# Commodity Costs and Returns Estimation Handbook

A Report of the AAEA Task Force on Commodity Costs and Returns

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# CHAPTER 4

# PURCHASED AND FARM-RAISED EXPENDABLE INPUTS

Operating costs arise from the use of expendable inputs during the production process. An operating or expendable input is completely used within the current production period. This chapter discusses procedures to use in estimating the cost of most expendable or operating inputs. Those inputs not covered here are the operating portion of machinery and labor costs, and charges for custom services which are discussed in Chapter 5. The interest expense associated with the acquisition of operating inputs is discussed in Chapter 2, and also in Chapter 5.

Capital inputs, as opposed to expendable inputs, are factors of production that are not used up during a single production period, provide services over time, and retain a unique identity. The term **durable asset** (input) is often used to describe **physical capital** because the word durable denotes long-lived or not temporary. These inputs are discussed in later chapters of this report. Most inputs are easily classified as expendable or capital. Some classification problems arise, however, when considering an input that has short-term carryover effects, such as phosphate fertilizers that supply nutrients over more than one year. These issues are discussed for the relevant input categories throughout this and succeeding chapters.

An operating input may be purchased from off-farm suppliers or may be a primary product or a by-product that is produced by another enterprise on the farm. In either case, the input's cost per unit of production must be estimated. Two alternative methods of estimating the cost of an operating input are commonly used.

1. The first method is straightforward: Multiply the price of the input (if it was purchased from an off-farm supplier) or the opportunity cost of the input (if it was produced on the farm) by the quantity used per unit of production (i.e., the application rate) to obtain the cost per unit of production. Thus, the input's price (or its opportunity cost) and quantity used per unit of production must be known or be estimated. The value of the input must be measured in the same units as the application rate (e.g., $12.50/gal times 0.5 gal/acre equals $6.25/acre). Methods to calculate the opportunity cost of inputs that are produced on the farm are discussed by type of input throughout this chapter.

2. If it is not possible to obtain the actual values, or estimates of the input's price and quantity, it may be necessary to derive an estimate of the cost per unit of production from farm accounting records or income tax records. This situation commonly occurs with miscellaneous supplies, with general office expenses, or with a fertilizer expenditure for the farm that is not broken down by crop. In cases where the production period does not coincide with the record-keeping period, care must be taken to assure that all expenses related to the production period are utilized. If the total cost for an input is available on a whole-farm basis, the cost must be allocated to the various enterprises produced on the farm. An appropriate allocation procedure should be used and documented; these procedures are discussed in Chapter 9. Care should be taken to assure that the shares sum to one (or 100%). Once the total cost has been allocated to

individual enterprises, the cost per unit of production is determined by dividing the total enterprise cost by the appropriate unit of production (e.g., $12,000 divided by 600 acres equals $20/acre).

The choice of reporting format is dependent in part on the method selected to estimate the cost of expendable inputs. The alternatives range from reporting a detailed list of each input, with its trade name or formulation, price, quantity, and cost, to reporting a general name for a group of similar inputs with their aggregated cost. A detailed listing of inputs provides a great deal of insight into the production process. The use of specific input names allows a precise description of each input which in turn provides a reference point for projected or historical cost estimates. A major advantage of detailed listings is that the causes of cost changes between time periods or between production areas can be identified quickly and easily. This method also has major advantages to new producers and to those who wish to compare production alternatives. A disadvantage is the appearance of recommended inputs by name when there are other inputs and methods available. Furthermore, historical cost and return (CAR) estimates aggregated over a sample of producers require use of generic categories, e.g., herbicides, insecticides, etc., rather than individual products.

With the second reporting format, similar inputs could be grouped and given a general name (e.g., herbicides, insecticides, seed, fertilizers, and feed). After estimating the cost of each input in the group, the total cost of the group would be derived. Listing the total cost of each group will provide the user with the desired cost estimate, reduce the amount of information presented, and avoid the appearance of product recommendation. The first alternative for estimating costs could be used, but this information would be retained in supporting documentation. This approach can be used to prepare CAR estimates for individual farms as well as to summarize costs over a sample of farms using somewhat different brands of inputs.

## INPUTS USED TO PRODUCE CROPS

### Fertilizers

Fertilizers include natural and synthetic materials that are spread on or worked into the soil to increase its fertility. Nitrogen, phosphorus, and potassium compounds are common types of fertilizers, as are numerous micronutrients including sulfur, magnesium, and zinc. The units, quantities, and prices of N, $P_2O_5$, $K_2O$ and other nutrients should be reported. Often, mixtures or formulations such as 5-15-30 (5 pounds of N, 15 pounds of $P_2O_5$, and 30 pounds of $K_2O$ per 100 pounds of fertilizer) are used. In this case the quantity applied and the price of its mixture can be reported. Manure is also used to fertilize the soil and improve soil tilth. Lime, a soil amendment which is used to ameliorate soil acidity, may also be classified as a fertilizer.

Most fertilizers are purchased from off-farm suppliers at a known market price and are applied at a known rate per acre. Thus, the cost is simply price multiplied by quantity applied. For example, if 122 pounds of $NH_3$ are used per acre, at a price of 16 cents per pound, the ammonia cost is $19.52 per acre. Fertilizers, especially dry bulk starter fertilizers and custom blends, are often applied with specialized application equipment by the fertilizer dealer. When possible, the cost of the fertilizer material should be separated from the application cost. This split may be difficult to make when custom blend prices are quoted

on an as-applied basis. However, a cost estimate based on the fertilizer application rate and the cost of individual nutrients could be used to separate application cost from fertilizer cost.

Carry-over effects can pose a particularly difficult allocation problem. In many instances, lime is applied to control soil pH, or gypsum is applied to control salinity with the expectation that its useful life will extend five years or more before reapplication is necessary. Since the services of these inputs clearly last more than one production period, the application should be treated as a capital asset whose services are extracted over time. The appropriate way to allocate these costs is discussed in Chapters 2 and 6. In other instances, annual applications of P, K, and other nutrients may be suggested by plant nutrient withdrawal estimates, but because of relative immobility in the soil, these nutrients are applied only every other year or even less frequently. If the excessive application to the first crop is needed to ensure nonlimiting nutrient availability to that crop, the entire cost, whether used by the actual yield, should be allocated to that crop. If the excessive application is chosen to avoid a second annual application, the cost of the fertilizer should be allocated as a capital service over the two periods.

By-products produced and consumed (disposed of) on the farm should also be priced to establish complete CAR estimates for individual enterprises. Manure, for example, may be a by-product of on-farm livestock or poultry operations and used to provide fertility needs of crop production. If a market exists for the by-product, the opportunity cost methods described in Chapter 3 can be used to assign a price to the by-product. When a market is not available, an opportunity cost can be imputed by calculating the cost of other inputs saved by using the by-product (for example, the cost of commercial fertilizer saved by using manure).

**Example 1.** A by-product with a positive market value consumed on the farm.

One thousand gallons of swine manure contain usable nutrients that would cost $9 if purchased in the form of commercial fertilizer. The application cost of this commercial fertilizer replaced by the swine manure is $1. The farmer applies the manure from the hog enterprise to the corn crop. Transportation and application costs are $7 per 1,000 gallons. The net value of the manure to the swine enterprise is the nutrient equivalent value, less the transportation and application costs, plus the money saved in commercial application cost ($9 - 7 + 1), $3 per 1,000 gallons. The swine CAR estimate would include $9 income for manure, $1 less expense for applying commercial fertilizer, and costs of $7 for hauling and spreading. The opportunity cost of the manure to the corn enterprise is the lowest cost alternative source of fertilizer applied to the field. In this example, the alternative is commercial fertilizer that would cost $9 with an application cost of $1. The opportunity cost or "buying price" of the manure for the corn enterprise is $10 per 1,000 gallons. ***The Task Force recommends that the manure should be valued at its market price or its nutrient equivalent value if a market price is not available. The nutrient content of the manure must be evaluated carefully for losses so the nutrient equivalent value is not overestimated. The costs associated with delivering and spreading the manure to achieve the price should be included in the livestock CAR estimate.***

Suppose the swine farmer does not have land to which he/she can apply manure. The opportunity cost of the manure to the swine enterprise is the net selling price (local market value less transactions costs born by the seller). Suppose the neighbor agrees to pay $9 per

1,000 gallons applied to his field. The swine producer estimates it will cost $7 per 1,000 gallons to transport and apply the manure. The net selling price would be $2 per 1,000 gallons. The CAR estimate for this swine enterprise would include the $9 in the revenue section per 1,000 gallons and $7 in the cost section per 1,000 gallons.

**Example 2.** A by-product (which must be disposed) with a negative market value.

A cattle feedlot produces manure that must be disposed due to sanitary, health, space, and environmental considerations. The feedlot owns a small area of crop and pasture land nearby that can accept a fraction of the manure being produced. The amount of manure applied is limited by environmental considerations and the amount of nutrients that can be used by the crop. The remainder of the manure must be shipped some distance and sold to forage producers. The cost of transporting the manure to the distant market exceeds the price received for the manure by $2.50 per ton.

If the amount of manure applied to the owned land is extremely small, it can probably be lumped with the other manure in determining the cost (revenue) of disposal. If not, the estimates should include separate cost and revenue lines for on-farm and off-farm disposal. For the off-farm manure, the opportunity cost to the cattle feeding enterprise is the highest price for which the manure can be sold less any transactions costs. The low value of the waste minus its transportation cost results in a negative net selling price (-$2.50 per ton). The CAR estimate for cattle would include a revenue line showing the revenue received and one or more lines listing the cost of transporting and spreading the manure on the buyer's field. The on-farm manure would be handled as in Example 1.

## Seed and Transplants

Seed and transplants for annual crops, perennial but nonpermanent crops, (e.g., alfalfa, asparagus, etc.), and multiyear, long-lived tree and vine crops include the basic components necessary to establish or begin the growth of the producing crop, whether in hibernative seed form, in live growing transplantable form, or in dormant or rootstock transplantable form. Seed and transplant quality and quantity are critical elements in the agronomic or horticultural success of the crop. Although the cost of seed seldom represents a major portion of the total cost of producing row crops, the cost of transplants often represents a major expense in vegetable production. Interperiod allocations of tree and vine rootstock costs are discussed in Chapter 10.

A detailed listing of seed and transplants can be used to provide a great deal of insight into the production/costs process. Variety names and numbers should be used in a very detailed list to provide a specific pricing reference point for current or historical cost estimates and for updating prices. In addition, the costs of seed treatments and coatings should be included if they are incurred. A very specific listing of seed and transplant amounts and prices has major advantages to new producers of the crop and to those who wish to compare crop production alternatives. Price and use data can be gathered from local seed dealers, local greenhouses and nurseries, farmers, or seed catalogs with a minimum of confusion. Amounts can be updated quickly, efficiently, and accurately.

Another major advantage of detailed seed and transplant amounts and prices is that the causes of cost changes between time periods or between production areas can be quickly and easily identified; a change in cost can be attributed to quantity change, price change, or variety change. A major disadvantage of detailed listings is that a typical or average amount and variety must be identified. It may be particularly difficult to provide a detailed listing for the aggregate CAR estimates, where the average quantity, price, and dollar value can be listed. In situations when the quantity and price vary widely, common practice is to list only the lump sum dollar value.

Various compromises between a detailed listing and reporting a total expenditure for all seed can be used. These compromises attempt to pick up the specific advantages of a detailed listing while attempting to avoid large-scale surveys of seed suppliers to collect data that will likely not have a large effect on relative profitability between crops or between production regions. Compromise alternatives might include a supplementary schedule of detailed varieties, use amounts, and prices to keep the report as uncluttered as possible.

Use of field run or farm-produced (nonpurchased) seed and transplants is common for some open-pollinated small grains, for preseason greenhouse production of transplants for some horticultural crops, and for on-farm nursery production of tree and vine rootstock supplies. For nonhybrid, or open-pollinated, seeds retained from the production of a previous crop, a seed value will need to be assigned using the procedures to estimate the value of farm-raised inputs discussed in the section of Chapter 2: Valuing Factors for which there is no Market Transaction. For the production of transplants or rootstock, two major alternatives exist: producing plants for later replanting could be treated as a separate enterprise, or this enterprise could be included as an integral part of the whole production process. The first, or separation approach, is most useful in situations in which transplants are produced for sale as well as for on-farm replanting, or in which additional transplants must be purchased. In each of these separation situations, the net market selling price is readily available and should be used to value the seed or transplants to the enterprise producing the transplants. The enterprise planting the seed or transplants should value them at the net market buying price. The difference between the two is a return to marketing or vertical integration. Further discussion is contained in Chapter 3 and Chapter 10.

### Pesticides, Growth Regulators, and Harvest Aids

Pesticides are applied to soils, seeds, or plants to control or destroy pests such as weeds, insects, and diseases. Growth regulators are used to promote or inhibit plant growth at certain stages of development. Harvest aids, such as defoliants, are used to better prepare the crop for mechanical harvesters. These types of inputs are usually in chemical form, but biological forms of pesticides, including beneficial insects and bacteria, are also used.

Chemicals may be identified by a chemical name or a trade name, usually accompanied by a formulation specifying the rate of active ingredient per gallon. Tank mixes, including some predefined and named mixes of other brand-name chemicals, are commonly used. To simplify pricing, cost reporting, and uses of the information contained in the CAR estimate to address environmental and rotational questions, a detailed listing of brand names, pounds of active ingredient, and chemical formulation (such as wettable powder, granular or aqueous suspension) and concentration is preferred. Notes to a CAR report should contain available information on the potential for chemicals to move off-site, carry over into future

production cycles, or create health and safety concerns for the farm operator or employees. To avoid brand names and the implication that a recommendation is being made, generic names and dollar costs may be necessary.

This group of inputs typically can be valued for an individual farm by multiplying quantity of input by its price for projected CAR estimates. Entries for historic CAR estimates either can be calculated in this manner when quantities and prices are known, or the total farm pesticide costs recorded in the record can be allocated to individual crops.

## Irrigation

Irrigation systems used throughout the United States and the rest of the world are extremely diverse. Because of their diversity, attempts to generalize about their costs are generally inadequate and incomplete. However, one starting point is to divide systems into two groups based on the source of water: surface or groundwater. Surface water systems, whether from lakes or rivers, usually involve shared ownership of a common resource and an attendant legal system of water rights. Surface water systems also involve structures and delivery systems, many of which are permanently attached to the land, such as earthen and/or concrete-lined ditches, headgates, and other gravity-flow delivery and diversion systems. Groundwater systems usually involve a well, pump, gearhead, and motor as well as permanently attached and/or mechanical discharge and delivery systems. Groundwater systems involve a different system of legal rights, but they do not usually involve shared ownership of a common resource.

Between these two rather simple examples exists a multitude of combinations, including booster pump-pressurized surface water systems, surface water systems with supplemental groundwater wells, and booster pump-pressurized systems that pump from ponds originally filled with either surface, groundwater, animal waste, or municipal sewage sources.

The primary issues involved with allocating irrigation costs to a specific crop are as follows:

1. the original purchase cost of the water resource, if associated with the surface rights, or the water rights if separable from the surface rights;

2. system operating costs, including fuel, lubricants, and repairs for groundwater wells and booster pumps, and labor for all systems;

3. the acquisition and ownership costs associated with permanent improvements and mechanical delivery systems such as sprinklers, gated pipe, and subsurface or surface drip systems; and

4. other water acquisition costs, such as irrigation district taxes, assessments, or maintenance costs.

The first issue is addressed in Chapter 7 on land costs and Chapter 9 on rights to produce, and the second issue is treated in detail in the section on irrigation operating costs in Chapter 5. The third issue is addressed in Chapter 6 on machinery and equipment. The remaining issue is the treatment of costs

associated with membership in an organized irrigation district. Irrigation districts are often organized as legal entities with authority to tax water right holders within defined boundaries. These taxes are attached to water rights, which in turn are usually attached to the surface right. Cost and return estimates for crops produced within an irrigation district should identify water district taxes clearly and include the amount in the same fashion as land taxes.

Some irrigation districts will also often charge an annual assessment for water use separately from district taxes. If the district charges a flat fee, the water assessment should be listed as an allocated cost per acre; if a graduated fee or per-water-unit fee is assessed, the water assessment should be identified as an operating cost with the cost per unit and the number of units used reported in the CAR. Other districts do not charge dollar fees to water users, but rather, do require water rights owners to supply labor and/or equipment and materials to maintain common-property ditches, mains, and laterals. Labor and equipment supplied to the district should be valued at opportunity cost in the same manner as other paid or nonpaid labor and machinery. Materials should be valued at cash expenditure value. Labor, equipment, materials, and general district costs not allocable on a per acre-inch basis should be included in the allocated overhead cost section of the CAR.

### Miscellaneous Supplies

Miscellaneous supplies for crops include all of the physical (as opposed to financial, insurance, and service-oriented) inputs used in the production of crops, other than the basic inputs discussed previously (especially fertilizers, pesticides, and seeds). Most miscellaneous supplies are purchased and are consumed within one crop production cycle, but some are produced on the farm or as by-products, and some have useful lives that exceed one year (e.g., tree stakes and spreaders, bi-wall drip irrigation tubing, and buckets for hand vegetable harvesting). Typical examples of purchased, annual crop supplies include baling wire and twine, packaging for a roadside stand, or farmers' market produce, and pheromone for insect traps.

The primary issue involved with miscellaneous supplies relates to how the expenditure is reported. Brand names will probably not be used because most miscellaneous crop supplies are more of a generic nature than are chemicals or animal feed additives, for example. If brand names are identifiable and a specific brand name is commonly used, then the brand name could be listed as an identifier. Price and use data can be gathered from local suppliers, farmers, or supply catalogs. Grouping these inputs into a category called "Miscellaneous Supplies" may be preferred due to the nature of these inputs. Because they are miscellaneous, a great amount of detail may be excessive and unnecessary.

## INPUTS USED TO PRODUCE LIVESTOCK

### Feed

Feed is defined as anything fed to livestock to meet their nutritional needs. Typical feeds include feed grains, forages, minerals, and vitamin concentrates. Modern feeds may also include fat and synthetic amino acid concentrates. Some mixed feeds also include antibiotics fed as growth enhancers. Antibiotics are generally considered feed additives as described below.

## Chapter 4. Purchased and Farm-Raised Expendable Inputs

Feed is typically the largest cost component in livestock production. Marginal costs of feed per pound of live-weight gain usually increase with animal weight in the range of market weight. Quantity of feed consumed per pound of live-weight gain typically increases with total live-weight. Price per pound of feed may be higher for younger livestock and poultry because they require a higher proportion of protein and other relatively expensive nutrients. Energy is often the least expensive nutrient in the feed.

Cost estimation involves specifying the types, quantities, and prices of feed consumed within the production period. Only the feed that is consumed within the current production period should be counted as feed expense; unconsumed feed should be counted as inventory. Prices and quantities of feed required will vary with the nutrient content of the feed. Quantities and types of feed required will also vary with the age, size, and genetic type of the livestock. There is a wide variety of feeds fed to livestock. As a result, the "average" quantity of feed fed and the "average" price of feed may not be useful in preparing accurate cost estimates for specific operations. Average quantities and average prices adjusted to reflect expected changes in prices of major ingredients may be useful in preparing representative cost estimates for regions or states.

An issue in feed cost calculation is the valuation of feed raised on the farm. Farm-raised feeds should be valued at their opportunity cost as described in Chapter 2.

**Example 3.** Farm raised feeds.

Consider the example of a farmer producing corn, grain, and hogs, faced with the following data.

| | |
|---|---|
| Local market price for corn: | $2.10 per bushel |
| Handling and transportation costs (delivery to the local elevator): | $0.10 per bushel |
| Net market selling price: | $2.00 per bushel |

The net selling price of the grain to the corn production enterprise is thus $2.00 per bushel. Assume that to buy corn for the hog enterprise, the farmer would have to pay $2.10 per bushel to have corn delivered from a neighboring farm and $2.20 to have corn delivered by the local elevator. The cost of the corn to the hog enterprise is the lowest price at which corn can be delivered from off the farm to the hog enterprise, the neighbor's delivered price of $2.10 per bushel for amounts up to that available from the neighbor. ***The Task Force recommends that in this example, the lowest net buying price of corn ($2.10 per bushel) be used as the opportunity cost of corn for the hog enterprise.***

Large transactions costs occur when there is no local market for an intermediate commodity that is very expensive to transport. An example of this situation is a dairy farm that is located far from any source of hay or silage. This dairy farm produces hay for its own consumption. There are no other consumers or producers of hay nearby. As a result, the net market selling price of hay ($55 per ton) is the market price in a distant location ($70 per ton) minus a transportation charge ($15 per ton). The net market buying price of hay ($85 per ton) is the price in the distant market plus transportation costs to the farm. When the farm produces more hay than the dairy herd consumes, it is a net seller of hay and the opportunity cost of this hay to the dairy herd is $55 per ton. If the farm produces only part of the hay required, each ton produced

substitutes for a ton of purchased hay and the opportunity cost to the dairy enterprise is $85 per ton. As stated in Chapter 3:

> ***In the case of factors produced and utilized on the farm, the Task Force recommends using the cost of purchasing the factor from off-farm as the cost of the factor to the utilizing enterprise because this reflects the opportunity cost of the factor to the utilizing enterprise.***

Therefore in this case, ***the Task Force recommends the alfalfa hay be valued to the alfalfa enterprise at its net selling price ($55 per ton) and to the dairy enterprise at its net buying price ($85 per ton). This applies the appropriate opportunity cost to each enterprise. The difference of $30 per ton ($85 - $55) is a return to the marketing enterprise or vertical integration in the business.***

### Feed Grinding, Pelleting, Mixing, and Handling

Most feed fed to livestock is processed to some extent either on the farm or commercially. The most common on-farm activities are cracking, grinding, and mixing. Many livestock producers will own and operate a tub-grinder, and some larger operations may have an on-farm feed mill. The costs of preparing feed using these capital inputs can be computed using the techniques suggested in Chapters 5 and 6. The costs of the labor used in these operations should also be estimated. All of these feed processing costs should be included as a separate item in cost and return estimates. In many cases the price of commercially prepared and delivered feed includes many of these processing operations. In addition, commercially prepared feeds are often delivered to the farm and in some cases directly to feed bunks or other decentralized locations on the farm. As with the custom application of fertilizer or chemicals, the cost of the feed material should be separated from the processing and handling costs when possible. If there are known efficiencies associated with certain processing operations (pelleted versus ground feed), these should be reflected in the estimated feed requirements and documented in notes to the CAR report.

### Feed Additives

Feed additives are defined as material added to feed for purposes other than meeting the basic nutritional requirements of the animal. Common examples of feed additives are feed grade antibiotics fed to enhance the growth of the animal or to treat specific illnesses. Other feed additives may be used to maintain feed quality, reduce dust, or enhance texture and palatability.

Many brand names may exist for a given generic feed additive. The concentration of a particular feed additive may vary across brand names and across products sold by a particular company. Thus, care must be taken in the cost estimation procedure to assure that quantities and prices are compatible. In other respects, including feed additives in CAR estimates is a straightforward selection of price and quantity.

### Medicine and Veterinary Supplies

Medicine is defined as any medication not included as a feed additive. Examples include injectable medicines, injectable iron and vitamins, injectable substances used to stimulate estrus, injectable hormones, medication added to drinking water, topical medications and disinfectants, oral medications, and substances

to control internal and external parasites. Veterinary supplies are items used to deliver medicine or otherwise maintain the health of the livestock including syringes, needles, blades, disinfectants, and rubber gloves.

Due to the wide variety of inputs included in this category, it may be preferable to establish categories for medicine and veterinary supplies rather than present a detailed listing of individual items. Some records systems, designed to monitor animal health among other herd productivity indicators, distinguish between routine medication (vaccines, iron, and vitamin injections) and occasional treatment for disease.

**Breeding Fees and Semen**

Costs in this category include materials, semen, and services associated with breeding activities. Breeding fees are fees charged by owners of breeding stock (usually males) for services provided by their animals. This cost category also may include fees charged by owners of females that carry and deliver offspring from implanted fertilized ova owned by another individual. Semen is an operating expense for livestock producers using artificial insemination. The cost of breeding fees and semen will vary greatly with the genetic makeup of the semen donor. Expected fertilization rates also affect the value of semen. Quantity and prices of semen and breeding fees can be collected. Summaries or averages of these data may be separated for those producing breeding animals versus feeders.

**Livestock Purchased for Resale**

Livestock purchased for resale are defined as animals purchased with the primary intent of selling them at a later date. This generally excludes animals held for breeding and animals held for draft or other purposes. Feeder pigs and feeder cattle are examples of animals commonly purchased for resale. Livestock purchased for resale can be a major expense for feeding enterprises. Thus, the need for accurate cost estimates is obvious, but measuring quantity and prices is complicated by several issues.

Quantity is often described by two variables: number of head and weight per head. There can be substantial variation in the age, size, and quality of livestock purchased for resale. United States Department of Agriculture (USDA) grades can be used as a measure of quality. Most USDA grades are based on the weight and appearance of the feeder animal. Variation in health status and genetic makeup can cause considerable variation in quality within a single grade. As a result, quality is difficult to measure, and, within a grade or other description, average quality usually is assumed.

Prices vary with age, size, and quality. Price per head usually increases with size while price per pound decreases with size. Prices for livestock purchased for resale are dependent on the expected value of the animal at resale and the expected costs of holding the animal until resale including feed, mortality, medicine, facilities, labor, and other expenses. As a result, animals with the characteristics necessary to earn high prices at resale consume less feed to reach resale weight, survive to resale with less medication, occupy facilities for fewer days to resale, and generally incur lower costs to resale will command higher prices at purchase. Thus the price of the animals and the costs and efficiencies included in the CAR estimates must be estimated in a consistent manner.

The procedure for estimating costs of livestock purchased for resale includes measuring total expenditures for livestock associated with the livestock sold. When a group of animals is sold, the expense of purchasing *all* the animals in that group must be charged—including any that may have been purchased with them and died during the feeding period. While the need for this data is usually very clear, it is often difficult to obtain the data on purchases in preparing historical CAR estimates. The approach requires careful record keeping, particularly in operations where many different groups of livestock at different stages are in inventory at any point in time.

**Grazing Fees and Pasture Rental Rates**

Land used for grazing provides a major source of feed for cattle and sheep. The value of the forage removed or grazed from the land must be included in CAR estimates as a feed item. However, unlike other feed sources, animals are moved to the feed rather than vice versa. The measurement of the amount of forage removed from the land is most difficult. Grazing fees and pasture rental rates usually provide the best estimate of the value of forages removed by grazing.

Federal, state, and private grazing fees and pasture rentals are arranged under a variety of lease arrangements, terms, definitions, and conditions. Federal grazing fees (Bureau of Land Management and U.S. Forest Service) are set on an animal unit month (AUM) basis whereas state trust land fees are charged on a dollar per acre, dollar per head, and dollar per AUM basis in various states. Animal units (AU) are a classification system devised to indicate pasture carrying capacity and consumption of forages by various classes of animals. Animal unit definitions can vary but the current scientific studies generally support animal unit computations based on daily forage intake of 2% of body weight for ruminants and 3% of body weight for nonruminants, normalized to a 1.00 animal unit base for a 1,000-pound beef cow. The AU equivalent for various sizes of roughage-consuming animals is shown in Table 4.1. To use this procedure, consider a 1,400-pound bull. At 2% of body weight, the bull is expected to consume 28.0 pounds of dry-matter per day. Normalizing by the cow's 20.0 pound daily consumption, the bull is considered equivalent to 1.40 AU.

An AUM is the amount of feed needed to support one AU for one month. A 1,000-pound cow requires 20 pounds of dry-matter intake daily and 600 pounds over a 30-day month. A 1,400-pound bull would need 840 pounds (600 x 1.4). This approach is used to estimate the number of animals a range or pasture can support by estimating the forage production and converting the result to AUMs.

The rates charged to lease private pasture are expressed in a variety of ways. The methods of expressing the lease rate for private forage leases include total lease price, dollars per acre, dollars per head, dollars per AUM, dollars per year or grazing season, dollars per pound of gain, and dollars per pound in-weight to the pasture. Also, services (e.g., care of cattle, use of facilities, checking water) may or may not be provided by the lessor and the services provided greatly affect the lease price. The operating condition and requirements can vary also; these include minimum residue requirements, on- and off-dates, total numbers, and range maintenance. The final method, which may well be the most commonly used method, is that private pasture is grazed by the owner's livestock and no fee is charged. Footnotes should be used to specify these details regardless of whether individual or aggregate CAR estimates are being prepared. A more detailed discussion of grazing rights and grazing fees is contained in Chapter 9: Joint Costs, General Farm Overhead, and Rights to Produce.

TABLE 4.1 Daily Dry-matter Consumption by Various Animals Based on Their Body Weight

| Animal | Weight | Daily Dry-Animal Matter Intake | Daily Dry-Matter Intake | Animal Unit Equivalents |
|---|---|---|---|---|
| | lbs | % of weight | lbs | AU |
| Cattle (mature) | 1,000 | 2 | 20.0 | 1.00 |
| Cattle (yearling) | 750 | 2 | 15.0 | 0.75 |
| Sheep | 150 | 2 | 3.0 | 0.15 |
| Goat | 100 | 2 | 2.0 | 0.10 |
| Horse | 1,200 | 3 | 36.0 | 1.80 |
| Donkey | 700 | 3 | 21.0 | 1.05 |
| Bison | 1,800 | 2 | 36.0 | 1.80 |
| Elk | 700 | 2 | 14.0 | 0.70 |
| Moose | 1,200 | 2 | 24.0 | 1.20 |
| Bighorn sheep | 180 | 2 | 3.6 | 0.18 |
| Mule deer | 150 | 2 | 3.0 | 0.15 |
| White-tailed deer | 100 | 2 | 2.0 | 0.10 |
| Pronghorn antelope | 120 | 2 | 2.4 | 0.12 |
| Caribou | 400 | 2 | 8.0 | 0.40 |

Source: Holechek et al.

*Leased Forage*

The most common methods of stating the price for private leases are either dollar per acre or dollar per AUM. Either of these charge methods is logical and can be used successfully if the units are well defined and understood. Other charge methods, such as dollars per pound of gain, do not lead to an autonomously set fee; the actual fee cannot be determined until the average rate of gain is known or estimated. It is also unclear how to convert a gain-based fee to a dollar per AUM or acre basis.

The most important issue in pasture rental rates is to understand and define clearly the units used in setting the lease price. It also is important to state the terms of the rental agreements clearly to avoid misinterpretation. Rates are typically quoted as dollars per unit, dollars per acre, or total dollars. Consider first the case of dollars per unit.

**Dollars Per Unit of Livestock.** Several options are available for estimating grazing fees on any of the dollars per unit bases. Each of these methods has distinct advantages for range management relative to others or to non-unit-based grazing fees or pasture rental rates. However, the method selected in developing CAR estimates should reflect actual practice

rather than some theoretical construct. For example, the method selected should depend upon the practice used between lessee and lessor for a specific farm, or common practices for representative farms, or average practices for more highly aggregated production situations.

The methods of measuring the costs associated with leased forage relate primarily to collection of market rental rates and appropriate additional costs for livestock and/or pasture management services not included in the rental rate or grazing fee. Measurement methods include the following three systems.

1. *Dollars per head or AUM.* Animal unit equivalency factors used to convert to AUMs have not been standardized, but it is most common to count only animals over six months of age. It is important to state the equivalency factor that was used. For example, if yearling cattle are part of the lease, was each yearling counted as equivalent to 1 AU or was some other equivalency such as 0.75 used?

2. *Dollars per pound of gain.* This type of lease arrangement is the least informative because the cost of the lease is not known until after the grazing period when livestock are sold.

3. *Dollars per hundredweight entering the pasture.* The procedure must clearly define the number of head and weight of animals entering the pasture.

The strength of dollars per unit cost systems is that stocking rates, consequent fixed resource use, and other input use can be measured on the same basis as the output is measured. As a result, updates, revisions, and projections can be made rather easily; comparisons between grazing systems assuming differing stocking rates or comparisons among geographic areas or grazing systems can also be made easily and efficiently. The primary weakness of these methods is the increased complexity of the data collection.

A simpler way to compute grazing costs is to measure them in dollars per acre and assume some type of standard stocking rate.

**Dollars Per Acre.** To avoid at least some of the complexity, definition, and data collection issues, an estimate of dollars per acre could be included either as a return for a crop (either pasture, preseason, or crop aftermath) grazing activity or as a cost for a livestock activity. Calculating lease rates on a dollar per acre basis is perhaps the least ambiguous, but problems still arise when the lease includes state and federal rangeland. The question arises as to whether the number of acres included in the lease price should include only deeded acres or all acres in the pasture.

The primary advantage of this method is simplicity of definition, programming, and data collection, but it sacrifices the variable nature of stocking rates and clouds cost/return changes in intertemporal and spatial comparisons as the components (use and value per grazing unit) are subsumed into a total. The dollars per acre method could be used quite

successfully, though, especially for crop aftermath grazing of such crops as corn stalks, cotton stubble or post-frost alfalfa in which little more than livestock maintenance is expected.

The easiest and least accurate method is total dollars.

**Total Dollars.** This procedure uses a single total dollar amount for pasture leases or grazing fees. Stating the total cost of the lease clearly defines how much was paid but it does not provide all information as to the basis for this charge. The main advantages of this system are simplicity and direct data collection and verification with farm records.

*Raised Forage*

Placing a value on forage produced on the farm or ranch for consumption by owned livestock, as opposed to forage leased to or from a separate source, is similar to the problem of valuing farm-raised grain or hay fed to livestock. One alternative is to evaluate the livestock-pasture combination as one enterprise.

***If separation of enterprises is required, the Task Force recommends that the net selling price be used to value the forage to the pasture enterprise and the net market buying price be used to value forage used by the livestock.***

A limitation that must be recognized is that average market prices for unharvested forage typically include the value of services provided by the lessor of the forage, such as fencing, watering facilities, and labor to care for livestock. Adjustments must be made to value only the forage or to include appropriate livestock management or pasture management costs.

**Miscellaneous Supplies**

This final category is used to capture livestock operating expenses that have not been included elsewhere. Examples include ear tags for identification, batteries for electric prods and fences, markers, and disposable plastic boots. The challenge associated with this category is to ensure that inputs assigned to this category have not been included in a previous category.