



# Outdoor Hog Production

*Best Practices for Resource Conservation in the San Francisco Bay Area*

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University of California Cooperative Extension  
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# Outdoor Hog Production

## *Best Practices for Conservation in the San Francisco Bay Area*

### Introduction and Project Background

*By Susan Ellsworth and Silvana Pietrosevoli*

Sustainable hog production, as with all sustainable agriculture, requires knowledge of local climate, ecology and economic conditions. Therefore, the development of best management practices for truly ecological production relies on the adaptation of prevailing models to reflect local conditions. This guide contains a series of factsheets intended to support outdoor pork producers, resource managers and agricultural professionals in implementing resource conservation best management practices within the Greater San Francisco Bay Area and Northern San Joaquin Valley. For our purposes, outdoor hog production refers to range or pasture-based, dry lot, or other alternatives to conventional slatted floor systems.

#### Collaborators

Collaborators on this project include UC Cooperative Extension Livestock advisors, Resource Conservation Districts, and numerous hog producers from around the Greater San Francisco Bay, Northern San Joaquin and Southern Sacramento Valley. Technical expertise was provided by the Center for Environmental

Farming Systems at North Carolina State University.

To characterize alternative hog production systems in this region, collaborators visited fourteen operations in eleven counties, including Alameda, Contra Costa, Marin, Mendocino, Nevada, San Joaquin, San Mateo, Santa Clara, Sonoma, Stanislaus and Yolo Counties. These visits allowed collaborators to explore issues related to potential environmental impact, husbandry and overall production, thereby informing the development of this resource guidebook. All farms visited were characterized by high standards of animal health and welfare and a wide diversity of management approaches.

#### Climate and Ecology

The Bay Area and surrounding counties are characterized by a Mediterranean climate with the majority of precipitation falling between October and April, followed by little to no rain from May through September. Total rainfall varies from 15” in the East and South Bay (Livermore and San Jose) to almost 50” in the North Bay (Mill Valley and Healdsburg). Topography is varied, with rolling hills and valleys, wetlands and estuary, as well as the low lying Coast Range running northwest to southeast. The Coast Range, though modest in elevation (Mt. Diablo at 4261’), nevertheless prevents the ocean air from



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readily entering the Central Valley, resulting in a hotter, drier climate to the east and a moister, milder climate to west, with numerous “microclimates” throughout. Given the seasonality of precipitation, both perennial and intermittent streams are common and riparian areas are often the only green vegetation in late summer and fall. Along with topography and rainfall, soils are also highly variable, resulting in a range of forage types and availability throughout the study area. Within the valleys, foothills and grasslands that make up the majority of grazed rangeland, annual grasses and forbs dominate, often interspersed with oak and various woody shrubs. In other areas, larger stands of perennial grasslands are present, also mixed with oaks and other vegetation types. Improved, irrigated pasture is limited to some regions. Lack of rain during the dry season, combined with thin soils and sloping hillsides makes erosion a significant consideration, particularly on annual range.

### Economic Context

Hog production has declined significantly in California over the last 50 years. In the Greater Bay Area, the number of operations has dropped by approximately 90%. Yet, during that time human populations have grown, and in the last ten years, demand for locally-raised meat products has increased dramatically (Gwin et al, 2008). In particular, consumer interest in flavorful, hormone/antibiotic free, humanely raised products has created demand for pork that outstrips supply.

Recognizing the opportunity to serve this market demand, an increasing number of direct-market oriented producers are adding hogs to their farms and ranches, in many cases relying on outdoor or forage-based systems. Additionally, given the reproductive capacity, opportunities to vary market age and weight, and relatively short time from birth to market, hogs are an agricultural commodity that has proven viable for many beginning farmers and ranchers.

### Case Studies

In an effort to better understand the needs of producers in the area, collaborators visited 14 outdoor hog production sites from a wide range of

ecological niches characteristic of the study area, as well as from a diversity of production approaches. Detailed surveys were conducted at 10 of the 14 locations to better understand conservation and production challenges and successes.



Figure 1 : Map of Field Visits to Outdoor Hog Producers by County

Of the 10 operations surveyed, hog production sites ranged in size from 5 to 200 acres on both private and public land, with the majority (80%) operating as farrow to finish systems. The remaining 20% purchased weaned animals for finishing, with nearly all operations harvesting the animals and selling the meat products directly. Of the 10 sites surveyed, all but one operate primarily as outdoor swine units; eight based on natural vegetation, two on natural and established grasses, and the last utilizing a deep bedded system where animals are reared in open-ended hoop houses with ample bedding material. In many cases, those in permanent or semi-permanent enclosures experienced significant loss of vegetative ground cover.

In the majority of operations, animals were reared in groups with plenty of space and freedom to express

instinctive behaviors. Predominant breeds included Tamworth, Large Black, Berkshire, Duroc, Hampshire, Red Wattle, Old Spot Gloucester, Yorkshire and European wild boar.

In general, producers used portable shelters, feeders and drinkers to allow for rotation of areas under production, thereby reducing the potential for nutrient build up, soil impact, parasites and other animal health-related issues. Most operations provided their animals with hay or straw bedding which is composted after use and either reused in pasture and crop fields, or sold as soil amendment.

Drylot, pasture and range-based systems were utilized, as well as alternatives like deep-bedded systems, with the majority of farrowing and lactating areas under continuous use, often with permanent infrastructure. Pasture and range-based grazing was observed more frequently in weaner or finisher areas, though in several operations all aspects of production are under continuous use.

For most operations, vegetative ground cover was comprised of naturally occurring, primarily annual grasses, often resulting in bare ground under continuous use with high stocking rates. Several operations worked to establish forage species through seeding; one as part of an irrigated pasture rotation and the other relying on straw mulch for protection. Stocking density varied widely from less than 1 hog/acre on extensive rangeland to 250

hogs/0.25 acre in the deep bedded system.

Most operations utilize at least some alternative feeds, ranging from dairy products such as whey, milk, yogurt or ice cream to bakery and restaurant waste, culled vegetables and fruits, to brewers grain, and cereals. The use of alternative feed contributes significantly to reduced feed costs and to improved economic sustainability; for most alternative hog operations, feed is one of the largest production costs.

The majority of animals were sent to commercial slaughter facilities within the region with average market weights ranging from 220 to 300 lbs per animal. Farmers employ a variety of marketing strategies to sell their products, including direct marketing to consumers through CSAs and on-farm sales, farmers markets and pig share, restaurants, local butchers and in a few cases, auction.

### Opportunities to Improve Sustainability

Environmental impact in outdoor swine production systems is generally associated with natural behaviors such as rooting, trampling and selecting dunging areas. If poorly managed, such behavior is often correlated with damage to vegetation, soil disturbance and soil nutrient build up, which in turn can result in erosion, soil compaction, nutrient leaching, and increased nitrogen and phosphorus in watercourses (Menzi et al., 1998, Miao et al., 2004; Eriksen et al., 2006, Quintern and Sundrum, 2006).

All the operations visited during the study were well managed, demonstrating high levels of animal health and welfare. Nevertheless opportunities to improve resource management were also present, exacerbated in many cases by prolonged drought. The following is a list of management successes and challenges observed during case-study visits:

#### ***Resource Management Successes***

- Use of well-adapted breeds
- Portable shelters with bedding
- Portable feeders
- Seasonal management
- Use of alternative feed sources



Brewers grains mixed with milk and whey. Photo courtesy of Devil's Gulch Ranch.

## ***Resource Management Challenges***

- Bare ground
- Soil compaction
- Potential for excessive nutrients in soil and water
- Excessive wallows
- Lack of shade

Factsheets included within this guide are designed to address many of these resource management concerns and opportunities, by laying out best management practices adapted to the local climate, ecology and market conditions. Also included are recommended conservation practices as developed by the Natural Resources Conservation Service.

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Banner photo credit from L to R: Pigs on pasture. Photo courtesy of Root Down and Silvana Pietrosevoli.

# Outdoor Hog Production

Best Practices for Resource Conservation in the San Francisco Bay Area



## Introduction to Outdoor Hog Production

By Sheila Barry, Susan Ellsworth and Silvana Pietrosevoli

Approximately 99% of grower/finisher hogs produced in the United States today are reared in confined, indoor slatted-floor systems designed to maximize efficiency of weight gain, waste-management and treatment of potential health conditions. However, there is growing interest among consumers for meat products raised in less industrial environments, particularly outdoor, pastured, and in some cases, organic production systems, which are then sold in specialized niche markets. This factsheet will provide an overview of some of the most common outdoor and alternative hog production systems in California, and across the U.S., and provide background for other resources within this collection.

Depending on their production goals, hog production systems can be classified as farrow-to-wean, farrow-to-finish or grower operations. Farrowing is the process of a sow giving birth to a litter of pigs.

### Farrow-to-finish

In a farrow-to-finish system, producers specialize in all stages of growth and development from breeding and farrowing to growing the pigs to market weight

(230-300 lbs or more depending on the market).

### Farrow-to-wean

In this system, a producer specializes in breeding sows and then raising the pigs until they are weaned, between three and eight weeks, at which time they are sold to another producer for finishing.

### Grower/Finisher

A finishing operation typically buys weaner/feeder (pigs from weaning to 10 weeks of age) or growers (from 10 to 16 weeks) and grows them until they reach market weight (22-26 weeks of age).

For more information see the factsheet in this series on [Farrowing and Weaning Best Practices](#).

All of these operations can be adapted to alternative production systems which typically emphasize access

### Common Outdoor Hog Systems in the San Francisco Bay Area:

- Pasture & Rangeland Based
- Drylots
- Wood lots
- Deep Bedded Systems
- Integrated Cropping Systems



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to forage, outdoor areas, and the ability for hogs to demonstrate various instinctive social and natural behaviors such as establishing herd hierarchy, rooting, wallowing, and nesting.

The following are some of the most common outdoor and alternative hog production systems in northern California:

**Pasture & Rangeland Based:** In a pasture or rangeland-based system, hogs are raised on pasture (irrigated or improved) or rangeland (dryland), where the consistent presence of vegetative ground cover is a key element of the production system. Though hogs are not ruminants, they will graze as well as root and trample, so careful management is required to ensure the maintenance of ground cover. In such systems, animals generally need to be moved (rotated) to preserve forage and enable recovery of high use areas. They typically rely on portable shelter, feed and watering infrastructure as well as cross-fencing to create multiple paddocks. In some cases hogs may be included in a multi-species rotation, wherein different livestock species are cycled through the same pasture to more fully utilize feed and provide improved nutrient cycling. For more information see the factsheet in this series on [Rangeland and Pasture Management](#) and [Multi-Species Grazing](#).



Hogs in an orchard. Photo courtesy of Dinner Bell Farms.

**Drylot:** Drylot systems are typically permanent, with fixed fencing and higher stocking densities. Though feeders and waters may not be permanent, they often remain in the same



A deep bedded system. Photo courtesy of Long Ranch.

location and, due to overall high use, little to no ground cover remains. Sometimes referred to as “dirt lots”, these systems are often characterized by wallows as well as areas with high compaction, potentially posing erosion, nutrient or water quality concerns.

**Wood lots:** Wood lots are wooded or forested areas where hogs are able to forage for vegetation, grubs and acorns. Though rarely used for hog production in California, woodlots are an excellent environment for pigs, allowing them to exhibit their full range of natural behaviors including nesting in leaf debris. If properly managed, pigs can contribute to the management of these areas, particularly through trampling and browsing on undesirable species such as blackberry and poison oak. However, they still need to be rotated to avoid excessive soil disturbance or damage to tree roots or trunks. Wood lot systems are often characterized by electric fencing and portable feeders and troughs to ensure that one area isn’t impacted too heavily. See factsheet on [Pig Production in Oak Woodlands](#).

**Deep bedded systems:** Deep bedded systems involve the raising of hogs in semi-permanent, often hoop house type structures, with 12” or more of bedding. The depth of bedding enables the animals to select and modify their environment through rooting or nesting with less damage to soil or vegetation. Hoop barns are typically low-cost shelters with an arched steel pipe structure, wood walls (4-6 ft), and a stretched polypropylene roof. Though stocked at lower rates than conventional slatted floor systems,

hoop barns often have a significantly higher stocking rate than pastured hogs at approximately 13 ft<sup>2</sup>/ animal. The floor beneath the bedding can be of concrete or soil and bedding is periodically replaced, with older bedding removed and composted.

***Integrated cropping systems:*** Hogs can also be integrated into cropping systems such as vegetable or orchard crops whereby they are allowed to consume crop residue after harvest, simultaneously tilling the soil with their snouts, grazing on weeds and adding nutrients with their manure. Hogs can also be used to help till in cover crop prior to planting. It is important in such systems to allow enough time after a hog has been present in the field (at least 120 days before harvest) for manure to break down so as to mitigate food safety-related concerns.

Though some producers may utilize just one alternative production approach, many combine approaches to enable improved management of forage and soil or to rest areas by moving animals to designated sacrifice zones. Some operations may finish pigs in deep bedded systems, while others may allow their animals to forage in a woodlot for a short period of time during acorn season. A producer using an alternative production approach may also take advantage of other niche market opportunities like animal welfare certifications or heritage breeds.

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Banner photo credit: Pigs in pasture. Photo courtesy of Magruder Ranch.

# Outdoor Hog Production

## Best Practices for Resource Conservation in the San Francisco Bay Area



### Site Selection and Planning *By Sheila Barry, Susan Ellsworth and Silvana Pietrosevoli*

Deciding where to locate an outdoor swine operation is one of the most important early considerations for any producer. Appropriate site selection will lay the groundwork for a successful business while minimizing environmental impacts, ensuring animal welfare and minimizing conflict with neighbors.

The following is a list of key considerations for choosing your outdoor hog production location:



**General location considerations:** When locating your operation, you’ll want to consider a number of general factors such as access to processing, local zoning, general social acceptance and access to markets. In California, many markets are centered in more densely populated urban areas some distance from agricultural land. Access to feed resources is also important, particularly if you’re planning to utilize alternative feeds like whey, brewer’s grains or other by-products.

**Size:** It is critical that a producer consider the size of operation he or she will ultimately manage and ensure that a particular site can accommodate the total number of animals desired without damaging natural resources. The area required per animal will vary considerably depending on site characteristics and management, however the stocking densities provided in Table 1 can be used as a guide.<sup>1</sup>

Irrigated Pasture	Growers/Finishers	15-30 head/acre
	Sows + Litters	4-6 head/acre
Rangeland	Growers/Finishers	4-10 head/acre
	Sows + Litters	0.5-1 head/acre

Table 1. Stocking densities for outdoor hog operations



**Soil:** Selecting a site with appropriate soil is a key consideration both because of its relationship to forage quantity and quality as well as drainage and erosion potential. Soils should be well-draining in order to minimize plugging or waterlogging, which in turn can result in erosion, run-off or compaction, not to mention management difficulties related to mud. Highly erodible soil should be avoided, particularly for high-use areas – visit [web soil survey](#) or talk to your

<sup>1</sup> Proposed stocking densities are recommendations only and derived from observation of outdoor hog systems in California, Texas, North Carolina and Europe

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local [Resource Conservation District \(RCD\)](#) to determine if this will be an issue in your area. Alternatively, sandy soils or those with shallow ground water should be avoided due to nutrient leaching potential. Because drylots may have limited vegetative cover, locate them on sites with less than 5% slopes to minimize erosion. As with all agricultural production, sites should also be evaluated for flood risk. Hogs have a tendency to follow the same path between shelters, feeders, drinkers and fencelines, so consider overall site layout and potential erosion and compaction from trails. Stony, flinty or rocky soils may pose a risk to hog's hooves and legs and should be avoided if possible.



**Neighbors:** Even the most well-managed outdoor swine operations have the potential to generate odors, noise and dust, so it is critical to consider your neighbors and ensure that your site has a sufficient buffer to minimize these impacts. This buffer may take the form of vegetation such as a hedgerow or line of trees, topography, or man-made infrastructure such as a large fence or highway barrier. In some cases, simply ensuring enough distance between the production site and a neighbor may sufficiently mitigate these issues. Vegetative buffers such as trees or shrubs have the added value of providing habitat for insects, birds and other wildlife, while creating shade, bedding and potential food sources for livestock. In some cases, vegetative filters may also help capture and utilize run-off before it leaves the site. See factsheet on [Riparian and Wetland Management](#) for more details on filter and buffer. If an appropriate vegetative buffer does not exist, consider establishing one as an early site modification and talk to your local [Natural Resources Conservation Service \(NRCS\)](#) office for guidance.



**Sensitive habitat:** Consider proximity to sensitive habitat such as riparian areas, waterways, rare plant communities or habitat for special status wildlife. Contact your local RCD or NRCS to determine what sensitive species might be present in your area.

**Other Swine Operations:** Similarly, you'll want to make sure that you aren't located too close to another hog operation as a means of preventing the spread of disease. Generally, 1.5-2 miles is considered sufficient provided appropriate bio-security measures are taken (Levis et al, 2011).

**Key concepts:** Location matters! When you are deciding on a site for your outdoor hog operation, the following are some essential things to consider:

1) access to markets and feed resources, 2) size of the operation, 3) soil quality, 4) proximity to neighbors and how they'll feel about hogs, 5) any environmentally sensitive areas nearby and 6) whether there are biosecurity risks associated with neighboring swine operations.

Climate is another critical factor to consider in choosing a location for your swine operation. Temperature and precipitation stand to impact both animal health as well as the environment within and immediately adjacent to the production site.

**Temperature:** Hogs can adapt to varied temperatures, but generally tolerate cold weather better than hot. In Northern California where summer temperatures routinely reach triple digits, hogs should be managed early in the morning or in the evening to reduce heat stress and should have access to drinking water at all times. Water demand will increase at hot times of year and care should be taken to ensure that drinking water does not get too hot, or that pipes don't freeze in winter.



**Rainfall:** Whether you are a pasture or drylot-based operation, it's critical to understand how much precipitation to expect at a given site. Sufficient rainfall is particularly important for rangeland-managed hogs, to ensure sufficient forage and ground cover. In light of California's Mediterranean climate and low precipitation averages, low stocking rates will generally be required to limit the impact of hogs on the soil and vegetation. In areas prone to large rain events, consider the erosion potential of a drylot or a pasture with degraded cover and how it might impact adjacent waterways, sensitive habitat or neighbors.

**Shade and Shelter:** Ensuring sufficient shade is essential for keeping hogs cool and minimizing sunburn, to which hogs may be prone if they are not allowed to wallow. In selecting your production site, make note of what areas have natural shade and at what times of day. If natural shade is not available, shade structures may need to be provided. Hogs will also need free access to clean, dry shelter in the case of wind, rain, heat and cold.

**Wind:** While air movement can help keep hogs cool during hot summer months, locations with persistent or frequent strong winds should be avoided. Wind not only dries out pasture more rapidly, but contributes to erosion and transports odors.

**Feeders/Drinkers:** Protect high use areas, such as around drinkers, feeders, sprinklers and shelters to minimize impacts to soil and the creation of wallows. Consider installing feeders or drinkers on a cement



slab or perforated sheets made of wood, plastic or rubber. Do not locate feeders or drinkers in the vicinity of watercourses.

**Wallows:** While wallows enable hogs to cool off and minimize sunburn, they typically lead to significant erosion and or compaction damage that may take years to recover. Providing shade or access to sprinkler systems are better alternatives that will minimize ecological damage as well as supporting animal welfare. Hogs will create wallows from any water or food source they can, such as nipples or slop buckets so be conscious in designing your site of this potential. Some producers use nose rings to minimize a hog's interest in rooting which contributes to the creation of wallows, though this practice is somewhat controversial as rooting and wallowing are both considered instinctive behaviors.

**Predators:** Understanding what wildlife may be present in and around a potential production site is another important consideration. In particular, the potential for predators should be assessed. Predators are primarily a concern for newborn or young pigs and can include foxes, coyotes, feral dogs, and in some cases eagles or crows. While predators are rarely an issue for larger hogs, an attack may cause them to break out of paddocks. Inquire with neighbors or other livestock producers in the area as to the presence of predators. Appropriate housing, exclusion fencing and guard animals will also minimize predation.



**Feral hogs:** Feral hogs are a growing issue in California and are now present in 56 of 58 counties. The major danger is the introduction of diseases, and the potential for feral hogs to mate with outdoor kept sows. Make note of whether feral hogs are present in your area and take appropriate exclusionary measures if they are present. See factsheet in this series on [Managing Wild Pigs](#) for more information.

## Key Concepts: Understand the climate and local ecology

Temperature, wind and rainfall will affect not only the health of your hogs, but will also your ability to manage their impact on natural resources. Climate and geography will also help you understand predator risks or the need to safeguard against feral hogs.

Before bringing animals onto the production location, it is important to create a site plan that takes into account the number of animals you plan to raise and their management needs as well as natural resource considerations both on and adjacent to the site.

It is generally recommended to manage groups of animals according to their age, sex and physiological status. In particular, you will want to consider where each of the following types of animals will be housed and how this will integrate into a larger management plan:

- Boars
- Gestating and dry sows, gilts
- Lactating sows and litters
- Weaners to growers
- Growers to finishers

If you will need a quarantine paddock, herd handling or sorting facility, consider where this infrastructure will be located and how roads and paths will work to promote easy and stress-free movement of animals. As a means of minimizing damage to soil and vegetation, fences should be laid on the contour when possible.



Farrowing area for sows. Photo courtesy of Hidden Villa

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*Photo credits from top to bottom; Pg 1: banner photo courtesy of Holm Ranch and Pasture 42; farmers market meat courtesy of Cliff1066; soil courtesy of NRCS; Pg 2: Pig sign courtesy of Skott Reader; stream photo courtesy of Alameda RCD; Pg 3: rain gauge courtesy of woodleywonderworks; hog shelter courtesy of Magruder Ranch; waterer on cement courtesy of Silvana Pietrosevoli; hog in wallow courtesy of Silvana Pietrosevoli.*

# Outdoor Hog Production

Best Practices for Resource Conservation in the San Francisco Bay Area



## Rangeland and Pasture Management

By Morgan Doran, Stephanie Larson, Sheila Barry and Silvana Pietrosevoli

### Pasture and Rangeland in California

Forage from rangelands and pastures is the primary, and sometimes only, feed source for beef cattle, sheep and goats, and can be a significant feed source for outdoor-raised hogs. Rangelands are comprised of non-irrigated and non-cultivated grasslands, woodlands and shrublands and provide many important ecosystem services for society, such as: forage for livestock, wildlife habitat, water storage and release, water filtration, recreation and beautiful views to name a few. Pastures are irrigated forage crop systems typically harvested by grazing animals and are located on higher quality soils where irrigation water is available. Pastures are normally seeded with warm or cool-season perennial grasses and clovers and are much less diverse, but more productive than rangelands. While both rangelands and pastures are forage production systems, management of one system is quite different from the other.

Rangelands in the Bay Area and surrounding counties are generally low in productivity, yielding 2,000 to 4,000 pounds forage/acre/year, but have a

very diverse mix of annual and perennial plant species. The vegetative growth cycle begins with fall rains and continues through the winter and spring months as long as there is adequate precipitation. By late-spring, herbaceous plants generally release their seed and die or enter dormancy during the summer months. Grazing is typically seasonal to coincide with the forage growth cycle and



Pigs on perennial pasture. Photo courtesy of Magruder Ranch.

rangelands are generally extensively grazed (low stock density and long grazing duration). High-density, short-duration grazing can occur on rangelands, but is only effective when forage is growing rapidly, typically from February through April.



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**Pastures** are more similar to cropland than rangeland and can produce between 6,000 and 9,000 pounds forage/acre/year. Grazing on irrigated pastures generally occurs from April or May through October or November, but longer grazing periods and an occasional hay harvest are not unusual. The long growing season and high productivity of irrigated pastures makes them well suited for high-density, short-duration grazing, which is much more intensive than grazing on rangelands. Establishing irrigated pasture requires a high initial investment, but once established it will be productive for many years.

Both rangelands and pastures are important forage resources for livestock producers, but their value and productivity can be greatly compromised from poor management. The propensity for hogs to root and create wallows in wet areas obligates the outdoor hog producer to carefully monitor and manage hog grazing to minimize undesirable impacts.

### **Managing Hogs on Pasture and Range**

Maintaining sufficient vegetative ground cover on rangelands or pastures is beneficial for hogs and for the environment in an outdoor hog production system. In the San Francisco Bay Area and surrounding counties, the climate makes it especially challenging to maintain ground cover year around. The area's wet winters and spring months with good forage conditions are typically followed by hot and dry summer months with no forage growth. Extra planning is required to minimize unfavorable livestock impacts, such as the deterioration of

Environmental risks of high-use areas include:

- Increased soil compaction which reduces water infiltration and soil productivity
- Increased overland water flow during rain events that transport soil and fecal material offsite
- Soil losses due to erosion
- Downstream water quality impairments from soil and fecal material, and
- Weed infestations.

ground cover, excessive soil disturbance, and nutrient loading that may lead to soil and water pollution and weed infestations.

Even with good planning, maintaining cover in high use areas is difficult. In outdoor hog production systems, bare soil is common where hogs congregate, for instance around feed and water sources, farrowing pens or pastures, traffic corridors and lounging areas.



Pigs consuming corn. Photo courtesy of Pasture 42.

### **Understanding the Role of Forage in Outdoor Hog Operations**

A range or pasture-based hog operation must take into account the nutritional needs of the hog while maintaining the health of the pasture or range ecosystem.

#### ***Nutritional Needs***

Hogs have a monogastric digestive system, much like a human's, which is very good at digesting sugars, starch and proteins, but cannot digest fiber, except for very minimal hindgut fermentation. In contrast, cattle and sheep have a stomach compartment called the rumen, where billions of microbes ferment (digest) fiber into chemical compounds that can be utilized as nutrients. In any species of animal, the type of digestive system determines the type of diet. For cattle and sheep, the diet is primarily high-fiber forages, but for hogs the appropriate diet consist of feeds with high levels of easily digestible nutrients containing low fiber content. A pasture pork operation must grow forages that can be



utilized by hogs. Appropriate forages for hogs include legumes, such as alfalfa and clovers, root vegetables (tops and roots), young and tender grasses and grain-bearing crops. In an integrated livestock and cropping system, corn can be grown for this purpose and harvested by swine after the grain is fully developed.

Sows will have their highest nutrient demand at the onset of farrowing and during lactation. This demand is best satisfied with a grain-based ration supplemented with high quality forages. The amount of grain-based feed consumed will vary with nutrient demand, quality of forage and amount of feed offered. Keep in mind that gestating sows should not be overfed and allowed to become too fat.

Nutritional requirements of outdoor hogs are generally 15% higher than those of confined hogs to compensate for the additional energy needed to search for food and to maintain body temperature. Hogs might also graze on other forages, such as acorns, which can provide additional energy in their diet.

Food by-products and grocery wastes, such as outdated bread or tortillas, milk whey and bakery waste are commonly used by Bay Area hog producers and can help reduce the need of grain-based feeds. While by-products and food wastes are good grain alternatives, they should not supply a large fraction of the total diet since their nutrient value, and quality may vary considerably. Beware of food scraps from restaurants that can consist of all types of meats, vegetables, fats and carbohydrates.

**Grazing System Design**

A successful grazing system in California’s Mediterranean climate requires adaptation to the unique resources of the farm including soil, terrain, forage mix and animal type. Management will need to be flexible, practical and simple to carry out, while allowing the producer to reach his or her production and conservation goals. To begin, establish your goals

and conduct a resource inventory including forage resources (rangeland and pasture), trees, barns, groups of animals, soil, topography and water sources. A ranch map can be very useful in planning resource utilization and management. Your grazing system will need to match resource availability with animal needs, while adjusting stocking rates for forage, soil and climate conditions.



Brewers grain mixed with whey. Photo courtesy of Devil’s Gulch Ranch.

***Grazing hogs***

Grazing guidelines for hogs in the greater Bay Area region are not well established and will vary greatly between rangeland and pasture forage production systems. In either case forage height and ground cover should be monitored regularly so that hogs can be rotated through paddocks before damage to vegetation and soil occurs. Determining an appropriate stocking density (hogs/acre) and stocking rate (hogs/acre/year) is difficult due to variable precipitation and forage growth within the year and year-to-year. Stocking densities provided in Table 1 can serve as approximate starting points in stocking rangeland and pasture systems with hogs, but

Forage System	Type of Hog	Hogs/Acre
Irrigated Pasture	Growers/Finishers	15-30 head/acre
	Sows + Litters	4-6 head/acre
Rangeland	Growers/Finishers	4-10 head/acre
	Sows + Litters	0.5-1 head/acre

Table 1: Stocking densities for outdoor hog systems

adjustments will be needed as forage supply changes and local experience is gained.

In irrigated pastures, water should only be applied after hogs are removed, and future grazing should be postponed until forages have recovered to 4-8" and the ground is no longer wet. On both rangeland and pastures, grazing when the soil is saturated should be avoided to prevent adverse impacts on forage and soil and the formation of wallows. In rangelands, grazing should be planned to minimize bare ground and maintain adequate Residual Dry Matter (RDM) to protect soil from erosion and positively influence forage growth and composition during the following growing season. RDM is a very useful management tool and there are helpful guides to understand RDM and implement an RDM monitoring program such as ([Bartolome et al., 2006](#); [Guenther, K., 2008](#)), as well as a companion video that can be viewed [online](#).

Understanding animal behavior will also help minimize grazing impacts. Hogs are social animals and tend to concentrate their activities in small areas with high impact. In general, groups of 15-20 are easier to manage than bigger groups and mixing pigs

from different groups may lead to fights as the animals establish new hierarchies. For these reasons and in light of their foraging behavior, a rotational and/or strip grazing system may allow for better utilization of forage while providing rest between grazing periods. This may include the use of narrow lanes or alleys to move animals among paddocks or sections of the farm.

### Fencing

The use of temporary, electrical fences in different configurations can help determine appropriate fencing and rotational patterns before permanent or semi-permanent fences are constructed. In some cases, establishing permanent perimeter fences may prove most convenient, with temporary or semi-permanent cross-fencing to facilitate rotation between paddocks. Fences must follow the lay of the land and landscape features, taking into consideration the need for buffer strips when in the vicinity of water courses or other sensitive areas. See factsheet on [Riparian and Wetland Management](#).

Figure 1 demonstrates several different grazing systems for outdoor hog production.

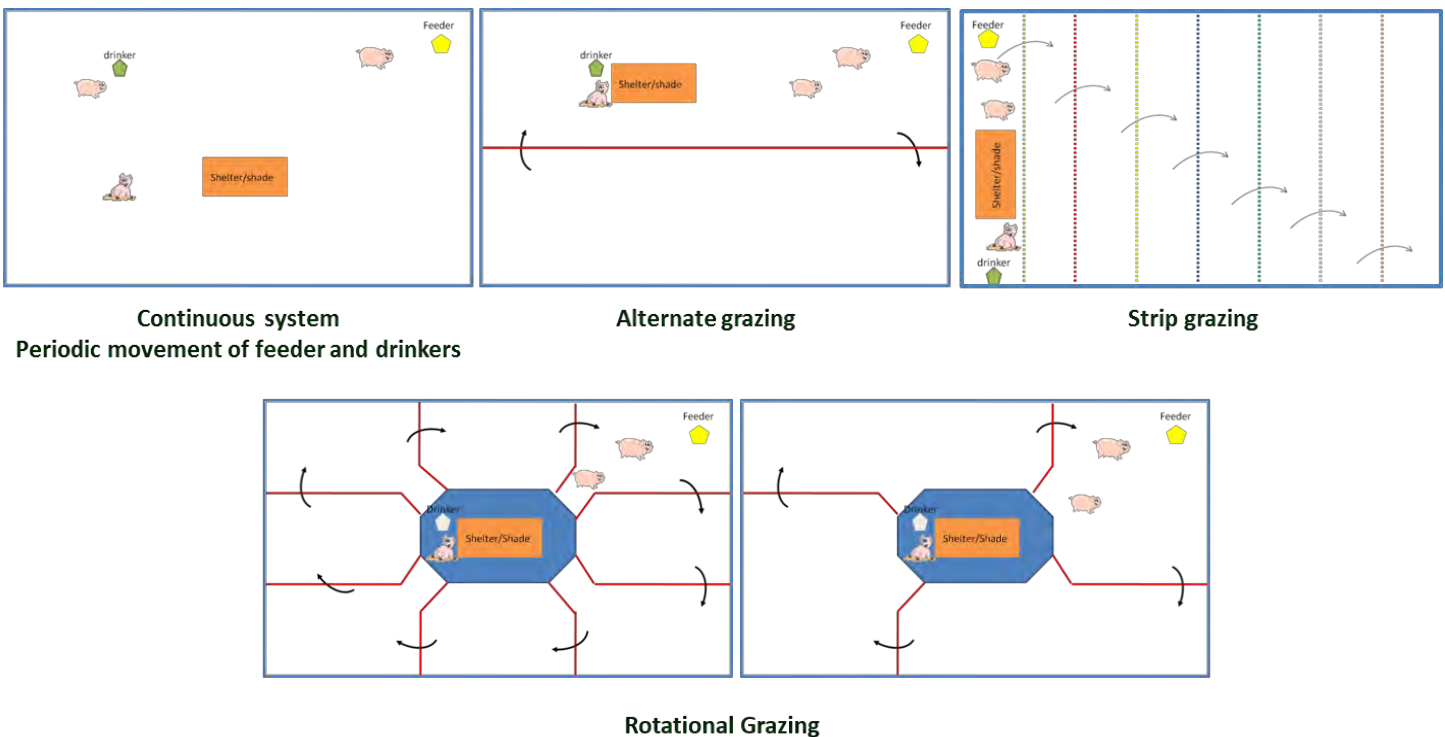


Figure 1: Grazing systems for outdoor hog production (blue line depicts permanent fence). The rotational grazing design encompasses two phases for a 12 week forage growing and grazing period: Phase 1 includes 8 paddocks for weeks 1-8 and Phase 2 combines paddocks to create 4 larger enclosures for weeks 9-12. Design will vary according to the length of the forage growing season. Images courtesy of Silvana Pietrosevoli, North Carolina State University Center for Environmental Farming Systems.

## Managing High Impact Areas

Any type of livestock system will have congregation points where impacts will be very high relative to more extensively grazed areas. These heavy use areas are sometimes determined by humans when choosing where to locate water or feed troughs, as well as corrals, barns or other structures that cause animals to persist at high densities. Animals often favor locations with naturally occurring shade (trees), water (creeks or ponds) or feed (acorns or fruit). Congregation points are a necessary part of animal husbandry, but care should be taken to locate and manage them to minimize their corollary environmental impacts such as bare soil, compaction, and above-normal nutrient loads from manure and urine. One practice used by some producers to reduce impacts around feeding and watering sites is to locate the trough on a movable platform that is slotted or perforated. This allows water to drain to the ground, but prevents hogs from disturbing the soil.



Slatted mat for drinkers. Photo courtesy of Silvana Pietrosevoli.

a seed mix over areas with disturbed soil in the late-summer or early-fall months. Establishing desirable plants in high impact areas will reduce the occurrence of undesirable plants and mitigate negative environmental impacts.

Contaminated groundwater is another potential risk from high impact areas as nutrients, especially nitrogen, leach through the soil carried by water from precipitation and irrigation. Vegetation buffers this nutrient leaching by utilizing the nutrients for plant growth before they are transported below the root zone. Vegetation also slows overland water flow which increases the time nutrients are available for plant uptake as well as improving animal welfare by altering the temperature and humidity near the soil surface and reducing joint problems by acting as a cushion. Most importantly, improved animal welfare derived from a healthy rangeland or pasture environment can result in better sow reproductive performance (see factsheet on [Farrowing and Weaning](#)) and higher financial returns.

## Weed Management

### *Common Bay Area Weeds*

Weeds are a common problem in almost any agricultural system and can vary from being a mild nuisance to extremely noxious or poisonous. Compared to rangelands, irrigated pastures and drylots are more intensively managed or disturbed, have higher levels of nutrients, and may have more bare soil due to excessive water or animal use. Once established, weeds are difficult to control, let alone eradicate, because seeds can often persist in the soil for several years.



Portable shelters help minimize impact to pasture or range. Photo courtesy of Magruder Ranch.

## *Minimizing Impacts of Bare Soil*

Adequate vegetative ground cover is critical during the winter months to protect soil from intense rainfall events. Grasses increase water infiltration, which reduces overland water flow and erosion. Deep-rooted forbs, such as chicory, will also increase infiltration and add more variety to the suite of forages and nutrients for hogs. A useful guide by [Lennox et al. \(2007\)](#) provides advantages of seeding high impact areas on coastal dairies which can be applied to Bay Area hog operations. Even moderately impacted sites can be treated by simply broadcasting

Common Bay Area weeds in rangelands include grass species such as: medusahead, goatgrass, Mediterranean barley; and red brome and broad-leaf species such as: thistles, perennial pepperweed, fiddleneck (toxic) and black mustard. Rangelands can often become heavily infested with noxious weeds due to a competitive advantage under specific conditions that result from management and the environment. Common weeds in irrigated pasture and drylot areas (bare dirt) include common cocklebur, turkey mullein, smutgrass, foxtail barley and English plantain, of which the latter three are indicative of too much or pooling water in pastures.

### ***Managing Weeds***

Options for controlling and managing weeds include: herbicides, hand pulling, mowing, disking, prescribed fire and prescribed grazing. The size of the weed population, dispersal and type of weeds, as well as constraints (i.e. terrain, organic certification) will help determine the correct method or combination of methods used to control weeds. Very small infestations can often be controlled by hand pulling or spot spraying individual plants before the population is too large. Mowing may work on annual weeds if the plants are cut below the growing points. Yellow starthistle and Mediterranean barley are notoriously difficult to control with mowing since the growing points are often at ground level. Perennial weeds cannot be controlled with mowing since the plant will continue growing from the root. Prescribed fire can be very effective on some grass and thistle species, but burning requires extensive planning, often with local fire districts, and is extremely limited by air quality regulatory controls. Herbicides can be very effective if properly selected and applied and are helpful in gaining initial control of very large weed populations. There are many types of herbicides available for use on rangelands and pastures and consultation should be sought from a pest control advisor (PCA) or from [UC Cooperative Extension](#) before choosing and applying an herbicide. It is important to follow all labeled directions and uses of each herbicide, including any grazing restrictions that

are required after application.

No single method will effectively control all weed infestations, which is a good reason to use an integrated approach that employs multiple methods. A good weed control program begins with preventing weed infestations by maintaining healthy growth of desired plants that will competitively exclude weeds. Persistent monitoring for unusual plants that could be weeds will help with early detection of small weed populations which are much easier to control. Once weeds become established, a combination of weed control methods applied over several years is the most effective approach.

### **Nutrient Management Planning**

Hog operations typically depend on a significant importation of feeds from off the farm. Any importation of feed also imports nutrients, some of which are retained in growing animals while the remainder is lost as un-utilized feed or excreted as manure and urine. Growing hogs will utilize about one-third of consumed feed for tissue development and energy while two-thirds will be excreted. [Stender \(2012\)](#) provides a good summary of feed efficiency for growing hogs.



Soil sampling can assist with nutrient management. Photo courtesy of Chris Bordeaux.

Imported nutrients, in the form of feed and hog wastes, can be managed by distributing them across a rangeland or cropping system, either on- or off-farm that will utilize the nutrients for forage or crop production. A nutrient budget should be developed to ensure nutrient applications are balanced with nutrient off-take by harvested forage or crops.

A grazing system that favorably influences and utilizes nutrient distribution will ensure that grassland and cover crops have sufficient nutrient bases to promote crop health. Uniform distribution of nutrients will also help prevent accumulated “point” source pollution sources in either the soil or in surface runoff which could negatively impact ground and surface water quality.

Because of the significant potential for off-site transport of nutrients from outdoor hog operations, a modified nutrient management plan should be prepared. Contact your local [Natural Resources Conservation Services \(NRCS\)](#), [Resource Conservation District \(RCD\)](#) or private consultants to assist in preparing a nutrient management plan for your outdoor hog operation (see [Conservation Practices for Outdoor Hog Systems](#) factsheet).

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Banner photo credit: Pigs in pasture. Photo courtesy of Magruder Ranch.