Cover Cropping in California's Water-Scarce Environments: COVER CROPPING FOR LAND REPURPOSING

Why it Matters

With increasing variability in winter precipitation and groundwater pumping limits associated with the Sustainable Groundwater Management Act (SGMA), growers are actively pursuing ways to reduce groundwater use by transitioning farmland to alternative uses: an estimated 0.5 to 1 million acres of agricultural land will come out of production due to water limitations (Hanak et al., 2019). While some lands will be repurposed permanently, other acreage will be temporarily fallowed—left unplanted, unirrigated, and possibly even disced to prevent vegetation establishment—for shorter durations.

As land management shifts, new questions are emerging about how to mitigate unintended consequences of land fallowing, and even improve land quality and water capture during prolonged periods of rest. This fact sheet outlines considerations for alternative vegetative cover while achieving repurposing objectives.

Leave the land bare or plant vegetation?

Fallowed and abandoned land can pose environmental and public health risks and create pest issues. Bare soils are vulnerable to loss via erosion by wind and water. Agricultural land is the leading dust source in California (Adebiyi et al., 2025), contributing to poor air quality, reduced visibility, and rising risks of respiratory and cardiovascular disease and illness, including Valley Fever (Howard et al., 2024). Bare fallowed land can also create 'fallowed heat islands' that retain heat, elevate land surface temperatures, and increase water demand in adjacent croplands (Kibria et al., in review; Adebiyi et al., 2025). Fallowed lands also risk becoming areas of invasive weed and pest proliferation.

In contrast, maintaining vegetative cover, such as cover crops, hedgerows, vegetative buffers, or permanent native vegetation, can mitigate many negative impacts associated with fallowing. Vegetative cover protects soils by

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reducing runoff and erosion (Taylor et al., 2024), improves soil health (Ghimire et al., 2018; Tautges et al., 2019), increases water infiltration (Chen & Weil, 2010), and builds soil organic matter (Aguilera et al., 2013; Garba et al., 2024; Liu et al., 2005). Native perennial vegetation, in particular, can provide broader ecosystem benefits by supporting habitat, increasing local biodiversity (Demeter et al., 2021), and reducing local flood risk (Demeter et al., 2021).

Define Your Goals

Vegetation choices during repurposing should be guided by what you want the land to do–both now and into the future. Different vegetation decisions support different outcomes. For many growers, priorities may include limiting weeds, managing pests, or increasing populations of beneficial insects and pollinators. Others may be focused on soil and land improvements such as soil health and structure, increasing soil organic matter, improving water infiltration, or reducing dust, runoff, and erosion. Additional goals may include transitioning to new land uses, such as establishing rangeland, planting alternative low-water crops, restoring native habitat, or developing additional uses such as solar development or groundwater recharge basins.

Repurposing with vegetation

Long- or Short-Term Cover Cropping

Best for:

In annual production systems or where perennial or permanent crops have been removed, cover crops or conservation cover (i.e., permanent perennial vegetative cover) can be planted during fallow periods ranging from a single winter season to multiple years.

Strategies for Best Use:

Winter is the optimal time for cover cropping, as cover crops capture winter rainfall, protect soils from erosion, and require minimal irrigation. Cover crops also take up residual soil nutrients, such as nitrogen, that might otherwise leach to the groundwater.

Once established, perennial species provide a relatively lower maintenance option for longer-term cover.

With annual cover crops, seasonal management may be needed to achieve optimal benefits. Leaving cover crop residue on the soil surface—by crimping, mowing, or undercutting—can act as mulch, helping conserve soil moisture. If reseeding is a priority, select reseeding varieties and allow plants to develop mature seed heads before termination. Some growers may instead choose to terminate early and disk cover crop biomass when they replant annually, which is recommended for non-native varieties.

Clear management goals should guide species selection. For example, incorporating native species can provide forage for native pollinators and beneficial insects. Using a diverse cover crop mix can also act as an insurance strategy, as different species vary in their tolerance to soil and weather conditions.

Advantages:

- Protects soils from erosion
- Flexible option for short- to longer term land repurposing
- Supports native biodiversity and pollinator populations

Dryland Agricultural Crops

Best for:

Interest is returning for the practice of dryland (or ‘rainfed’) farming, a practice in which crops rely on precipitation with minimal supplemental irrigation. Transitioning from water-intensive crops to low-water or dryland crops can significantly reduce water use while maintaining production on marginal working lands (Peterson et al. 2022).

Depending on location, this strategy may be used when the land is dry (summer and fall) or during the rainy season (winter and spring). In California, dry-farmed crops include grains and beardless cereals, such as sorghum, barley, and wheat, which offer market flexibility as forage, silage, bale, or grain depending on weather conditions. Dryland forage mixes, including barley and vetch, provide additional marketing opportunities. Emerging markets are also creating new opportunities for low-water crops, such as agave or grazing crops like clover, that require substantially less water.

Strategies for Best Use:

Dryland crops can be managed to provide additional benefits across seasons. Rotating dryland crops with cover crops may further increase soil fertility, improving soil health and structure. Conservation approaches such as using no-till or reduced tillage can further benefit soils and reduce water losses.

General Advantages:

- Keeps working lands in production
- Adaptable to year-to-year variability in water
- Compatible with crop rotation, cover cropping, or a combination of approaches

Considerations:

The success of dry farming may vary by region and depend on climate and weather patterns. Because crops depend more on rainfall, dryland crops are more sensitive to year-to-year precipitation variability than irrigated systems.

Grazing Rangeland

Best for:

Restoring previously cultivated land to rangeland can be a beneficial way to repurpose irrigated agricultural lands while maintaining working landscapes. The reintroduction of rangeland for grazing will be most suited to areas that were historically oak savanna or Grassland across the Central Valley.

Relative to fallowing, establishing native grasses and forbs has the potential to contribute significantly to carbon sequestration, water capture, resilience to flood, pollinator and wildlife habitat, and soil health and structure, while maintaining agricultural productivity. Additionally, native grassland species are more beneficial than invasive[1] annual grasses in terms of soil and ecosystem benefits, providing diverse grazing windows and reducing fire risks.

Strategies for Best Use:

Adding riparian buffers along stream channels in rangeland areas significantly reduces nutrient and sediment runoff to water bodies. Riparian buffers, hedgerows, and other natural exclusion options can also be used to create a natural barrier to replace or reinforce fences, keeping cattle from sensitive habitat areas while further supporting pollinator and wildlife habitat.

Native rangeland may require some supplemental water to establish. However, after plants are established, little to no irrigation is required in subsequent years. As an alternative to land fallowing, rangeland development may be more suitable for extended periods, as grassland establishment may take several years before the landscape is robust enough to support the maximum expected grazing capacity.

General Advantages:

- Keeps working lands in production
- Resilient to variable inter-annual water availability
- Supports native biodiversity and pollinators
- Can be adapted to different livestock options and can facilitate future land use alternatives

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1. Invasive species and non-native species are not used interchangeably in this document. Invasive species are non-native species that have been identified by the California Invasive Plant Council (Cal-IPC) as species that, "once introduced, establish, quickly reproduce and spread, and cause harm to the environment, economy, or human health" (https://www.cal-ipc.org/plants/impact/). Non-native species are species that are not native to California and have been introduced to the state, but do not pose the same risks to the environment at this time.

Species Selection:

Construct a community, prioritizing native plant species. California native grassland species should be prioritized to the maximum extent possible. Native species are adapted to the regional climate and interannual precipitation variability, especially within established native plant communities. However, native grasses and forbs may be more challenging to acquire or may create challenges if invasive species are allowed to outcompete native species before they can establish. Timing is also important: most native species should be planted in the fall to ensure root development through spring and reduce water needs in the summer.

Establishing rangeland requires a diverse plant palette, but seeding should be done in a staggered way to prevent competition during establishment. Consider seeding over multiple years, prioritizing seeding annual grasses and forbs in year one, and seeding perennial grasses and forbs in years two and three.

If a project cannot access enough native species, non-native alternatives should be considered, but integrated sparingly. Aggressively invasive species, such as Wild Oat (Avena fatua), Soft Brome (Bromus hordeaceus), Ripgut Brome (Bromus diandrus), and Foxtail Barley (Hordeum jubatum), should be avoided. Some native species, such as Lupine species, are also not suitable for livestock grazing due to toxicity to grazing animals.

Here, we provide a non-exhaustive list of native grasses and forbs that may be cultivated as a community to support multiple objectives with rangeland establishment[2]. Consider selecting a mix with at least five grasses and seven forbs, but more diversity is preferred.

Grasses:

- Alkali Sacaton (*Sporobolus airoides*)
- Blue Wild Rye (*Elymus glaucus*)
- California Melicgrass (*Melica californica*)
- Creeping Wild Rye (*Elymus triticoides*)
- June grass (*Koeleria macrantha*)
- Nodding Needlegrass (*Stipa cernua*)
- One-sided Bluegrass (*Poa secunda*)
- Purple Needlegrass (*Stipa pulchra*)
- Small-flowered Melic (*Melica imperfecta*)

Forbs:

- Baby Blue Eyes (*Nemophila menziesii*)[3]
- Blow-wives (*Achyrachaena mollis*)
- Bird's-Eye Gilia (*Gilia tricolor*)
- California Bluebell (*Phacelia campanularia*)[2,3]
- California Five-Spot Flower (*Nemophila maculata*)[2,3]
- California Goldfields (*Lasthenia californica*)
- California Poppy (*Eschscholzia californica*)
- Checker Bloom (*Sidalcea malviflora*)
- Chinese Houses (*Collinsia heterophylla*)[2,3]
- Common Tidy Tips (*Layia platyglossa*)
- Common Yarrow (*Achillea millefolium*)
- Dwarf Checkerbloom (*Sidalcea sparsifolia*)
- Ferris' Goldfield (*Lasthenia ferrisiae*)
- Foothill needlegrass (*Nassella* or *Stipa lepida*)
- Foothill (or Tufted) Poppy (*Eschscholzia caespitosa*)
- Lacy (or Tansy) Phacelia (*Phacelia tanacetifolia*)[2,3]
- Lupine species (*Lupinus formosus var. formosus, L. bicolor, L. densiflorus, L. microcarpus* var. *microcarpus, L. nanus*, and *L. succulentus* are all native)
- Pincushionplant (*Navarretia intertexta*)
- Red Goosefoot (*Chenopodium rubrum*)
- Whitehead Navarretia (*Navarretia leucocephala*)
- Wild Licorice (*Glycyrrhiza lepidota*)

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2. See the UC SAREP Characteristics of California Native Species for Potential Use as Cover Crops resource (Link: https://airtable.com/app2EAEgp3KdfZcU2/shrL70b37fvwY4op9/tblgNA5wAhmlBfV8S)
3. Identified as a top species to support pollinators because of the ample nectar and resources made available to pollinators, especially near early flowering crops such as almonds (Cane, 2010)

Habitat Features and Restoration

Best for:

Habitat restoration or creation—whether across an entire site or in targeted areas—is a longer-term repurposing strategy for previously cultivated land. Even small habitat features can provide lasting benefits, including support for pollinators and beneficial insects, natural pest control, ambient cooling, improved air quality, wind buffering, and enhanced soil health and fertility. For example, one study found that with just five native wildflower species[4], **10 square yards of wildflower pasture could support enough pollinators to pollinate 3 acres of almond trees** (Cane, 2010).

Successful habitat restoration builds on existing or historic habitat features near the site. Selecting native plant species adapted to local climate conditions and site-specific microclimates improves establishment and persistence. Use a diverse native seed mix—ideally with a roughly 1:1 grass-to-forb ratio—to enhance ecological function and resilience.

Strategies for Best Use:

Habitat features can be integrated into nearly any land use type. A wide variety of habitat types may be incorporated within a single project, including riparian zones, wetlands, grasslands, oak savanna, foothill scrub, upland valley terraces, living fences, and general pollinator or bird-focused habitat. Examples include restoring native vegetation on rangelands, creating a wildlife corridor and beneficial insect habitat with native hedgerows, and riparian buffers along property boundaries or waterways. Other examples include bird and pollinator habitat incorporation around recharge ponds or basins. Appropriate habitat features depend on site conditions, proximity to other habitat and natural water features, among other things.

Unique Advantages:

- Provides habitat and wildlife corridors for native species
- May reduce pest control management costs on adjacent lands
- Improves air quality and provides local cooling benefits
- Enhances water quality through nutrient and sediment filtration
- Can be integrated into diverse projects to deliver multiple benefits

Vegetation under Solar Development

Best for:

Photovoltaic and agrivoltaic development provide opportunities to repurpose or diversify land use while supporting the transition to renewable energy. Vegetation can be integrated into solar projects in multiple ways, and research shows that solar installations can effectively coexist with certain crops, cover crops, livestock grazing, and native habitat.

Establishing and maintaining vegetative cover under solar arrays helps protect future agricultural potential by preventing topsoil loss, maintaining soil fertility, improving rainfall infiltration, supporting biodiversity, and reducing weeds and dust impacts on surrounding areas. In addition, solar panels can provide partial shade, which may improve soil moisture retention (Barron-Gafford et al., 2019), possibly reducing irrigation needs and even increasing yield efficiency in production systems. These benefits are increasingly important for growers and landowners facing groundwater constraints under drought and SGMA.

Strategies for Best Use:

Solar does not always require complete removal of existing crops. Agrivoltaics—placing solar

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4. Chinese houses (*C. heterophylla*), California five-spot (*N. maculata*), baby blue eyes (*N. menziesii*), lacy or tansy phacelia (*P. tanacetifolia*), and California bluebell (*P. campanularia*)

panels in fields adjacent to or within active cropping systems (i.e., tomato, peppers, grapes, etc.) either above or between crop rows—is an area of active research and piloting in California. This approach shows promise for keeping some lands in production while reducing water stress and irrigation demand through partial shading.

Property owners seeking to increase pollinator diversity for adjacent crops may want to establish native habitat within and around solar arrays. Research has found that native plant seed mixes can be established just as successfully beneath solar arrays as in open areas (McCall et al., 2024), and native plants may outcompete non-native weeds, lowering vegetation management costs.

For sites focused on native grassland or cover crop establishment, sheep grazing within solar arrays has proven effective for managing vegetation, reducing vegetation maintenance costs, and lowering wildfire risk associated with invasive weeds. Alternatively, simply seeding a cover crop between solar panel rows can be a low-maintenance option that provides the numerous benefits of vegetative cover.

General Advantages:

- Can diversify land use and provide multiple revenue streams
- Supports renewable energy transition
- May not require full removal of existing crops

Considerations:

Careful project design can maximize multiple benefits of vegetation. Solar panel height, orientation, and tilt, as well as other infrastructure modifications, should be selected with vegetation type, harvesting equipment access, and grazing compatibility in mind.

Restored grassland and seasonal wetland, planted primarily with grass-species-focused cover crops. Managed by CDFW in Merced County.

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Resources:

This report and other mentioned resources can be found at: https://linktr.ee/CoverCropGuidance

The Western Cover Crop Selection Tool can be used as a resource to select cover crops based on specific management goals, farm location, and establishment windows.

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Published May 2026

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Funding for this resource was made possible through support from the California Department of Food and Agriculture (CDFA). Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the CDFA or collaborative agencies.