

Managing rangelands: promoting sustainable rangeland management practices

DIRECT SEEDING: a fast and cost-effective method for large-scale restoration of degraded rangelands



Direct seeding and its merits as a restoration option

Direct seeding is currently receiving much attention as a method of rangeland improvement. Direct seeding is suitable for small or large areas where the terrain and cost of transplanting seedlings prevent natural regeneration or planting. It is an age-old practice that has regained favor due to the high costs associated with alternative methods of planting and transporting seedlings from nurseries for transplanting.

Direct seeding reduces the time and labor required, increasing resource efficiency, and preserving soil structure through reduced tillage. It is a method recommended in the lowlands and landscape depressions (*Marab*) that receive additional amounts of rainwater from runoff because the extra soil moisture improves seedling emergence and establishment. Furthermore, under intensifying climate change and increasing soil degradation rates, direct seeding without disturbing the soil (no-tillage) is becoming more appealing. Such practice helps the soil retain moisture and maintain more organisms that break down organic matter into vital nutrients, increasing the potential for nutrient recycling, leading to healthy soil.

BACKGROUND

Rangeland degradation resulting from unsustainable human activities and climate change is a serious threat to natural resources in arid and semi-arid areas. Changes in rangelands use, and management practices are urgently required to slow down and even reverse degradation.

There are several solutions available to tackle rangeland degradation. One of the most rapid and cost-effective options is direct seeding, which involves sowing seeds directly into their final growing location rather than transplanting seedlings nurtured elsewhere.

Due to the low cost of direct seeding, large-scale degraded rangeland in many areas of the world can benefit from this practice. In choosing whether to restore rangelands with native or exotic species, we must choose suitable species based on their responses to specific site characteristics for the restoration project's success.

Improving the impact of direct seeding

The limit on the success of direct seeding in drylands is due to drought, soil surface crusting and compaction, slow permeability, low available water capacity, and seed mortality due to heat and predation by birds or insects. Direct seeding is feasible on drylands if well-adapted species and recommended seeding methods are used. Outcomes can be improved through better site selection and ground preparation through drilling and pitting seeds to enhance germination and survival. Drills and pits can be created by hand or machine, and they contribute to protecting the seeds and improving moisture capture in arid areas.

Choosing species for direct seeding

Choosing seed species depends on the restoration's objective and the biophysical and socio-economic condition of the target site and its community. In general, plants that grow naturally in the same habitat have the greatest chance of success. Exotic species such as fodder shrubs may also perform well under direct seeding once their ecological demands in the target site are met.

Enhancing seedling emergence & establishment

Seed pretreatment methods such as mechanical and chemical scarification or soaking seeds in hot water can also improve direct seeding efficiency by breaking dormancy and overcoming field stress factors. Seed pretreatment also speeds up seedling emergence and enhances seed survival. Sowing at the right time and the proper depth is critical to the success of direct seeding.



Rangeland rehabilitation using direct seeding: perennial ryegrass (*Lolium perenne*) in Central Tunisia (left) and Mediterranean saltwort (*Salsola vermiculata*) in the Syrian Badia (right)

Methods of direct seeding

Given the nature of rangeland landscapes, the most common method of direct seeding is **hand broadcasting** - sprinkling the seeds by hand. It is the easiest and cheapest method, requiring less labor compared to seedling transplantation. In most cases, this intervention is usually combined first with seedbed preparation through light soil surface scarification. After broadcasting, the seeds should be covered to protect against birds and other predators.

Another direct seeding technique is **drilling** - dropping seeds at a fixed depth and covering them with soil. In this method, sowing tools are used for placing the seeds into the soil. Several options are available, such as mechanical seed drillers and pitting machines. The latter is towed by an ordinary two-wheel-drive pickup making it popular and achievable with small scale farmers. Small shallow 'pits' are scooped out by the action of inclined metal disks just before the rainy season. Seeds are placed in each pit either by hand or through a seed hopper mounted on top of the pitting machine. Seeds that germinate in the pits find favorable conditions for emergence and growth.



Mechanical seed drillers, rangeland improvement project, Kairouan – Tunisia

Advantages of direct seeding

- Rapid and cost-effective method for large-scale restoration of degraded rangeland
- Seeds are easier and cheaper to transport and store than seedlings
- Large areas can be covered with direct seeding because of its relatively low transport costs, while storage of seed is straightforward and cheaper than for seedlings
- Requires less time and labor than transplanting
- Plants develop deep, robust root systems that allow them to establish themselves quickly to withstand drought and wind, unlike transplanted seedlings
- Timing of seeding is more flexible depending on species, seed treatments, and rainy season

R4D INITIATIVES

Along mountain slopes or where plowing and harrowing are difficult, **dibbling** is usually practiced. Dibbling entails making small holes in the ground for seeds using a pointed stick or a long piece of wood, then dropping seeds into the holes and covering them with soil, all by hand.

A new approach in direct seeding is planting pellets stuffed with combinations of fertilizer nutrients and pesticides to enhance the establishment of vegetation cover by aerial seeding in semi-arid regions. The seeds are coated with materials that will not disintegrate when in contact with moisture on the soil surface, and the pellets absorb enough moisture to cause germination through the coat. Another potential solution to land degradation is the use of biodegradable materials such as geotextiles that hold moisture, allowing seeds to germinate and establish roots even during low rainfall. This method can also control erosion and sediment.

For remote and inaccessible sites, **aerial sowing** is an option. It is often used to spread seeds to large land areas that need vegetative cover after severe degradation that has depleted the soil seed bank.

Advantages of direct seeding

- Able to access rough and distant terrains through aerial seeding
- Promotes vegetative growth in less accessible areas, such as hillsides, rocky, and uneven terrain (Though more success can be achieved in lowlands)
- Better root growth in preparation for harsh conditions such as drought or overgrazing
- A higher level of seed germination in the years following the original sowing (depending on biophysical conditions).



Precision aerial seeding using drone to combat rangeland degradation



Direct seeding using pitting machine, Aleppo – Syria



Seedlings emergence in pits of Mediterranean saltwort (*Salsola vermiculata*), Aleppo – Syria

Effective establishment and maintenance:

- Selection of suitable sites and appropriate pre-sowing treatments is vital for successful direct seeding
- Always assess remnant vegetation, soil, risks, and opportunities along with the purpose of the revegetation
- A mixture of seeds (including shrubs and herbaceous species) can be sown simultaneously to increase the chance of at least one species establishing even in case of prolonged drought
- Sowing at the right time, generally at the beginning of the rainy season to ensure optimum soil moisture, increases success
- Sowing at the right depth for species seed size is vital to root establishment
- The sowing rate should be based on seed viability (not total seed) and adjusted density compared to the original and reference rangeland ecosystem. This ensures adequate seeding rates are met in case the seed germination rate was low.
- For successful root establishment, seed quality should be checked first to estimate proper seeding density
- Certain species require pretreatment to break seed dormancy (mechanical or chemical treatment)
- If the seeds are too small, mixing them with sand makes a bulky mixture easier to handle
- Respect plant association and try to balance species composition accordingly to avoid plant competition over limited resources
- A high seeding rate increases overall seedling emergence and establishment
- Avoid incorporating the seed too deeply, especially in heavy soils (clay) or where soil surface sealing is a problem as the plants are less likely to establish themselves.



Restored rangeland site, Almaty – Kazakhstan

Citations

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SUMMARY

Direct seeding is a fast and cost-effective method to revive rangeland vegetation. It is also well suited for large-scale degraded environment, due to its reduced costs (no need for nursery and seedling transplantation). However, the micro-environment of the developing seedling is important. Therefore, selecting groups of species with similar habitat requirements in the establishment phase will improve species' establishment and increase restoration success. Timing of sowing should also be considered, as well as methods to enhance seed germination, such as seed pretreatment techniques and seeding depth.

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