March 2013

AFR 13-01

Agribusiness Finance Report

Colorado State University Extension

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http://dare.colostate.edu/pubs

APPRAISING THE VALUE OF IRRIGATED CROPLAND: CONSIDERATIONS IN THE LOWER ARKANSAS RIVER BASIN

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Abstract

Agricultural land values, and the relative importance of individual characteristics in determining these values, is of longstanding interest to economists and of practical importance to agricultural real estate appraisers, loan officers and farm managers. The purpose of this document is to review the basic approaches to agricultural land appraisal, and then apply a subset of these approaches to value native rangeland, pasture, irrigated cropland for the Lower Arkansas River Basin. An imputed value of irrigation water is also discussed. The general methods of appraisal considered in the analysis include the market value and income approaches. Using data from 2005 to 2012, a general finding for irrigated cropland in southeastern Colorado appears to fall in a range of $1,964 to $3,183 per acre. Non-irrigated cropland values range $416 to $528 per acre. The capitalized value of a herd of 70 cow-calf pairs is $58,333 in the absence of a value for the cow asset. Note that these values may understate current market activity that is heavily influence by recent record high commodity prices and drought.

Overview

Agricultural land values, and the relative importance of individual characteristics in determining these values, has been a point of inquiry for the earliest economists (e.g., Smith (1776), Ricardo (1817)). Yet, it has only been with innovations in analytical methods that include capitalization and hedonic approaches (e.g., Rosen (1974)) and innovations in empirical techniques (e.g., Burt (1986)) that permitted the development of descriptive and predictive models that are useful in weighing the importance that economic factors have in determining the value of agricultural land.

Fundamental sources of land value and variation in value include, but are not limited to, expectations of future streams of income from cropping, rents and government payments (Nickerson et al, 2012). Variations in farmland values across space and time can be attributed to changing profitability in agriculture, but also to non-agricultural factors. As reviewed by Drescher, Henderson and McNamara (2001), agricultural factors that influence land value include agronomic characteristics such as climate and soil

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productivity (e.g., Miranowski and Hammes (1984)), farm size, expected capital gains, capitalized farm program payments and interest rates. Non-agricultural factors influencing land values include location, surrounding population density, infrastructure, local demand in value-added agricultural processing and urban access.

Economic studies of land values have been useful in developing a practical means for agricultural real estate appraisers to assess farmland values. Three typical appraisal methods are the market value method, the income method and the cost approach (Boehlje and Eidman (1984)). The following subsections are a brief description of each approach with contemporary examples from the Lower Arkansas Basin where appropriate.

Market Value Approach

An underlying principle of the market value approach is to determine the value of the property if it were sold. Application of the method involves examining comparable sales and involves a few basic steps:

a) Defining the kind of sale method to be used (cash, contract, etc.).
b) Selecting and analyzing nearby sales
c) Determining the comparability of nearby sales to the parcel in question and
d) Adjusting for value changes between the time of sale and the appraisal (Boehlje and Eidman).

Recent transactions in the Lower Arkansas River Basin provide a context for the market value approach. Private transactions data from Otero and Kiowa counties (2005-2012) set a context for recent market based transactions between willing buyer and seller.

In Table 1, the mean sales value of 46 transactions was nearly $2,000 per acre for irrigated cropland. Land prices are trending upward based on recent increases in farm commodity prices, so that these recent sales may easily approach $3,000 per acre. Similarly, the mean sale price of non-irrigated cropland is $528 per acre with recent sales may easily approach $1,000 per acre depending on relative productivity. The predominant non-irrigated crop in the sample and in southern Colorado is winter wheat (greater than 85% of acres), but irrigated cropping is more diverse with corn and alfalfa receiving the largest share of crop acres.

The difference in average land values reported in Table 1 is $1,436. While this value cannot be completely attributed to the productivity and crop choices permitted with irrigation, it is an important price signal of the production value of irrigation versus other alternatives.

Economists have used the difference between sales transactions of irrigated and non-irrigated land (or land with a different portfolio of irrigation rights) to impute the value of irrigation in agricultural production. The principal assumption underlying this approach is that is that buyers and sellers of agricultural land are able to differentiate the factors of production as they relate to future profits when agreeing to sale prices for agricultural land (Shultz and Schmitz (2010)).

Influences of Government Payments and Crop Insurance on Land Values from Market Transactions

Via federal omnibus legislation, income support is provided as specific crop payments to farmers. Subject to reauthorization by Congress, these income support payments come via three mechanisms: direct payments, loan deficiency payments and countercyclical payments. Direct payments are based on historical crop prices, acreages and yields and are paid as a lump sum payment. Loan deficiency payments are made based on actual production in a crop year and the difference between a posted count price and a marketing year average price. Countercyclical payments are paid on historical production levels and the difference between a target price and the marketing year average price. Numerous economic studies find that these government payments are capitalized into land values (please see Feichtinger and Salhofer (2011) for a review); that is, the market values reported in Table 1 also include the presence of income streams derived from the federal government.

Similar crop insurance is an important risk reducing tool that tends to improve the certainty of revenue streams that are attributed to land values. The net

Table 1. Recent Land Transactions for Irrigated and Non-Irrigated Cropland (2005-2012)

Geographic Area	*Land Type*	*Average Value*	*# of Transactions*
Otero County	Irrigated	$1,964	46
Kiowa County	Non-Irrigated	$528	110

benefits (risk reduction benefits minus premium costs) are also capitalized into cropland values. The cost of crop insurance is also included in the enterprise budget analysis that follows.

Income Approach – Farmland Rental Rates

The income approach if real estate appraisal is most consistent with economic principles of capitalization. In this approach, the present value of an income stream is determined for an agricultural parcel. The income stream may be determined by evaluating a typical crop rotation, or by considering the land rental rate as an income stream roughly equal to the foregone opportunity that a land owner has for cropping farmland themselves. Economists generally assume that land represents an asset with a perpetual income stream, so that the net present value of the asset may be written as in equation (1):

$$(1)\ V = \frac{R - E - L - I}{r}$$

where the value (V) of farmland per acre is determined by total cash receipts per acre (R), minus cash expenses (E), minus unpaid labor for the owner (L) minus interest in nonreal estate capital such as an operating note (I), all divided by the capitalization rate (r) (Boehlje and Eidman (1984)).

In order to solve for (V) in equation 1, a proxy is needed for the net returns to farming and the capitalization rate. Net returns are often derived from existing farm rental rates or farm profitability calculations that may be observed in enterprise budgets.

The Agribusiness Management team conducts an annual custom rate survey as part of their activities with Colorado State University Extension (Tranel et al, 2012). The custom rate surveys can be found at: http://www.coopext.colostate.edu/abm/custrates11.pdf Aggregated survey responses for cash land rental rate are reported for Southern Colorado and include the following:

The rental value represents an average tipping point between a landowner choosing to crop themselves or leasing to another producer. In this sense, it represents an annual economic value of crop production taking into account pecuniary (out-of-pocket) and non-pecuniary (out-of pocket and opportunity) costs. These rental rates can be used in the numerator of equation 1.

The rental values reported in Table 2 give insight into implicit land values. If this rental value is capitalized into perpetuity at 6% (a long run, after tax rate of return to agriculture production) the implicit value of the irrigated cropping is approximately $2,416 per acre and non-irrigated cropping is $416 per acre. This compares well with the market values established in Table 1. Also, if the rental values are capitalizes at 13%, a statutorily established capitalization rate for property tax assessment in Colorado (Colorado.gov, 2012), the values are $1,115 per acre and $192 per acre for irrigated and non irrigated cropland respectively.

Note that the difference in rental rates between irrigated and non-irrigated cropland is $115 to $125 dollars per acre. The capitalized value (6% capitalization rate) for this difference is $1,917 to $2,083 per acre. As mentioned in the previous section, this is a signal of the value of water in agriculture production for the parcel, but not all of the value can be attributed to irrigation water alone.

Income Approach – Farmland Profitability

The economic value of land assets also depends on the net returns that a typical operator can generate from its use. One means for measuring profitability is to develop enterprise budgets that list revenues, operating costs and factor payments to the resource. The net return to typical crop patterns for the area can be used to create the numerator in equation (1). In this approach, net returns of a typical crop mix (or rotation) is apportioned according to their acreage.

Colorado State University Agribusiness Management Team compiles enterprise budgets for regions in

Table 2. Cash Land Rental Rates for Southeastern Colorado, ABM Custom Rate Survey (2011)

Crop	*Range of Responses*	*Most Common*
Irrigated Alfalfa	$130 - $160	$140
Irrigated Corn	$130 - $160	$150
Non-irrigated Cropping	$20 - $35	$25

Colorado. These budgets may be found at:

http://www.coopext.colostate.edu/abm/cropbudgets.htm (Deering et al., 2012).

Importantly, the cost activities listed in the enterprise budget (such as chemical application) are based on custom rates – an opportunity cost to the farmer. If the farmer provides these services themselves, then the actual cost may be lower than that listed in the budget. For this reason, the net returns in this budget are an economic rather than accounting profit, and it is likely accounting profits are greater than the economic profits. The enterprise budgets include charges for a typical crop insurance premium – actual purchases by farmers and their chosen coverage levels may differ. Lastly, these budgets do not always include factor payments to land, the farmers' uncompensated labor, risk and capital recovery cost for the farm operation. These payments will reduce net returns.

Table 3 provides a listing of an expected long run price, yield, costs, net returns and net returns minus a land rental payment crops that might be grown on this parcel. Costs are taken from the aforementioned enterprise budgets, rental rates from the custom survey, and long range prices from the author's expert opinion.

Note that the negative return to dryland wheat is an economic rather than accounting value return to the commodity. If the farmer completes their own tillage and harvesting operation, then net returns are likely to be positive, albeit at low values. In general, dryland wheat farmers smooth income by receiving large windfalls in a single year and poor returns in subsequent years. Further, recent prices of alfalfa hay ($250 per ton), corn ($8.50 per bushel) and wheat ($9.00 per bushel) mean that farmers will make significantly higher returns in 2012.

If a crop rotation of 1/3 corn 2/3 alfalfa is assumed, a net return above economic costs is $380 per acre before factor payments are made. Factor payments are needed for the use of equipment, land and to pay the farm manager for their uncompensated labor. Should this total $145 per acre for land and $44 per acre for operator labor and risk, then the return to the operator is $191 per acre. Capitalized at a rate of 6% per acre, the implicit value to this crop rotation is $3,183 per acre.

In summary, the value of irrigated cropland in southeastern Colorado appears to fall in a range of $1,964 to $3,183 per acre. Non-irrigated cropland values range $416 to $528 per acre. It may be that the aforementioned parcel has used crop resources in support of a cow-calf operation. In the next section, the values of these forage resources and beef enterprise profits are considered.

Range/Pasture Rental Rates and Cow-Calf Returns

Diversified agriculture production in southeastern Colorado often includes cow-calf production. In this production system, cattle are pastured/grazed during the summer season, calves are weaned in the Fall and then backgrounded for 30 days and sold to feedlots. In the fall, cows are occasionally pastured on aftermath (stalks from corn or milo that has harvested previously), occasional grazing of winter wheat prior to dormancy, fed alfalfa and grass hay throughout the winter and spring calving. Cows return to pasture as it greens in the Spring.

In this production system, grazing and hay production are important inputs whose non-cash revenue are also attributable to the farm's land resources. It's important to provide a market value, or opportunity cost of forage used in livestock production.

Table 3. Long Run Price, Yields, Net Returns and Net Return Minus Land Payments for Southeastern Colorado

Crop	*Long Run Price*	*Yield*	*Costs ($/ac)*	*Net Return ($/ac)*
Irrigated Alfalfa	$150 /ton	5 ton/ac	$348	$402
Irrigated Corn	$5.00/bu	180 bu/ac	$563	$337
Irrigated Wheat	$6.00/bu	70 bu/ac	$405	$15
Dryland Wheat	$6.00/bu	30 bu/ac	$214	-$34

The previously cited 2011 Custom Rates Survey provides an estimated value per head per month for range, pasture and forage for grazing in southern Colorado. Table 4 summarizes this information.

If the parcel were to provide 4 months of native grassland grazing, 2 months of irrigated pasture grazing and one month of corn/milo aftermath grazing, the value of grazed forage would total approximately $124.50 per head per year. The parcel's carrying capacity is currently unknown.

Cow-calf systems have highly variable profits because of the underlying fluctuation in calf prices. Cow-calf net returns (including cash rent for pasture) have been estimated by the Livestock Marketing Information Center from -$25 per cow to $160 per cow during the period 2006 – 2012. Average returns are reported in Table 5 for two regional information sources.

If the pasture and native rangeland are used for maintaining a cow-calf enterprise on the parcel in question, the returns should be capitalized into the land resource value. A few important points apply to this situation:

- Cow-calf returns will depend on the carrying capacity of operation. If the operation produces forage for the equivalent of 70 cow-calf pairs per year, then one might expect roughly $2,100 of annual returns to the entire operation. This results in a capitalized value of $35,000 for the entire parcel (6% real discount rate, infinite time horizon). Alternatively, if the pasture is owned and a pasture lease is not paid, profitability will increase by roughly $20 per head so the capitalized value is $58,333.

- Care must be taken when calculating the value of forage if it is being fed to cattle. Alfalfa hay and baled corn/milo stalks are available to be sold. If this is fed to cows, but not considered in the cash revenues to the operation and treated as cost to the cattle enterprise, then net returns might be understated. At the same time, if the forage is counted as revenue, but it is fed to cows and the costs are not considered, then the forage value is treated as revenue twice, once as a crop sale and once as a calf sale, and returns are overstated.

Table 4. Cow-Calf Rental Rate ($ per head per month) in Southeastern Colorado according to 2011 Custom Rates Survey (CSU Extension)

Land Resource	*Range of Responses*	*Most Common*
Native Rangeland	$11 □ $24	$14
Irrigated Pasture	$25 □ $30	$26
Wheat Pasture	$12 □ $15	$15
Corn/Milo Stocks	$12 □ $20	$16.50

Table 5. Cow-Calf Net Returns over Variable Costs for 2006-2010, 2011

Data Source	*2006-2010 Average Returns*	*2011 Average Returns*
Livestock Market Information Center (LMIC) [a]	$30.40 per head per year	$160 per head
Southwest Standard Performance Analysis (SPA) [b]	$23.16 per head per year	N/A

[a] LMIC is a consortium of universities reporting market, production and profit data for livestock production. This data is for southern plains cow-calf production, returns over cash costs including pasture rent. Available at: www.lmic.info

[b] SPA data is collected in a variety of regions according to standardized approaches. Returns to cows are imputed from a rate of returns to assets (0.69%) multiplied by the value of the cow investment ($3,356) all on a cost basis. Available at: http://agrisk-tamu-edu.wpengine.netdna-cdn.com/files/2012/07/SW-Key-Measures-Summary-_Last-5-Years_.pdf

Concluding Remarks

The purpose of this document is to describe typical appraisal approaches for determining the value of agricultural land in southeastern Colorado. Three approaches are identified: a market valuation approach, and income approach and a cost approach. The two most common methods (market an income) are described in detail and applied to typical lands in southeastern Colorado. Based on these methods, the generic value of irrigated cropland in southeastern Colorado appears to fall in a range of $1,964 to $3,183 per acre. Non-irrigated cropland values range $416 to $528 per acre. A cow-calf herd of 70 head is anticipated to create a capitalized value to the ranching operations of $58,333 sans the value of the cattle themselves. Note that these values may understate current market activity that is heavily influence by recent record high commodity prices and drought.

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James Pritchett joined the Department of Agricultural and Resource Economics at Colorado State University in May of 2001. Dr. Pritchett's primary interdisciplinary research and extension efforts are focused on agribusiness, farm and ranch management with special attention on the allocation and use of scarce water resources. He is currently examining the rural economic impacts of water transfers and the economics of limited irrigation in the West.

Dr. Pritchett's role as an extension specialist has resulted in more than 245 presentations to stakeholder and peer groups, $10 million in contract and grant funding and numerous trade and peer reviewed publications. International work includes teaching and outreach in Peru, Russia, China and Mexico. Pritchett currently serves as the Associate Department Head and a leader of College of Agriculture Sciences Strategic Water Initiative.

Dr. Pritchett enjoys teaching a wide variety of courses in agribusiness finance, management and economics. Most recently, he has taught AREC 408 Agriculture Finance, AREC 428 Agribusiness Management, and BUS 635 Business Economics for World Markets. He has received outstanding teaching awards from the Colorado State University College of Agriculture Sciences (2006, 2008) and the Western Agricultural Economics Association (2009).

Originally from southeastern Colorado, Dr. Pritchett attended Colorado State University and obtained a B.S. in Agricultural Business and an M.S. in Agricultural Economics. Pritchett was awarded a doctorate in Agriculture and Applied Economics from the University of Minnesota in 1999, and then served as an Assistant Professor in Agricultural Economics at Purdue University from 1999 to 2001 before returning to Colorado.