation, thus can be useful for management and nutritional evaluations in different countries.
An upper limit to potential herbage DMI at grazing is set, which is considered to be the lower of two limits set by either physical (rumen fill) or grazing restrictions. Potential herbage DMI at grazing and the herbage allowance are then used to predict herbage DMI of cattle fed only pasture, using an empirical algorithm. If pTMR or supplements are fed, substitution rate is predicted to calculate actual herbage DMI.
The **NDS Grazing Assessment Tool** should be useful for applied research, teaching and extension purposes, allowing a quick and practical understanding of the effects of feeding level, that is, pasture and supplements offered, on herbage DMI and related performance. It is also a tool to aid decision making around management strategies for the different cattle type.

Grazing tab Inputs

Even though the fresh grass intake by cattle and the effects on performance production is a complex system and it is influenced by a range of factors, including the milk yield potential, body weight, age, reproductive stage and innate grazing behavior of cattle, the quantity of herbage available to the animals, its quality (digestibility) which affects the rate of passage through the rumen, and also the uniformity and botanical composition of the herbage in the sward, we tried to minimize the input of the information needed in order to facilitate the tool's usability.

Inputs required for each feeding period:

- **Herbage allowance** (**HA**) - kg or lbs DM herbage offered/cow/day. Herbage allowance is defined as the amount of herbage above a specified sampling height allocated to livestock (kg or lbs DM/cow per day) on the current pasture. At low HA, non-nutritional factors related to pasture structure determine PDMI. In contrast, at high levels of HA, PDMI increases at a progressively lower rate as HA is increased. It has been identified as a major factor influencing DM intake and livestock performance. High plant density results in a higher intake level because the animal can stand in one spot in a pasture and graze from many plants. At the opposite, a thinner stand will result in a lower intake because the animals needs to spend more time walking around and looking for plant to graze.
  This parameter can be predefined by default as *very low*, *low*, *average* and *high*. However, it can be customized by the user under each unique grazing conditions, whether more information are available.
- **Grazing hours** – hours/day of access to the paddock. It is the amount of time available for grazing or the daily time spent grazing by livestock.

Grazing Tab Outputs

The outputs of the Grazing tab have different sections providing a range of useful information to evaluate the DMI of grazing animals receiving the recipe we are formulating.

Summary DMI

The grid includes the DMI expected for each of the macro components feeds offered:

- Grazed herbage
- Partial TMR (if offered)
- Supplement (if offered)
- Extra-forages (if offered)

Pasture type	**Grass Pasture 22 CP 48 NDF**	**4,68 kg DM**
Base diet	**pTMR (FRM VL GU 03_2017 Pasture)**	**17,53 kg DM**
Supplement	**Pasture supplement**	**1,00 kg DM**

These data provide an idea of how the total DMI is obtained.

Herbage DMI details

The grid provides the main details in order to understand how the model predicts the herbage DMI:

- *Potential dry matter intake of herbage* (**PotDMI** kg or lbs DMI/cow/day) - upper limit to potential herbage DMI for animals offered only pasture, which is the minimum out of two limits: (i) physical limitation related to rumen fill, (ii) 'grazing limit' related to ingestive constraints that is the total DMI predicted by the model.
- *Harvesting efficiency* (HE %) – it is the efficiency of grazing predicted by the ratio HA:PotDMI. It measures the pasture offered relative to the cow's demand for pasture at grazing. It is expected that, as HA decreases, herbage DMI/animal decreases, but grazing time and the efficiency of grazing increases.
- *Herbage DMI without supplementation* (kg or lbs DMI/cow/day) – it is the herbage DMI of animals offered only pasture and it is obtained by multiplying HE times HA. This value cannot be greater than PotDMI, otherwise it is set equal to PotDMI, because at high HA, nutritional factors such as herbage quality and the metabolic demand of the animal appear to be less relevant and intake appears to be mainly controlled by rumen fill. This value is also shown as % BW.
- *Forage substitution rate* - when extra-forages are offered, the herbage DM intake of animals may decrease. Forage substitution rate expresses the decrease in kg or lbs DM intake of herbage per kg or lbs DM intake of extra-forage

intake. It is based on the fill effect of the extra-forage compared to the grazed pasture and predictions are driven by uNDF content of the forages involved.

- *Concentrate substitution rate* - when supplements are offered, they partially replace herbage DM intake. Concentrate substitution rate expresses the decrease in kg or lbs DM intake of herbage per kg DM intake of supplement. It is based on herbage DMI before supplementation expressed as % BW.
- *Herbage DMI offering pasture and base diet* (kg or lbs DMI/cow/day) – when grazing animals are also eating pTMR and/or supplements and/or extra-forages.
- *Herbage intake rates* – herbage DMI/hour spent grazing.
- *Base diet DMI expected* – DMI of pTMR, supplement (if offered) and extra-forages (if offered)
- *Total DMI expected* – total of herbage DMI and base diet DMI.

Potential dry matter intake of herbage	**15,03**	kg DMI/cow/day
Harvesting efficiency	**60,07**	%
Herbage DMI without supplementation	**14,42**	kg DMI/cow/day
Herbage DMI without supplementation	**2,17**	kg DM % BW
Forage substitution rate	**0,95**	Decrease in kg intake of herbage per kg intake of forage (DM)
Concentrate substitution rate	**0,28**	Decrease in kg intake of herbage per kg intake of concentrate (DM)
Herbage DMI offering pasture and base diet	**4,68**	kg DMI/cow/day
Herbage intake rate	**0,58**	kg DM/hour
Base diet DMI expected	**17,53**	kg DMI/cow/day
Total DMI expected	**22,21**	kg DMI/cow/day

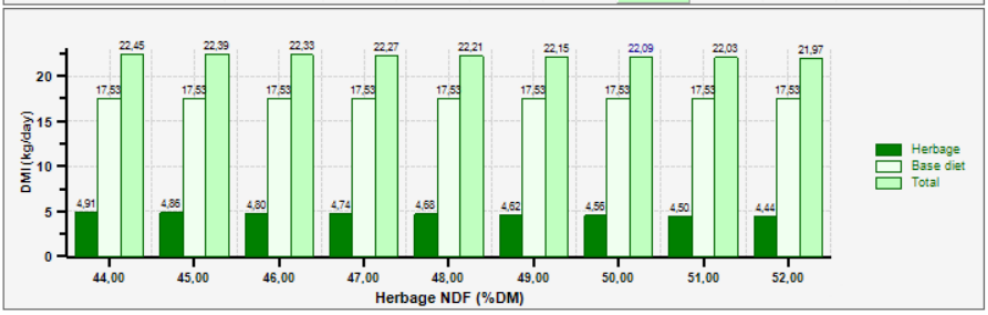
Sensitivity analysis for herbage NDF

Physical and physiological factors regulating feed intake change in importance with increasing herbage quality. aNDFom is an important nutritional factor through its effects on digestion and rumen fill, described in the tool by the forage undigestible NDF (**uNDF**) content (% NDF), with a lower rate of digestion and higher rumen fill as uNDF in the diet increases. At high HA, with herbage containing high concentrations of uNDF, intake is limited by the physical capacity of the animal, and it becomes a function primarily of dietary characteristics; for herbage containing low concentrations of uNDF, intake is controlled by the physiological energy demands of the animal, and is principally a function of animal characteristics.

Since there are variation in the aNDFom concentrations of pasture over the grazing period, reflecting the changes in the stage of maturity of plants and associated with variations of uNDF intake, the grid shows the expected variation in DMI (herbage, base diet and total DMI), when the herbage NDF change (%DM) around the current value, shown in the green column.

Sensitivity analysis for Herbage NDF

Herbage NDF	% DM	44,00	45,00	46,00	47,00	48,00	49,00	50,00	51,00	52,00
Herbage DMI	kg DM/d	4,91	4,86	4,80	4,74	4,68	4,62	4,56	4,50	4,44
Base diet DMI	kg DM/d	17,53	17,53	17,53	17,53	17,53	17,53	17,53	17,53	17,53
Total DMI expected	kg DM/d	22,45	22,39	22,33	22,27	22,21	22,15	22,09	22,03	21,97



Sensitivity analysis for herbage allowance

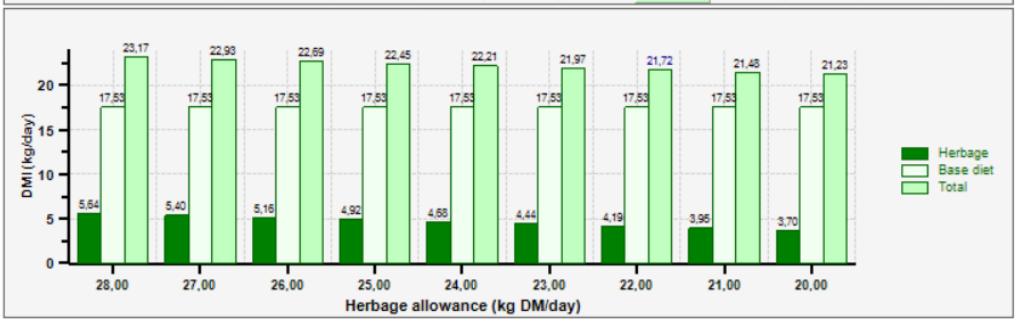
The relationship between HA and PDMI depends on the levels of HA, the cutting height of the herbage and the level of production of the animals. The height of herbage sampling cut, above which HA is expressed, is an essential factor

influencing the relationship between HA and PDMI. Herbage allowance is commonly measured at 3/5 cm above ground level (1.5/2 inches), but sometimes it is measured at ground level.

Since HA plays a strong role in determining PDMI, as demonstrated by many studies, it might be of interest to evaluate DMI as HA change compared to the current input. The grid shows the expected variation in DMI (herbage, base diet and total DMI), when the herbage allowance change around the current value, shown in the green column.

Sensitivity analysis for Herbage allowance

Herbage allowance	kg DM/d	**28,00**	**27,00**	**26,00**	**25,00**	**24,00**	**23,00**	**22,00**	**21,00**	**20,00**
Herbage DMI	kg DM/d	**5,64**	**5,40**	**5,16**	**4,92**	**4,68**	**4,44**	**4,19**	**3,95**	**3,70**
Base diet DMI	kg DM/d	**17,53**	**17,53**	**17,53**	**17,53**	**17,53**	**17,53**	**17,53**	**17,53**	**17,53**
Total DMI expected	kg DM/d	**23,17**	**22,93**	**22,69**	**22,45**	**22,21**	**21,97**	**21,72**	**21,48**	**21,23**



Get grazing data

After having carefully considered the predictions provided by the tool, one could decide to get the data back to the current recipe:

- ✓ Herbage DMI will be taken for the pasture feed included in the recipe
- ✓ pTMR DMI (if TMR is delivered) will be adjusted according to total DMI and hours on pasture
- ✓ supplement and/or extra-forages DMI (if offered) will be unchanged, according to the amounts defined

So, it will be formulated a new recipe for the animals managed on the specific pasture and performances will be evaluated according the **CNCPS Model**.

Implications

The **NDS Grazing Tool** represents a simple approach to the prediction of daily pasture DMI, with more emphasis on animal factors than on sward factors. In fact, sward structure, herbage mass and botanical composition, although known to be important, are not included in the present model for the sake of simplicity.

The tool is able to predict DMI for supplemented and un-supplemented cattle under a wide range of nutritional management conditions and it is useful for applied research, teaching and extension purposes. However, given the variability in management, environment, and other factors out of the control of the **Grazing Tool**, animal performance expected only provide an idea of the realistic output that can be obtained. The recipe proposed by the tool is based upon the information available on the farm and the user should check carefully the predictions in order to avoid misuse and/or misrepresentation of data.

The **NDS Grazing Tool** is conceived as an evolving model and continue be updated as new researches are conducted and become available, and thanks to the feedback from the user of the **NDS Professional** platform.

Send us your comments on these topics! Dave is at rumendvm@gmail.com; RUM&N at info@rumen.it

Note that the features and utilities developed by the NDS team described above are not components of the underlying CNCPS model, and do not change the CNCPS outputs or results. *Questions about use of these features should be directed to the NDS support team, and not to the CNCPS group at Cornell.*

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