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An international terminology for grazing lands and grazing animals

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The Forage and Grazing Terminology Committee

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(n.) Noun
(v.) Verb
(adj.) Adjective
(cf.) For comparison see
(e.g.) For example
(Syn.) Synonym

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Preface

In 1991, *Terminology for Grazing Lands and Grazing Animals* was published with the objective of 'developing a consensus of clear definitions of terms used in the grazing of animals.' This first effort involved primarily organizations and agencies within the USA but included representation from New Zealand and Australia. It was the intent from the beginning to expand this to a truly international effort at a later date. At the XVII International Grassland Congress (IGC), held jointly in New Zealand and Australia in 1993, a resolution was passed at the final business meeting as follows: 'It is recommended that the International Grassland Congress endorse the continuing development of uniformity of terminology for grazing systems and grazing management, and that the Forage and Grazing Terminology Task Force report progress at the XVIII Congress.' During the XVIII IGC, held in Canada in 1997, a new Terminology working group, chaired by Mort Kothmann, was formed to begin discussions regarding the first revision of this publication. As was the objective from the beginning, this first revision was to be international in scope and a focused effort was made to include broad international representation and expertise.

Preliminary work by the working group was accomplished during the next few years. In 2000, Terminology became the first project to be jointly supported by the IGC and the International Rangeland Congress (IRC) and a new Terminology Committee was jointly appointed by Bob Clements (Chair, IGC Continuing Committee) and Maureen Wolfson (President, IRC Continuing Committee). Work of the Terminology Committee progressed leading up to the first joint meeting of the IGC and the IRC in Hohhot, Inner Mongolia in the Peoples Republic of China. At the meeting in 2008, resolutions were passed by both the IGC and the IRC requesting that Terminology for Grazing Lands and Grazing Animals be completed and presented at both the IX IRC in Argentina in 2011 and the XXII IGC in Australia in 2013. With the completion of this revision in 2010, the wishes of both congresses will be fulfilled.

As with the first edition of Terminology, our objective has been to develop a consensus of terms and definitions to ensure clear international communication

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regarding grazing lands and grazing animals. Terms included here have relevance to both domesticated and wild grazing animals. It is intended that these terms enhance communication in education, science, industry and production and that they become the standard for use in publications. It has been our goal to include terms that are relevant specifically to grazing lands and grazing animals and to present these, where appropriate, in a hierarchy that shows the relationships among such terms. For example, certain terms such as 'grazing land' are all-inclusive and are then followed by terms relating to the various types of grazing lands. We have attempted to agree on a single, concise definition for each term and to avoid multiple definitions. Variations among terms used in countries where English is one of the official languages were taken into account. Because of international variations in a few terms, we have included a list of the various international interpretations in an Appendix but have recommended the use of a specific term and definition. It is hoped that this will take us towards a more uniform international language. In the case of most terms and definitions, we have arrived at a consensus opinion. In a few cases, use will be needed to see whether these will stand the test of time. We hope that in such cases, we have taken the steps to move the language forward towards more precise and meaningful terms and definitions. Finally, as we reviewed terms and definitions, there were some that did not appear to contribute to clear communication. We have listed these in an Appendix and provided an explanation for our recommendation that they are not used.

Ours is a living language that will continue to evolve as new concepts emerge, techniques and methods change, and our international language becomes more precise. Thus, the mechanism established by the IGC and the IRC for periodic review and revision of Terminology for Grazing Lands and Grazing Animals must be continued but with sufficient time between revisions to allow for adequate testing to see where terms are missing and revisions are required.

Finally, on behalf of the International Forage and Grazing Lands Terminology Committee, we are submitting this *International Terminology for Grazing Lands and Grazing Animals* to the IGC and the IRC with our appreciation for the challenge and opportunity that you have entrusted to us. It has been a privilege and an honour to serve.

March, 2011

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An international terminology for grazing lands and grazing animals

1. Grazing land terms

Note No. 1.
1. In this publication, 'grazing animals' refers to grazing herbivores, both domesticated and wild, that feed mainly or only on forage and does not include insects or other animals that consume vegetation to some degree.
2. Some of the definitions of grazing land types (below) imply current land use and some are based on potential vegetation or land capability. The context should be specified if it is not apparent.
3. The grazing land terms, cropland, forestland, pastureland/grassland and rangeland can provide the basis for land-use mapping units.
4. The definitions given are generic with some potential for overlap (i.e. grassland). The term grassland bridges pastureland and rangeland and may be either a natural or an imposed ecosystem. Grassland has evolved to imply broad interpretation for lands committed to a forage use.

1.1 Grazing land (**n.**). Any vegetated land that is grazed or has the potential to be grazed by animals (domestic and wild). This term is all-inclusive and covers all kinds and types of land that can be grazed.
1.1.1 Cropland (**n.**). Land devoted to the production of cultivated crops. May be used to produce forage crops (cf. Crop, 2.1.1; Forage crop, 2.1.1.1).
1.1.2 Forestland (**n.**). Land on which the vegetation is dominated by trees or, if trees are lacking, the land bears evidence of former forest and has not been converted to other vegetation or land use.

Note No. 1.1.2.
This is a general definition. For land-mapping purposes, the proportion of tree canopy cover and other characteristics may be defined precisely.

1.1.2.1 Agroforestry (**n.**). Land-use system in which trees are used for forest products (e.g. timber, pulp, fruits, rubber, syrup and browse) combined with agricultural crops including forage crops and/or animal production.

Note No. 1.1.2.1.
The following terms are sometimes used and apply to agroforestry as follows:
Agro-silvo-pastoralism (**n.**). Incorporates agricultural crops, potentially including forage crops and livestock production, where trees may produce timber, pulp, fruits, rubber, syrup or browse for grazing animals.
Silvo-pastoralism (**n.**). Refers to the exclusive use of land for forest products and animal production by browsing of shrubs and trees and/or grazing of co-existing forage crops.

1.1.2.2 Grazable forestland (**n.**). Forestland that produces, at least periodically, understory (understorey) vegetation that can be grazed. Forage is indigenous or, if introduced, it is managed as though it were indigenous (cf. Rangeland, 1.1.4).
1.1.2.3 Woodland (**n.**). A plant community in which, in contrast to a typical forest, the trees are often small, characteristically short-boled relative to their crown depth and forming only an open canopy with the intervening area being occupied by shorter vegetation, commonly grass (cf. Savanna, 1.1.4.2.7). See Helms (1998).
1.1.3 Pastureland (**n.**). Land (and the vegetation growing on it) devoted to the production of introduced or indigenous forage for harvest by grazing, cutting, or both. Usually managed to arrest successional processes (cf. Grassland, Note No. 1.1.3; Pasture, 5.3.4; Rangeland, 1.1.4).

Note No. 1.1.3.
1.1.3 Grassland (n.). The term 'grassland' is synonymous with pastureland when referring to an imposed grazing-land ecosystem. The vegetation of grassland in this context is broadly interpreted to include grasses, legumes and other forbs, and at times woody species may be present (cf. Native or Natural Grassland, 1.1.4.2).
There are many descriptive terms for pastureland/grassland that take into account their age and stability. The following are recommended.

1.1.3.1 Annual pastureland/grassland (**n.**). Forage is established annually, usually with annual plants, and generally involves soil disturbance, removal of existing vegetation, and other cultivation practices.
1.1.3.2 Cultivated pastureland/grassland (**n.**). Forage is established with domesticated introduced or indigenous species that may receive periodic cultural treatment such as renovation, fertilization or weed control.

1.1.3.3 Permanent pastureland/grassland (n.). Land on which vegetation is composed of perennial or self-seeding annual forage species which may persist indefinitely. It may include either naturalized or cultivated forages.

1.1.3.4 Temporary pastureland/grassland (n.). Land on which vegetation is composed of annual, biennial, or perennial forage species kept for a short period of time (usually only a few years).

Note No. 1.1.3.4.
Temporary pastureland/grassland can be regularly resown or can be integrated in a crop rotation (ley). It is usually composed of simple mixtures of grasses, grass/legume or legume species.

1.1.3.4.1 Ley (n.). Temporary pastureland/grassland that is integrated in a crop rotation.

1.1.3.5 Naturalized pastureland/grassland (n.). Forage species present are primarily introduced from other geographical regions that have become established and have persisted under the existing conditions of environment and management over a long time.

1.1.3.6 Semi-natural pastureland/grassland (n.). Managed ecosystem dominated by indigenous or naturally occurring grasses and other herbaceous species (cf. Native grassland, 1.1.4.2).

1.1.3.6.1 Meadow (n.). A natural or semi-natural grassland often associated with the conservation of hay or silage.

Note No. 1.1.3.6.1.
A meadow may exist as a result of discontinuous features of hydrology, landscape position, or soil characteristics that differ from the surrounding landscape and vegetation. Descriptive terms include 'mountain meadow,' 'alpine meadow,' 'wet meadow,' and 'hay meadow.' 'Flower meadows' are kept for aesthetic interest and can also provide feeding or bedding.

1.1.4 Rangeland (n.). Land on which the indigenous vegetation (climax or sub-climax) is predominantly grasses, grass-like plants, forbs or shrubs that are grazed or have the potential to be grazed, and which is used as a natural ecosystem for the production of grazing livestock and wildlife.

Note No. 1.1.4.
Rangelands may include natural grasslands, savannas, shrublands, many deserts, steppes, tundras, alpine communities and marshes.

1.1.4.1 Desertland (n.). Land on which vegetation is sparse or absent and is characterized by an arid climate. Deserts may be classified as hot or cold deserts depending on latitude and elevation.

1.1.4.2 Native or natural grassland (n.). Natural ecosystem dominated by indigenous or naturally occurring grasses and other herbaceous species used mainly for grazing by livestock and wildlife (cf. Naturalized pastureland, 1.1.3.5; Rangeland, 1.1.4; Pastureland and Grassland, 1.1.3).

Note No. 1.1.4.2.
There are many types of natural grasslands, with vegetation characteristics determined by climate and soil conditions, by grazing animals and by fire. Examples of local/regional variations follow. Geographical regions where examples may be found are provided in parentheses following the definition. This is not an all-inclusive list of grassland types or of locations in which they are found but provides some examples.

1.1.4.2.1 Campos (n.). Grassland consisting mainly of grasses, along with herbs, small shrubs and occasional trees; on undulating and hilly landscape, with variable soil fertility. Differs from Cerrado in having a longer and more severe winter and a relative abundance of native legumes. The campos is the northern part of the Pampa. The sub-tropical climate is humid, warm in summer and mild in winter. (Examples: Uruguay, southern Brazil and north-eastern Argentina).

1.1.4.2.2 Cerrado (n.). Savanna (1.1.4.2.7) with varying amounts of trees and shrubs along rivers and in valley bottoms. It is characterized by a tropical climate with alternating wet and dry seasons. The wet season lasts usually 6 months. (Example: central Brazil).

1.1.4.2.3 Llanos (n.). Extensive system of grasslands, seasonally flooded, with infertile and acidic soils. The tropical climate is characterized by alternating wet and dry seasons. (Examples: plains east of the Andes in Bolivia, Colombia and Venezuela).

1.1.4.2.4 Pampa (n.). Treeless grasslands on flat and fertile plains. The Pampa is a temperate grassland or a sub-tropical steppe. The climate is humid to arid; summers are warm and winters are mild. (Examples: eastern and central Argentina).

1.1.4.2.5 Prairie (n.). Nearly level or rolling grassland, originally treeless or with a few scattered trees, and usually on fertile soils. It may be characterized as a short-grass, intermediate-grass, or tall-grass prairie depending on the influence of a continental climate

and variation in total summer precipitation, rate of evapo-transpiration, periodic fire and soil depth. Soil depth and precipitation generally increase from west to east and vegetation changes from short-grass prairie in the west to tall-grass prairie in the east. (Example: North America).

1.1.4.2.6 Sahelian steppe (**n.**). Discontinuous vegetation dominated by annual C_4 plants, especially grasses, and scattered shrubs. The arid or semi-arid tropical climate with alternating wet and dry seasons is characterized by a strong variability in rainfall patterns and one short rainy season. The soils are generally poor. (Example: Sahel at the south margin of the Sahara in Africa).

1.1.4.2.7 Savanna (**n.**). Grassland characterized by precipitation between 375 and 1500 mm year^{-1}, variable proportions of trees or large shrubs, especially in tropical and sub-tropical regions. It is often a transitional vegetation type between grassland and forestland. Tropical savannas are characterized by a climate with alternating wet and dry seasons. The wet season usually ranges between 5 and 9 months. Sub-tropical savannas have a wet climate with warm summers and mild winters. (Example: South America, Africa, Australia, sub-tropical and tropical regions of North America).

1.1.4.2.8 Steppe (**n.**). Semi-arid, sparse to rolling grassland characterized by short to medium-height grasses occurring with other herbaceous vegetation and occasional shrubs. Russian steppes are characterized by the high severity and length of continental winters with precipitation between 250 and 500 mm year^{-1}. Forest-steppe soils are black or brown-earth with high to medium contents of organic matter and high mineral contents. (Examples: south-eastern Europe, Asia, North America).

1.1.4.2.9 Veld (**n.**). Indigenous vegetation used as grazing and/or browsing which may be composed of any of a number of plant growth forms (predominantly C_4 grasses and *Acacia* or broad-leaf trees) and need not necessarily be climax vegetation (See Booysen, 1967). (Example: South Africa).

1.1.4.3 Marshland (**n.**). Flat, wet, treeless wetland usually covered by shallow water and dominated by marsh grasses, rushes, sedges, other grass-like plants and forbs.

1.1.4.4 Shrubland (**n.**). Land on which the vegetation is dominated by low-growing woody plants (cf. Shrub, 2.2.6).

1.1.4.5 Tundra (**n.**). Land areas in arctic and alpine regions devoid of large trees, varying from bare ground to various types of vegetation consisting of grasses, sedges, forbs, dwarf shrubs and trees, mosses and lichens.

2. Vegetation: descriptive terms

Note No. 2.
This section is concerned with the characteristics of vegetation on grazing lands and of the forage harvested from such lands either by grazing animals or by cutting and harvesting.

2.1 Vegetation (**n.**). Plant life in general (Webster's New World Dictionary of American English, 1988; cf. Flora, 2.1.2).

Note No. 2.1.
The vegetation of grazing lands may be indigenous or exotic and may be a monoculture, a mixture of two or more species, a plant community or several plant communities.

2.1.1 Crop (**n.**). The cultivated produce of the land (cf. Forage, 2.1.3; Forage crop, 2.1.1.1).

2.1.1.1 Forage crop (**n.**). A crop of cultivated plants, other than separated grain, produced to be grazed or harvested for use as feed for animals (cf. Forage, 2.1.3).

2.1.2 Flora (**n.**). All plant species occurring within a site or a region.

Note No. 2.1.2.
The flora of a site, region or country may be described in a systematized list of the collective species.

2.1.3 Forage (**n.**). Edible parts of plants, other than separated grain, that can provide feed for grazing animals or that can be harvested for feeding [cf. Forage (v.), 3.2.1.2].

2.1.3.1 Browse (**n.**). Leaf and twig growth of shrubs, woody vines, trees, cacti and other non-herbaceous vegetation that can be ingested by herbivores [cf. Browse (v.), 3.2.1.1].

2.1.3.2 Herbage (**n.**). The above-ground biomass of herbaceous plants, other than separated grain. Grasses, grass-like species, herbaceous legumes and other forbs collectively; the foliage and edible stems of herbs (cf. Herbaceous, 2.2.4).

2.1.3.3 Mast (**n.**). Fruit and seed of shrubs, woody vines, trees, cacti and other non-herbaceous vegetation available for consumption by animals.

2.1.3.3.1 Fruit (**n.**). The seeds of plants and pulpy surrounding tissues.

2.1.3.3.2 Pod (**n.**). The seed case of a leguminous plant.

2.1.3.3.3 Seed (n.). Mature (ripened) ovules consisting of an embryonic plant and a store of food (stored in the endosperm, in some species), all surrounded by a protective seed coat.

2.2 Forage plants and plant characteristics

Note No. 2.2.
This section is concerned with descriptions of the characteristics of forage plant species.

2.2.1 Forb (n.). Any herbaceous, dicotyledonous broad-leaved plant (cf. Legume, 2.2.5; Grass, 2.2.2; Grass-like, 2.2.3).
2.2.2 Grass (n.). Plant or plant species of the *Poaceae* family.

Note No. 2.2.2.
Given the importance of grasses in grazing lands, other terms have been used to further define specific characteristics. Two examples are given in 2.2.2.1 and 2.2.2.2.

2.2.2.1 Bunchgrass/tussock grass (n.). Grasses producing tillers, but not stolons or rhizomes, and having an erect and clumped growth form (Examples: Tufted grass, Caespitose grass).
2.2.2.2 Creeping grass (n.). Grasses spreading by stolons, rhizomes or both.
2.2.3 Grass-like (adj.). Resembling a grass. **(n.).** Herbaceous monocots, usually a member of the *Cyperaceae* (sedges) or *Juncaceae* (rushes), which are families that are similar to grasses in appearance.
2.2.4 Herbaceous (adj.). Herbaceous refers to the non-woody above-ground parts of grass, grass-like and forb plants. Herbaceous species are differentiated from woody species by not having perennial woody stems.
2.2.5 Legume (n.). Plant or plant species of the *Fabaceae* family with a wide range of physical characteristics from herbaceous forbs to shrubby and tree forms (cf. Forb, 2.2.1; Shrub, 2.2.6; Tree, 2.2.7).

Note No. 2.2.5.
The ability to form a symbiotic relationship with bacteria to fix atmospheric nitrogen is found in many species of legumes.

2.2.6 Shrub (n.). A woody plant having multiple stems arising at or near the base. Mature height is generally <5–6 m.
2.2.7 Tree (n.). A woody plant characteristically with one primary stem from the base. Mature height generally greater than 5 m. Coppice growth on a tree may have multiple basal stems.

2.3 Forage canopy characteristics

Note No. 2.3.
This section is concerned with the terms used to describe the structural characteristics of the plant canopy. These characteristics are the product of overlapping processes of growth, defoliation and decomposition. The approach used here is to separate the description of state variables in this section from the dynamic variables defined in Section 3.

2.3.1 Sward (n.). A population or a community of herbaceous plants characterized by a relatively short habit of growth and relatively continuous ground cover, including both above- and below-ground parts.
2.3.2 Canopy (n.). The above-ground parts of a population or community of forage plants. It may include both herbaceous and woody vegetation.
2.3.2.1 Canopy architecture (n.). The spatial distribution and arrangement of the constituent parts of the canopy.
2.3.2.2 Canopy cover (n.). The proportion of the ground area covered by the canopy when viewed vertically.
2.3.2.3 Canopy density (n.). The bulk density of the canopy (mass unit volume^{-1}).
2.3.2.4 Canopy height (n.). The surface height of an undisturbed canopy or the compressed height of a canopy, normally measured from ground level.
2.3.3 Botanical composition (n.). The relative proportions of the plant components (species and morphological units) in a canopy above a defined sampling height, preferably ground level.

Note No. 2.3.3.
Botanical composition may be calculated based on forage mass, cover, density or frequency. Cover is measured in units of proportion or percentages. Frequency is presence or absence count data that follow the binomial distribution. Density is the number of individuals per unit area (e.g. plants m^{-2}).

2.3.4 Leaf area index (LAI) (n.). The area of green leaf (one side only) unit area^{-1} of ground. Refers to leaf only or to lamina plus half the surface area of exposed sheaths and petioles.
2.3.5 Biomass (n.). The total dry weight of vegetation unit area^{-1} of land above a defined reference level, usually ground level, at a specific time (cf. Forage mass, 2.3.6).

2.3.6 Forage mass (n.). The total dry weight of forage per unit area of land above a defined reference level, usually ground level, at a specific time (cf. Biomass, 2.3.5; Applicable also to Herbage, 2.1.3.2 and Browse, 2.1.3.1).

Notes No. 2.3.5 and 2.3.6.

1. Dry weight is defined as dried at 105°C to a constant weight unless otherwise noted.
2. Biomass and forage mass are instantaneous measures. To describe them over time, a series of instantaneous measures of biomass/forage mass are averaged. Change over time or the accumulated biomass/forage mass is determined by the difference between an end point and an initial point.
3. Biomass can include both forage and non-forage vegetation per unit area while forage mass is specific to forage plants.
4. Depending on requirements, biomass and forage mass should be specified as above-ground at a specified cutting height, or below-ground as described by measurement method.
5. In practice, the soil surface can be difficult to define objectively, and subjective decisions about the soil/litter interface and the distribution of stems, roots, stolons and rhizomes may be required but the methods used to define the soil surface should be clearly stated.
6. It should be specified whether the biomass or forage mass is alive or dead, at the time of harvesting, and the proportions of each if both are included.
7. The term forage mass is preferred to alternatives like 'standing crop,' 'forage yield' and 'available forage,' which involve assumptions (often unspecified) about canopy characteristics and harvesting procedures. The term 'pasture cover' is also widely used as a synonym for herbage mass, but is best reserved for use as a measure of the proportion of ground covered by a crop canopy (cf. Canopy cover, 2.3.2.2). Use of indeterminate terms like 'available' to describe an amount of forage is not recommended.

2.3.6.1 Aftermath (n.). Forage that grows following a harvest.

2.3.6.2 Residue (n.). Forage remaining on the land after harvest (cf. Stubble, 2.3.6.3).

2.3.6.3 Stubble (n.). The basal portion of stems and leaves of herbaceous plants left standing after harvest (cf. Residue, 2.3.6.2).

2.3.7 Litter (n.). An accumulation of dead detached plant material at the soil surface.

Note No. 2.3.7.
When appropriate, litter may be more narrowly defined, for example as tree litter (large woody material including branches and dead trees). Mulch is frequently used as a term for herbaceous material.

3. Forage growth and harvest

Note No. 3.
In this section, terms are defined primarily in the context of grazed forages but are equally relevant to mechanically harvested forages. Measurements may be reported in terms of fresh weight or (preferably) dry matter or organic matter weight per unit area (g m^{-2}; kg ha^{-1}; t ha^{-1}) and per unit time (day, year), but may also be expressed per plant or plant unit.

3.1 Components of growth, senescence and decomposition

Note No. 3.1.
Terms in this section are presented in order of logical progression and not in alphabetical order.

3.1.1 Growth (n.). The production of new plant tissue by forage plants.

Note No. 3.1.1.
The term forage growth is used here specifically to define the rate of production of new plant tissue. It can also be used as a general descriptor of plant development and structural change over time (see Accumulation, 3.1.2).

3.1.2 Accumulation (n.). The increase in forage mass unit $area^{-1}$ over a specified time, representing the balance among growth, senescence, decomposition of dead organs and consumption by animals.

3.1.3 Senescence (n.). Applied to plants or organs, it is the process of remobilization and transfer of soluble constituents from mature to immature plant tissues that occurs with advancing age of plant parts, or through drought stress or depredation by pests, and is usually accompanied by chlorosis and subsequent death of mature tissue. Senescence is accompanied by a loss of dry matter as cell contents of the live tissue are metabolized and/or translocated.

3.1.4 Decomposition (n.). The processes of biodegradation of dead plant material, including detachment from the plant, movement to the litter layer and incorporation into soil organic matter.

3.2 Defoliation and harvest

3.2.1 Defoliation (**n.**). Removal of plant tissue by grazing animals or machinery.

Note No. 3.2.1.
While 'defoliate' is derived from 'foliage' which means 'leaves,' defoliation under grazing or mechanical harvest removes leaves, stems and inflorescences in varying proportions.

3.2.1.1 Browse (**v.**). To consume browse *in situ* by animals [cf. Browse (n.), 2.1.3.1; Forage, 3.2.1.2; Graze, 3.2.1.3].
3.2.1.2 Forage (**v.**). To search for or to consume forage [cf. Forage (n.), 2.1.3; Browse, 3.2.1.1; Graze, 3.2.1.3].
3.2.1.3 Graze (**v.**). To consume predominantly herbaceous forage *in situ* by animals [cf. Browse, 3.2.1.1; Forage, 3.2.1.2].

Note No. 3.2.1.3.
The verb, graze, should be used in the active form with the animal as the subject. The verb should not be used in the passive voice so as to imply that a person is the subject or actor; i.e., cattle graze; people do not graze cattle.

3.2.2 Harvest (**n.**). Forage defoliated by a single grazing or cutting, or over a series of grazings or cuttings. It may be reported as daily amount, a single harvest, or seasonal or annual totals.

Note No. 3.2.2.
The terms 'Forage production' and 'Forage yield' are often used as alternatives to the term 'Forage harvested' but may be misleading, particularly in the context of dynamic tissue flow measurements (cf. Forage mass, 2.3.6).

3.2.3 Ungrazed (**adj.**). (i) describes the status of grazing land that is not grazed by animals and; (ii) the status of plants or plant parts that are not grazed by animals (cf. Rest, 5.6.5).

3.3 Conserved forage

3.3.1 Conservation (**n.**). The process of saving forage for future use. Forage can be conserved *in situ* (e.g. stockpiling) or harvested, preserved and stored (e.g. hay, silage, haylage).
3.3.1.1 Fodder (**n.**). Harvested forage fed intact to livestock. It includes fresh, conserved and dried forage.
3.3.1.2 Hay (**n.**). Harvested forage preserved by drying generally to a moisture content of less than 200 g kg^{-1}.
3.3.1.3 Haylage (**n.**). Harvested forage ensiled at a moisture content of less than 500 g kg^{-1}.
3.3.1.4 Silage (**n.**). Forage harvested and preserved at high moisture contents (generally >500 g kg^{-1}) by organic acids produced during partial anaerobic fermentation (Syn. Ensilage).
3.3.1.4.1 Ensiling (**v.**). To produce silage by the process of fermentation of forages.
3.3.1.4.2 Silo (**n.**). The container used in the preservation of forage as silage.
3.3.1.5 Stockpiled forage (**n.**). Forage allowed to accumulate for grazing at a later time [Syn. Feed wedge (New Zealand), Foggage (Europe, South Africa)].

Note No. 3.3.1.5.
Forage is often stockpiled for later grazing in a period when growth is reduced or nil (example autumn and winter in temperate regions, summer in Mediterranean regions, dry season in tropical regions) but stockpiling may occur at any time during the year as a part of a management plan. Foggage usually refers to late growing-season accumulation for winter grazing. Stockpiling can be described in terms of Deferment, 5.6.1 and Accumulation, 3.1.2.

4. Forage nutritive value and intake

Note No. 4.
This section deals with terms describing the nutritional value of forages, intake and ingestive behaviour of grazing animals and terms that attempt to standardize forage demand for use in comparisons among animals of different species, ages and physiological states.

4.1 Nutritional value and quality of forage

4.1.1 Ash (**n.**). The non-organic, mineral component of plant material.

Note No. 4.1.1.
The residue remaining after complete combustion of organic matter.

4.1.2 Crude protein (**n.**). The nitrogen in forage multiplied by 6.25.

Note No. 4.1.2.
Crude protein does not distinguish between true protein and non-protein nitrogen and does not describe crude protein digestibility or quality.

4.1.3 Digestibility (**n.**). The proportion of the dry matter, organic matter or nutrients absorbed during passage though the digestive tract.

Note No. 4.1.3.
Apparent digestibility is the difference between dry matter, organic matter or nutrient consumed and dry matter or nutrient excreted in the faeces expressed as a proportion but does not account for endogenous excretions in the faeces. *True digestibility* is the actual digestibility of the dry matter, organic matter or specific nutrient consumed and excludes endogenous excretions in the faeces.

4.1.4 Energy (**n.**). The potential to do work. Usually expressed as megajoules (MJ) kg^{-1} [megacalories (Mcal) kg^{-1}] forage dry matter where one calorie is standardized to be equal to 4.184 joules.

Note No. 4.1.4.
Terms referring to energy are defined in NRC (1981). Additional energy systems include those in use in Australia, France, the Netherlands, Sweden, the United Kingdom and the United States (See Appendix I, 4.1.4).

4.1.4.1 Gross energy (**n.**). The heat of combustion of matter.
4.1.4.2 Digestible energy (**DE**) (**n.**). The energy apparently absorbed from the digestive tract (energy in the food minus energy lost in the faeces).
4.1.4.3 Metabolizable energy (**ME**) (**n.**). The energy available for metabolism by an animal (energy in the food minus faecal energy, urinary energy and gaseous energy losses) (See Utilized Metabolizable Energy, Appendix I, 4.1.4.3).
4.1.4.4 Net energy (**NE**) (**n.**). Metabolizable energy minus energy lost as heat of fermentation and heat of nutrient metabolism. The net increase in useful animal product expressed per unit increase in food intake.
4.1.4.4.1 Net energy for maintenance (**n.**). Change in retained energy per unit of feed intake measured between an intake of zero and intake when retained energy equals zero.
4.1.4.4.2 Net energy for gain (**product deposition**) (**n.**). Change in retained energy per unit of feed intake measured in a growing animal consuming an intake that results in a retained energy greater than zero.
4.1.4.4.3 Net energy for lactation (**n.**). Change in lactation energy (i.e., energy in milk) per unit of feed intake measured under conditions in which retained energy remains constant.

4.1.5 Fibre (**US: Fiber**) (**n.**). A nutritional entity that is relatively resistant to digestion and is slowly and only partially degraded by herbivores (Barnes *et al.*, 2007).

Note No. 4.1.5.
Fibre is a biological unit rather than a distinct chemical entity (Van Soest, 1982). Fibre is considered to be composed of structural polysaccharides, cell-wall proteins and lignin (Barnes *et al.*, 2007) but chemical composition varies with type of plant cell wall and method of determination.

4.1.6 Quality (**adj.**). A description of the degree to which forage meets the nutritional requirements of a specific kind and class of animal.

Note No. 4.1.6.
'Quality' is a relative term. Nutritional requirements and anatomy vary among different kinds and classes of grazing animals; thus, what constitutes 'high-quality' forage for one animal may be 'low-quality' forage for another. Quality should be quantified in terms of animal response.

4.1.6.1 Anti-quality (**adj.**). A description of any chemical factor in forage (such as lignin, an alkaloid, a phytohormone or a toxin) that negatively affects the animal including their animal physiology, health and well-being, reproduction and intake, or the degree to which the forage meets nutritional requirements of a specific kind and class of animal (cf. Quality, 4.1.6).
4.1.6.2 Nutritive value (**n.**). The predicted animal response based on chemical composition, digestibility and nature of digested products, as estimated by *in vitro* or *in vivo* chemical analyses.
4.1.6.3 Relative feed value (**RFV**) (**n.**). An index for ranking cool-season grass and legume forages based on the intake of digestible energy calculated from acid-detergent fibre (ADF) and neutral-detergent fibre (NDF) concentrations in forage (See Appendix I, 4.1.6.3).
4.1.7 Total digestible nutrients (**TDN**) (**n.**). A general measure of the nutritive value of a feed calculated from the intake of digestible nutrients, with adjustment for the energy value of fat (See Appendix I, 4.1.7).
4.1.7.1 Relative forage quality (**RFQ**) (**n.**). An index for ranking all forages based on the intake of total digestible nutrients calculated by summative equations after estimating digestible portions of protein, fatty acids, fibre and non-fibrous carbohydrate (See Appendix I, 4.1.7.1).

4.2 Forage intake (**n.**). The forage consumed by an animal.

Note No. 4.2.
Intake is expressed per unit of time such as intake d^{-1}, intake $month^{-1}$, intake $year^{-1}$ or intake stocking $season^{-1}$.

4.2.1 Dry-matter intake (**n.**). The amount of forage consumed by an animal on a dry-matter basis (cf. Voluntary intake, 4.2.3).
4.2.2 Organic-matter intake (**n.**). The amount of forage consumed by an animal on an organic-matter basis (cf. Dry-matter intake, 4.2.1).
4.2.3 Voluntary intake (**n.**). The amount of forage consumed by an animal unrestricted by the quantity available.
4.3 Forage selection (**n.**). The removal by animals of specific forages or components of forages rather than other forages or plant parts (cf. Preference, 4.3.2).

Note No. 4.3.
Diet selection by the grazing animal is a function of preference modified by opportunity.

4.3.1 Anti-herbivory (**n.**). Chemical or structural forage characteristics that inhibit or limit selection and consumption of the plant by livestock and wildlife (cf. Anti-quality, 4.1.6.1).
4.3.2 Preference (**n.**). A measure of relative intake of alternative forages or forage constituents, where access to forage is unrestricted (cf. Forage selection, 4.3).

Note No. 4.3.2.
Preference describes an animal response but makes no assumptions about mechanisms determining the response (Hodgson, 1979). Preference is a relative expression that requires the opportunity for choice between two or more components. This is an objective measure of selective behaviour and is preferred to the more subjective term 'palatability' (See Appendix II). While palatability attempts to describe the perceived acceptability of a single forage type without comparison to an alternative choice, it is subject to various interpretations, can be confounded with preference and is not a recommended term (See Provenza, 2003).

4.4 Ingestive behaviour (**n.**). The behaviour of the animal involved in grazing including time devoted to searching for, selecting, prehending and consuming forage, usually on a daily basis.

Note No. 4.4.
Ingestive behaviour is usually described in terms of quantifiable activities including those listed below (4.4.1 to 4.4.4). Ingestive behaviour is influenced by animal, plants and soil factors, the environment, time of day, season, precipitation, management and other factors.

4.4.1 Bite weight (**n.**). The total weight of forage (dry-matter basis) in one bite taken by an animal.
4.4.2 Biting rate (**n.**). The number of bites taken during a specified time; usually as bites min^{-1} or bites d^{-1}.

Note No. 4.4.2.
Biting jaw movements should be separated from jaw movements devoted to gathering forage for biting and to chewing forage prior to swallowing.

4.4.3 Grazing event (**n.**). The activity of grazing (including biting and masticating but not ruminating) without stopping (cf. Stocking period, 5.6.9).

Note No. 4.4.3.
When monitoring grazing activity, it is necessary to define a specific interval that will be the separation point of grazing events from other activities.

4.4.4 Grazing time (**n.**). The total amount of time devoted to grazing during a specified time; usually 24 h.

Notes No. 4.4.1, 4.4.2 and 4.4.4
Bite weight, biting rate and grazing time are components of ingestive behaviour. Intake can be estimated as the product of these three components (Intake = bite weight × biting rate × grazing time).

4.5 Standardization of terms describing forage demand among grazing animals

Note No. 4.5.
To characterize forage demand and impact of grazing animals, there is a frequent need to equate grazing animals across species and animals with different live weights and physiological stages within species. Many strategies have been suggested for such comparisons. Each has strengths and weaknesses. Some compare animals based on metabolic size and assumed metabolic requirements (See Animal unit, 4.5.1.1), while others attempt to

equate animals based on their expected forage demand (See Forage intake unit, 4.5.1.2).
When using these terms (or others found in the literature), it is important to understand their limitations and to cite the source of the definition so that the nature of the comparison is clearly understood.

4.5.1 Standard units

Note No. 4.5.1.
Examples of standard units in different regions of the world are found in Appendix I, 4.5.1. Globally, it would be useful to standardize these units. Animal unit (4.5.1.1) and Forage intake unit (4.5.1.2) below are recommended.

4.5.1.1 Animal unit (n.). One mature, non-lactating bovine (middle-third of pregnancy) weighing 500 kg and fed at a maintenance level for zero gain (8.8 kg dry matter d^{-1}; NRC, 1984), or the equivalent, expressed as $(weight)^{0.75}$, in other kinds or classes of animals (See Animal unit, Appendix I, 4.5.1).

Note No. 4.5.1.1.
An animal unit is based on the assumption that metabolic requirements are related to metabolic weight and provide the basis for comparing among different kinds and classes of animals (See Brody, 1945).

4.5.1.2 Forage intake unit (n.). A unit to measure the rate of forage consumption by grazing animals where one forage intake unit is equivalent to the consumption of 8.8 kg dry matter d^{-1} (See Appendix I, 4.5.1.2).

Note No. 4.5.1.2.
By definition, one forage intake unit has a dry-matter intake rate of 8.8 kg d^{-1}; thus, any animal at any age or stage of production may be represented as a certain proportion or multiple of the forage intake unit, based solely on its rate of forage dry-matter intake d^{-1}. The intake rate of an animal that is larger or smaller than 8.8 kg dry matter d^{-1} will have a forage intake-unit-equivalent, which is a proportion or multiple of one forage intake unit.

4.5.2 Animal unit day (n.). The amount of dry forage consumed by one animal unit per 24-h period (8.8 kg).

Note No. 4.5.2.
Animal unit day is used to express the quantity of forage intake by one animal unit or one forage intake unit for a 24-h period of time and may be extrapolated to other time periods, such as a week, month, or year (cf. Animal unit, 4.5.1.1; Forage intake unit, 4.5.1.2).

5. Management of grazing lands

Note No. 5.
Terms included in this section describe land units used for grazing and the grazing management applied to achieve defined objectives.

5.1 Grazing land management (n.). The manipulation of the soil–plant–animal complex of the grazing land in pursuit of a desired result.

Note No. 5.1.
The definition may be applied to specific kinds of grazing land by substituting the appropriate term such as grassland, pastureland or rangeland in place of grazing land.

5.2 Grazing management (n.). The manipulation of grazing in pursuit of a specific objective or set of objectives.
5.2.1 Extensive grazing management (n.). Grazing management that uses relatively large land areas per animal and a relatively low level of labour, resources or capital (cf. Intensive grazing management, 5.2.2).
5.2.2 Intensive grazing management (n.). Grazing management that uses relatively high levels of labour, resources or capital to increase production per unit area or per animal, through a relative increase in stocking rates, grazing pressure and forage utilization (cf. Extensive grazing management, 5.2.1).

Note No. 5.2.2.
Intensive grazing management is not synonymous with rotational stocking. Grazing management can be intensified by substituting any one of a number of stocking (grazing) methods that increase production and efficiency of resource use.

5.3 Grazing management unit (n.). The entire grazing land area used to support grazing animals over a defined time, generally a year.

Note No. 5.3.
A grazing management unit may be a single area or it may have a number of subdivisions (cf. Paddock, 5.3.3; Pasture, 5.3.4). It may also include periods of grazing and periods of rest depending on the stocking method(s) used or migrations of wildlife and does not imply continuous occupation by grazing animals during the defined time.

5.3.1 Camp (**n.**). An area where animals choose to rest or are confined by herders (cf. Paddock, 5.3.3).
5.3.2 Field (**n.**). A defined area of land used for cultivating crops or growing forages.
5.3.3 Paddock (**n.**). A grazing area that is a sub-division of a grazing management unit and is enclosed and separated from other areas by a fence or barrier (cf. Camp, 5.3.1; Grazing management unit, 5.3; Pasture, 5.3.4).
5.3.4 Pasture (**n.**). A type of grazing management unit enclosed and separated from other areas by fencing or other barriers and devoted to the production of forage for harvest primarily by grazing (cf. Grazing management unit, 5.3; Paddock, 5.3.3; Pastureland, 1.1.3; Forage, 2.1.3).

Note No. 5.3.4.
Although pasture (5.3.4) and pastureland (1.1.3) are often used as synonyms, pasture refers to the place whereas pastureland refers to land devoted to the production of forage for harvest primarily by grazing and provides the basis for a land-use mapping unit. Animals eat forage (2.1.3) growing in the pasture. Animals do not eat the pasture. The pasture is a grazing management unit of pastureland. The pasture may be sub-divided into two or more paddocks (5.3.3) for management purposes.

5.4 Grazing system (**n.**). A defined, integrated combination of soil, plant, animal, social and economic features, stocking (grazing) method(s) and management objectives designed to achieve specific results or goals.

Note No. 5.4.
1. A grazing system is site-specific because it integrates specific biotic and abiotic components and their environments, management objectives and social factors. System behaviour is a consequence of the interrelationships among the parts of the system. When a system component is managed in isolation away from the influence of the rest of the system, it is no longer under the same influences and may behave differently. Thus, when managed within a system, responses and behaviour of plants and animals may differ from those observed when managed alone or in another system.
2. Descriptive common names may be used; however, the first usage of a grazing system name in a publication should be followed by a description using a standard format. This format should include at least the following information: number, size, kind, slope, erosion status and soil classification of land units; number, kind, gender, size and age of livestock; duration of use and non-use periods for each unit in the system; stocking method(s) (see 5.5 and 7.0); type(s) of forage; and geographical location and elevation; type of climate, mean annual and seasonal temperatures, and precipitation amounts and distribution.
3. Grazing systems generally can be grouped into categories (see Williams, 1981).

5.4.1 Nomadic systems (**n.**). Systems based on extensive movement of herds and flocks in search of forage, led by human family units with no permanent home base.
5.4.2 Semi-sedentary systems (**n.**). Systems based on a village permanently occupied by women and children from which herds and flocks, usually tended by men and boys, are absent for extended periods of time in search of forage.
5.4.3 Transhumance systems (**n.**). Systems that differ from semi-sedentary systems in that the grazing is cyclical beginning at the end of winter with flocks and herds leaving lowland grazing areas where permanent villages are located and moving to mountain pastures for grazing during summer. Latitudinal transhumance occurs in tropical climates where the cyclic movement is under the influence of alternating wet and dry seasons.
5.4.4 Sedentary systems (**n.**). Grazing systems managed at a particular location(s) by resident management. May be managed by either or both extensive and intensive grazing managements and can include rangeland, pastureland, cropland and forestland within the grazing system. Many systems in use today are in this category.
5.5 Stocking method (**n.**). A defined procedure or technique to manipulate animals in space and time to achieve a specific objective(s) (Syn. Grazing method).

Note No. 5.5.
In most cases, the term 'stocking' is preferred to 'grazing' (i.e. 'stocking method' vs. 'grazing method') because grazing refers to the consumption of standing forage (cf. Graze, 3.2.1.3), whereas it is the method of stocking grazing animals that allows the manipulation of how, when, what and how much the animals graze.
One or more stocking methods are used within grazing systems to accomplish objectives. A stocking method is not site-specific. The objective of a stocking method may be 1) to allocate nutrition among varying classes of livestock [examples: creep stocking (grazing), first-last stocking]; 2) to improve efficiency of forage use [examples: frontal stocking (grazing), mixed stocking]; 3) to reduce negative effects on soils or plants [examples: rotational stocking, deferred stocking]; 4) to extend stocking seasons [example: sequence stocking (grazing)]; or 5) to accomplish an experimental objective [example: put-and-take stocking]. One or more stocking methods can be used within a grazing system. It is important to select the correct stocking method to accomplish the intended objective(s). When describing the use of a stocking method, it is important to describe the context or the overall grazing system in which the method is applied. Examples of stocking methods are provided in Section 7.

5.6 Timing of grazing or harvest

5.6.1 Deferment (n.). The postponement or delay of grazing or harvesting to achieve a specific management objective (cf. Deferred stocking, 7.4).

Note No. 5.6.1.
A strategy aimed at providing time for plant reproduction, establishment of new plants, restoration of plant vigour, a return to environmental conditions appropriate for grazing or the accumulation of forage for later use.

5.6.2 Grazing station (n.). The position from which an animal takes multiple bites without moving its feet.
5.6.3 Period of occupation (n.). The length of time that a specific land area is occupied, whether by one group of animals or by two or more groups of animals in succession (cf. First-last stocking, 7.5; Forward creep stocking, 7.6; Period of stay, 5.6.4; Syn. Grazing interval).
5.6.4 Period of stay (n.). The length of time that a particular group of animals occupies a specific land area (cf. First-last stocking, 7.5; Forward creep stocking, 7.6; Period of occupation, 5.6.3).

Note No. 5.6.4.
'Period of occupation' and 'period of stay' differentiate between the total time a specific land area is utilized and the time that a particular group of animals is using said land area. The term is useful in describing stocking methods such as first-last stocking. The 'period of occupation' is the total time that a specific land area is utilized and may involve several different groups of animals moving through in sequence, as in first-last stocking or in migrations. It differs from stocking period in that grazing may or may not be involved (example: feeding hay on pasture in winter when ice prevents grazing). The 'period of stay' defines the fractional part of the 'period of occupation' that any one of the two or more animal groups occupies the specified land area and is only a part of the period of occupation.

5.6.5 Rest (v.). To leave an area of grazing land ungrazed or unharvested for a specific time, such as a year, a growing season or a specified period required within a particular management practice (cf. Ungrazed, 3.2.3; Syn. Spell).
5.6.6 Rest period (n.). The length of time that a specific land area is not stocked between stocking periods (cf. Rest, 5.6.5; Syn. Spelling period; Recovery period).
5.6.7 Spell (v.). Syn. Rest, 5.6.5.
5.6.8 Stocking cycle (n.). The time elapsed between the initiation of successive stocking periods on a specified grazing land area, usually in a regular cycle of use (cf. Stocking period, 5.6.9; Syn. Grazing cycle; Rotation cycle).

Note No. 5.6.8.
One stocking cycle includes one stocking period (5.6.9) plus one rest period (5.6.6). Stocking cycles may be variable or fixed time.

5.6.9 Stocking period (n.). The length of time that grazing livestock or wildlife occupy a specific pasture or paddock (cf. Grazing event, 4.4.3; Syn. Grazing period).
5.6.10 Stocking season (n.). (i) The time during which grazing can be practised normally each year or portion of each year. (ii) On US public lands, an established period for which grazing permits are issued (Syn. Grazing season).

Note No. 5.6.10.
The stocking season may be the whole year or a very short time span and is normally a function of forage mass and climate. In this context, the vegetative growing season may be only a part of the stocking season. Likewise, the stocking season may be only a part of the vegetative growing season.

6. Land–forage–animal relationships

Note No. 6.
This section describes relationships among grazing animals, land and forage. Unless otherwise noted, all animal and forage weights are expressed in kg and land areas are expressed in ha.

6.1 Stocking rate (**n.**)**.** The relationship between the number of animals and the total area of the land in one or more units utilized over a specified time; an animal-to-land relationship over time (cf. Stocking density, 6.2).

Note No. 6.1.
1. Unless otherwise specified, this includes the total area of land in the grazing system supporting the total number of animals, including land areas being deferred or cropped (if crops are included in the system), and not just the areas actually grazed during the stated time.
2. Where needed, it may be expressed as animal units or forage intake units per unit of land area over time (animal units over a described time/total system land area).

6.1.1 Carrying capacity (**n.**)**.** The maximum stocking rate that will achieve a target level of animal performance, in a specified grazing system that can be applied over a defined time without deterioration of the grazing land.

Note No. 6.1.1.
In general terms, carrying capacity is a useful concept when based on adequate historical data and experience but is a number in a constant state of change.
Carrying capacity includes the effects of variables that are not easily measured and whose impacts are not readily anticipated and for which it may be difficult or impossible to adjust (example: weather). Thus, carrying capacity is both site-specific and varies from season to season and year to year.
The 'average' carrying capacity refers to the long-term carrying capacity averaged over years, whereas the 'annual' carrying capacity refers to a specific year. It may also be defined over parts of years.
While the definition above applies to the objective of animal production, there are increasing numbers of land uses that can be the primary objective of carrying capacity. These include economic, environmental and ecological objectives and those relating to biodiversity, ecotourism, global climate change and recreation. Because of the multifunctional uses of grazing lands, the carrying capacity can differ from one objective to another.

6.2 Stocking density (**n.**)**.** The relationship between the number of animals and the specific unit of land being grazed at any one time; an instantaneous measurement of the animal-to-land area relationship (cf. Stocking rate, 6.1).

Note No. 6.2.
Where needed, stocking density may be expressed as animal units or forage intake units per unit of land area (animal units at a specific time/unit of land area currently grazed).

6.3 Grazing pressure (**n.**)**.** The relationship between animal live weight and forage mass per unit area of the specific unit of land being grazed at any one time; an instantaneous measurement of the animal-to-forage relationship (See Mott, 1960, 1973).

Note No. 6.3.
Grazing pressure may also be expressed as a ratio of animal units or forage intake units per unit forage mass to compare across differences in animal species or stages of production. Expressing grazing pressure in units of animal demand provides the basis for calculation of Grazing pressure index (6.4).
To describe grazing pressure over time, a series of instantaneous measures are averaged. This differs from Grazing pressure index (6.4), which is a ratio of the integration of forage consumption to the integration of forage growth rate over time.
This definition can be appropriately altered to be specific to herbage or browse by substituting these terms in place of forage.

6.4 Grazing pressure index (**n.**). An animal-to-forage relationship measured in terms of integrated forage consumption by the animal (kg d^{-1}) over initial forage mass plus integrated forage growth rate (kg d^{-1}) over time (cf. Grazing pressure, 6.3; Animal unit, 4.5.1.1; Forage mass, 2.3.6; See Appendix I, 6.4).

Note No. 6.4.
Grazing pressure index differs from grazing pressure in that grazing pressure is an instantaneous measurement of the animal-to-forage relationship.

6.5 Forage allowance (**n.**). The relationship between forage mass and animal live weight per unit area of the specific unit of land being grazed at any one time; an instantaneous measurement of the forage-to-animal relationship. The inverse of grazing pressure (See Mccartor and Rouquette, 1977; Sollenberger *et al.*, 2005).

Note No. 6.5.
This definition can be appropriately altered to be specific to herbage or browse by substituting these terms in place of forage.
Forage allowance is expressed as a ratio of forage mass (kg ha^{-1}) to animal live weight (kg ha^{-1}) at a specific time (Sollenberger *et al.*, 2005). To describe forage allowance over time, a series of instantaneous measures are averaged.
Where needed, it may be expressed as a ratio of forage mass to animal units or forage intake units per unit area at a specific time.

7. Stocking methods

Note No. 7.
The term 'stocking' is preferred to 'grazing' (i.e. 'stocking method' vs. 'grazing method') because grazing refers to the consumption of standing forage (cf. Graze, 3.2.1.3), whereas it is the method of stocking grazing animals that allows manipulation of how, when, what and how much the animals graze (See Note No. 5.5).
While terms including 'Rotational grazing' and 'Creep grazing' are well established in the literature, the recommended terminology is 'Rotational stocking' and 'Creep stocking.' The alternative terms are included as synonyms in certain cases below.
This section provides examples of stocking methods. This is not an all-inclusive list but provides examples of the more commonly used methods.

7.1 Alternate stocking (**n.**). A method of repeated grazing and resting of forage using two paddocks in succession.

7.2 Continuous stocking (**n.**). A method of grazing livestock on a specific unit of land where animals have unrestricted and uninterrupted access throughout the time when grazing is allowed (cf. Rotational stocking, 7.15; Set stocking, 7.18).

Note No. 7.2.
The length of the stocking period should be defined and in context with the rationale and season of use (Example: Grazing stockpiled forage from late autumn to late winter).

7.3 Creep stocking (**n.**). A method to allocate unrestricted quantities of high-quality forage to maximize intake by juvenile animals while restricting forage intake to meet but not exceed the nutritional requirements of their dams (See Blaser *et al.*, 1986; Syn. Creep grazing).

Note No. 7.3.
This method allows juvenile animals to graze in areas that their dams cannot access at the same time to optimize animal performance through highly selective grazing without competition from the dams.

7.4 Deferred stocking (**n.**). A method to defer grazing on land units that may or may not be in a systematic rotation with other land units (cf. Deferment, 5.6.1).

Note No. 7.4.
A key concept of deferred stocking is that the deferment is a conservation practice for restoring and maintaining the desired condition of the grazing land. It is not a practice to increase livestock production within a stocking season. However, along with other management strategies, such as reseeding, weed control and prescribed burning, deferred stocking can improve the response of desired vegetation and, over time, increase animal production potential.

7.5 First-last stocking (n.). A method of utilizing two or more groups of animals, usually with different nutritional requirements, to graze sequentially on the same land area.

Note No. 7.5.
If more than two groups of animals graze sequentially, this would be described as 'first, second and last stocking.'
The objective of this stocking method is to allocate nutrition among different groups of animals with different nutritional requirements such as lactating dairy cows and dry cows. Higher selective grazing and greater forage mass present during the period of occupation by lactating cows can contribute to meeting their higher nutrient requirements, compared with dry cows that are the second group to occupy the paddock. It may also include the objective of increasing total forage use such as grazing cattle or sheep as the second group of grazing animals behind horses as the first group (see Mixed stocking, 7.10).

7.6 Forward creep stocking (n.). A method of creep stocking where dams and offspring rotate through a series of paddocks with offspring as first grazers and dams as last grazers. A specific form of First-last stocking (7.5). (Syn. Forward creep grazing).
7.7 Frontal stocking (n.). A method that allocates forage within a land area by means of a sliding fence that livestock can advance to gain access to ungrazed forage (See Volesky, 1990; Syn. Frontal grazing).
7.8 Intensive early stocking (n.). A method of using high grazing pressure during an initial restricted period of the stocking season followed by total removal of livestock for the remainder of the season to allow rest and recovery by the forage (See Smith and Owensby, 1978; Grings *et al.*, 2002).

Note No. 7.8.
This method, designed for use with native rangelands dominated by warm-season species, provides a way to maximize use of forage during the early part of the stocking season when digestibility is generally highest and to overcome low forage digestibility during late summer.

7.9 Intermittent stocking (n.). A method that imposes grazing on a particular management unit or area of land for indefinite periods at irregular intervals.
7.10 Mixed stocking (n.). A method of stocking two or more species of grazing or browsing animals on the same land unit, not necessarily at the same time but within the same stocking season.

Note No. 7.10.
Objectives of mixed stocking include increased forage utilization, altering botanical composition, weed control and interruption of parasite cycles. Mixed stocking may be a form of first-last stocking where one animal species is followed by a second animal species with different grazing behaviour with the objective of increasing total forage use.
In wildlife systems, many animal species can occupy the same land area either simultaneously or intermittently. Mixed stocking on rangelands is sometimes referred to as 'common use.'

7.11 Mob stocking (n.). A method of stocking at a high grazing pressure for a short time to remove forage rapidly as a management strategy.
7.12 Non-selective stocking (n.). A method that uses high grazing pressures that increase the consumption of less-preferred forage species by grazing animals (cf. Mob stocking, 7.11).

Note No. 7.12.
Non-selective stocking is generally attempted by using mob stocking with a high animal-to-forage ratio during short time periods. In practice, stocking to overcome preference is achieved rarely.

7.13 Put-and-take stocking (n.). A method of using variable animal numbers during a stocking period or stocking season, with a periodic adjustment in animal numbers in an attempt to maintain desired management criteria, e.g., a desired quantity of forage, degree of defoliation, or grazing pressure.
7.14 Ration stocking (n.). A method of confining animals to an area of grazing land to provide the daily allowance of forage animal^{-1} (cf. Strip stocking, 7.19; Syn. Ration grazing).
7.15 Rotational stocking (n.). A method that utilizes recurring periods of grazing and rest among three or more paddocks in a grazing management unit throughout the time when grazing is allowed (cf. Continuous stocking, 7.2).

Note No. 7.15.
The lengths of the grazing and rest periods should be defined.
Words such as 'controlled' or 'intensive' are sometimes used in an attempt to describe the degree of grazing management applied to this stocking method. These words are not synonyms for rotational stocking.

7.16 Seasonal stocking (n.). A method to restrict use of a land unit(s) to one or more specific seasons of the year.

7.17 Sequence (sequential) stocking (n.). The grazing of two or more land units in succession that differ in forage species composition.

> **Note No. 7.17.**
> Sequence stocking takes advantage of differences among forage species and species combinations, grown in separate areas for management purposes, to extend stocking seasons to enhance forage quality and/or quantity or to achieve some other management objective.

7.18 Set stocking (n.). A method that allows a specific, non-variable number of animals on a specific, non-variable area of land during the time when grazing is allowed (cf. Variable stocking, 7.20).

7.19 Strip stocking (n.). A method that confines animals to an area of grazing land to be grazed in a relatively short time, where the paddock size is varied to allow access to a specific land area (cf. Ration stocking, 7.14; Syn. Strip grazing).

> **Note No. 7.19.**
> Strip stocking and ration stocking may or may not be a form of rotational stocking, depending on whether or not specific paddocks are utilized for recurring periods of grazing and rest (cf. Rotational stocking, 7.15).

7.20 Variable stocking (n.). The practice of allowing a variable number of animals on a fixed area of land during the time when grazing is allowed (cf. Set stocking, 7.18).

References

During the development of the first edition of Terminology for Grazing Lands and Grazing Animals (FGTC, 1991), a search and review of the literature was conducted by the National Agricultural Library (Washington, D.C.) and by members of the committee in an attempt to collect and evaluate previously published terms and their various definitions. As the second edition was completed, additional references were included. While by no means all-inclusive, this collection of references is perhaps one of the more exhaustive listings currently available and would be of use to anyone wishing to review this subject.

Definitions of terms were referenced if they were used verbatim as they appeared in the original reference. All other definitions have been developed or revised by the first and second Forage and Grazing Terminology Committees. In certain cases, a reference was included to provide the reader with a source of additional information.

AFRC (Agricultural and Food Research Council) (1990) AFRC Technical Committee on responses to nutrients Report No 5. Nutrient requirements of ruminant animals: energy. *Nutrition Abstracts and Reviews*, **60**, 729–804.

Allen V.G. (1991) Terminology for grazing animals. *Proceedings of Grazing Livestock Nutrition Conference*. In F.T. McCollum and M.B. Judkins (ed.) Proceedings of the 2nd Grazing Livestock Nutrition Conference, 2–3 August, 1991, Steamboat Springs, Colorado, pp. 103–110. Oklahoma Agricultural Experiment Station, Stillwater.

Baker R.D. (1982) Estimating herbage intake from animal performance. In: Leaver J. D. (ed.) *Herbage intake handbook*, pp. 77–93. Hurley, Berks, UK: The British Grassland Society.

Baker R.D. (2004) Estimating herbage intake from animal performance. In: Penning P.D. (ed.) *Herbage intake handbook*, 2nd edn, p. 2. Reading, UK: The British Grassland Society.

Barnes R.F. (1981) The role of forage in the United States. In: Wheeler J.L. and Mochrie R.D. (eds) *Forage evaluation: concepts and techniques, Proceedings of a workshop Forage evaluation and utilization – an appraisal of concepts and techniques, 27–31 October 1980*, pp. 2–3. Armidale, New South Wales, Australia. 27–31. Netley, Australia: Griffin Press Limited for American Forage and Grassland Council and Commonwealth Scientific and Industrial Research Organization (CSIRO).

Barnes R.F., Nelson C.J., Moore K.J. and Collins M. (eds) (2007) *Forages: the science of grassland agriculture. Glossary*, 6th edn. Vol II. Ames, Iowa, USA: Blackwell Publishing Professional.

Berretta E.J. and Do NASCIMENTO D. Jr (1991) *Glosario estructurado de términos sobre pasturas y producción animal. (Structured glossary of terms about grassland and animal production)*. Montevideo, Uruguay: IICA-PROCISUR. (Diálogo; 31).

Blaser R.E., Hammes R.C. Jr, Fontenot J.P., Bryant H.T., Polan C.E., Wolf D.D., Mcclaugherty F.S., Kline R.G. and Moore J.S. (1986) *Forage-animal management systems*. Bulletin 86-7. Blacksburg, Virginia, USA: Virginia Agricultural Experimental Station.

Booysen D.V. (1967) Grazing and grazing management terminology in Southern Africa. *Proceedings of the Grassland Society of Southern Africa*, **2**, 45–57.

Box T.W. and Hardesty L.H. (1984) Coming of age in range management. *Rangelands*, **6**, 195–198.

Brink V.C. (1982) What is grassland? In: Nicholson A.C., McLean A. and Baker T.E. (eds) *Proceedings of Symposium on Grassland ecology and classification*, pp. 21–25. Victoria, British Columbia, Canada: British Columbia Ministry of Forests.

Brody S. (1945) *Bioenergetics and growth, Ch 13*. New York, New York, USA: Reinhold Book Corporation.
Clements R.J. (1989) Rates of destruction of growing points of pasture legumes by grazing cattle. In: *Proceedings of XVI International Grassland Congress, Nice, France 4–11 Oct. 1989*, p. 1027. Versailles, France: Association Française pour la Production Fourragère.
Csiro (2007) *Nutrient requirements of domesticated ruminants*. Melbourne, Australia: CSIRO Publishing.
Danckwertz J.E. (1981) *A technique to assess the grazing capacity of sweetveld with particular reference to the false thornveld areas of the Ciskei*. M. Sc. (Agriculture) thesis, University of Natal, South Africa.
De Bonneval L. (1993) Systèmes agraires, Systèmes de production. Vocabulaire français-anglais avec index anglais (Agricultural systems. Production systems. French-English Dictionary with English index). Paris, France: INRA.
Editorial (Agroforestry Systems) (1982) What is agroforestry? *Agroforestry Systems*, **1**, 7–12.
Edwards P.J. (1973) Definitions of some pasture terms. *Proceedings of the Grassland Society of Southern Africa*, **8**, 133–135.
Fao 2010 *Tropical Livestock Units*. (Date of access: 2 December 2010).http://www.fao.org/ag/againfo/programmes/en/lead/toolbox/Mixed1/TLU.htm
Fao (1965) *Glossary of pasture and fodder terms*. Rome, Italy: FAO.
Fgtc (The Forage and Grazing Terminology Committee) (1991) Terminology for Grazing Lands and Grazing Animals. Blacksburg, Virginia, USA: Pocahontas Press, Inc., or *Journal of Production Agriculture* **5**, 191–201.
Grings E.E., Heitschmidt R.K., Short R.E. and Haferkamp M.R. (2002) Intensive-early stocking for yearling cattle in the northern Great Plains. *Journal of Range Management*, **55**, 135–138.
Heady H.F. (1970) Grazing systems: terms and definitions. *Journal of Range Management*, **23**, 59–61.
Heath M.E., Barnes R.F. and Metcalfe D.S. (1985) *Forages, the science of grassland agriculture*, 4th edn. Ames, Iowa, USA: Iowa State University Press.
Helms J.A. (1998) *The dictionary of forestry*. Bethesda, Maryland, USA: Society of American Foresters.
Hinnant R.T. (1994) What is an 'Animal-Unit? A time to conform. *Rangelands*, **16**, 33–35.
Hodgson J. (1979) Nomenclature and definitions in grazing studies. *Grass and Forage Science*, **34**, 11–18.
Holechek J.L., Gomes H., Molinar F., Galt D. and Valdez R. (2000) Short-duration grazing: the facts in 1999. *Rangelands*, **21**, 18–22.
Hughes J.G. and O' Connor K. F. (1976) Objectives, concepts and principles in grazing management. *Tussock Grasslands and Mountain Lands Institute Review*, **32**, 5–15.
Ibraham K. (1975) *Glossary of terms in pasture and range survey research, ecology and management*. Rome, Italy: FAO.
Inra (1998) *Alimentation des bovins, ovins et caprins (Feeding of cattle, sheep and goats)*. Paris, France: INRA.
Joint Committee of the American Society of Range Management and the Agricultural Board of the National Academy OF Sciences, Subcommittee on Range Research Methods. (1962) *Basic problems and techniques in range research. Publ. No. 890*. Washington, D.C., USA: National Academy of Sciences - National Research Council.
Kellner O. (1912) *Die Ernahrung der landwirtschaftlichen Nutztiere (The nutrition of livestock)*. Berlin: Paul Parey.
Kilgour R. and Dalton C. (1984) *Livestock behaviour. A practical guide*. London, UK: Granada Publishing Ltd.
Kothmann M.M. (1974) Grazing management terminology. *Journal of Range Management*, **27**, 326–327.
Kothmann M.M. (2009) Grazing methods: a viewpoint. *Rangelands*, **31**, 5–10.
Lacey J.R. and Van Poollen H.W. (1979) Grazing system identification. *Journal of Range Management*, **32**, 38–39.
Lewis C.E. (1988) Multiple land use with grass and trees: concept and practice. In: *Proceedings of 1988 Forage and Grassland Conference, 11–14 April, Baton Rouge, Louisiana,* pp. 282–293. Belleville, Pennsylvania, USA: American Forage and Grassland Council.
Lewis C.E. and Pearson H.A. (1987) Agroforestry using tame pastures under planted pines in the Southeastern United States. In: Gholz H. L. (ed.) *Agroforestry: realities, possibilities and potentials*, pp. 195–212. Dordrecht, The Netherlands: Martinus Nijhoff Publishers.
Maff (Ministry of Agriculture, Fisheries and Food) (1981) *Definitions of terms used in agricultural business management*. London, UK: HMSO.
Marten G.C. (1988) Intensive grazing of cool season forages. In: *Proceedings of 1988 Forage and Grassland Conference, 11–14 April, 1988, Baton Rouge, Louisiana,* pp. 305–318. Belleville, Pennsylvania, USA: American Forage and Grassland Council.
Mccartor M.M. and Rouquette F.M. Jr (1977) Grazing pressures and animal performance from pearl millet. *Agronomy Journal*, **69**, 983–987.
Meissner H.H. (1982) Beef cattle C.3 – Classification of farm and game animals to predict carrying capacity. *Farming in South Africa* 1–3.
Minson D.J. and Whiteman P.C. (1989) A standard livestock unit (SLU) for defining stocking rate in grazing studies. In: *Proceedings. XVI International Grassland Congress, Nice, France, 4–11 Oct. 1989,* p. 1117. Versailles, France: Association Française pour la Production Fourragère.
Moller I.D., Andersen P.E., Hvelsplund T., Madsen J. and Thomsen K.V. (1983) En ny beregningsmetode for fodermidlernes energiverde til kvaeg (FEk). [A new method of calculating the energy value of feedstuffs for ruminants]. *Bereting fru Stakens Husdfyrbrugsforag No. 5*. Copenhagen, Denmark: Landhusholdningsselskaset.
Moore R. M. (ed.) (1970) *Australian grasslands*. Canberra, ACT, Australia: Australian National University Press.
Moore J.E. and Undersander D.J. (2002) *Relative forage quality: an alternative to relative feed value and quality index*. Gainesville, Florida, USA: Florida Nutrition Conference.
Mott G.O. (1960) Grazing pressure and the measurement of pasture production. In: Skidmore C. L., Boyle P.J and Raymond L.W. (eds) *Proceedings 8th International*

Grassland Congress, Reading, UK, pp. 606–611. Oxford, UK: Alden Press.

Mott G.O. (1973) Evaluating forage production. In: Heath M.E., Metcalfe D. S. and Barnes R.F. (eds) *Forages: the science of grassland agriculture*, 3rd edn, pp. 126–135. Ames, Iowa, USA: Iowa State University Press.

Mott G.O. and Lucas H.L. (1952) The design, conduct, and interpretation of grazing trials on cultivated and improved pastures. In: Wagner R.E., Myers W.M., Gaines S.H. and Lucas H.L. (eds) *Proceedings 6th International Grassland Congress, Pennsylvania State College, Pa., 17–23 August 1952*, pp. 1380–1385. Hershey, Pennsylvania, USA: Pennsylvania State College.

Nicol A. M. (ed.) (1987) Feeding livestock on pasture. In: *Occasional Publication No. 10, New Zealand Society of Animal Production*, pp. 144–155. Christchurch, New Zealand: Bascands Commercial Print Ltd.

Nrc (1981) *Nutritional energetics of domestic animals and glossary of energy terms*, 2nd edn. Washington, D.C., USA: National Academy Press.

Nrc (1984) *Nutrient requirements of beef cattle*, 6th edn. Washington, D.C., USA: National Academy Press.

Nrc (1985) *Nutrient requirements of sheep*, 6th edn. Washington, D.C., USA: National Academy Press.

Nrc (1996) *Nutrient requirements of beef cattle*, 7th edn. Washington, D.C., USA: National Academy Press.

Nrc (2000) *Nutrient requirements of beef cattle*, 7th edn. Update 2000. Washington, D.C., USA: National Academy Press.

Nrc (2001) *Nutrient requirements of dairy cattle*, 7th edn. Washington, D.C., USA: National Academy Press.

Nrc (2007) *Nutrient requirements of small ruminants, sheep, goats, cervids, and new world camelids*. Washington, D.C., USA: National Academy Press.

Provenza F.D. (2003) *Foraging behaviour: managing to survive in a world of change*, pp. 15–19. Logan, Utah, USA: USDA-NRCS; Utah State University; Utah Agricultural Experimental Station.

Rohweder D.A., Barnes R.F. and Jorgensen N. (1978) Proposed hay grading standards based on laboratory analyses for evaluating quality. *Journal of Animal Science*, **47**, 747–759.

Rouquette F.M. Jr. (1988) Intensive grazing of warm-season grasses in humid areas. In: *Proceedings 1988 Forage and Grassland Conference, 11–14 April, 1988, Baton Rouge, Louisiana*, pp. 319–333. Belleville, Pennsylvania, USA: American Forage and Grassland Council.

Sac (2001) *The farm management handbook 2001/2, p. 142*. Edinburgh, UK: SAC.

Savory A. (1988) *Holistic resource management*, pp. 509–511. Covelo, California, USA: Island Press.

Scarnecchia D.L. (1985a) The animal-unit and animal-unit-equivalent concepts in range science. *Journal of Range Management*, **38**, 346–349.

Scarnecchia D.L. (1985b) The relationship of stocking intensity and stocking pressure to other stocking variables. *Journal of Range Management*, **38**, 558–559.

Scarnecchia D.L. (1990) Concepts of carrying capacity and substitution rations: a systems viewpoint. *Journal of Range Management*, **43**, 553–555.

Scarnecchia D.L. (2004) Viewpoint: Entropy, concept design, and animal-unit equivalence in range management science. *Journal of Range Management*, **57**, 113–116.

Scarnecchia D.L. and Kothmann M.M. (1982) A dynamic approach to grazing management terminology. *Journal of Range Management*, **35**, 262–264.

Scarnecchia D.L. and Kothmann M.M. (1983) A mathematically and conceptually united approach to grazing management terminology. In: *Proceedings. XIV International Grassland Congress, Lexington, Ky, 15–24 June, 1981*, pp. 522–525. Boulder, Colorado, USA: Westview Press.

Smart A.J., Derner J.D., Hendrickson J.R., Gillen R.L., Dunn B.H., Mousel E.M., Johnson P.S., Gates R.N., Sedivec K.K., Harmoney K.R., Volesky J.D. and Olson K.C. (2010) Effects of grazing pressure on efficiency of grazing on North American Great Plains rangelands. *Rangeland Ecology and Management*, **63**, 397–406.

Smith E.F. and Owensby C.E. (1978) Intensive-early stocking and season-long stocking of Kansas Flint Hills range. *Journal of Range Management*, **31**, 14–17.

Smith B., Leung P. and Love G. (1986) *Intensive grazing management: forage, animals, men, profits*. Kamuela, Hawaii, USA: The Graziers Hui.

Society for Range Management (1989) *A glossary of terms used in range management*, 3rd edn. Glossary Revision Special Committee, Publications Committee. Peter W. Jacoby, Chairman. Society for Range Management. Denver, Colorado, USA: Edison Press.

Sollenberger L.E., Moore J.E., Allen V.G. and Pedreira C.G.S. (2005) Reporting forage allowance in grazing experiments: an alternative approach. *Crop Science*, **45**, 896–900.

Suttie J.M., , Reynolds S.G. and Batello C. (eds) (2005) *Grasslands of the world*. Rome, Italy: FAO.

Thomas H. (1980) Terminology and definitions in studies of grassland plants. *Grass and Forage Science*, **35**, 13–23.

Timberlake J. and Van Der Poel P. (1979) *Glossary of terms used in range ecology, soil conservation, soil science and land use planning*. Gaborone, Republic of Botswana: Division of Land Utilization, Department of Agriculture Field Services.

Trollope W.S.W., Trollope L.A. and Bosch O.J.H. (1990) Veld and pasture management terminology in southern Africa. *Journal of the Grassland Society of Southern Africa*, **7**, 52–61.

Undersander D. and Moore J.E. (2004) *Relative forage quality (RFQ) Indexing legumes and grasses for forage quality*. http://www.uwex.edu/ces/forage/pubs/rfq.htm (Accessed 2 December 2010).

Vallentine J.F. (1971) *Planning range improvements*, pp. 1–20. *Range development and improvements*, pp. 1–20. Provo, Utah, USA: Brigham Young University Press.

Vallentine J.F. (1990) *Grazing management*, pp. 456–473. San Diego, California, USA: Academic Press.

Van Es A.J.H. (1998) Feed evaluation for ruminants. The system in use from May 1997 onwards in the Netherlands. *Livestock Production Science*, **5**, 331–345.

Van Soest P.J. (1963) Use of detergents in the analysis of fibrous feeds. II. A rapid method for the determination of fiber and lignin. *Journal of the Association of Official Agricultural Chemists*, **46**, 829–835.
Van Soest P.J. (1982) *Nutritional ecology of the ruminant*. Corvallis, Oregon, USA: O & B Books, Inc.
Van Soest P.J. and Wine R.H. (1967) Use of detergents in the analysis of fibrous feeds. IV. Determination of plant cell wall constituents. *Journal of the Association of Official Analytical Chemists*, **50**, 50–55.
Volesky J.D. (1990) Frontal grazing: forage harvesting of the future? *Rangelands*, **12**, 177–181.
Volesky J.D., Mowray D.P. and Achaval F. (1990) Frontal grazing: A new method of forage harvesting. In: *Proceedings of Forage and Grassland Conference, 6–9 June, 1990, Blacksburg, Virginia, USA*, pp. 142–146.

Appendix I. References and additional information for selected terms

4.1.4 Energy systems. The following are references for major energy systems in use internationally today.

Australia	CSIRO (2007) *Nutrient requirements of domesticated ruminants*. Melbourne, Australia, CSIRO Publishing.
France	INRA (1998) *Alimentation des bovins, ovins et caprins* Paris, France: INRA. Ouvrage collectif (1989) *Alimentation des bovins, ovins et caprins*. INRA: 471 pp. Ouvrage collectif (2007) *Alimentation des bovins, ovins et caprins – Besoins des animaux – Valeurs des aliments*. Tables INRA 2007. Éditions Quae, Collection Guide pratique: 330 pp.
Netherlands	Van Es (1998) Feed evaluation for ruminants. The system in use from May 1997 onwards in the Netherlands. *Livestock Production Science*, **5**, 331-345.
Sweden	Moller *et al.* (1983) En ny beregningsmetode for fodermidlernes energiverde til kvaeg (FEk). Bereting fru Stakens Husdfyrbrugsforag No. 55.
UK	AFRC (1990) AFRC Technical Committee on responses to nutrients Report No 5. Nutrient requirements of ruminant animals: energy. *Nutrition Abstracts and Reviews*, **60**, 729-804.
USA	NRC (2000) *Nutrient requirements of beef cattle, 7th edn.*, Update 2000. National Academy Press, Washington, D.C., USA. NRC (2001) *Nutrient Requirements of Dairy Cattle, 7th edn.* National Academy Press, Washington, D.C., USA. NRC (2007) *Nutrient requirements of small ruminants: sheep, goats, cervids and New World camelids*. National Academy Press, Washington, D.C., USA.

Georgetown, Texas, USA: American Forage and Grassland Council.
Webster's New World Dictionary of American English (1988) *Third college edition*. Cleveland, Ohio, USA: New World Dictionaries.
Wedin W.F. (1985) Advances in pasture management and utilization. In: *Proceedings of Forage and Grassland Conference, 3–6 March, 1985, Hershey, Pennsylvania,* pp. 26–32. Belleville, Pennsylvania, USA: American Forage and Grassland Council.
Wedin W.F. (1986) Pasture. In: *The Encyclopedia Americana, International edition*. Vol. 21, p. 523. Danbury, Connecticut, USA: Grolier, Inc.
Williams O.B. (1981) Evolution of grazing systems. In: Morley F.H.W. (ed.) *Grazing animals, World Animal Science B 1*, pp. 1–12. New York, New York, USA: Elsevier Scientific Publishing Company.

4.1.4.3 Utilized Metabolizable Energy (UME). For additional information, see Baker (1982; 2004).

Note No. 4.1.4.3.
Utilized Metabolizable Energy is a measure of output from a forage system based on the estimated energy requirements of animals and the energy value of forage. The UME may be expressed either per animal on a daily basis [megajoules (MJ) per head] or per unit area over a specified time [gigajoules (GJ) per hectare]. It is calculated as the sum of ME requirements for maintenance and production of the classes of livestock involved less the ME value of all feed supplements provided from outside the area and augmented by the ME value of any conserved herbage made on the area but unused (see Baker, 1982; 2004).

4.1.6.3 Relative feed value (RFV). For additional information and the method of calculation, see Rohweder *et al.*, 1978; Undersander and Moore, 2004.

4.1.7 Total digestible nutrients (TDN).

Note No. 4.1.7.
The concept of TDN dates back to the late 1800s and was based on the sum of digestible crude protein, crude fibre, nitrogen-free extract and ether extract where ether extract was multiplied by 2.25. Digestibility was estimated by the use of average digestion coefficients derived from digestion trials to determine apparent digestibility of protein, fat and carbohydrates in various feeds. The TDN system

was not adopted in Europe where the Starch Equivalent System (Kellner, 1912) was developed in a parallel effort. The Starch Equivalent System is closer in concept to the Net Energy System than is TDN (Van Soest, 1982). Total digestible nutrients is similar to digestible energy (DE) and can be converted as: 1 kg TDN = 4.4 Mcal DE (NRC, 1996). More recently, TDN has been redefined for use in calculations of Relative forage quality, 4.1.7.1.

4.1.7.1 Relative forage quality (RFQ). For additional information and the method of calculation, see Moore and Undersander (2002); Undersander and Moore (2004).

4.5.1 Standard Units.

Note No. 4.5.1.
Animal and Livestock units do not predict intake *per se*. To calculate expected intake, it is necessary to adjust the animal to be compared with the standard for desired production level and the influence of age, physiological status (e.g., pregnant or open, lactating or dry, rate of gain or loss), health of the animal, the physical and chemical characteristics of the forage, and the environment.
Example: A 500-kg dry, pregnant beef cow will have a lower dry-matter intake than a 500-kg cow in early lactation. Simply equating these animals based on metabolic body size would assume equal forage demand and does not account for the greater feed demand of lactation. Likewise, the quality of the forage will influence dry-matter intake.
The use of a Standard Unit in a publication should be followed by a reference to the specific standard unit used and a description that includes at least the following information: kind (species and breed), class, gender, size, age and physiological status of livestock and assumes a normal state of health.

Animal Unit (AU).

Southern Africa	An animal with a mass of 450 kg that consumes 10 kg dry matter d^{-1} and that gains 0.5 kg d^{-1} on forage with a digestible energy concentration of 550 g kg^{-1} (Meissner, 1982; Syn. Large Stock Unit).
USA	See Animal unit, 4.5.1.1 (FGTC, 1991).

Table 1 Calculation of animal units (Based on FGTC, 1991).

Live weight (LW) (kg)	Metabolic LW ($kg^{0.75}$)	Animal Unit (metabolic LW/105.7)
300	72.1	0.682
400	89.4	0.846
500	**105.7**	**1.000**
600	121.2	1.147
700	136.1	1.288

Bold data indicates the standard reference animal to which others are numerically related.

Livestock Unit (LU).

France	A dairy cow weighing 600 kg and producing 3000 L of milk at 40 g kg^{-1} fat content and consuming 19 kg DM d^{-1} (De Bonneval, 1993).
UK	A 626-kg Friesian dairy cow yielding 4 500 L milk at 36 g kg^{-1} fat content (MAFF, 1981; SAC, 2001).

Tropical Livestock Unit (TLU). One cattle with a live weight of 250 kg (See FAO, 2010).

Table 2 Exchange ratios for livestock in Tropical Livestock Units (TLU) based on metabolic live weight [Based on FAO (2010)].

Live weight (kg)	Metabolic live weight ($kg^{0.75}$)	TLU
150	43	0.68
200	53	0.85
250	**63**	**1.00**
300	72	1.15
350	81	1.29

Bold data indicates the standard reference animal to which others are numerically related.

4.5.1.2 Forage intake unit (FIU). (See Scarnecchia and Kothmann, 1982; Scarnecchia, 1985a and 1985b).

Note No. 4.5.1.2.
While animal unit does not provide an estimate of potential dry-matter intake needed to adjust stocking rates based on animal units, forage intake unit approaches this from the alternative perspective of comparing animals based on their level of forage consumption. Both terms contribute to standardizing forage demand among grazing animals.

Based on forage intake units, daily forage DM demand = the total number of FIUs times 8.8 kg. The use of forage intake unit in a publication should be followed by a description using a standard format. This format should include at least the following information: forage-species and cultivar, stage of growth, plant height and forage mass; animal-kind (species and breed), class, gender, size, age and physiological status (e.g., pregnant or open, lactating or dry, rate of gain or loss) of livestock and assumes a normal state of health.

Table 3 Calculation of forage intake units.

Animal (examples)	Live weight (kg)	Daily DM intake (kg)*	Forage Intake Unit (DM intake/8.8)
Ewe, maintenance	70	1.2	0.14
Mature dairy goat doe, mid-lactation, suckling single kid	60	2.0	0.22
Ewe, 1st 4–6 weeks lactation, suckling twins	70	2.5	0.28
Two-year-old beef heifer nursing calf	300	6.9	0.78
First 3–4 month postpartum			
5 kg milk d^{-1}			
Dry pregnant mature beef cow	**500**	**8.8**	**1.00**
Middle-third of pregnancy			
Cow nursing calf, average milking ability	500	9.9	1.13
First 3–4 month postpartum			
5 kg milk d^{-1}			
Bull, maintenance	1000	15.3	1.74
Regaining body condition			

*Based on NRC (1984, 1985, 2007). Bold data indicates the standard reference animal to which others are numerically related.

6.4 Grazing pressure index, revised (GPI). Modified by S. Cui (Texas Tech University, Lubbock) and M. Kothmann (Texas A&M University, College Station).

For additional information and original rationale of calculation, see Scarnecchia and Kothmann (1982); Smart *et al.* (2010).

Note No. 6.4.
Mathematically,

$$\text{Grazing Pressure Index (modified)} = \frac{\int_{t_0}^{t} \text{Forage Consumption rate } dt}{\text{Forage Mass}(t_0) + \int_{t_0}^{t} \text{Forage Growth rate } dt}$$

t = time

Herbage consumption (kg d^{-1}; intake) integrated within a specific time period (t_0 to t) is divided by the integration of forage growth rate (kg d^{-1}) over the same time period plus forage mass at t_0.

Appendix II. Terms not recommended for use

In any profession, it is inevitable that terms and the interpretation of these terms evolve in an effort to describe new techniques and management strategies. Some of these terms contribute to our professional language but others do not. As we have examined the terms and definitions that emerged during the work of this committee, we have identified the following terms as among those that do not appear to contribute to clear communication in the international language of our profession. We have listed these terms along with their definition. The rationale for recommending their non-use follows in the box.

Terms not recommended for use

Available forage. 'Available forage' refers to that portion of the forage, expressed as mass of forage per unit land area, that is accessible for consumption by a specified kind, class, gender, size, age and physiological status of grazing animal (cf. Forage allowance, 6.5; Forage mass, 2.3.6).

Forage is a defined entity (2.1.3). Its quantity is measurable as Forage mass (2.3.6). That which is 'available' for grazing has value as a concept but is impossible to measure quantitatively with current knowledge and techniques. What is 'available' to a grazing animal is influenced by many factors known and unknown. In attempts to measure 'available forage,' measures of forage mass are usually taken and related to assumptions about what the animal would consume. This leads to this term often being used erroneously for Forage mass (2.3.6).
Measurements of forage mass and canopy characteristics (Section 2.3), along with information on the environment and the specific kind, class, age

and physiological status of the grazing animal, contribute to understanding grazing behaviour and the availability of forage to the grazing animal.

Available pasture. Forage available for grazing (See Available forage, above; cf. Pasture, 5.3.4).

Pasture refers to a specific type of grazing management unit, not to what animals consume (See Note No. 5.3.4). Forage grows in the pasture. Animals graze forage in the pasture. Animals do not graze the pasture. Pasture is the place. Thus, 'available pasture' would refer to whether or not a particular pasture was available for use.

Continuous grazing. A method of stocking livestock on a specific unit of land where animals have unrestricted and uninterrupted access throughout the time when grazing is allowed (cf. Continuous stocking, 7.2; Rotational stocking, 7.15; Set stocking, 7.18).

Animals do not graze continuously and plants are not defoliated or grazed continuously. Grazing events are interspersed with resting, ruminating and social activities. Animals are stocked continuously during the time that grazing is allowed; thus, the recommended term is Continuous stocking (7.2). Additionally, stocking rates can be variable (Variable stocking, 7.20) under continuous stocking.

Controlled grazing. Term used variously to imply intensive management or rotational stocking (cf. Grazing management, 5.2; Stocking method, 5.5; Grazing system, 5.4; Rotational stocking, 7.15).

A key reason that this term is not recommended is that it is an 'either–or' term; there are no degrees of control. It is either in control or out of control. Thus, if a particular stocking method or system is considered to be 'controlled', the implication is that other valid methods and systems are 'out of control.' This is especially the case when using controlled grazing as a synonym for rotational stocking. Nineteen other valid stocking methods are provided in Section 7 that, when used appropriately, are neither out of 'control' nor more or less well controlled than other appropriate stocking methods. The word 'control' also unduly implies the ability to control actual grazing patterns (defoliation frequency and intensity, degree of selection) by manipulating the timing, rate, sequence of animal stocking and movement.
Grazing management (5.2.1 and 5.2.2) is best described in terms of intensity that can range from intensive to extensive. 'Control' *per se* does not imply nor lend itself to a range of possibilities.
The 'control' imposed is a matter of level or degree and is better described in terms of *grazing management* and *stocking methods.*

Fixed stocking. The practice of allowing a fixed number of animals on a fixed area of land during the time when grazing is allowed (cf. Set stocking, 7.18; Variable stocking, 7.20).

The recommended term is Set stocking (7.18). This concept is better described as set (non-variable) as opposed to Variable stocking (7.20) rather than as 'fixed' and 'unfixed' as the antithesis.

Flip-flop grazing. The repeated grazing and resting of forage using two paddocks in succession (cf. Alternate stocking, 7.1).

'Flip-flop' is not a creditable scientific term and fails to be as descriptive as 'alternating' between two paddocks.

High-intensity grazing [also high-intensity/low-frequency grazing (HILF)]. 'A rotational grazing system employing high to medium stocking density, commonly 3–5 pasture units, grazing periods generally over 2 weeks and often 30–45 d, and two to four (sometimes only one) grazing period cycles per year; synonym slow rotation grazing and high utilization rotation grazing' (Vallentine, 1990).

Rotational [grazing] stocking (7.15) is a Stocking method (5.5), not a Grazing system (5.4). Furthermore, Stocking density (6.2) is an animal-to-land ratio that provides no information on Forage mass (2.3.6), Canopy (2.3.2) characteristics or degree of forage use. The management approach of applying a high Grazing pressure to a grazing area (paddock) at infrequent intervals should be described in terms of Stocking rates (6.1), Stocking density (6.2) Grazing pressure (6.3), Stocking periods (5.6.9), Rest (5.6.5), Grazing management (5.2) and Stocking method (5.5).

Holistic resource management (**Holistic management**)**.** Refers to a management process/philosophy that frequently involves the use of rotational stocking with relatively high stocking densities (Savory, 1988).

Holistic management is not an individual method but is a philosophy and should not be used as a name for any particular stocking method.

Leader-follower grazing. The use of two or more types of animals, usually with different nutritional requirements, to graze sequentially on the same land area (cf. First-last stocking, 7.5).

First-last stocking is the preferred term because it is more flexible. 'Leader-follower' allows for only two groups of animals. In some cases, there could be more than two groups of animals. In these cases, the method would refer to 'first, second and last' grazers.

Low-density grazing. Grazing management with an objective of maintaining high forage-to-animal ratio which encourages selective grazing by the animal.

This is a relative concept that is best described in terms of Stocking rate (6.1), Stocking density (6. 2), Grazing pressure (6.3), Grazing management (5.2) and Stocking method (5.5).

Multispecies grazing. Grazing by two or more animal species on the same land unit (cf. Mixed stocking, 7.10).

'Multi' refers to 'many', while this stocking method most often employs only two animal species. Thus, 'mixed' more accurately describes this method of stocking (See Mixed stocking, 7.10).

Management intensive grazing. Management intensive grazing (MIG) is described as a 'system' that is synonymous with 'rotational grazing.'

'Rotational grazing,' better labelled Rotational stocking (7.15), is not a Grazing system (5.4). Rotational stocking (7.15) is a widely accepted Stocking method (5.5).

Grazing management should be described in terms of systems and methods, while MIG incorrectly uses these terms and has connotations of a philosophy. 'Intensive' is a relative contextual term and it is not clear to what exact aspect of management the word 'intensity' applies.

Palatability. The acceptability of forage to an animal, estimated as free-choice selection of one forage over another or by degree of defoliation of one forage relative to another when the animal has access to both. This is a subjective term. The preference for one forage over another can be measured while factors affecting palatability are not generally quantifiable [cf. Preference, 4.3.2 (the preferred term) and Note No. 4.3.2].

Preference-follower grazing. See 'Leader-follower' above (recommended term is First-last stocking, 7.5).

Rest-rotation grazing. A grazing system employing various combinations of full year rest, deferment and full-season grazing, commonly in a 3- to 5-year cycle (Vallentine, 1990).

Rest-rotation grazing is not a Grazing system (5.4) and is not site-specific (see Note No. 5.4). This approach to grazing management should be described in terms of Stocking method (5.5), Grazing pressure (6.3), Stocking period (5.6.9) and Rest period (5.6.6).

Rotational deferred/deferment. A multi-pasture, multi-herd system in which deferment is scheduled among respective pastures on a rotating basis; grazing the standing crop follows deferment but is continuous in the other pasture units (Vallentine, 1990).

Rotational deferred grazing is not a Grazing system (5.4) and is not site-specific (see Note No. 5.4). This approach to grazing management should be described in terms of Stocking method (5.5), Grazing pressure (6.3), Stocking period (5.6.9), Rest period (5.6.6) or Deferred stocking (7.4).

Rotational grazing. If used, it is synonymous with Rotational stocking (7.15).

Animals do not graze continuously during rotation among paddock. Grazing events are interspersed with resting, ruminating and social activities. Animals are stocked on a rotating basis among three or more subdivisions of a grazing management unit during the time that grazing is allowed; thus, the recommended term is Rotational stocking (7.15).

Short duration grazing. A rotational grazing system employing high stocking density, one herd, commonly 5–12 pasture units, grazing periods of 3–10 d (less commonly 1–15 d), and two to several grazing period cycles per year; also the common 'rotation grazing' of improved pasture. Syn. Rapid rotation grazing or high-intensity, high-frequency grazing (HIHF) (Vallentine, 1990).

> Rotational [grazing] stocking is not a Grazing system (5.4); it is a Stocking method (5.5). Stocking density (6.2) is an animal-to-land relationship at a specific time and provides no information about Forage mass (2.3.6), Canopy (2.3.2) characteristics or the degree of forage use. This is a subjective term that can best be described in terms of Stocking method (5.5), Stocking period (5.6.9), Rest (5.6.5), Grazing pressure (6.3) and Forage mass (2.3.6).

Standard Livestock Unit. The Standard Livestock Unit (SLU) to measure stocking rate in grazing studies is a non-lactating bovine weighing 500 kg. Using the 0.75 power of live weight for conversion within animal species and the 0.90 power between sheep and cattle, the SLU can be derived for animals of different live weights. The SLU for pastures grazed by goats can be calculated using the conversion factors for sheep (Minson and Whiteman, 1989).

> The procedure, suggested by Minson and Whiteman (1989), attempts to correct for the known differences in intake between cattle and sheep/goats. While a means of correcting for this is needed, the SLU is not recommended. Mathematically, it is complex and susceptible to making errors in the calculations required. Furthermore, it fails to establish logic to the pairing of sheep/goats with cattle based on their live weights. Without defining a 'standard ewe size' to make the first interspecies conversion, the results will differ from user to user. The interspecies conversion recommended by Minson and Whiteman (1989) between a 500-kg cattle and a 50-kg sheep appears arbitrary.

Top and bottom grazing. See Leader-follower grazing above. Preferred term is First-last stocking (7.5).

Supporting Information

Additional Supporting Information may be found in the online version of this article:

Appendix S1: Chinese-language translation of this article.

Appendix S2: Spanish-language translation of this article.

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