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Photo: Kim Cassida

Low-Cost Renovation Practices for Perennial Pastures and Hayland in Michigan

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Grasslands harvested as pasture, hay, or haylage are a vital resource for livestock farmers and are the leading agricultural land use in Michigan. Improving grasslands on a small farm scale presents a special challenge because many of the commonly recommended methods require equipment that small producers may not own or be able to access. Fortunately, there are practical solutions to this problem.

Photo: Kim Cassida

Step 1 - Assessment

The first step in successful renovation of a forage stand is assessment of the stand and site to determine whether renovation—improvement of existing stands—is feasible, or whether a full-scale replacement may be better. Unless stand condition is extremely poor or you wish to establish a completely different type of forage, it is often more cost effective to renovate than to replace. This is because perennial forage crops do not yield as much in the establishment year as they will later in stand life, creating a forage availability shortfall. This results in reduced income when hay is being sold, and reduced feed supply if animals are being fed or grazed. Stand replacement also presents a greater risk of total establishment failure due to weather or other uncontrollable circumstances. Renovation typically results in a gradual increase in forage productivity without an abrupt shortfall, but improvement is measured over years, not months.

The success of renovation depends largely on selection of appropriate practices that fit the needs of the particular farm. If the previous stand failed, there is no point to repeating the same thing and hoping it turns out better. It is important to determine the reason for the failure and fix that problem before moving forward.

It is important to be sure that the planned improvements are suitable for the site. The USDA-NRCS provides a Web Soil Survey that is a useful tool for looking up soil type, drainage, and length of growing season for your farm, but there is little substitute for the experience of yourself, extension and conservation service personnel, or neighbors when evaluating the idiosyncrasies of local conditions. The suitability of forage species for the specific site conditions can be found in the MSUE Bulletin "*Recommended Forage and Pasture Crops for Michigan*" (Cassida et al, 2019).

It is also important that the improvement fit your intended use of the forage. Will it be harvested as pasture, hay, haylage or some combination of these? What species and class of livestock will be fed and what are the production goals for those animals? Will any forage be sold and to what market?

Next, make sure your planned improvements are truly needed and are being applied to areas where you will get best return on investment. It is usually most cost-effective to apply limited funds to the worst field that still has good potential for improvement. The USDA-NRCS *Pasture Evaluation Scoresheet* (Cosgrove et al., 2001) is an evaluation tool that can score the overall condition of grasslands, both pasture and hayfield. This scoresheet provides an easy-to-use ranking system to evaluate desirable and undesirable plant species, ground cover, species diversity, plant vigor, use patterns, soil compaction, soil erosion, and other factors.

Assess available resources. Do you have access to field equipment for field prep and planting? For small farms it is often more cost effective to borrow, rent, or contract equipment that will rarely be used, rather than owning it. Remember to include available labor in your resource assessment. The final resource consideration is capital. How much can you afford to spend on improvements?

Lastly, consider the time frame for reaching improvement goals. Can you afford slow, gradual progress, or is a faster return on investment needed? Faster returns often require greater upfront cash outlay.

Step 2 - Better Management of What You Already Have

After assessment, consider whether your forages can be improved simply by improving management of the existing stand. Management approaches such as changing harvest schedules, implementing a managed rotational stocking system, improving soils, or controlling weeds can allow continued use of the field while improvements are being made. These approaches will not yield instant results, but if you have the flexibility to wait a year or two the payback can be significant.

A single strand of electric wire is effective and inexpensive for subdividing cattle pastures. Photo: Kim Cassida

Portable electric net is good subdivision fence for sheep and goats. Photo: Richard Ehrhardt

Every time a forage plant is cut or eaten, a "harvest" has occurred. Harvest management has an enormous impact on stand persistence. Perennial forage plants depend on two things to support regrowth after harvest. The first is nutrients stored in crowns, roots, or lower stems. These nutrient reserves are like a bank account that must be replenished by photosynthetic activity before the crop is harvested again. If the bank account is not allowed to recharge fully between harvests, the balance eventually declines to zero and the plant dies. Because forage quality decreases as forages grow and mature, harvesting forages for optimum nutritional quality almost always occurs before recharge is complete. The second key factor for persistence is the amount of green leaf left behind in cut stubble or post-grazing residual forage. This is called residual forage. Harvest methods that leave more leaf residual behind in the field help plants recover from harvest faster because surviving leaves continue to make carbohydrates and reduce the drain on nutrient reserves.

Managed rotational stocking systems

on pastures will control when and how much forage is eaten by livestock, thus ensuring that a leaf residual is always present and that there is enough time between grazings for nutrient reserves to be restored. Moreover, managed grazing fosters more uniform forage utilization and allows control of where nutrients are returned as dung and urine so that some areas do not become over-fertilized while others are depleted. Location of fence, water, mineral, and any pasture supplements can also be manipulated to ensure animals return nutrients more uniformly across the pasture.

Improve the soil! The first step is taking a soil test to check for soil pH and availability of the major nutrients phosphorus (P) and potassium (K). A soil organic matter test (SOM) will provide an inexpensive benchmark for measuring improvement in soil health over time, because soils generally improve as SOM increases. Detailed instructions for soil sampling can be found in the MSUE publication "*Sampling Soils for Fertilizer and Lime Recommendations*" (Warncke, 2000). One exception from that publication is that permanent grasslands do not need to be sampled deeper than 4 to 6 inches, because surface application concentrates soil fertilizer nutrients near the soil surface.

When funds are limited, it is more effective to correct soil pH before soil nutrients. Correcting pH is the first priority because plants cannot access nutrients when soil pH is acidic, even when the nutrients are present. On average, minimum pH for most forage grasses is 5.5, clover and birdsfoot trefoil is 6.0, and alfalfa is 6.8. See MSUE bulletin "*Recommended Forage and Pasture Crops for Michigan*" (Cassida et al, 2019) for pH and other site preferences for specific species.

Once soil nutrient shortfalls are identified in soil test results, make a plan to increase levels of the nutrients that are in the shortest supply first. It can be difficult for small farms to find a fertilizer supplier willing to apply small amounts. Fortunately, when livestock are present on the farm, chemical fertilizer is not the only possible nutrient input. When feeding livestock, every purchased feedstuff that comes onto the farm as grain, minerals, or hay serves as a soil nutrient source because animals do not retain 100% of the nutrients they consume. Most of the nutrients eaten cycle back out of the animal in manure. Manure has the added advantage of providing micronutrients and organic matter to improve soil health as well as N, P, and K. Manure nutrients can be used to best advantage if the purchased feed is fed and the animals apply manure directly on the fields with the greatest fertility deficiency.

Bale grazing is an effective soil improvement method. It is the practice of feeding hay or baleage on pasture instead of in or near a barn. Round bales can be placed strategically in pastures or hayfields where soil nutrients are needed. The bales are fed sequentially across the field, using electric fencing to control animal access. Using this system, livestock can be "rotated" through a field in the winter when soils are frozen, returning nutrients to the soil via dung, urine, and the "wasted" hay that is not eaten. Growing, pregnant, or lactating livestock recycle approximately 50% of N and 85% of P and K that is eaten, while an adult dry cow at maintenance may recycle close to 100%. Hay that is not eaten is not truly "wasted"—it still returns its nutrients to the soil. Therefore, a single 1000-lb bale of average quality hay (15% moisture, 12% crude protein, 2.5% K, 0.25% P) can return up to 16 lb of N, 4 lb of P_2O_5, and 25 lb of K_2O fertilizer equivalents to the area where it is fed. When hay is purchased off-farm, it represents a substantial net gain of nutrients to the farm. The uneaten hay can also provide seeds to help reseed bare areas. Therefore, it is important to avoid using hay that is full of weed seeds in this system.

The practice of delivering hay to animals wintered outside on pasture can be used to control manure and seed distribution in a similar manner if the hay is delivered or unrolled on different parts of the field over the winter. This practice requires more labor and equipment use than bale grazing because hay needs to be transported to the field on a regular basis throughout the winter. In comparison, bales for bale grazing can be set out all at once in late fall, and winter labor consists of moving the electric fences.

Round bales separated with electric fence and ready to be grazed. Photo: Jerry Lindquist

Unrolled hay being fed on winter pasture. Photo: Jerry Lindquist

Stockpiling is the practice of deferring grazing to accumulate large amounts of forage for later grazing. Common applications include deferring grazing on the spring flush until later in the summer and extending the grazing season into the fall and early winter. For the purpose of renovation, the key advantage of stockpiling is soil improvement – keeping animals on the pasture longer returns valuable nutrients in manure to the soil instead of concentrating them near the barn. The disadvantage of stockpiling is the need to pull acres out of the grazing rotation so they can accumulate forage for later use. This extra acreage can be hard to come by when farmland is expensive. Fall/winter stockpiling has limited utility in Michigan counties with heavy or

unpredictable early snowfall. Livestock accustomed to this system will dig to reach forage under snow, but the energy expenditure to access forage goes up as the snow gets deeper. Deep snow, heavily crusted snow, or ice sheeting puts an end to effective winter grazing and livestock will require supplementation. Any forage species can be used for summer stockpiling, but the nutritive value of winter stockpiled forage is best with species that retain green leaf well into the cool weather, such as endophyte-free tall fescue. Forages that drop their leaves after frost, such as alfalfa, or collapse under the weight of snow are not good choices for winter stockpiling.

Green tall fescue under snow cover in January. Photo: Kim Cassida

To make a forage stockpile for fall/winter grazing, graze the pasture as usual through early to late July, with more northern locations beginning the stockpile earlier. If the pasture does not contain at least 30% legumes to provide nitrogen, apply 30-50 lb N/acre in July to help boost forage growth. Then rest the pasture for at least 60 days to accumulate new growth. In the fall, good stockpiling species do not flower and therefore all forage growth will be vegetative and high quality. Cool weather also causes grasses to increase sugar content as "antifreeze" which further improves nutritional value. After killing frost, there will be little new growth and the pasture can be grazed without significant damage to root nutrient reserves needed for winter survival. Strip grazing is the best forage allocation method in this system because it helps reduce trampling and maintains a uniform degree of utilization so that the stockpile can be stretched as long as possible.

Weed control is problematic in many pastures and hayfields because there are few effective herbicides to remove weeds from mixed grass-legume stands. Keep in mind that many pasture "weeds" are nutritious and palatable. When this is the case, money is better spent on other renovation practices. Weed control may be economically justified when weeds are toxic, low-yielding, or reduce market value of hay. A weed problem in grassland is often a red flag for soil pH, soil fertility, or grazing management issues that need to be corrected. Therefore, the first line of defense for weed control in established grassland is to use management practices that strengthen the desired forage species and help them outcompete weeds. Everything previously discussed helps in this regard.

Timely mowing is an effective control for some pasture weeds, such as goldenrod and brush, which are rarely problems in hayfields due to the frequent cutting schedule. Scouting is important. Spot application of herbicides can be used to address emerging weed problems before they spread to become big problems, especially thistles. A shovel is a useful tool to root out early invaders, but be sure to remove the plant from the field and destroy it because many weed seeds can continue to ripen after the plant is cut. If the weeds are taller than the desired species, wick or wiper applicators can be used to apply glyphosate to the top of the canopy, sparing the shorter desirable species.

Mixed species grazing is the practice of grazing different livestock species on the same pasture. It can help control weeds because different animal species have different preferences for plant species. Goats in particular are known for eating many weeds that other livestock refuse, especially woody brush. Sheep will typically eat more weeds than cattle. However, all livestock can learn to eat weeds by watching other animals, especially their mothers. Mixed grazing also improves forage utilization across space because animals will graze closer to the dung of other species than to their own.

Step 3 - Diversify the Forage Base

Finally, we arrive at what most growers think of first—planting! If improved management is not enough to move the grassland in the desired direction, then assistance in the form of added seed may be needed. Also, if the desired forage species is not already present in the grassland, either as mature plants that can be allowed to set seed or seeds stored in the soil "seed bank", no amount of management will cause it to spontaneously appear. The only way to get those species is to add their seed.

Natural reseeding is a simple, effective method for thickening stands of perennial grasses, red and white clover, and birdsfoot trefoil. This method only requires the ability to defer machine harvest or grazing long enough for forage seeds to ripen and fall. Seeds in the replenished soil seed bank will then germinate when normal management is resumed. Obviously this requires that the desired forage species are already present in the field. Natural reseeding cannot be used with alfalfa because it suppresses growth of its own seedlings, a phenomenon known as autotoxicity, and therefore it is not possible to thicken an alfalfa stand by adding more alfalfa seed. Natural reseeding should not be used if the field contains a high proportion of weeds, because weeds are more efficient at reseeding than most improved forages.

Use mixtures of forage species because productivity of mixtures is often better across time as individual components wax and wane over the season. Because legume forages can obtain nitrogen from air, a process known as fixation, adding legumes to a predominantly grass stand can reduce the need to purchase N fertilizer while also increasing forage protein levels and digestibility for the livestock. Conversely, adding a grass to a legume like alfalfa can extend the useful lifetime of a hayfield by several years, speed hay drying rates, improve fiber digestibility of the hay, reduce erosion, and reduce bloat risk of pastures. Mixtures of any kind enhance soil health by supporting a diversity of living things underground as well.

Invest in the best quality seed you can afford. Buying cheap seed is often a case of getting what you pay for. Variety Not Stated (VNS) or bin run seed is often inexpensive. This is seed that the distributor does not want to guarantee as an improved variety. This may be because it really is not good quality seed or it may be an improved variety for which they legally cannot or do not wish to verify the genetics. Such issues include age of the seed lot, declining germination, exceeding the regulated age limit for certified seed fields, or simply overstocking. Therefore, buying VNS seed is a lot like gambling—it may be very good seed at a bargain price or it may be nearly worthless. There is no way to know which it is ahead of time.

The cost of good seed, while it may seem steep at the time of purchase, is a relatively small contributor to the total cost of production in a grassland that may persist for 5 to 10 years, or more, under good management. Seed cost should be considered in relation to the total lifetime forage production potential of the resulting stand. While it can be a significant one-time cash outlay, seed cost for perennial forages is always a relatively small proportion of the lifetime cost of production when perennial forages may last five to ten years or more. Improved varieties are typically more expensive because of the cost involved in variety development. Certified seed is the most expensive because it is carefully regulated to prevent genetic drift away from original variety traits. MSUE publishes an online

Mixtures of species such as grasses and clovers enhance grassland value. Photo: Kim Cassida

Forage Variety Test Report (Cassida, 2019) that summarizes yield performance of alfalfa, clover, and grass varieties in Michigan. Tests from other states with climates that are similar to Michigan (New York, Pennsylvania, Ohio, and Minnesota) can also be useful. Using varieties that performed well in these tests will help ensure that the chosen seed will meet expectations.

Frost-seeding is an inexpensive, effective method for adding legumes such as red clover, white clover, birdsfoot trefoil, and some grasses (ryegrasses) to forage stands. This practice is described in detail in the MSUE Bulletin "*Frost-Seeding – an Effective Forage Establishment Practice for Michigan*." (Cassida et al., 2018). In brief, frost-seeding employs freeze-thaw action in soil to bury seed that was broadcast in February or March. Seed can be broadcast using inexpensive rotary seeders carried by hand or mounted on the back of an ATV. Effective control of forage residue the fall before frost-seeding is a critical step in use of this practice, because heavy residue prevents the required soil-seed contact. Pastures or hayfields to be frost-seeded should be grazed heavily or hayed late in the previous fall. Frost-seeding is less effective on sandy soils or northern regions where snow does not melt before nighttime temperatures stay above freezing.

Tread-in seeding uses a similar strategy in that seed is broadcast over a low-residue area, but it then uses hoof action of livestock to trample the seed into the soil. Therefore, it has a wider window of possible planting dates and can be used at any time of year recommended for particular forage species. Tread-in seeding can be used in pastures that are too steep or rocky for access with farm implements. It is also useful for adding new forage species where animals are grazed in wooded areas (silvopastures) where tree spacing is too narrow for machine access. Tread-in seeding is accomplished by broadcasting seed using a hand-cranked or ATV-mounted spreader, and then grazing the area with a high stocking density of cattle or sheep for a short time (no more than 24 hours). Livestock must be removed before seed begins to germinate which may occur within 48 hours for some species under ideal conditions. This method should not be used when soils are muddy because seed is likely to be pushed too far into the soil and excessive surface compaction can result from hoof traffic on wet soils.

No-till seeding is an effective renovation method but it does require access to a no-till pasture or grain drill. For small farms, it is unlikely that a drill would be used often enough to justify purchase. Small drills for pasture seeding or hayfield overseeding can be rented from some county soil conservation districts and implement dealers in Michigan. MSUE publishes a detailed guide to no-till forage seeding "*Steps to Successful No-Till Establishment of Forages*" (Leep et al., 2003).That guide also explains the process of complete stand replacement using no-till. Like frost-seeding, renovation by no-tilling requires control of forage residue before planting. For a renovation project, this can be provided by winter, heavy grazing, or seed can be drilled into hay stubble, but competition from recovering sod is likely to be stiff. Another method for reducing competition from existing plants is a light disking to expose about 25% of the soil surface, but this method also exposes weed seeds and may result in heavy weed pressure.

One seeding method that is ***not*** recommended by MSUE is feeding forage seeds to livestock so that they can pass through and be planted in the dung. Research shows that most forage seed fed to animals is simply digested. The small amount of viable seed that makes it to the soil represents an extremely expensive source of seed in purchase price per pound of seed actually planted per acre. In addition, seeds will be unevenly distributed across the pasture. Money is much better spent on other methods of planting.

Conclusion

A little effort expended in planning, soil improvement, and harvest management can go a long way towards improving productivity of hayland and pastures with relatively little capital outlay. When reseeding is necessary, methods such as natural reseeding, frost-seeding or no-till seeding into the existing stand may cost less than complete stand replacement.

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