UC CE Sustainable Conservation

GUIDANCE IN ESTABLISHING ON-FARM RECHARGE SITES FOR GROUNDWATER BASINS

On-farm recharge is the practice of taking surface water supplies that are more transient in availability and applying these waters to actively farmed lands for the purpose of recharging groundwater systems. The practice of on-farm recharge is particularly useful in agricultural areas that rely on groundwater to provide a significant portion of the annual crop water needs and is a tool to achieve sustainable groundwater levels over time.

This guide is intended to provide support to growers, agencies and policy makers who are considering developing a successful on-farm recharge management program including operational elements, while addressing regional water quality needs.

Is the Field Suitable for On-farm Recharge?

Several factors will determine the suitability and priority of a site for on-farm recharge including:

- Local groundwater conditions – Is the sub-basin considered a regional priority and is recharge therefore being considered for funding and regional support? Reviewing GSA basin management plans can be an important part of this process and provides perspective on local site relevance.
- Access to recharge water – Does the site being considered have the required water delivery infrastructure as well as a way to adequately distribute water on the site? Access to water via canals, open ditches and river systems is crucial to securing necessary volumes of recharge water.
- Site recharge capacity – The site's capacity to transfer water from the surface to the groundwater is highly variable and depends on local surface soil infiltration characteristics as well as the capacity of subsurface strata to transmit infiltrated water. One tool for evaluating recharge potential is the Soil Agricultural Groundwater Banking Index (SAGBI). SAGBI recharge scores are focused on the top 6 feet of soil. LandIQ® is a recent development based on SAGBI, but provides additional details about deeper soil horizons. Mapping resources can be found online at http://earthgenomevm.cloudapp.net/GRATViewer/
- Soil and water quality of site, groundwater and surface supply – Not only does on-farm recharge help to increase groundwater storage and water available for future pumping, typically surface water supplies are lower in salinity, nitrates and other potential drinking water contaminants. Sites having relatively low levels of these contaminant stored in the surface soil or that have a high site recharge capacity are most likely to have a beneficial impact on aquifer water quality.

- Overall site suitability – Sites with the best potential for success have a high need for groundwater replenishment, have the necessary infrastructure in place to deliver and uniformly spread large volumes of water and have the soil infiltration and subsurface strata characteristics capable of transporting and storing large water volumes during limited surface water access periods such as flood events.

Crop Suitability and On-farm Recharge

Not all crops are equally suited for on-farm recharge. Crop type together with the timing of recharge should be considered when evaluating site suitability and farm economics. Although there is a significant lack of research trial information available on the impacts of crop type to periodic flooding, some anecdotal information is available from growers and the research community who have experience with extended periods of field ponding.

Annual Crops – Perhaps the best way for a crop to cope with extended periods of flooding is to delay or decide not to plant a crop as in the case of annual crops. Many annual crops have the flexibility of being planted later in the year or can be planted to an alternative crop depending on the timing of available surface water. Prioritizing annual cropping systems for recharge eliminates the potential for yield and quality crop impacts that can affect permanent crops over multiple years thereby limiting farm economic risk exposure. Crops such as cotton, tomatoes and many melon varieties can be planted later in the season (April and beyond) often with little or no impact on yield and quality.

Permanent Crops – The physiologic and economic impacts of extended or intermittent ponding on permanent crops is poorly understood and complicated by site factors such as time of year, climatic condition, crop stage, crop age, site infiltration rate as well as other factors.

- Alfalfa – Numerous observations have shown considerable crop resilience to extended periods of flooding particularly when ponding occurs after the first year of establishment.
- Grape vines – Growers have noted that vines are less sensitive to extended periods of in- season ponding. Optimum timing for flooding is thought to occur prior to bud break, however early and post bud break periods also show crop resilience to flooding. Limit flooding during berry sizing period and avoid ponding on hot days. Little information is known about ponding in table grapes and practices should be considered separately from wine, juice and raisin production systems.
- Almonds – The limited information available on almonds suggests that extended periods of ponding should be avoided where possible. However, practices such as alternate row irrigation and limited duration ponding may be practical for these systems. Particular caution has been expressed by university scientists that point to the potential for multiyear yield impacts.
- Peaches, nectarines, plums – Rootstocks, bloom and leaf-out periods are similar to almonds; similar cautions and concerns over extended period flooding have been raised. Significant nutrient and crop physiology differences between almonds and the stone fruit are noteworthy. Stone fruit nitrogen demands are much lower than in almonds and varietal differences between stone fruits suggest late-season varieties may be more suitable to periodic winter flooding.

Practices That Improve Site Suitability

Growers do have some control over site suitability through the farming practices they implement. Alternate furrow, row or check irrigation can extend the period of field flooding while limiting or eliminating impacts to crop yield and crop quality. Where hardpans or contrasting soil layers are present within the plow zone, deep ripping or slip plow operations can dramatically improve soil infiltration characteristics. The use of cover crops can similarly increase soil infiltration rates and can have the added benefit of taking up residual soil nitrogen at the end of the season. Soil amendments including gypsum, acids and organic materials can have positive effects on infiltration depending on site soil and water chemistry.

Site Fertility Management

In an effort to limit the degradation of groundwater resources, numerous practices can be incorporated to improve the nitrogen use efficiency of a farming system and limit nitrating leaching below the root zone.

- Develop a nitrogen management plan each year to minimize the chance for over fertilization which can lead to higher residual (leachable) soil nitrate levels.
- Maintain high water application efficiencies that limit in-season movement of nitrates.
- Consider collecting post-harvest soil nitrate tests to confirm farm nitrogen use is in balance.
- Eliminate or limit pre-plant and pre-season applications of synthetic fertilizer.
- Limit the use of organic amendments. There is of particular concern when high rates are used during the fall and winter months over multiple years making winter leaching of nitrates likely.
- Delay the application of organic amendments including composts and manures.
- Follow University guidelines to evaluate the rates and timing of nitrogen fertilizers.
- Where feasible, incorporate the use of slow-release fertilizers and consider the use of nitrification and urease inhibitors.

Summary

California agriculture is rapidly undergoing a change in how surface and groundwater are managed. The passage of the Sustainable Groundwater Management Act has facilitated a new urgency aimed at implementing on-farm practices that help address the issue of long-term groundwater overdraft. Accessing expertise from local agronomists, water agencies and advisors as well as guidance from University of California crop, nutrient and irrigation management materials can help identify the potential benefits of on-farm recharge and evaluate regional priorities for specific site development.

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