

ENVIRONMENTAL MANAGEMENT IN PASTORAL SYSTEMS

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***Abstract:** Sheep rearing may affect pastoral land and vegetation in several ways: herding; mechanical impacts on soil and plants through trampling; removal of leaves, stems, and other plant parts; removal or redistribution of nutrients; use of terrain; and willingness to travel. These factors vary depending on animal dietary preference, digestive system, mouth anatomy, size, species, and weight. This paper investigates the relationship between grazing and ecosystem – dietary preferences of sheep, size and weight of sheep, and grazing distribution – as well as grazing infrastructure requirements – management of handling facilities and animal management.*

***Key words:** environmental management, pastoral systems, sheep*

INTRODUCTION

Environmental management in pastoral systems in sheep rearing needs to consider the relationship between grazing and ecosystem – dietary preferences of sheep, size and weight of sheep, and grazing distribution.

1. Dietary Preferences of Sheep. Depending on the type of plants they eat, livestock species are browsers (goats), grazers (cattle, horses) [24], or intermediate feeders (sheep) [13], but these categories are not absolute. For instance, sheep graze selectively both herbaceous and woody vegetation, but their diet is partially determined by the availability of different experiences, inherited behaviours, learned behaviours, nutritional needs, and types of vegetation. Dietary preferences of sheep are shown in Table 1.

Table 1.

Dietary preferences of sheep

“Species”	“Dietary preferences”	“Digestive system”	“Mouth parts and adaptations for grazing or browsing”
Sheep	<ul style="list-style-type: none"> - Intermediate feeders. - Graze forbs and grass. - Browse woody plants. 	Ruminant	<ul style="list-style-type: none"> - “Cleft upper lip allows close grazing. - Small mouthparts and narrow muzzle allow them to be more selective of plant species and plant parts and to graze prostrate plants. (see Askarizadeh, Heshmati & Jouri, 2011) - Large rumen relative to body mass allows them to utilize low-quality forage. - Consume a grass-dominated diet, especially if grasses are succulent, but consume more forbs when available.”

Source:[13]

Livestock species (including sheep) can have a significant impact on vegetation management-related conservation objectives: controlling annual grass is best done by cattle because sheep and goats prefer forbs over grasses; and controlling broadleaf weedy plants is best one by sheep and goats.

Ecosystems are impacted by livestock grazing, overgrazing, and under grazing [2, 11]: “grazing affects herbaceous vegetation that provides hiding cover for a variety of grassland amphibians, songbirds, reptiles, small and large mammals, etc.”, leaving only a

remnant cover; grazing affects vegetation characteristics, which affects wildlife habitat structure and productivity on short- and long-term time; grazing alters the structure and composition of rangelands, impacting biodiversity (insects) and ecosystem function and altering the environment for predators and prey; grazing “causes the loss of entire native plant communities because of the invasion by exotic annual grasses and associated alteration of fire regimes”; grazing deteriorates riparian areas; grazing “impacts many native plant communities and the wildlife species adapted to these settings because it leaves little ability for desirable perennial plants to reproduce (either by seed or vegetatively)”; grazing makes it easier for predators to locate nests in shorter, less-dense vegetation; grazing reduces invertebrate biomass; overgrazing affects songbird diversity because it leaves little vegetative cover; overgrazing causes the absence of native vegetation, facilitating the invasion of exotic annual grasses; under grazing affects some bird species because of the abundance of short and sparse vegetation; under grazing produces vegetation with more litter, less shrubs, and taller, denser vegetation.

Grazing and browsing are affected by topography [1, 2, 13]: cattle and horses have more difficulty traversing steep slopes and prefer level to gently rolling ground → “cattle tend to graze less than sheep or goats on steep slopes if both steep and gentle topography is available; sheep and goats readily graze on steep slopes because they are more agile, smaller, and sure-footed and have a strong tendency to graze into the wind” → “overuse on the side of a pasture from which the prevailing winds blow.” [3, 28] Moreover, “windswept ridges and arid areas where water is limiting in summer but where snow and shrubs are a valuable forage combination in winter” are extremely valued by domestic sheep operators [6, 12, 17, 21, 22].

2. Size and Weight of Sheep. Sheep differ in size and weight depending on age, breed, and sex. “Their size and weight are directly related to forage consumption, an important consideration when estimating a site’s carrying capacity, i.e., the number of animals that can graze a site without harming resources.” This is extremely important given that different sheep numbers cause perennial species to be replaced by annual species [10]. A typical sheep weights 70 kg and eats daily 1.5 kg/day of dry matter [4, 5, 13, 20, 23].

Rangeland scientists have determined that livestock activity and stock density “may have greater trampling affect than an animal’s weight: thus, more-active livestock and higher stock densities (i.e., more animals per unit of land at any given time) increase trampling impacts” [3, 14]. Likewise, “sheep and goat trampling per individual had a lower impact on the environment than that of wild ungulates” [7, 8, 18, 19]. Animal trampling affects compaction of soils with a high proportion of small particles (such as clay), “causes stream banks to slough off (when the soil is wet),” and shears off new plants. These impacts are not necessarily negative: for instance, it can prepare a seedbed by damaging undesirable seedlings of weedy plant species and by incorporating seeds into the soil.

3. Grazing Distribution. Specialists distinguish between ideal, good, and poor grazing distribution [26].

An ideal grazing distribution of livestock “occurs when proper utilization extends uniformly over the entire pasture, which means that grazing animals must be enticed or forced to seldom-grazed areas.” [26] Improved grazing distribution has two positive effects: “it results in higher harvest efficiency since livestock consume a greater proportion of the available forage and spreads defoliation effects across a greater proportion of available forage plants.” (idem)

A good grazing distribution “can increase both fodder harvest efficiency and grazing capacity.” But grazing distribution is affected by several factors such as [9, 16, 25 26]: “grazing habits of kind and class of livestock (particularly as related to length and

steepness of slope), placement of water developments, salt and mineral placement, palatability of forage, vegetation type, kind and combination of range sites and range condition classes, location of shade, fencing patterns, pasture size, grazing system, stocking density, and prevailing winds.” There are a few techniques for improving livestock grazing distribution (Table 2), among which grazing management is the most important because it can improve livestock distribution and, thus, “increase accessible forage and effective grazing capacity” [15, 28]. To achieve management goals, one needs to balance livestock grazing with time and space [2], and grazing capacity with livestock population [11].

A poor grazing distribution results in “increased number of erosion problems in heavily used areas; low animal production (per ha) because of reduced harvest efficiency; low harvest efficiency because the pasture is underutilized; low range condition in localized heavily used areas.” [28]

Table 2.

Techniques for improving livestock grazing distribution

Approach	Action / Consideration
Enticing animals to specific locations	<ul style="list-style-type: none"> - “Mowing and burning - Rub and oiler placement - Salt and mineral placement - Shade - Supplemental feeding location - Water development placement (the most important)”
“Force distribution of grazing animals”	<ul style="list-style-type: none"> - “Fence along range sites - Pasture shape - Pasture size”
“Grazing management strategies”	<ul style="list-style-type: none"> - “Flash grazing - Rotational grazing - Season of grazing - Stocking density”
“Livestock considerations”	<ul style="list-style-type: none"> - “Class of livestock (ewe, ram, lamb) - Vegetation and terrain characteristics”

Source: [27]

MATERIALS AND METHODS

The material use in this paper consists in books and articles – older and more recent – about the management of the environment in pastoral systems, with focus on sheep. The research method is bibliographic, with focus on two main topics: sheep rearing (dietary preferences of sheep, size and weight of sheep, and grazing distribution) and grazing infrastructure requirements (management of handling facilities and animal management).

RESEARCH RESULTS

Environmental management in pastoral systems is about grazing infrastructure requirements – management of handling facilities and animal management – of great importance because they affect both vegetation and land.

1. Management of handling facilities. They include: “a delivery or gathering area accessible to livestock vehicles; a loading chute or ramp; fencing: sheep require electric fencing (electrified cord, mesh, ribbon, wire) or mesh-style fencing (field fencing); predator protection: sheep are highly susceptible to predation by bears, domestic dogs, people, and wolves; sheep can be protected by guard dogs that intimidate predators by aggressive behaviour (barking, posture, etc.); sturdy wooden or pipe pens and corrals for

processing and shipping animals; water sources: sheep consume 4.5-9.0 l per day, but they may get by with much less when consuming high-moisture forage; sheep need access to clean, fresh drinking water daily; sheep's daily water requirement may vary greatly with disease, forage moisture, stress, temperature, and workload; sheep's watering troughs should be appropriately sized." [13]

2. Animal Management. A farmer may graze one animal species in a pasture or more than one animal species (dual use or multispecies grazing) "in the same pasture, at the same or different times, thus making efficient use of forage because of differences in dietary needs and preferences, but the species combination should be selected based on land management objectives." [13] Multispecies grazing "can increase efficiency of forage utilization due to ability to gain access to forage (plant growth habit, terrain, topography) not available to the co-grazing species, to less rejection of forage due to dung contamination, to preference for certain species or plant parts, or to willingness to consume plants that are not preferred or would have adverse effects on the other animal species" [28].

Animal management also includes management of sheep genetic resources [9, 22], rearing technology [7], sustainable management of sheep nutrition [5, 27, 28], and waste management [4].

CONCLUSIONS

Pasture floral composition in sheep raising continue to be a topic of interest for researchers and is one of the sheep feeding-related topics: biodiversity, floral composition of pastures, grazing systems, pastoral systems, pastoralism and conflict, pasture quality, and transhumance. Sheep farmers need to consider pasture management, with focus on climate, floral composition, soil, terrain, and water supply. The mixtures of pasture and hay forage crops for sheep need to include alternative/annual forages, cool season grasses, forbs/phorbs, legumes, and warm season grasses in combinations of at least three forage plant species.

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