Are Forages Green?

Preface

Green is the colour of freshness and sustainability. It is also the colour of immaturity and inexperience. Our eyes discern more shades of green than any other colour. In the landscape the green of trees is often seen best at a distance where the colour may appear blue and grey, but the beckoning pastoral landscape with verdant foliage is a comfort to the soul. In 'cool', temperate societies around the world, the pastoral landscape is embedded in art, literature and music, always representing comfort and peacefulness. The pastoral landscape gives us the images of cowboys driving herds of cattle across boundless grasslands and shepherds (pastors) minding docile flocks, both providing nourishment and vestments, and perhaps making mankind feel less lonely on the landscape. The grassy landscape is likely hard-wired into our psyche; it is from grasslands, not forests that mankind emerged.

The perceived 'greenness' and sustainability of forages is not without merit. More than any other crop, forages are protective of the environment, thanks to massive root systems, long periods of growth and year-round ground cover. Forages shield the soil against salinization and degradation by erosion and subsidence. In fact forages, more than any crop, build soils by furnishing abundant carbon (C) and nitrogen (N) from their ample roots, and even more so if livestock waste is returned. Forages provide for an elaborate and diversified soil ecosystem and food web, replete with both small and minute soil organisms, by enhancing soil structure, conserving nutrients, and nourishing with carbohydrate exuded from roots, and indirectly from applied manure. Forages protect the freshness of streams and lakes by reducing surface runoff and leaching. They may reduce emissions of greenhouse

Shades of green— winter, Abbotsford, BC, Canada.

gases such as nitrous oxide and carbon dioxide by sequestering C and N, and they improve air quality by reducing dust emissions that often come from tillage and wind erosion. Forages also emit a pleasing scent to the air, and provide nectar and pollen for beneficial insects. Forages may reduce the need for pesticides and mineral fertilizers. And, finally, forages provide feed and habitat for birds and wildlife. Natural grassland biomes (defined broadly) occupy 40% of the land surface of the earth (excluding Greenland and Antarctica) in the form of savannahs, prairies, steppes, cerrado and pampas (www.fao.org). And a new forage biome, of sorts, has emerged world-wide in recent centuries, comprising anthropogenic (seeded) grasslands that have often replaced forests and natural grasslands. Managed grasslands with high residency compared to natural grasslands feed many of the ruminants that provide humans with meat, milk, recreation, power and materials. Managed grasslands are also used by a variety of wildlife and, occasionally, by 'free ranging' pigs and chickens.

PAINTING BY JEAN FRANCOIS MILLET, 1814-1875

Figure 1. Peasant spreading manure.

One might say that a 'green revolution' in Europe began in the early 1700's when farmers in the Netherlands replaced the traditional two cereal crop - fallow rotation with a four year rotation that included wheat, barley, clover and a root crop (usually turnips) used for livestock. The dramatic yield increase from this new management style was related to three factors: N fixation by the clover, cycling of manure nutrients to cereal crops (Fig. 1), and elimination of a fallow year which was previously mandated, and which could expose the soil to erosion. This 'green revolution' followed into England when Charles 'Turnip' Townshend (Fig. 2) brought over this new rotation. The resulting greater supply of food sustained the rising population associated with the Industrial Revolution. It has been suggested that the ample supplies of barley provided for great consumption of ale, which replaced contaminated drinking water, and that the ale was later replaced as a favorite beverage in England with boiled tea because industry, more than agriculture, required a high level of sobriety. Variations on these rotations are still being practiced in more and less industrialized regions, and in both conventional and organic systems. And somehow, still today, reasons that legumes are so beneficial for succeeding crops are not fully understood.

In the year 2000, in the small Canadian town of Walkerton, Ontario, 2500 people were made ill and seven died from drinking water contaminated with E. coli 0157:H7 that has been connected to the spreading of cattle manure on a forage field, prior to heavy rains. There were several system failures that led to the tragedy, among them inadequate guidelines for farmers. For the townsfolk in Walkerton the bucolic landscape had turned into a nightmare. And today, the iconic country-sides of England, Netherlands, Ireland, Switzerland and many other beloved regions are no longer havens for modern environment-minded thinkers. The forage-ruminant sector was prominently featured in the landmark 2006 Food and Agriculture Organization (FAO) publication called 'Livestock's Long Shadow' (see: www.fao.org). This publication posited that consumption

Shades of green — summer in southeast Ireland.

of animal based foods is, for example, responsible for 18% of greenhouse gases (GHG) worldwide, which exceeds emissions from transportation. More recently, Dr. Robert Goodland, a long-time adviser to the World Bank (and undergraduate biogeography professor of SB) attributed no less than 51% of all GHG emissions to livestock production. The recent publication "Our Nutrient World" (Sutton et al. 2013, see: initrogen.org) estimated that, globally, 80% of the N and phosphorus (P) present in crops and forages is fed to livestock while only 20% is consumed directly by people. The inefficiencies of the N and P cycles are such that 80% of N and 25-75% of P used by agriculture ends up in the environment. Efficiencies are lowest in forage-ruminant based systems even when efforts are made to properly utilize manure. The forage-ruminant system is particularly criticized for poor nutrient efficiency, for causing loss of habitat and biodiversity, and for emitting large amounts of the GHG methane, even when accounting is made for the many benefits like producing food on marginal land. Whether confined or pastured cattle are less harmful for the environment is perplexing, but removing livestock from the landscape makes it feel empty. For those espousing meatless Mondays (Mark Bittman, no relation), half-portions of meat (referred to as demitarian diets) or full vegan diets, the landscape of grassland and cow no longer has an unqualified "green" light.

PAINTING BY GODFREY KNELLER, 1646-1723

Figure 2. Charles "Turnip" Townshend (1687-1738) who introduced the four-crop rotation systems to England in the early Industrial Revolution.

Both the FAO report (Livestock's Long Shadow) and "Our Nutrient World" acknowledged that with research the environmental impact of forage-ruminant systems can be mitigated. Happily, forages are the subject of scientific attention like at no time before, and perhaps this fact is not well known to their detractors. Our book includes articles representing some of the most interesting and advanced work in the field of forage science today. It is not comprehensive in breadth or depth and is not intended to replace more authoritative sources. The book is intended to inspire interest as well as to inform, and to provide readers with a cross section of thoughts, movements and research thrusts. It is hoped that by reading this book, students, agricultural workers and advisors, and even scientists and policy makers, will gain a greater insight into the fascinating and perplexing and 'cool' world of temperate forages.

Shabtai Bittman
Derek Hunt

Homage to a Landscape Lost: Grasses in Wind Project in Austria

PHOTO BY A. GUERINO

The "Gräser im Wind" (grasses in wind) roadway art project in Carinthia, Austria is a portrayal of a meadow landscape regained following construction of a transportation system. The art project is intended to provide a visual break in the landscape. It is based on two components, the noise protection wall of the "Koralmbahn" railway line and the landscaping of the roundabout.

When traveling from Kühnsdorf or from Völkermarkt, the large noise barrier (7.86 and 3.36 x 120 m) gives an appearance of grass being blown by the wind, despite the wall being of rigid structure (see photo at right). The roundabout centerpiece contains 76 curved 6-m tall stainless steel pipes depicting grass in motion from the blowing wind, mirroring the grass painted on the noise barriers.

Images of grass in this project were used to re-connect people to their natural surroundings by art. The grassland setting evokes poetic reflections.

Armin Guerino Wien, Austria | armin@guerino.at

PHOTO BY A. GUERINO