

# Be Safe Get to Know Your COP

by  
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## Introduction

The cost of production (COP) is the costs associated with production divided by the number of units produced. The most difficult task in calculating the cost of production is usually thought to be assembling all the costs associated with production. There are volumes written about the correct procedures for assembling these cost. However the correct method of determining the number of units produced and/or the difference between the price and income per unit is seldom discussed.

One reason for this lack of discussion is the relationships seem very straightforward. In single product enterprises the cost of production can be compared directly to the price of the product, regardless of the method used to calculate the cost of production. Therefore why discuss the method(s). In joint product enterprises the method used, to determining the number of units produced and/or the difference between price and income per unit, is critical.

A joint product enterprise is one in which two or more products are produced from one production process and the costs associated with the production of each individual product can not be measured with existing information. So determining the relationship between cost of production and the products' prices is more difficult.

This paper will look at some methods commonly used to calculate the cost of production. The pros and cons of each method will be discussed. The conclusion will argue for the use of one method, when an enterprise produces joint products.

## Dairy Farm - Dairy Enterprise

A dairy farm or even just a dairy enterprise is a joint product enterprise. The joint products of a dairy enterprise are milk, cull cows, calves, change in livestock inventory, MILC payments, and coop dividends. The joint products of a dairy farm may also include steers, property tax credit on income taxes, crop-related government payments and maybe even some crop sales and other miscellaneous income. The major product of a dairy farm is milk but other products are produced and sold as well.

Consider the following information:

Milk Income per cow = \$3,520 (22,000 pounds)  
Other Dairy Income per cow = \$480  
Milk Price is \$16.00 per hundredweight.

Purchased Feed	\$800 per cow
Paid Labor	\$300 per cow
Interest Paid	\$200 per cow
Other	\$1340 per cow

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Total Operating Costs	\$2,640 per cow
Unpaid Labor and Management	\$400 per cow
Depreciation	\$300 per cow
Interest on Equity Capital	\$400 per cow
Total Overhead Costs	\$1,100 per cow
Total Costs	\$3,740.00 per cow

Given these facts:

What is the feed cost per hundredweight of milk?

What is the total cost of production per hundredweight of milk?

What is the profit per cow?

What is the return to unpaid labor, management and equity capital per cow?

## Methods

### Per Unit Sold

This cost of production method commonly is used with single product enterprises. The divisor in this method is the number of units of the major product that were produced by the single or joint product enterprise.

The main advantage of this method is it is familiar to most individuals so learning another method is not required. Also, it is easy to determine the divisor, just use the number of units of the major product produced. In this example the number is 220. In addition, it seems as if you don't need to know the price of the products to calculate the cost of production.

The problems with this method began when you try to determine the cost per unit a individual expense item (such as cost of feed per 100 lbs of milk) and continue when the total cost of production is compared to the price received. The cost of feed per hundredweight, using this method, would be \$3.64 ( $\$800 / 220$ ). However that implicitly says that none of the feed was required to produce the other income (calves, cull cows, etc.). This is probably untrue, but usually it is not possible to separate feed costs between those required to produce milk and those required to produce a calf.

This problem, of allocating all the costs of production to the major product, continues even when all costs are considered. Using the example, the operating cost per hundredweight of milk is \$12.00 ( $\$2,640 / 220$ ); and the total cost of production per hundredweight is \$17.00 ( $\$3,740 / 220$ ). This is greater than the price received per hundredweight (\$16.00); therefore the producer might be lead to the conclusion that having a dairy cow is unprofitable. However, if the enterprise is examined on a per cow basis ( $\$4,000$  income -  $\$3,740$  costs =  $\$260$  profit), this proves to be untrue.

This is the major problem with this method. The cost of production per unit can **not** be compared to the price received. The cost of production must be compared to some other unit of

revenue. This new unit of revenue is called "Income per Unit" (of major product sold). Income per unit is calculated by adding the income from the sale of all the products and dividing that sum by the number of units of the major product produced. In the example, the income from the sale of all the products is \$4,000 (milk income (\$16.00 X 220 = \$3,520) plus other income (\$480)). This sum is divided by the 220 hundredweight of milk produced; thus the Income per hundredweight of milk sold equals \$18.18.

**The cost of milk production calculated using this method must be compared to the Income per Unit, not to the milk price received.**

If the correct comparison is used the enterprise is correctly identified as profitable. (\$18.18 income per unit - \$17.00 cost per unit = \$1.18) then (\$1.18 times 220 hundredweight = \$260 profit) The enigma is that an individual unfamiliar with the necessity to calculate "Income per Unit", will compare the cost of production calculated to the price. This gives producers incorrect information on which to base production, marketing, hedging, forward contracting, or other decisions.

## **Residual Claimant**

When using this method, the income from the sale of the joint product(s) is subtracted from the total cost and the remaining cost is divided by the units produced (of the major product). In the example, \$3,740 cost - \$480 of other income = \$3,260 of residual costs. This divided by 220 hundredweight of milk produced to equal a total cost of production of \$14.82 per hundredweight.

This method allows the comparison between the cost per hundredweight and the price per hundredweight of milk. The profit per cow is the milk price per hundredweight (\$16.00) minus the cost per hundredweight (14.82) times the number of hundredweights sold (220). Doing this calculation yields a profit per cow of \$260. One of the advantages of this method is that an individual unfamiliar with its' calculation background can compare the results presented to the price.

However, it has disadvantages especially if the components of the cost of production need to be calculated. How should the operating cost of production per hundredweight be calculated? The operating costs were \$2,640 per cow. Should some of the other income be subtracted from that value before dividing by the hundredweights produced? If so, how much?

This problem is further compounded if the cost of various individual cost items must be calculated. Example: what is the feed cost per hundredweight?

Also, this method implicitly sets the profit on all non-major products to zero.

## **Equivalent Production**

To use this method a new divisor (number of units produced) must be calculated. The new divisor is the number of units of the major product the enterprise would have had to produce in order to have the same income as it has now. In other words, if this were not a joint product enterprise, how many units of the major product would it need to produce to obtain an identical income?

The formula for calculating the equivalent units of production is:

$$\frac{\text{Total Enterprise Income (from all products)}}{\text{Price of Major Product}}$$

In the example, the equivalent hundredweight production is 250 (\$4,000 / \$16.00). In other words, this dairy farm could produce 220 hundredweights of milk and \$480 of other income

**Or** 250 hundredweights of milk and have identical income.

When this method is used the “equivalent units of production” are divided into the cost items and/or categories to obtain the cost of production. The feed cost per equivalent hundredweight is \$3.20 (\$800 / 250) and the total cost is \$14.96 (\$3,740 / 250). The profit to the enterprise is \$260 ((\$16.00 - \$14.96) X 250).

The major advantages of this method is the **cost of production can be compared to the price received** for the product, plus the cost of production of individual costs items can be easily calculated. Also, the cost of these individual cost items can be compared to the price of the product.

The major disadvantage of this method is the percent profit (or loss) on each product is identical. In other words, if the profit on milk is 10 percent, the profit on calf sale, cull cow sales, etc. are also 10 percent.

## Conclusions

When individuals see a cost of production value they immediately compare it to the price of the product. Therefore the “Equivalent Production” method is the best for joint product enterprises because the cost of production can be compared directly to the price and components of the cost can be easily calculated and compared.

The “Per Unit Sold” method can confuse producers and lead to incorrect decisions because the producer may not understand that the comparison value is Income per Unit, not the price of the product. This can lead to bad decisions.

The “Residual Claimant” method has limited application because it can only easily calculate the total cost of production.

Note: if an enterprise has only one product, all methods produce identical results.

Problem 1: 110 cows

Milk Income	= \$387,200 (22,000 pounds / 100 X \$16.00 X 110)
Other Schedule F Income	= \$52,800
Cull Cow Income from Form 4797	= \$13,750
Increase in Dairy Herd Inventory	= \$16,500
Purchased Feed	= \$88,000
Paid Labor	= \$33,000
Interest Paid	= \$22,000
Other	= \$147,400
Unpaid Labor and Management	= \$44,000
Depreciation	= \$33,000
Interest on Equity Capital	= \$44,000

- What is the feed cost per hundredweight of milk?
- What is the total cost of production per hundredweight of milk?
- What is the profit per cow?
- What is the return to unpaid labor, management and equity capital per cow?

Problem 2: 250 cows

Milk Income	= \$880,000 (22,000 pounds / 100 X \$16.00 X 250)
Other Schedule F Income	= \$25,000
Cull Cow Income from Form 4797	= \$37,500
Purchased Feed	= \$225,000
Paid Labor	= \$125,000
Interest Paid	= \$75,000
Other	= \$425,000
Unpaid Labor and Management	= \$100,000
Depreciation	= \$87,500
Interest on Equity Capital	= \$100,000

	Beginning	Ending
Feed Inventory	\$300,000	\$287,500
Dairy Cattle Inventory	\$525,000	\$550,000
Accounts Payable	\$25,000	\$0
Prepaid Expenses	\$20,000	\$70,000

- What is the feed cost per hundredweight of milk?
- What is the total cost of production per hundredweight of milk?
- What is the profit per cow?
- What is the return to unpaid labor, management and equity capital per cow?